

XVII.—THE TRANSFORMATION OF SALT MARSHES INTO FISH PONDS.

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SALT MARSHES.

The waters of the sea on several points of our western and southern coasts are left to evaporate in a natural way in vast basins which are called salt marshes (*les marais salants*). These basins vary in shape and depth, and the water of the sea passes successively from one to the other. In the last basins (those nearest shore), where the water is only a few centimeters deep, the salt is deposited under conditions which vary in the different localities. Thus, in the salt-pits of the west the first deposit of salt is gray, and in order to give it a white color it is necessary to subject it to a refining process, whilst in the south the salt obtained from the salt-pits is white and pure.

The salt harvest depends altogether on atmospheric influences, such as the heat of the sun and the winds which more or less favor the evaporation of the water. In many places, especially in the West, the salt harvest will be almost an entire failure when the season is rainy or cool.

Vast pieces of ground, on which considerable sums of money have been spent, therefore become almost entirely unproductive. For this reason, and in view of the constantly-increasing demands for food for the masses, people have in many places been led to abandon the manufacture of salt by the spontaneous evaporation of the sea-water, and have begun to utilize to greater advantage the grounds once devoted to this industry by transforming in them into fish-ponds.

The ponds of this kind which have been constructed on the coast of the basin of Arcachon, in the department of Gironde, are excellent models of such fish ponds, and cannot be too highly recommended to the attention of the owners of salt marshes.

THE PONDS OF THE ARCACHON BASIN.

By ministerial order of August 6, 1852, Mr. Coste was commissioned

Transformation des marais salants en réservoirs à poissons. Translated by HERMAN

JACOBSON.
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to visit the coast of Italy and ascertain under what conditions experiments might be made, on a large scale, in the way of propagating marine animals.

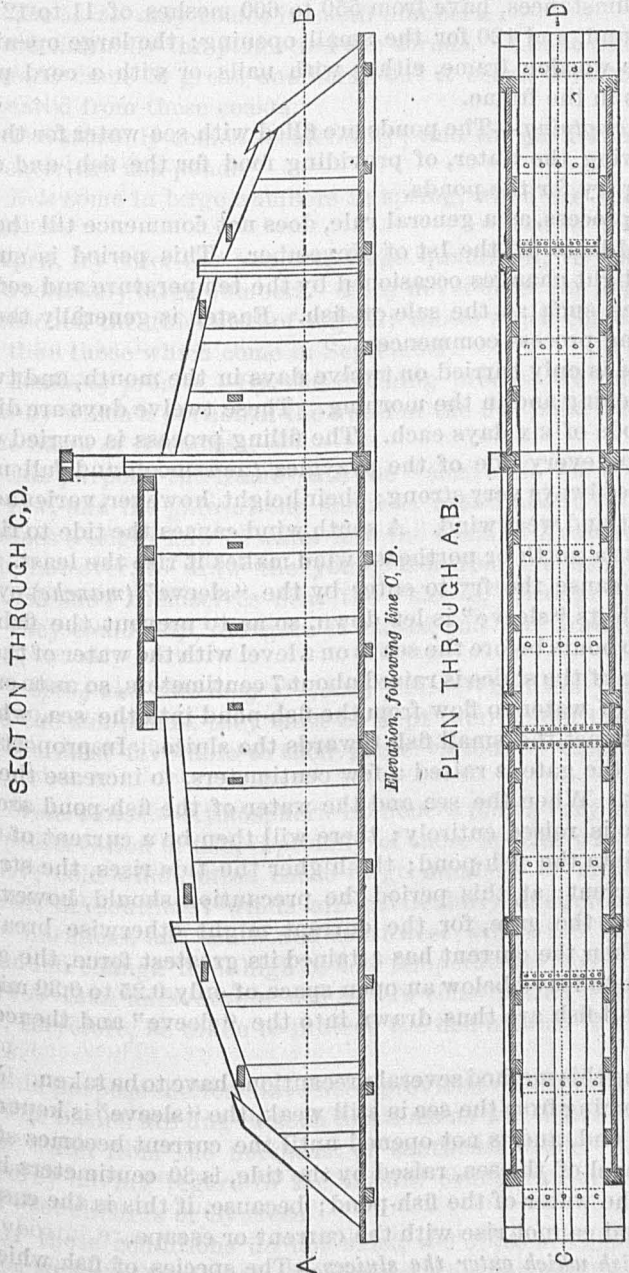
The result of Coste's visit to Italy was his interesting work on *Comacchio*. *Comacchio*, a colony of fishermen located in the midst of the lagoons of the Adriatic, has solved the interesting problem of cultivating the domain of the sea, "the fruits of which," says Coste, "are gathered, ripened, and multiplied in vast fish-ponds, and somewhat later harvested with as much profit and less labor than those of the soil."

Does not this way of characterizing the industry of *Comacchio* apply in almost every particular to the ponds of the Arcachon Basin? Whilst, therefore, the famous scientist envied Italy on account of her piscicultural industry, this very industry flourished in our own country, in the Arcachon fish-ponds, where, on a smaller scale, it is true, and under other, but no less favorable conditions, the fruits of the sea ripen and are harvested with as much profit and less labor than those of the soil.

It would be difficult to mark the exact time when these ponds were constructed, or to trace to any one man the invention of this ingenious system of cultivating the sea. The Marquis *de Cirac* was the first person who conceived the idea of utilizing the vast alluvial grounds of his domain. He inclosed them with dikes, and thus constructed salt marshes. The salters soon noticed that with the water destined to supply their salt-pits there came young fish; they saw them grow and flourish. The fisheries, at first only carried on to supply the wants of the family, soon became a business which extended from the hamlet to the city. The manufacture of salt was abandoned for the new industry, and people studied how to improve the apparatus which was to assure its success. Every year some progress was made, and the fish-ponds have now arrived at that state which, without being the height of perfection that might be attained, nevertheless justifies us in designating their arrangement as a model to all who desire to devote themselves to marine pisciculture. And it is of this arrangement that we now intend to give a brief description.

The fish-ponds were, as we have already remarked, originally salt marshes. They may still be recognized by their general appearance, there being vast sheets of water, separated from each other by pieces of ground equally large and devoted to agriculture. These last-mentioned pieces of ground are called "*bosses*" (protuberances), and have been formed by soil taken from the diggings which constitute the deeper portions and have been assigned to the fish. By means of sluices constructed in convenient places in the dikes which separate the fish-ponds from the basin of Arcachon, the water in the ponds is renewed, and the young fish, when still in the condition of small fry, are introduced into the ponds. These sluices are generally constructed of wood, and consist of four principal parts, viz: In the middle the bridge, which is placed at the higher part of the dike, and which serves as a passage-

way; towards the right, and adjoining the bridge, a post, with slides for a large sluice-gate; farther on, another post with slides for the



SECTION THROUGH C, D,

Elevation, following line C, D.

PLAN THROUGH A, B.

Ground-plan, following the line A, B.
ELEVATION AND GROUND-PLAN OF A SLUICE.

“sleeve”; and on the left, towards the Arcachon basin, a third post, with slides for a net.

The "sleeve" is a net in the shape of a truncated cone, 7 meters long; its opening is underneath the frame to which it is fastened; it must, under all circumstances, have from 550 to 600 meshes of 11 to 12 millimeters all round, and 120 for the small opening; the large opening is fastened on a wooden frame, either with nails or with a cord passed through holes in the frame.

Filling and emptying.—The ponds are filled with sea-water for the purpose of renewing the water, of providing food for the fish, and of obtaining young fry for the ponds.

The filling process, as a general rule, does not commence till the 15th of March, and lasts till the 1st of November. This period is subject, however, to slight changes occasioned by the temperature and commercial necessities, such as the sale of fish. Easter is generally the time when the filling process commences.

This process is only carried on twelve days in the month, and twice a day, in the evening and in the morning. These twelve days are divided into two periods of six days each. The filling process is carried on for six days during every tide of the syzygies (new moon and full moon). These tides are always very strong; their height, however, varies according to the east and west wind. A south wind causes the tide to rise the highest, whilst a north or northeast wind makes it rise the least.

In order to cause the fry to enter by the "sleeve" (*manche*) system, the frame with its "sleeve" is let down, so as to prevent the fish from escaping; two hours before the sea is on a level with the water of the fish-pond, the gate of the sluice is raised about 7 centimeters, so as to cause a small current of water to flow from the fish-pond into the sea, which is intended to attract the small fish towards the sluice. In proportion as the tide rises the gate is raised a few centimeters, to increase the force of the current. When the sea and the water of the fish-pond are on a level, the gate is raised entirely; there will then be a current of water from the sea into the fish-pond; the higher the tide rises, the stronger will be the current; at this period the precaution should, however, be taken to lower the gate, for the current might otherwise break the "sleeve." When the current has attained its greatest force, the gate is lowered, so as to leave below an open space of only 0.25 to 0.30 millimeter. The small fish are thus drawn into the "sleeve" and thence into the fish-pond.

In employing this method several precautions have to be taken. When the current coming from the sea is still weak, the "sleeve" is kept closed at the narrow end, and is not opened until the current becomes strong, or when the level of the sea, raised by the tide, is 30 centimeters higher than that of the water of the fish-pond; because, if this is the case, the fish in the pond cannot rise with the current or escape.

Species of fish which enter the sluices.—The species of fish which, by means of this contrivance, enter the fish-ponds are as follows:

(1.) *The mullet* (black mullet, white mullet, and "land-jumper"—*saut-ouri du pays*); the black mullet is much more frequent than the others.

(2.) *The barbel* only comes in small numbers.

(3.) Occasionally the *plaice* and the *dorado*. About fifteen years ago the dorado came in great numbers; but it seems now to have almost disappeared from these coasts.

(4.) The *sole* only comes accidentally; and the *gurnet* and *turbot*, &c., never enter the fish-ponds.

(5.) *Eels* come in large numbers in spring, when the sluices are first opened.

In April, fry enter the ponds in large quantities; in September they come in tolerably large numbers. They never enter the ponds until they have reached the thickness of a quill; those which come in April are larger than those which come in September.

The draining process.—By the draining process we understand the process by which a portion of the water of the fish-pond is caused to flow into the basin of Arcachon.

For this purpose the frame with the "sleeve" is let down when the tide is low, and the gate of the sluice is raised about 0.07 centimeter; this causes a slight flow of water into the basin of Arcachon not strong enough, however, to draw the young fish from the fish-pond. When young fish show themselves near the "sleeve," through the meshes of which they could slip, the gate is closed and the draining process is stopped.

The keeping and fattening of young fish.—When the young fish have entered the fish-ponds, they must be kept there under those conditions which are most favorable to their preservation, development, and fattening.

(1.) *Preservation.*—Atmospheric influences play a very important part in the preservation of fish, especially of those species which are kept in captivity; cold winds often cause large numbers of mullet to perish. Northeast or southeast winds are particularly dangerous; northwest wind is harmless, and south and southwest winds are very favorable. Any sudden change from high to low temperature, frost or ice is less dangerous than unfavorable winds. In constructing a fish-pond, care should, therefore, be taken to protect the fish against these hurtful influences.

For this purpose shelters have been provided in the following manner:

(1.) The basins are dug in such locations as will afford shelter to the sheet of water from the northeast or southeast winds. This object is attained by having regard to the natural configuration of the ground, by artificial shelters or by trees.

(2.) If these conditions do not exist, the dikes are made as high as possible, so as to form ramparts against the northeast and southeast winds, and in every case trees are planted on the banks of the fish-

ponds; the tamarind is the only tree capable of resisting the force of the wind on the shores of the basin of Arcachon.

(3.) Pits are dug in the shape of holes or trenches, thus creating depressions in the ground, 1.30 to 2 meters (and more) deep, where the mullet can take refuge either during great heat or severe frost. These pits are particularly beneficial to the fish when they cause fresh water to flow into the ponds. The temperature of this subterranean water, which is nearly always the same, 8 to 12 degrees, has a very salutary effect, by cooling off the water of the fish-ponds in summer, by keeping up a suitable degree of saltness, and by preventing the sheets of water from freezing in winter. When the surface is frozen, care should be taken to break the ice at regular intervals, so as to establish the proper circulation of air. For this purpose holes are made in the ice, and fagots or bundles of sticks whose ends are mixed with straw, either in small quantity or in sheaves, are stuck in the holes. Without these precautions one would run the risk of losing a large number of mullet, which often gather in the pits in dense masses, and there die from asphyxia.

(4.) Fresh water is brought into the ponds from neighboring water-courses, or from ponds or wells dug in the neighborhood. Such water, by reason of its composition and temperature, produces the same result as subterranean water obtained by digging.

Raising and fattening.—The deep places of a pond are specially intended to afford shelter to the fish, but they would not answer the purpose of raising fish, the rapid development of the fry and the fattening of the grown fish, especially the herbivorous kinds, like the mullet.

With the view of supplying the necessary conditions for raising fish, pastures are provided for them—shallow portions of the pond where those plants will grow which serve as food for the fish. These pasture-lands generally occupy vast plains on the bottom of the pond, where the fish can rest and feed, and where they are exposed to the direct influences of air, light, and sun. The best pasture-lands are those portions of the pond which present an extensive plain, very deep, and with scanty vegetation.

On these pasture-lands the fish might be surprised by cold winds, and might perish in large numbers. In order to protect them, and prevent them from straying away, the water of the fish-pond is lowered from the 1st November to about the 15th March. This causes the fish to seek the deep and sheltered places, where they are protected from hurtful winds, and where they can easily be caught, whenever there is any demand for fish.

The vegetation of the pasture-land and that of the pond in general is of great importance for raising fish.

Aquatic plants not only afford shelter to the fish, but also supply them with food, both in a fresh condition and when decayed. These plants also contribute indirectly to the food of fish by serving as shelter and nourishment to a very large number of small aquatic animals,

especially larvæ and shells, which certain kinds of fish will eagerly devour.

For raising mullet, and particularly for fattening them, the *Ruppia spiralis* and *Ruppia rustellata* are the plants which should be particularly cultivated in fish-ponds; for by observing the mullet when on the pasture-lands and by examining its entrails one will find that this fish consumes a large quantity of *ruppias* and a large number of microscopic shells adhering to this plant. This food gives to the mullets from most fish-ponds a peculiar flavor, which can be specially noticed when one takes care to preserve the detritus of this plant in the body of the fish.

Another plant has also been noticed, called by the country people "lége"; it is really an agglomeration of confervæ, which makes its appearance in loose threads, forming a sort of green moss on the surface of the water. When this plant grows too extensively it has a hurtful effect; but otherwise it contributes to the nourishment of several kinds of fish, for it nearly always contains a large number of small bivalves and diminutive crustaceans.

For raising and fattening mullet, old fish-ponds are preferable to new ones or to those which have been but recently constructed. In these last-mentioned ponds the fish grow very little during the first three years; after that time they develop in proportion as the pond becomes older. The yield of a pond, which is very small during the first few years, increases in proportion as the fish-pond is filled with ooze, plants, shells, &c. Careful observations have taught men the method which should be adopted to increase the productiveness of a pond during the first years and to aid the action of time, which is never very rapid. It will be sufficient in most cases to introduce and propagate suitable plants which the mullet likes, such as the *ruppia*, also those marine shells which live on these plants, and which are found in great abundance in old fish-ponds. It might also be advisable to raise only carnivorous kinds of fish during the first year, such as the barbel, the dorado, the plaice, the sole, &c., providing them with the food necessary for their development by propagating small crustaceans, shells, &c.

After some years have elapsed, when the time appears to have arrived for substituting mullet for carnivorous fish, these latter must all be caught, because their presence, at least in large numbers, would cause serious ravages among the mullet.

In order to obtain fish of good size and possess a tolerable degree of fatness, the quantity of fry and young fish of different ages should be proportioned to the size of the pond and its ability to supply a suitable quantity of food. Without observing these precautions it will be difficult to obtain fish of the size and quality which are in demand in the market.

THE FISHERIES AND PRODUCTS OF THE FISH-PONDS.

(1.) *Sluice-fishing*.—Sluice-fishing is carried on when the level of the sea is higher than that of the water in the fish-ponds; at the extreme

end of the sluice, towards the sea, there is placed a frame made of wire, with meshes 11 millimeters in width, and when this has been done the gate is raised entirely. The water of the sea rushes into the sluice, and creates a current. The fish which are in the pond are drawn towards the sluice by the movement of the water and by its freshness, and as it is always their tendency to go against the stream, they enter the sluice. When a sufficient number of fish have entered, the gate of the sluice is quickly closed, so as to prevent the fish from returning to the pond. They may then be caught in the water with a line, or one can wait till the water of the sea has receded, when the fish can easily be taken out. Fish of small dimensions are thrown back into the pond. This method of fishing is generally employed only in September and October. It is employed particularly for catching eels, called "*mouregains*" by the country people, by proceeding in the following manner:

Beginning in October, and all during winter, when the weather is bad and there is much wind and rain, one drains off the water for three to six hours during the early part of the night, especially during very dark, moonless nights (these are the times and conditions when the eel is liveliest), in order to attract the eels towards the sluice.

When the sea has completely receded, generally after two hours, the wire frame is placed outside the sluice, as I have described above, and the gate of the sluice is raised about $1\frac{1}{2}$ centimeters; a strong current is thereby established from the fish-pond to the sea, and the eels pass with this current underneath the gate and gather in the sluice. At daybreak the gate is let down again to prevent the eels from returning to the fish-pond. Generally about 500 kilograms of eels are in this way caught in one sluice. This is a very excellent method of fishing, as it does not involve any expense. As a general rule, only full-grown eels are caught. Care should be taken not to drain off the water from the pond, or to catch full-grown eels during the month of March, for during that month the young eels would escape from the pond and would pass through the wire grating. During the other months the young eel is very quiet; it remains in the pond and shows no desire to escape.

(2.) *Trammel-fishing*.—For trammel-fishing one uses an ordinary trammel with lead and cork. The fishermen who manage it are in a boat, and row about, describing circuits or labyrinths, all the while making a noise, in order to frighten the fish which become entangled in the meshes of the net. On account of the large size of the meshes, one only catches large or medium-sized fish. This method of fishing is only employed during the day, from the end of August till Easter.

Pond-mulletts are only caught from the end of August, for the following reasons:

During the hot season the fish grow most rapidly; if, therefore, they were caught during this period of the year, this would occasion a considerable loss, not only in weight, but also in quality; for fish, trans-

ported during the hot season, often undergo a change; they lose much of their freshness, and cannot be sold to advantage. The fisheries of the basin of Arcachon are, moreover, very abundant during summer, and the sale of fresh vegetables interferes considerably with the sale of pond-fish. These are the reasons which have determined the owners or farmers of fish-ponds not to commence fishing until the weather gets colder. The fisheries generally extend till Easter, because the Holy Week is very favorable for the sale of fish.

Fishing with the fish-gig.—This method is exclusively employed in catching the various kinds of eels, from February till Easter. The reasons for this are as follows:

In order to use the fish-gig advantageously, the water in the ponds must be very low, so that the eels may be gathered in larger or smaller groups. The fish-gig should only be used when frosts need no longer be feared, for, on account of its troubling the water, the fish-gig would, in case of a severe frost, increase the danger to the mullet. The ooze is carefully gone over in all directions with the fish-gig, and its five prongs are inserted in innumerable places. The eels which are caught in this manner are, therefore, partly lacerated.

Fishing with the fish-gig has this advantage, that in this way even the bottom of the pond is made to yield a profit; but, on the other hand, it involves considerable expense in the way of wages to the fishermen; and, after all, it only yields dead or torn eels, which cannot in that condition be sold to advantage, and which cannot be kept alive.

Production of fish-ponds.—In its present condition pond-culture only occupies itself with eels and mullet, called "*mules*" in this part of the country. The mullet constitute the more important object of these fisheries.

Pond-mullet belong mainly to three different kinds:

- (1.) The "*negrott*," or black mullet.
- (2.) The "*saoultott*," or sand-jumper (the golden mullet—*Mugil auratus*).
- (3.) The "*blancheou*," or white mullet (the "*ramado*" or *Mugil capito*).

Of these three kinds the black mullet, or the "mullet with thick lips," is found more frequently than the two other kinds. It enters the sluices in very large numbers, and seems to flourish better in the ponds than the other kinds. Its size is, generally, one-third greater than that of the other two kinds, more especially than the white mullet (*Mugil capito*).

The average annual yield from the mullet and eel fisheries may be estimated at 300 kilograms per hectare.

The establishment of fish-ponds, therefore, offers positive advantages, not only by increasing the quantity of food for the people, but also by being more profitable than the cultivation of the soil; for in these parts the average annual yield of a hectare of ground, set out in wheat or beans, is 100 francs; of meadow-lands which are not irrigated, 120 francs; of meadow-lands irrigated by fresh water, 250 francs; and of

salt marshes, 150 francs; whilst fish-ponds, when properly cultivated, will yield as much as 300 francs per month.

It must be borne in mind that this result is obtained in a perfectly natural manner, without using any artificial food. The fish are actually left to themselves in the ponds, where the *ruppia*, which grows spontaneously, is sufficient for their nourishment.

The construction and cultivation of fish-ponds cannot, therefore, be too highly recommended. Our population is constantly increasing, and its luxuries and actual needs increase still more rapidly. All classes of society eagerly seek enjoyment of every kind, and the scarcity (every day greater) of delicate meats, such as fish, threatens at no distant future to make many articles of food almost unattainable, food which is eagerly sought by all classes, absolutely necessary for weak and sick people, that it becomes a matter of great importance to place it within the reach of those (especially the last mentioned) who are not favored with a superabundance of this world's goods.

Two objections, however, have been raised against the fish-ponds. It has been said that they are a cause of insalubrity because their waters are often stagnant; and, secondly, the objection has been raised that they create a competition which endangers the privileged fisheries of the enrolled mariners.

Insalubrity.—The first of these objections shows an entire ignorance of the manner in which fish-ponds are managed, for their water is renewed twenty-four times per month; for example, during the three days which precede and the three days which succeed the new and the full moon, during the double day and night tide. Can water be called stagnant when it is renewed twenty-four times per month?

It has also been said that the mingling of fresh and salt water is productive of insalubrity, whilst this mingling is certainly recognized as favorable to the development of fish, improving the flavor and quality of their flesh.

Without entering into a scientific discussion of this assertion, we will confine ourselves, by way of refutation, to presenting the sanitary statistics of the country—statistics taken among those classes of people which are most exposed to the alleged fever-breeding miasmas of the fish-ponds; I mean the salters, lock-keepers, and the customs officers, the last mentioned being often compelled by their duties to pass their nights near the marshes. It must be granted that the salters are the most robust people in that part of the country; and as far as the customs officers are concerned, we point to the report of the inspector of customs, which says that of all the customs officers scattered along the coast of the basin, those of the district of Aude had the smallest number of sick, even less than the healthy district of Arcachon.

The fact that the mingling of fresh and salt waters, when the latter are not stagnant, is perfectly harmless, has been fully corroborated by Mr. Coste's observations in the lagoons of *Comacchio*. This famous

author says: "Intermittent fevers to which people living in a marshy country are generally exposed are not frequent at *Comacchio*; and whenever there are in the neighboring country any young people with a feeble constitution or threatened with consumption, they are sent into the marshes for the purpose of gaining strength, and are made to share the work and food of the fishermen."

Competition.—In a petition addressed to the minister of marine, the proprietors of fisheries, especially those of the district of La Teste, have thus expressed their grievances:

"During winter, when the scarcity of fish would allow us to realize some profit, we are deprived of this advantage by the number of fish from the fish-ponds which are brought to the Bordeaux market."

This was followed by a request to have the fish-ponds abolished, so that with them all competition might disappear, and the greater scarcity of fish bring about a corresponding rise in prices.

To expose such pretensions means to denounce them. Without seeking to refute them, we feel nevertheless constrained to say that this competition which has been denounced in such a manner does not exist at all, neither in the fish-market nor in the fisheries.

As regards the fish-market, it must be said that the ponds only furnish fish during winter, therefore at a time when bad weather has rendered fishing impossible, or at least prevents the fisheries from fully supplying the demand.

As regards the fisheries, it must be said that when the mullet enters the fish-ponds it measures, generally, only 6 centimeters in length and 8 millimeters in breadth. If caught by the fishermen these young fish would uselessly perish on their hands; it has, therefore, been found necessary to prohibit the fishing of young mullet. In the fish-ponds, on the other hand, the mullet is left in peace, and finds all those conditions which favor its preservation and development. Left to itself in the basin of Arcachon, the young mullet is often thrown by the tide on the shore, where it invariably perishes, and in nearly every case falls a prey to voracious animals, most of which are of no use whatever to man.

The fish-ponds, therefore, tend to utilize for the food of man products which otherwise would, to a great extent, be lost.

The young fry of the mullet, during the first stages of their development, remain in the basin of Arcachon. As soon as frost sets in, they leave this basin and seek deep and sheltered places farther out at sea. Their migration commences in November, and at that very time a large number of fish of prey are observed, notably hake, which, by their instinct, are led to the entrance of the Arcachon Basin, where they find an enormous number of young fry, especially of the mullet kind. On opening these hake their stomachs are found filled to repletion with young fry, particularly with young mullet. Before the migration of the

mullet, the hake were thin, but after a few weeks they have grown very fat.

There seems no way of counteracting these powerful causes of destruction but to place a certain quantity of fry in the fish-ponds. This destruction of the fry is very much to be regretted, for actual observations regarding the growth of fish of prey in the coast-waters, and that of mullet in the fish-ponds, show the following result: A thousand young mullet left in the basin of Arcachon are, when quite small, devoured by fish, whose flesh may be used as food, but which at best only furnishes half a kilogram of flesh fit to eat; whilst the same number of young mullet, placed in fish-ponds and raised there, furnish, when grown, more than 1,000 kilograms of the most delicious food.

Under these conditions, and in view of the constantly rising prices of all articles of food, especially animal food, we must say once more, and in the most emphatic manner, that the development and cultivation of fish-ponds cannot be too highly recommended, and that wherever they do not yet exist they should certainly be established.

SLUICES.

Introduction of young fish.—By means of sluices, constructed in convenient places in the dikes which separate the fish-ponds from the Arcachon Basin, the water of these ponds is renewed, and the fish, when still quite young, are introduced into the ponds.

The sluices are constructed of wood, and consist of four principal parts, viz: In the middle, the bridge which is placed against the high part of the dike, and which serves as a passage-way; to the right, towards the fish-pond and leaning against the bridge, there is a post with grooves for a large gate; farther on, another post with grooves for the "sleeve"; to the left, towards the basin of Arcachon, a third post with grooves for a fishing-net.

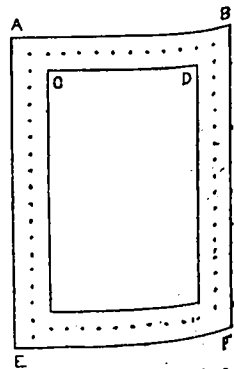
Use of the "sleeve."—The "sleeve" is a net in the shape of a truncated cone, 7 meters in length; its opening is exactly underneath the frame to which it is attached; it must always have 550 to 600 meshes of 11 millimeters' width, on its sides, and about 120 for the small opening. The net-makers are permitted to make the meshes larger for a portion of the net, measuring about 3 meters from the small opening; but they must gradually decrease in size until they have reached 11 millimeters; the small opening measures about 30 centimeters in circumference.

The large opening is attached to a wooden frame, either by nails or by a cord which is passed through holes made in the frame.

A B=1.10 to 1.30 millimeter.

C D=1 to 1.20 millimeters.

A E=The length or height is proportioned to the depth of the sluice.



In all cases, however, the line E F must touch the bottom, and the line A B must rise 0.50 millimeter above the level of the water, so as to prevent the mullet from leaping over the frame and escaping in that manner. The frame runs in two posts with grooves.

Manufacture and preparation of "sleeves."—At Bordeaux "sleeves" are prepared by the process employed for preserving awnings and sails. This process imparts to the twine a greenish color. It costs, per "sleeve," from 1 franc 75 centimes (34 cents) to 2 francs (39 cents), according to the weight, and makes a "sleeve" last one-third as long again as it would have lasted otherwise. A "sleeve" without preparation costs 25 francs.

This apparatus is made at *Bassens* (12 kilometers from Bordeaux) by women and children; the twine is manufactured at *Tonneins* (Department of Lot et Garonne); in making a "sleeve" 10 francs' worth (\$1.93) of twine is used; the maker gets 10 francs, and the profit of the merchant is 5 francs (96.5 cents).

If a "sleeve" has been well prepared it will last one year; this will greatly depend on the quantity of detritus, refuse, and plants floating in the sea and drifted towards the "sleeve"; sometimes a "sleeve" will last eighteen months; but as a general rule a "sleeve" without preparation becomes worn out in about eight months.

It will be good to immerse the "sleeve" from time to time in tan (an infusion of the bark of oak), which gives to the twine a reddish color.

STOCKING THE FISH-PONDS.

Process of stocking.—The following kinds of fish when quite young are made to pass from the sea into the fish-ponds by means of sluices:

Mullets, commonly known as "*mules*," enter in large numbers and form the most important part of the population of the ponds.

Barbels, commonly known as "*brignes*," only enter in small numbers.

Eels enter in large numbers in spring, when the sluices are opened.

The introduction of young fry into the ponds by means of a net ("sleeve") placed in the sluice often causes too large a quantity of barbels and eels to enter at the same time, which is not desirable, as these fish are exceedingly voracious, and are apt to devour all the young fry of the mullet. The only means of warding off this danger is to gather but few young mullet in the "sleeve," and to raise young mullet by *artificially impregnating* their eggs, which are generally emitted by the spawning process at the end of June or the beginning of July. By replacing the "sleeve" with a metallic frame (not letting any sea-water enter), and by hatching fecundated eggs only of the better kinds of mullet, the pond will be exclusively stocked with these fish, the cultivation of which is far more profitable than that of the barbels and eels. It may be well to state, in this connection, that the mullets, more especially the black ones, can easily stand saltness varying from zero to 8 degrees of Baumé's areometer, and a degree of heat and cold which would cause most other fish to perish.

Rules to be observed in transforming salt marshes into fish-ponds.—In transforming salt marshes into fish-ponds the following rules should be observed :

A request should be addressed to the minister of marine asking for the privilege of converting into fish-ponds the whole or part of a salt marsh. Such a request is never refused.

The water of the sea should be allowed to flow off by means of trenches.

The saltness should be taken out of the ground by rain-water, either by allowing the rain to fall on it, or by gathering the rain-water on the neighboring land.

Whenever there is a sufficient quantity of water from wells or water-courses, it is used for watering the ground and for freeing it from the greater portion of the sea-salt with which it is impregnated.

The ground should be allowed to dry until it has reached a degree of consistency sufficient to permit of its being worked with a spade.

The soil gained by digging is used for constructing large and solid dikes intended to retain the water in the fish-pond and to prevent the water of the sea from flowing into it.

In these dikes sluices should be constructed for renewing the water of the ponds, and for introducing the young and fry of fish.

By all possible means the growth of *Ruppia spiralis* in the ponds should be encouraged.

Deep places should be dug in certain portions of the pond, pastures should be established, and shelters should be constructed. Rain-water, wells, and water-courses should be utilized for the purpose of rendering the water of the ponds brackish.

Regulating the fish-ponds.—These fish-ponds, being fed from the basin of Arcachon by means of sluices, were classed among the coast-fisheries ; and, although they are located on private property (they were formerly salt marshes), they come under the general law of January 9, 1852, for regulating such fisheries.

Before the regulation of July 4, 1853, went into effect, the sluices were at their inner opening furnished with a "sleeve" or bag-shaped net, 7 meters in length, the meshes of which each formed a square of 11 to 12 millimeters ; the fry that came with the tide were drawn into this net and thus carried into the reservoir. The "sleeve" was used for preventing both the fry and the young fish, fattened in the ponds, from leaving the ponds ; and the size of the meshes was arranged accordingly.

The above-mentioned regulation has raised these dimensions to 25 and 18 millimeters : "The sluice or way of communication will be closed at its inner opening by a wire grating or by a net, the meshes of which shall each measure at least 18 millimeters square from the 1st of October till the 31st of March, and 25 millimeters from the 1st of April till the 30th of November.

"At the moment when the sea-water enters the ponds there may be

substituted for this grating a bag-shaped 'sleeve,' or net, the meshes of which, throughout its whole length, shall measure at least 18 millimeters from the 1st of October till the 1st of March, and 25 millimeters from the 1st of April till the 30th of November." (See Article 27 of the above-mentioned regulation.)

This provision might cause the ruin of the ponds. When the fry enter the inner basin, they generally measure only 6 centimeters in length and 8 millimeters in breadth; meshes of 25, and even of 18, millimeters would therefore not only *allow the fry to escape*, but also, as has been observed repeatedly and under different circumstances, *liberate those fish which have been raised in the ponds*, and which have reached the size of 20 centimeters.

For ordinary fishing, as in those fisheries which are carried on in the sea and in the basin of Arcachon, the prohibition of apparatus with narrow meshes is perfectly justified. Narrow meshes, in fact, would either injure or capture the fry, which would thus *perish uselessly* in the hands of the fishermen; the use of nets with narrow meshes has therefore been prohibited.

The ponds, on the other hand, which are guarded by apparatus with narrow meshes, *keep the fry*, and furnish them *with all the conditions which are essential for their preservation and development*.

These facts have been taken into serious consideration by the minister of marine. Article 9 of the decree of May 10, 1862, contains the following: "Fish-pits or fish-ponds may, after proper authority has been granted, be constructed on private property which receives water from the sea. The licenses granted by our minister of marine and the colonies will determine, according to the character and extent of the ground, the conditions upon which these ponds are to be managed."

At this day the size of the meshes of the nets ("sleeves") placed at the opening of the sluices is no longer regulated by law, but the owners of fish-ponds adopt the size which suits them best. Only one condition is imposed on them, viz, not to bring to market fish which do not have the regulation size—barbels 0.10 millimeter in length, mullets 0.14, and eels 0.25.

Under these conditions, the transformation of salt marshes into fish-ponds has steadily increased; at the end of 1876, there were 1,022.50 hectares of such ponds; and there is every reason to hope that this number will be increased tenfold.

