

# XXXIII.—OYSTER CULTURE IN MORBIHAN.

A REPORT PREPARED IN THE NAME OF THE COMMISSION OF THE COMPETITIVE EXHIBITION AT VANNES.\*

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\* L'Industrie Huitrière dans le Morbihan. Rapport dressé au nom de la Commission du Concours de Vannes par A. E. Hausser, Ingénieur des Ponts et Chaussées. Publié sous les auspices de M. le vicomte de Rorthays, préfet du département, par le Conseil général du Morbihan. Avec vignettes et 5 planches. Paris; Dunod, éditeur. Quai des Augustins, 49. 1876. 12mo. 152 pp.

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## I N T R O D U C T I O N .

The oyster, whose edible qualities are so remarkable, formerly abounded upon our coast, and has always been in great demand. Successful attempts at its cultivation date back to remote times, and Coste has given an exceedingly interesting description of the ancient industry of Lake Lucrin. In the days of the greatness of ancient Rome, the proconsul, C. Sergius Orata, attained such success in the cultivation and improvement of the oyster, that a liking for the pleasures of the table, no less than for the attractions of picturesque country life, drew every year numerous patrician families to the environs of Lake Lucrin, upon the pleasant shores of the bay of Naples.

Among the *débris* discovered about certain Roman camps, oyster-shells occur abundantly, and history proves that everywhere among the many productions serving as food for man, shell-fish in general, and oysters in particular predominate. This has resulted from the remarkable hygienic properties possessed by this class of animals, and to judge from the prescriptions of American physicians, one might be led to believe that the flesh of the oyster bore the character of an universal panacea.

We do not intend to plead here the cause of the oyster, or argue in favor of its increased use. The consumption has already attained such proportions as to form in itself the strongest argument in its behalf. When we consider that in America nearly ten thousand millions are eaten yearly, that in the city of New York alone the annual sales amount to from seven to eight millions of dollars, and that, according to M. de Broca, more money is expended there for oysters than for meat, some idea may be obtained of the consumption in that country, and of the important position occupied by this mollusk in the public welfare. Taking into account the valuable nutritive properties of this product, and the importance of making it a common article of food, one can understand our regret at seeing it disappear from some of the most important of the French beds. We do not need to seek the cause of its disappearance from the French coast; the fact is evident, and it is the fact that we should bear in mind. Coste, whose name will ever be remembered in connection with the great attempts of the past fifty years, in advancing fish culture and the cultivation of marine products, has, with

the characteristic glance of a man of genius, embraced the entire question, in all its bearings.

It is indispensable that we should, in this connection, review the plan of work of this learned man, together with his principal ideas. Whenever oyster-cultural enterprises are to be undertaken, it is Coste, and Coste alone, who should be consulted, and whoever desires to make oyster culture practical must reflect upon the failures of Coste and deeply ponder their causes.

We give here, in a few words, the course pursued by the master. M. de Quatrefages has contended that the artificial fecundation of the oyster is possible; Coste has shown that the oyster is hermaphrodite, that the eggs and spermatozoa originate in the tissues of the same organ, and that the mantle of the parent forms the only favorable medium for the process of hatching. In 1860, he wrote the following words, which are full of truth: "In the case of oysters, the natural processes are the only practicable ones to be followed in connection with the industry."\* This discovery, therefore, totally precluded the artificial fecundation resorted to in fish culture, rendered the crossing of species impossible, and led to a study of the natural development of the functions of the oyster, without the hope of controlling it. The fecundity of the oyster is very great. Each individual is capable of producing from 1,000,000 to 2,000,000 eggs, between the months of June and September. Hatching is accomplished, as already stated, in the mantle of the parent. The eggs, which are white at first, change in color, and when they have assumed a bluish or slaty gray tint, it is an indication that the embryos have arrived at maturity, and they are then expelled.

Impressed by what he had observed at Lake Fusaro, convinced, after his trip to the little bay of Seudra, that cultivation might improve the oyster and give it valuable qualities, persuaded, by the results of the mussel industry in the bay of Aiguillon, that man might exert a powerful influence in increasing the abundance of these mollusks, Coste conceived a comprehensive plan. He asserted that breeding was possible in basins or claires; he made a study of the spat-collectors, sought to collect all the spawn produced by the parent oysters, and affirmed that nearly all our shores might be planted and transformed into fertile regions of production. He insisted upon the duties of the department of marine, in connection with the enterprise. "The administration," he said, "will see, as if by magic, the isolated banks of the entire harbor of Brest and of the bays of Brittany, with the mouths of the affluent rivers, enlarged and united, by the formation of new ones, into vast areas of production. The depleted beds of Cancale and of Granville will be renewed, and will spread out towards very many localities, where the depths are such as to readily favor the attempts made to enrich them. The basin of Arcachon, all that section of la Manche, extending from Dieppe to Havre, from Havre to Cherbourg, and from

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\* Voyage d'exploration, Industrie du lac Fusaro.

Cherbourg to Granville, will become covered with oysters, and the extinct beds of the districts of Rochelle, Oléron, Rochefort, and Marennes will be brought back to their former prosperous condition.”\*

Such enthusiasm in a man of science, who based his propositions upon indisputable observations and upon the very judicious application of the principles of embryology, would naturally be communicated to others and create numerous adherents.

The first attempt at oyster culture on a large scale was made at Saint-Brieuc. Over the spawning oysters deposited upon the bottom, fascines were arranged and held in place by means of weights. The spat attached itself abundantly, and at the end of a few months, the first lot of branches, covered with young, were carried triumphantly to the palace of the Tuileries. “I consider it my duty,” said Coste, “to propose to your Majesty that you order the immediate restocking of our entire coasts, including that of the Mediterranean as well as those of Algiers and Corsica, and not excepting the salt lakes of Southern France. \* \* \* In this age, in which, by the efficacious application of the laws of physics, an invisible force carries thought along the conducting wires, with which the genius of man has encircled the globe, physiology shall exert its power upon organic matter, by an application of the laws of life.”†

Coste did not doubt the result; failure seemed to him impossible; he foresaw the complete transformation of the sea-coast, and exclaimed, in his letter of March 20, 1861, to the Emperor: “I thank your Majesty for having placed me in the front ranks of the greatest enterprise of the age, in connection with animate nature.” Attempts were multiplied, but progress and success seemed more and more retarded and lessened in the course of time. The bay of Saint-Brieuc was swept by a tempest. At Arcachon discouragement seized upon those who, in the beginning, were most enthusiastic; for little or no spawn was collected. Coste heard the name of charlatan sounded in his ears; his work was ridiculed even by those whom, in the expectation of success, he had loaded with favors, and our modern Athenians were lavish in criticisms, in which neither sarcasm nor bitterness was spared. Enfeebled by his labors and deprived of sight, Coste struggled on. He hoped against all hope, and maintained that the application of his principles would even change the social conditions of the sea-coast communities.‡ His views were met only by incredulity. He died at his post, despondent, greatly discouraged, and to the last hour misunderstood by that multitude, who treat with contempt all great ideas which do not meet with immediate success. While others were occupied in criticising, a few men labored faithfully, and in a few years, between 1868 and 1875, the production and cultivation of oysters made remarkable progress on the shores of Morbihan.

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\* Rapport à l'empereur du 5 février, 1858.

† Rapport à l'empereur du 12 janvier, 1859.

‡ See the preface to the work of M. de la Blanchère, *Culture des plages maritimes*.

In 1875, a local fair was held at Vannes, in one of the departments of France. Those who visited the section of practical oyster culture were convinced that the enterprise was not only practicable, but had even grown to the rank of an industry. Fifty-four oyster-culturists responded to the invitation of the prefect of the department, and displayed specimens of their productions, in a tank prepared for the purpose. In addition, they thought it appropriate to exhibit their materials and tools, and the methods of using them. A first glance sufficed to show that this branch of industry had its principles, its methods, and its utensils, elaborated and adapted by study and experience.

Two grand prizes, in addition to the ordinary awards, were specially offered for oyster culture. The first was to the culturist who, by his perseverance and success, had contributed most to the development of this special branch. The second was to the author of the best memoir on the general subject. The second prize was not given, but the first was doubled and divided between M. Chaumel and M. le Baron de Wolbock. Through the efforts of the prefect of the department, a special commission was organized, under the honorary presidency of the prefect of marine. The labors of this commission, consisting of the study of the memoirs presented by the competitors, the examination of the parks, and the discussion of the processes in use at Morbihan, excited a lively interest. Furthermore, it was decided that, in a general report, the commission should set forth the condition of oyster culture at Morbihan, in 1875, its progress, its prospects, and its demands. This was the consummation of its labors.

Appointed to edit this report, we have attempted to perform this delicate and arduous task to the best of our ability. If this memoir contains any valuable ideas, their merits should be attributed to the oyster-culturists of Morbihan. We assume the responsibility of the imperfections that may be found, and invoke the indulgence which we hope will not be refused to good intentions.

A. E. HAUSSER.

LORIENT, *July 25, 1875.*

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## CHAPTER I.

### BREEDING PARKS IN GENERAL.

*Time of spawning; extent of the parks.*—The determination of the exact time when the oyster becomes milky and its ovaries become charged with millions of eggs, is of such importance that we must devote some lines to the subject.

When the parent oyster, by a series of contractions, throws out about it that whitish cloud, so rich in life, it leaves to the forces of nature and to the instincts of its progeny the entire care of providing for the fixa-

tion and development of the embryo. The works of M. Coste and his followers, among others M. Fraïche and M. de la Blanchère, illustrate the structure of the young oyster, with its embryo shell and prominence armed with cilia, which, remaining in a state of perpetual vibration, constitute a temporary swimming apparatus. The young oyster, by this latter means, sustains itself in the water, until it finds a suitable object for its attachment. Then, the temporary swimming organ disappears, and soon afterward a little shell may be distinguished, about the size of a lentil, firmly attached to the side of the collector.

It has been noticed that mud is not suited to the newly-hatched oysters, which require a hard and clean surface for their attachment. But it was not known when to place such objects in the water, when to offer the embryos a suitable surface upon which they could live, for a short time at least.

Many culturists, observing that the oysters became milky in April and May, thought to prepare their collecting apparatus at that time. They were entirely deceived, and, in an industrial point of view, unsuccessful. It was this failure, experienced by Coste himself, which discouraged the first attempts.

M. Chaumel, in an interesting memoir, has given to the commission the series of experiences by which he succeeded in meeting the difficulty. "The situation in 1862-'63," said he, "was very trying. M. Coste, in discouraging letters, did not disguise from me the fact that he was on the eve of seeing his functions as inspector-general suppressed, and urged me on to a success which I already began to foresee, and for which I tried to make him hope.

"I was, in fact, convinced that the principle was good, but that he did not yet know how to apply it, and it was towards this end that all my efforts were now directed.

"I, as well as the greater number of oyster-culturists, had already noticed that the young oyster never attached itself to any but the cleaner portions of the collectors, and also that apparatus which had been even fifteen days in the water was already salt.

"It, therefore, became absolutely necessary for me to ascertain the exact time of spawning, which would, consequently, be the proper time for placing the collectors. Upon this success depended. I made many attempts to arrive at this desirable result; but what turned out the most successful were the most simple.

"At Pénerf and Auray, I arranged new collectors at every high tide after the month of April, and at the same time I opened a few oysters, to ascertain the condition of the ovaries. I noticed that the spawn, at first white in the ovary, deepened in color as it passed through the gills, becoming yellow and violet in turn, as the time of incubation approached, and finally assumed a bluish slate-color. When this hue appeared, I discovered several young oysters upon the last collectors put in place.

"The conclusion was easily deduced; the blue tint announced that the spawning time was at hand, and that we should hasten to arrange the apparatus. I announced to M. Coste the happy result I had obtained, and predicted a complete triumph."

This result, which to-day may seem of slight importance, had considerable weight at the time of its publication, ten years ago. When it became known that about the 1st of July, the time when the milky hue changes to the bluish color, was the commencement of the spawning season, then it was evident that one might with certainty, and without danger of interference from sediment, make ready the collectors to receive the young oysters.

From the time when this matter was determined, the problem of the arrangement of the collectors was solved.

In this way, moreover, judicious observations conduced to progress, and divers experiments were made. Attempts were made to collect the young oysters by keeping the spawning oysters shut up in basins furnished with sluices, and also by simply placing the collectors in the water. This last method produced magnificent results.

It was now well understood that the spawning season dated from about the 1st of July, and it was also known that the best results had been obtained in the deeper water; but it had not yet been ascertained that there was a classification to be made, and a judicious method to be followed.

To Dr. Gressy, of Carnac, is due the following observations: "The collectors should be placed in the shallower areas from June 15 to July 10, and in the deeper areas from July 10 to August 1.

"If, during the first-named period, the collectors are set in the deeper areas, polyps will grow over them, and they will receive only an insufficient number of embryo oysters. Polyps are never observed on the collectors in the shallow areas, because the young are unable to resist the heat, when exposed at low tide, but they are most abundant upon those which are seldom uncovered, or only at the spring-tides. Nothing can be more easily proved in the breeding parks. The deeper down we go, the more numerous and more luxuriant will we find the polyp growths, suspended over the collectors.

"By the 10th of July, the polyps have about finished spawning, while the oyster spawn is still very abundant; hence, after this time, the young oysters may attach themselves to the collectors, without fear of being smothered by the growing polyps. This physiological law, which I have observed in my parks, has not hitherto been made known."

It will, therefore, be seen that, before placing the apparatus intended for the attachment of the embryo oyster, it is necessary, not only to await the month of July, so as to escape the deposit of sediment, but also to follow a methodical order, and work in the shallower areas from the middle of June to the middle of July, and in the deeper ones from the middle of July to the first part of August.

*Ill-success of breeding in parks; the currents.*—The idea, at first, was not to collect the embryos at the mouths of rivers or along the shores. Aware of the extraordinary fecundity of the oyster, and knowing its period of spawning, it was supposed that all that was necessary was to transfer the adult oysters to basins, arrange collectors near them, and leave the rest to nature.

This method, which led many culturists to employ clusters (*ruches*) of tiles, where the spawning oysters were fastened upon shells or other collectors, was recommended by Coste. If one adult oyster produces 2,000,000 embryos, thousands of such oysters would yield the thousands of millions, required to satisfy the public demands, and that too within a very restricted area. Such was the reasoning employed, which appeared as striking as it was logical.

The method of proceeding is described in all of Coste's letters, regarding the industry at Marennes. "Each establishment," he says, "thus transformed into an actual factory, where man controls the influencing conditions and varies them at will, performs the double function of an artificial oyster bank, supplying spawn, and of a perfect collector for the attachment of the spat; in this manner, those oysters which have become adult and marketable will be replaced each year by their own progeny, carefully brought together and bred in the place of their birth; thus, by this indefinite rotation, a constant renewal is produced."

The attempts made to carry out this process at Morbihan resulted in completely upsetting this plausible theory.

Breeding in basins was found to be unprofitable. Such was the conclusion then arrived at, and this conclusion is to-day considered indisputable. What is the cause of it? The question is one which it would be quite useful for us to solve; for, in order to progress in so delicate a matter as the breeding of oysters, it is necessary to study all the phenomena, and even those which, at first sight, appear to be of secondary importance. We have said above that the young oyster, with its embryo shell, when first set free by the parent, is furnished with a temporary swimming apparatus, which enables it to move about and remain suspended in the water. In a closed basin, the young oysters, when they issue forth, fall to the bottom, and whether there be any mud or slime there or not, or anything beyond the proper bodies arranged to receive them, but a very small proportion attach themselves. Certain culturists, among them M. Charles, who own important breeding establishments near Lorient, attribute the ill-success to the saltness of the water in the basins, and its temperature. Besides, according to the latter, the oysters when they are placed in the basins are not in a healthy condition; being transported, handled, and moved about, during the period of fecundation, conception takes place under unfortunate circumstances, and the issue is but an abortion, producing still-born offspring. According to others, and Coste foresaw this difficulty, it is impossible to have a basin without some mud and ooze, in which the young oysters perish. While



granting to these several causes effects more or less important and decisive, we must seek others, and arrive at one of the most important subjects in oyster culture, the action of currents. We are convinced, and our opinion is founded upon the statements of the principal oysterculturists of the department of Morbihan, such as MM. Chaumel, Gressy, and De Wolbock, that a current is indispensable to the life and welfare of the embryo.

On the sea-coast, the tides vary in their movements according to the location. Near the shore, in the coves and mouths of rivers, the undulations, due to the tides, produce currents, which are called tidal currents. The rivers also have their currents, which on the flood tide carry the seawaters towards the interior, and on the ebb come back laden with sediment.

There is something peculiar about these currents, which is that they are unequally distributed, and often, when there is an inward or flood current at the surface, the water is flowing outward below, and *vice versa*. It is now known that the parent oyster does not give out its spawn, excepting at the beginning of the flood tide. "How admirable!" exclaims M. Chaumel. "Never does the parent oyster, doubtless from the fear of having its young left upon dry land to perish, give them forth at the last of the ebb; all of the emissions which I have witnessed have taken place at the first of the flood, when the oysters begin to be well covered by the rising water, but never, never when the sea was about to leave them dry."

We can readily admit the instinct of the mother oyster, especially as we shall have later to speak of the instinct of the embryo; but we must also take into account the fact that the water is less pure and vivifying on the ebb than on the flood tide, and thus, in the former case, the conditions are much less favorable for the oysters. After remaining some length of time under the influence of the ebbing waters, they feel the contact of the incoming tide, under the revivifying action of which they throw out their spawn, for some distance around.

Whether we take into consideration solely the action of the tides in connection with the spawning of oysters, or study their effects upon development in general, the result is always the same, as determined by careful observations, that the tides are necessary for the oyster and indispensable to its normal existence. If the oyster becomes fat and of a greenish color, it is an indication that it has been living under abnormal conditions, and it is well known that all animals confined in parks or basins, where they fatten, are not favorably situated for reproducing. Thus, in locations where the current is wanting, the oyster, even though performing its natural functions, reproduces very imperfectly. But, however important the tidal current may be for the mother oyster, it is still more necessary to the embryo, which has not the power of transporting itself to any distance, by means of its temporary swimming organs. The area which it can traverse of its own free will, so to speak,

is very limited. In a single drop of water its vibratile cilia cause it to move freely about in all directions, but it has not the power to stem a current, nor to swim far in a perfectly quiet sea. It is the current alone that transports it, preserves it, and places within its reach everything essential to its growth and existence, and it is the current alone that enables it to become readily attached to the collectors. "I feel certain," says M. Chaumel "that the organs of locomotion serve, at the same time, as organs of respiration, sight, and hearing, by means of which the embryo is able to find a suitable place for its attachment."

It is evident, therefore, that, if the idea of breeding oysters in a closed area must be abandoned, it is because the parent oyster, from the lack of a current, gives issue to imperfect offspring. The embryo, also without the means of moving about, is exhausted from the time of its birth, and generally falls to the bottom, where it perishes within sight of the collectors. These conclusions only apply to inclosures of medium size, having a superficial area ranging from 1 to 2 hectares (2½ to 5 acres). In more extensive basins, of 15 to 20 hectares (37 to 50 acres) each, special phenomena come into play, producing changes both at the bottom and at the surface, in the former case by the renewal of the water, and in the latter by the action of the wind, permitting to a certain extent more favorable results.

Taking everything into consideration, however, it is now admitted, at Morbihan, to be preferable to entirely renounce both the small and large inclosures, and depend upon the natural movements of the water, in the channels, coves, and rivers. This plan is the most economical one and the results are more certain.

We cannot do better than quote, in this connection, the remarks of M. Chaumel, who is one of the best authorities on the subject. "I regret," he says, in speaking of the works established in the river Trinité, "to see such extensive reservoirs, built at so great an expense, in which it is expected breeding can be successfully carried on. I know full well that it has been found possible in some places to collect embryo oysters in artificial basins, and an example is cited where shells, thrown upon the bottom, have become covered over with young oysters. I am, therefore, convinced that I was mistaken in what I had all along held to be the case, that the shells were really covered with the young, without its being noticed, before they were placed in the basins. The temperature of the water in these narrow basins, under the action of the sun's rays, attains that of a warm bath, and must, at least, present a serious obstacle to the operation of breeding. Reservoirs for the breeding of the young and walled parks are fundamentally wrong in principle. It is necessary to avoid placing any obstructions in the way of the currents, which are very essential to success."

*The muddy deposits of the shores of the Department of Morbihan.*—The currents, so important and so necessary to the life of the oysters, carry along with them, what is considered by many culturists a very destruc-

tive element, one of the most deadly enemies of the oyster; this element is mud. "Mud is a deadly poison to the oyster, whether large or small.

\* \* \* What then is essential to the prosperity of the oyster? Very little, indeed; a solid object, and water, devoid of mud."\* We might multiply these citations from Coste, Fraïche, and others; upon this point all seem to be in accord. It may, therefore, appear paradoxical when we state that, upon the coast of Morbihan, the oyster thrives only where there is mud; the fact is incontestible; reproduction succeeds only in the muddy estuaries, and good parks exist only in the sheltered places, almost covered over by slime. This assertion would appear improbable did it not admit of an explanation.

With these preliminary remarks, we will proceed to a consideration of the conditions required of a shore in Morbihan, in order that it may answer for the general cultivation of the oyster.

The sea bottom consists, for the most part, of mud, as is evidenced by the many soundings that have been made, and by the results of various explorations. It is also known that, in many of our rivers, as at Auray and in the Scorff and the Blavet, there are sloping shores, which, when the tide goes out, appear above the water as immense areas of a black or brown color, and into which one can easily sink up to his neck. Whence comes this fine flocculent mud, which has seemed, at times, to threaten the port of Saint-Nazaire, and whose action has been so difficult to resist. Does it come from the rivers, or is it produced by the constant disintegration of the rocks and shores? Why does it invade the mouths of all our rivers and all our bays and creeks? Some good may arise from our pointing out general causes, at least, if not by the determination of all the questions, and this is all our subject demands.

The constant wearing of the rocks, as in ages past, by the action of the sea upon the headlands, gives rise to three principal kinds of material: gravel, sand, and mud. These materials are carried along by the action of the waves. Gravel is moved only in times of heavy storms, when, lifted by the force of the waves, it is moved gradually along, until it finds a region of comparative shelter, where it remains buried. Sand is more frequently moved than gravel, but the strength of the waves is required to raise it and carry it along, and it needs a greater calm than the gravel, in order to fall to the bottom again. Mud, on the contrary, being fine and light, acts more as though it were in solution in the water, and remains suspended in it for a long time; carried along by the currents, which have no power over sand and gravel, it penetrates into coves, estuaries, and rivers, where it is deposited in the eddies, constantly raising the level of the shores. With regard to the movement of the sea alluvium, we are able to make the following deductions: Whenever we desire to determine whether a bay or estuary is a region of actual calm, we have only to examine the character of the bottom. If the bottom is muddy, the region is a quiet one; if sandy, it must be

\* De la Blanchère, Culture des plage maritimes.

subject to more or less disturbance; and if gravelly, it is certain to be the scene of much commotion in stormy weather.

The first condition to be sought for, as favorable to oyster culture upon a coast, is one of rest. However rich the bottom of a region may be in the elements essential to the oyster, it cannot serve for the breeding of oysters if it is not a quiet one. Consequently, to mark out on a chart of Morbihan the regions covered with mud, would be to indicate the bottoms where oysters can be cultivated, and, without visiting the region, one is able to affirm, by reference to the chart contained in this volume, that oyster culture is only possible in the Scorff, the Blavet the bay of Gâvres, the river Saint-Philibert, the river Auray in the gulf of Morbihan, the estuary of Pénérf, and the entrance to the Vilaine. It is precisely at these places that the oyster-culturists have located. Oyster culture cannot be carried on at the entrance to the river Étel, about the peninsula of Quiberon, and in the many bays possessed by the islands Groix, Belle-Ile, Houat, and Hédick.

It may be objected, with reference to our own statements above, that if the mud collects in sheltered situations it will cause an elevation of the bottom, against which the culturist of Morbihan will have to contend. An equilibrium is, however, finally established, and this fact is of so much importance to culturists as to warrant mention here. It appears as though, during the geological changes which resulted in our present coast line, the mouths of our rivers were given a size, quite out of proportion to the importance of the rivers. The Scorff and the Blavet, both humble rivers, unite majestically in the roadstead of Lorient, whose great depth caused it to be chosen as the great central station of the India Company, and more recently as a naval station. Ten kilometers from their mouths, these rivers lose their importance, from their small size, and farther up, the Scorff especially, dashes through narrow granitic valleys and becomes the haunt of trout. These two streams play no part in the role of rivers, so to speak, while at their mouths all the conditions are strictly marine. The valleys through which they flow, in the interior, give rise to no alluvium for them to carry down, and the only phenomena observable are those produced by the sea.

As we have stated before, the water enters the broad mouths of rivers, charged with mud, and, if it encounters perfect stillness there, the mud sinks and the bottom is gradually built up; but this elevation of the bottom has a limit. An equilibrium has already been established between the tendency to build up the bottom and the wearing action of the tidal currents, and at present both the landward and the seaward currents go, charged with mud, without producing any change in the level of the bottom. Two equal and opposing currents are thus represented as annulling each others actions.

We insist upon this point, because of its important bearing upon oyster culture, and the breeding of oysters in particular. A state of equilibrium having been established with regard to the beds of our rivers,

it follows that, whenever this equilibrium is disturbed, one or other of the forces we have described must come into play. If the rivers are dug out, the depth being increased, mud will be rapidly deposited until an equilibrium is again established between the actions of the two contending forces, one bringing in the alluvium, the other sweeping it out to sea. Then the deposition of mud will cease. If, on the other hand, liquid mud should be poured into the channel, causing a temporary elevation of the bottom, the currents would naturally clear it out again, and in a short time the mud accidentally deposited there would be carried away, and the bottom cleaned. Finally, if fixed obstacles are placed in the river, eddies will be produced, and, consequently, a deposition of mud, of which it is easier to affirm the existence than determine the intensity and scope. From the very beginning of oyster culture in Morbihan, we have, therefore, encountered these two elements, the currents and the deposit of mud, the actions of which are controlled by natural laws, and to which the culturists have been obliged to submit. It is not without some hesitation and many experiments that these results have been attained.

The difficulties met with and the failures and losses at the beginning, sometimes considerable, which have been sustained, all go to prove that one cannot, with impunity, oppose the action of natural phenomena.

Whenever nature's laws are violated, she knows how to avenge herself, and it is, therefore, much better to submit to them and avert the danger.

Dr. Henri Leroux, an excellent and intelligent observer, remarks as follows: "We reckon ourselves among the active partisans of science, but ask of it only the application of practical discoveries. We should consult science in order to ascertain the greatest advantages to be derived from our field of labor, but it is very dangerous to struggle against nature."

Science and work, study and observation are required of all the culturists of the department of Morbihan. Now, that the importance of the currents and of the deposits of mud are understood, we can appreciate the entire worth of our culturists, who have labored under great disadvantages from more than one point of view; but success has finally been attained, thanks to the persistent energy so characteristic of the Britons.

..... Labor omnia vincit  
Improbis.

*The general character of a shore, with reference to breeding parks.*—For the purposes of breeding, therefore, the culturists of Morbihan do not hesitate to establish themselves upon the muddy shores of the rivers Trinité or Auray. They know that, by the processes we are going to describe, they can collect a goodly number of young oysters. They seek to group themselves, as nearly as possible, in the neighborhood of natural oyster banks, over which the marine authorities watch with a solicitude, worthy of all praise.

The site being chosen, they endeavor to locate between ordinary low-tide level and the level of low water during the spring-tides. Collectors placed in these situations are only exposed during spring-tides, and remain almost entirely covered at ordinary low water. There is a great advantage in keeping as near as possible to the channels, and to the natural oyster banks, for there are to be found fewer eddies, more currents, and a greater number of embryo oysters.

M. Henri Leroux, to whom we have already had occasion to refer, sums up in the following just and brief manner, concerning the conditions which a shore should possess, in order to fit it for breeding purposes:

“Up to 1867, it was supposed that breeding could be carried on most successfully in those portions of the river where the water was most tranquil, but quite the reverse is true. Nowhere do the collectors become more fully covered with the young, than in the currents produced by the ebb and flood tides, and above all at the level of low water. Parks situated in a region of eddies are poorly located. In 1867, it was still conceded that the embryo oysters, leading as they do a wandering life for several days, must scatter themselves more or less equally throughout all parts of the rivers, where natural oyster beds exist. At present we are given to understand that, at a distance of 500 meters from an oyster bank, in the direction of the mouth of the river, no embryos are to be encountered; whereas very many oysters will attach themselves to the collectors arranged in the bottom of the river, above the oyster bed, these being carried up by the flood tide.

“The parturition of the oyster seems to take place rather at low water than at high water. It is essential, therefore, that the breeding parks be established in as close proximity to the oyster beds as possible, and also in the course of the tidal currents; at any rate, they will have no chance of success, if exposed to the violent action of the sea.”

These ideas present to us an example of the foresight of private industry, which is more powerful in its results than the wisest rules. One cannot always locate close by a natural bed, and again natural beds may die out, as experience has unfortunately taught us. Hence the culturists are always careful, when not breeding, to retain about their breeding parks a strong reserve of adult oysters. M. Alphonse Martin, who has such a well-managed establishment at Kergurioné, keeps 30,000 oysters in reserve, and the Baron de Wolbock has 50,000 at Kériollet. Thus, when they fear a scarcity of young, from the exhaustion of the beds, this reserve series becomes of the utmost importance. MM. Leroux and Leroy have a supply of 800,000 oysters, whence their supply of young is derived. So perfect a system cannot fail to produce good results.

Natural oyster beds, bordering the parks where oysters are kept in reserve, increase the richness of the results. The quantity of young produced will be augmented, and, in consequence of this prolific interchange, the richness of the oyster beds will be insured for the future.

## CHAPTER II.

## COLLECTORS—LIMING—FORMATION OF BREEDING PARKS.

*Collectors.*—After the selection of a site comes the choice of collectors—that is to say, of the apparatus for the attachment of the embryo oysters.

The word *park* conveys to the minds of many persons the idea of an inclosure; but breeding parks are never inclosed. It is, therefore, important to define the terms in use in oyster culture, in order to prevent confusion.

A *park* is any bank or shore, where spat collectors are used in connection with the spawning oysters; a *claire* is an inclosure surrounded by low walls and covered by the water at high tide, and serves as a depot for collectors, and for raising; and, finally, a *basin* is an inclosed area, protected from the influence of the tides, in which, by means of hydraulic apparatus, water-gates, or sluices, the height of the water may be regulated at will. Coste's attention was first directed to the subject of collectors, which, from the beginning, have been made the object of much study.

Most authors who have written upon oyster culture have contented themselves with reproducing Coste's note, which occurs in the supplement to his Voyage of Exploration. We will call attention, simply as a matter of interest, to what have, until to-day, been considered as the best collectors. Wood and tiles are the most important materials for the construction of collectors. Wood is used either as fascines, submerged and held in place by means of weights, or else as platforms; tiles are utilized in the greatest variety of ways. Coste recommended—

1. The simple roof collector.
2. The double-roof collector.
3. The roof collector with oblique rows.
4. The roof collector with opposed rows.

As a more complicated apparatus, he advised the "hive" collector, a large wooden box, open at the bottom and containing movable frames. On the latter, the spawning oysters and cockle-shells are disposed in layers—the one supplies the spawn and the other the means for its attachment. Finally, he suggested the use of stone, although, at the same time, he acknowledged the difficulty of removing the young oysters from it.

Study and experience in breeding have failed to discover any other substance suitable for collectors, but the method of using collectors has been greatly perfected.

Stone, which sinks so easily in the mud, cannot produce good results. M. Liazard, one of the culturists of Morbihan, who, since 1861, has not

hesitated to continue his labors in the difficult branch of oyster culture, has given numerous details of the failures in the use of stone. It would be needless to enter here into a long argument upon this subject; this kind of collector does not seem likely to come into general use. At Pénerf, however, limestone has been employed with some good results.

With wood there is not the same difficulty, and it is even now used, either in small rectangular pieces about the size of a tile, and half an inch thick, or made into platforms, such as are in use especially in the river Auray.

Fascines have been experimented with, especially by M. Chaumel, and, as they may answer for some sections, it may be useful to give some idea of their construction. The following account is by M. Chaumel:

“For the construction of good fascines, it is necessary to procure branches of some hard wood, with the bark as soft and smooth as possible; cherry, for example, answers perfectly. It is a great error to suppose that the embryo oyster attaches itself more readily to rough surfaces than to smooth ones, for precisely the contrary is true.

“After the wood has been prepared, the branches are arranged alternately, with the large end of one branch next to the smaller end of the adjoining one, so as to prevent their lying too close together and leave interspaces between them; then at each extremity, under the cord which binds them together, a large wedge is introduced, the object of which is to prevent compression when the bindings are tightened. In this manner, the fascines have plenty of light and water about them, and the embryos have ready access and may attach themselves to any part of the branches. It now simply remains to attach the fascines to a small chain, at intervals of about two yards, by means of pieces of wire, like those used in binding the extremities, care being taken, however, to fasten the wire around not more than one or two branches, in order not to draw them together.

“Fascines are the best collectors I know of for use at the bottom, and the oysters may be detached from them, to some extent, even with the fingers, especially after the lapse of a year. By this method not a single oyster is lost; they may perhaps be a little defective in form, but to so slight an extent as not to affect their sale. It is a singular fact that fascines which become uncovered give but poor results.”

We do not believe that, along the shores of Morbihan, fascines are destined to play an important part as collectors. Planks will also become less and less used; made into platforms they have been employed in the river Auray, and M. Liazard gives the following description of those in use by him:

“My platforms are constructed of four, five, or six thin boards, according to their widths; they are joined together by three bars, about three inches high. Those which I shall construct this year will consist of only four thin boards, as I wish to leave a space of about an inch and a half



between each two boards, so that the mud, deposited upon them, will run off at each side and not collect upon the top."

Tiles, however, are the apparatus *par excellence* for collectors, and they are now generally employed. Dr. Henri Leroux sums up as follows, regarding the efforts made to employ tiles successfully and in the most effective way:

"The tile," said he, "has the right of priority, but this is not its sole merit. Its cost is moderate, it is easily handled, and its weight tends to keep it in position in the water.

"The sea, however, is subject to so many unexpected movements, and the oyster bottoms are so covered with shifting mud, that the culturists had to struggle against great difficulties for many years.

"The tiles were first arranged in piles, in a manner pleasing to the eye, and it was hoped that the heavy stones, placed as a weight upon each pile, would give the requisite stability to these structures; but at the first high tide, a portion of them were overthrown and the work had to be done again.

"Upon a solid bottom, two tiles are placed upright, and upon the tops of these a third is laid crosswise, to separate those which are to follow. A considerable number of rows may be arranged and held in place by means of flat stones, laid in front of, above, and behind them. In this manner the tiles are sufficiently well secured, and may readily become covered with young oysters. A hard bottom is not often found, however, and generally occurs near the shore, where, at low tide during the summer, the sun destroys a large share of the young, the remainder finally succumbing to the cold dry winds of September and October.

If, on the other hand, the tiles are placed upon level bottom, the obstacle they present to the action of the sea soon leads to a deposit of mud or sand, which may cover them, either entirely or in part.

"In 1868, in order to preserve the tiles from contact with the bottom, we had a number of boxes made, capable of holding about four hundred tiles each. The desired object was attained, but the young oysters did not develop except upon those tiles which received air and light. These groups of tiles served as haunts for star-fishes, crabs, and other marine animals, which found there an abundance of provender. In fact, the construction and maintenance of the boxes led to an expense, out of proportion to the results of the harvest.



FIG. 1.— Bon-  
quet  
lector.

"The best method of arranging the tiles is unquestionably by means of stakes. The tiles, pierced with a hole at each extremity, are united in little piles of twelve or fourteen, by means of wires, firmly fastened to the head of the stake, which is from three to five feet long, and implanted in the bottom in such a way that

the lower tile is about six inches above it. Each of these clusters of tiles bears the name of 'bouquet' or 'mushroom.'

*Tiles arranged in "bouquets."*—In the principal breeding parks of the river Trinité, they have settled upon the use of tiles arranged in "bouquets," as represented in our design. At Morbihan this is also considered a very rational system. It has this great advantage, that the apparatus can be entirely prepared on land and so arranged that the setting up will consume but a very short space of time.

This is an excellent idea, as will be understood from what has already been said, and the details we have given concerning the deposition of sediment will indicate its bearings.

Whenever, in a river, subject to depositions of sediment, the nature of the bottom is modified, if only by a wooden stake, a deposit of mud is induced, which elevates the level of the bottom. One will gain some idea of the rapidity with which the deposit of sediment is formed, on learning that, in the military port of Lorient, after the alterations which modified the bottom, the deposition reached a depth of from twenty to

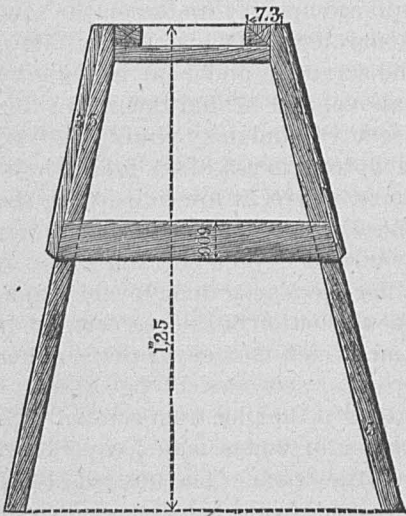


FIG. 2.

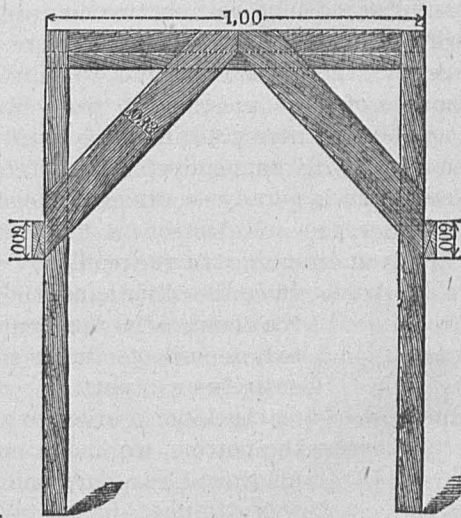


FIG. 3.

Frames for supporting "Bouquet" collectors on a hard bottom.

twenty-eight inches a year, the average being twelve inches. In the commercial port the case is identical, and several spells of bad weather, accompanied by a southwest wind, are sufficient to produce the muddy deposit. Culturists should not forget that the water is not charged with sediment, excepting when it is agitated. At such times, the waves washing upon the muddy shores become charged with mud, which is deposited at those points where the equilibrium of the bed has been modified, in one way or another.

The cluster of tiles fastened to a stake, if arranged above the muddy bed of a river in July, has been placed at the proper season, and from

then until the month of September causes but a slight deposit of mud. Whatever may be the extent of the deposit produced, at the moment when the stake is withdrawn, in order to secure the oysters attached to the tiles, the current resumes its normal action, sweeps away the accumulated mud, and restores the bed to its original condition.

We repeat, that, after having carefully examined the action of the current upon these bouquet collectors, we must assert that the greatest progress made in oyster culture, in Morbihan, consists in the discovery and reducing to practice of this system. The honor of this progress belongs to M. Eugène Leroux, one of the most indefatigable and persevering culturists of Morbihan. It is very interesting to note by what a succession of attempts Mr. Leroux arrived at the important result we mention.

"On May 31," said he, "I began to arrange the tiles in my parks. I constructed a wooden framework, and upon wires attached to the top of it I placed two tiles, followed by two others placed crosswise upon the first, this operation being continued until a dozen tiles were thus disposed of. When this arrangement had been completed, I saw that my tiles would not remain in place, since the currents tended to continually displace them. I, therefore, thought to retain them, by passing a wire around my little scaffolding, which made everything very secure.

"I did not finish the placing of my five thousand tiles in the parks until towards the end of June. It was a lengthy undertaking, as we could work only at low tide, and I will add that it was both laborious and expensive.

"I had read in the works of M. Coste that after every high tide it was necessary to remove from the tiles the sediment which formed there, from one tide to another, so I scrupulously set to work to wash mine, one by one; we were obliged to stand in the water up to our knees, and when the tide left us to continue our work with buckets of water, and then to carefully replace all the tiles.

"This troublesome operation continued until September; I considered it the work of a Roman, and saw the impossibility of undertaking it on a large scale.

"As soon as I discovered that my tiles had embryo oysters upon them, I discontinued the washing; I contented myself with rearranging the collectors that became displaced, and thus passed the winter.

"I determined to develop my undertaking on a larger scale. I ordered from Nantes 30,000 tiles, which were received in the month of May, 1867, and then I set myself to work distributing them in the parks. This necessitated a new arrangement. Planks were first placed flat upon the mud, and on these I arranged the tiles, four in width and ten in length, making forty tiles placed side by side in one layer. Upon this layer five other layers were arranged, making six in all, the last layer being covered with boards, holding stones heavy enough to act as weights,

to keep the entire structure in place, and prevent the movement of the water from causing the tiles to fall into the mud.

"The results in 1867 were fair, but did not equal those of the first year.

"I observed that tiles placed upon the bottom did not remain as clean as when placed above it. Here, therefore, was another point to be considered.

"In the month of November, 1867, I bored a hole at each end of my tiles. But, before doing this, I measured off the points where the holes should be, in order that they might correspond exactly in all the tiles, and permit of the tiles being joined in pairs opposite to one another. The wires, with which the tiles were strung together, measured each about 46 inches. Two tiles were first strung together, by means of a wire passing underneath and through the two extremities. Two more were then arranged in the same manner, but opposed to the first, and the series continued up to twelve. This work being finished, I passed a stake, about fifty-three inches long, through the middle of the bundle of tiles, and wound the four ends of the wires firmly around the top of it, which projected about five or six inches above the uppermost of the tiles. In this manner they were firmly fastened to it.

"I proved that my new invention was entirely successful and would resist the action of the sea. These collectors also had this additional advantage, that they could be placed in the water without the necessity of wading through the mud; from the boat in which they were carried we could set them up in the parks. This system has been so highly appreciated that all the culturists have adopted my invention, and it is the only one in use to-day."

Being as practical as it is reasonable and as judicious as economical, this system has given excellent results. The mode of arrangement varies but little in the different parks. M. de Wolbock perfected the system, by slipping very thin pieces of board between the tiles; but this addition, which is an excellent one, does not in any way alter the principle upon which the apparatus is constructed.

*Coating the collectors.*—If bare collectors had always been used, the greatest difficulty would have been experienced, when it came to the delicate operation of removing the young oysters from them. Coste, himself, when he rejected stone, simply followed the idea that the oyster, when it adheres too strongly to the surface of the collector, is wounded by the operation of removal. When breeding was first attempted at Arcachon, as well as at the Ile de Ré, and along the coast of Morbihan, numerous trials were made, and finally, after many drawbacks, the only rational system was arrived at, by applying unconsciously, perhaps, a principle which, had it been proclaimed in the beginning, would probably have averted many a failure. The science, to which M. Gressy and M. Henri Leroux appealed, plays an important part in oyster culture, and must

always be taken into account, whenever it is desired to arrive at practical results.

In giving some details concerning the coating of collectors, a method now in universal use, we desire to have it understood that, in oyster culture, this subject involves a principle, fully as important as those which relate to the action of the current and the deposition of sediment.

About 1858, a mason of the Ile de Ré, named Hyacinthe Bœuf, prepared a park with great care, and inclosed it with walls. After having filled up the bottom with various materials, and among others straw, he was surprised to find that the young oyster, instead of adhering to the bottom, preferred the calcareous stones of the inclosure. So he took his wall to pieces, stone by stone, and thus obtained a more or less abundant harvest.

At this time, no one investigated the reason why the oysters had shown such a preference; the fact was noticed, but nothing further was done.

Many observers remarked that, upon submarine walls of masonry, constructed with hydraulic cement, even in basins and in places distant from oyster banks, there were always found a considerable number of oysters, persistently seeking the joints of the masonry. The thing was considered as accidental, exceptional, and still, at the same time, numerous attempts were being made to facilitate the removal of the oysters from the tiles, by dipping the collectors in a material, soft enough to permit of the oyster being easily removed, and hard enough to offer an adhesive surface to the young.

Dr. Kemmerer, of the Ile de Ré, the veteran oyster culturist, whom Dr. Henri Leroux calls the *savant*, who studies with feet and hands in water, was the first to find a remedy for the too persistent adhesion of the young oyster to the tile. He began by soaking his tiles in the following composition: Hydraulic cement, 1 part; water, 4 parts; defibrinated blood, 1 part.

The results obtained by the use of this composition were excellent, as compared with those resulting from the old misunderstanding.

Defibrinated blood is not much used, and for those establishments scattered along the coast, far from great centers, it is very difficult to obtain. Efforts were made to dispense with it, and Dr. Kemmerer himself succeeded in making a mixture with lime as a basis.

In the report which he sent to the fair at Vannes, he expresses himself thus:

"The oyster attaches itself to all natural bodies, but nature cannot equal industry. Nature created the oyster beds, and as soon as the demand for oysters became more pressing, from the increased facility for transportation, afforded by our modern means of communication, the beds disappeared.

"The oyster culture of Coste does not, therefore, present the apparatus necessary for the purpose, since it cannot produce the oyster seed.

"I designate as seed the young oysters which, having remained from

seven to nine months upon the collectors, are ready for removal and planting in beds, where they may grow and develop. The first principle of the industry had been discovered, but the means of producing this seed were still wanting.

"Then it was that I invented the cement for collectors, the formula of which I have given.

"Between the collector and the oyster there should be interposed a calcareous substance, hard enough to withstand the action of the sea, and soft enough to permit of the easy removal of the oyster at any time. I had proved that cleanliness was the first necessity of a good collector, and soon I added that the collector cement alone had the power of renewing that cleanliness, at the will of the oyster culturist. From that day oyster culture was an established fact."

The success attained by coating the tiles, that is to say, by dipping them in lime or cement, has been complete and very characteristic. Several culturists, wishing to observe what the difference might be, have placed a certain number of tiles, some coated and others not, under the same conditions as regards cleanliness. The former had about three times as many young oysters upon them as the latter. The trial was therefore decisive.

In 1866, when M. de la Blanchère was seeking the principle in the case, he wrote:

"A principle should govern the employment of all collecting apparatus, not only as regards the time for setting the collectors, with reference to the spawn, but also as to the special state of cleanliness of the apparatus itself."

With Dr. Kemmerer, the principle was an easy removal of the oysters from the tiles; with M. de la Blanchère, it was cleanliness.

Without wishing to enter into the domain of the critic, we venture to say, however, that the principle had not yet been found.

While seeking a means of easily detaching the oysters from the tiles, and almost without being aware of it, there was discovered the attractive element, indispensable to a good harvest, the bait, so to speak, of the oyster—that is, lime in an easily assimilated state.

Such is the principle; we will proceed to explain it:

When the young oyster passes from the mantle folds of the parent, out into the sea, what does it instinctively seek? A place to which it can easily attach itself, and where it can readily defend itself against its enemies. It could readily attach itself to any substance, but in order to defend itself, it must be able to develop its shell, which serves as a protective armor. As lime is the predominant element of the shell, the preferable collector must have a basis of lime.

The young oyster seeks calcareous substances by instinct. Nature is certainly very provident. If calcareous material is wanting in the collector, that extremely perfect laboratory, contained within the infinitely small body, constituting the embryo oyster, will withdraw it from

the surrounding waters; but there is a question of instinctive preference, which must not be forgotten. This is the reason why Hyacinthe Bœuf found young oysters upon his walls, and not within his pen; this is the reason why we find oysters upon the joints of the masonry of the quays and other structures, in our ports. Wherever a calcareous solution has exuded, and then hardened upon the outside, there it is most readily dissolved and assimilated. Nevertheless, to Dr. Kemmerer is due the honor of having first introduced the process of liming into oyster culture. It will be said of him, perhaps, that he carried a torch by which he himself was not lighted. We may consider that he was looking for India and discovered America. He deserves the gratitude of all oyster culturists.

What is most remarkable concerning liming is the fact that both quick-lime and hydraulic cement are decomposed by sea-water. Hydraulic cement hardens in fresh water; but salt water, although it permits of a first hardening, in the course of time produces complete decomposition.

This change is favorable to the removal of the young oyster, and to the assimilation of lime by the young.

By combining these two substances, hydraulic cement and quick-lime, the oyster culturists of Morbihan, in all cases, attain the desired results, so far as this particular point is concerned.

If some of our culturists still seem to ignore the existence of a principle in the use of lime, as necessary for the attachment of young oysters, there are others who, without strongly insisting upon it, still affirm this truth. We may cite a few instances: "Quick-lime," says M. Alphonse Martin, "always retains a little moisture, thus placing at the disposal of the oyster all the materials which it needs."

"A coating of lime," says M. Gressy, "not only permits of the easy removal of the oyster, but also constitutes a substance eminently favorable for collecting the young. This fact is so well known, that no one to-day would place a collector in the sea, without having first dipped it in lime."

Finally, Dr. Henri Leroux writes as follows: "We will not now insist upon the necessity of coating the tiles, in order to obtain a good supply of oysters, as experience has sufficiently proved this fact. The tiles, covered with lime, will give three times as many oysters as those without it."

This principle being admitted, the liming is done in two very different ways, at Morbihan, according to whether it is intended to entirely free the oysters from the tile, or to allow a portion of the tile to remain attached to each shell.

When we come to speak of the removal of the oysters from the collectors, we will make some remarks concerning the matter of leaving a portion of the tile attached to the young. For the present, we will merely state that, under that system, the tile is cut, leaving a portion adhering to each oyster, forming a sort of heel.

Some of our culturists, such as M. Gressy and M. Henri Leroux,

who breed oysters in this manner, cover their tiles with a slight coating of hydraulic cement. The young oyster attaches itself to the cement, but the coating, being very thin, is soon worn away, leaving the oyster quite firmly fixed to the tile.

Others, on the contrary, who, six months after the collectors have been set, prefer to separate the oysters entirely from the tile, with the blade of a knife, generally cover the tile with two layers, and proceed in a different manner. We cannot do better than to give their method of procedure in their own language:

M. Eugène Leroux says: "I procured some quicklime, which was slacked just as it was to be used, and was put, while still in a state of ebullition, into a large vat, where two-thirds the same quantity of sand had been placed. My men stirred the mixture, until it had attained the consistency of clear broth. The collectors had been made ready, and, held by the lower end, were dipped into the vat. One immersion sufficed, after which the women took them in hand-barrows and exposed them to the air to dry, before setting them up. This excellent coating should be prepared with fresh water only; sea-water prevents its adhering for any length of time to the tiles, and if it comes off the labor is, of course, lost."

M. Lizard states: "It was necessary to find a substance which, placed between the outer coating and the tile, would decompose, after remaining long in the water, and thus leave the coating almost free. I tried different pastes, all of which gave good results, but it was necessary to select the most economical. I was satisfied with a mixture made of flour and a small quantity of the scrapings of potatoes, boiled in a sufficient quantity of water to produce a thin paste. The tiles were dipped in this, and after they were dry they were passed through a bath of hydraulic cement. I have always succeeded with this mixture; it is quickly made and costs but little. Every time I have neglected to use it I have regretted it."

M. Alphonse Martin says: "I first plunge each tile into a milk of quicklime, and when this coating is quite dry, I again dip the tile into a bath of hydraulic cement."

M. de Wolbock generally uses two layers of hydraulic cement.

It seems to us rational that, when not intending to leave the oyster attached to the tile, we should resort to two layers, the first of quicklime, which will not adhere very firmly, and the second of hydraulic cement. The first facilitates the removal of the oyster and the second, the adherence of the young.

Pursuing this idea, Dr. Kemmerer, in his report, makes the following proposition:

"In oyster culture, not a single oyster should be lost. I anticipate this result from the removable cement for collectors. Saturate your tile with water, cover the concave portion with wet paper, leaving the edges bare, then spread on the layer of cement, which must cover both the paper



and the edges, so that when the edges are scraped off, the entire concave surface can be removed, without damage to the adhering oysters.

"If the paper is not spoiled, it can be used a second time, or it may be replaced by the large leaves of some plant.

"The collector with a removable coating, applied to the industry at Arcachon, will offer the following advantages: it will prevent a loss of 20 per cent. and much labor may be dispensed with. The cement, bearing the young, may be transferred directly to the claires, without passing through the boxes. The oysters will grow and the cement may be easily broken into pieces, even with the hand."

It is useless to insist further upon the practice of liming; we have stated the principle and supported it by several illustrations.

At Morbihan, it is easy, in all cases, to settle whatever difficulties may arise. The question has been studied, and the path to be followed clearly pointed out.

*Arrangement of the collectors and of the breeding parks.*—We have reviewed the system of collectors and of coating the tiles; it is now in order to say something about the arrangement of the collectors and of breeding parks in general.

One principle also governs this question, and imposes itself upon each culturist. It is the transportation of mud in rivers, which are influenced by the tides. The culturists of Morbihan study the currents and the deposition of mud; they arrange their collectors along the shore in such a manner as to prevent their being covered up with mud, during the period when they remain in place. The principle being understood, the question of application is determined in each case by observation, it being impossible to formulate any general rule.

We will state, however, that the majority of culturists arrange their collectors in rows, at right angles to the shore. This system, which produces a sort of dam opposed to the current, must be modified in a certain measure, so as not to offer too much resistance to the general current. It might, perhaps, be preferable to arrange the collectors in rows parallel to the channel; this is an experiment yet to be tried. We repeat that the culturists of Morbihan pay considerable attention to the action of those natural forces, which produce the currents and the deposition of mud. In proof of this, we have only to refer to the judicious observations of Dr. Gressy.

"The 'bouquet' collectors, whether of tiles or of thin boards, when placed near together, will cause a deposit of mud in the parks, by reason of the obstacles which they oppose to the current.

"To obviate this inconvenience, I was the first to originate the idea of grouping the bouquet collectors in series of three rows each, placed in juxtaposition. Between each series I left a space of from five to six feet, so as to permit the current to flow freely, and by the force of the rising and ebbing sea to sweep out the deposit of mud, which might accumulate among the collectors in calm water. This system is universally followed in our river.

"The number of collectors to be arranged within a given area varies, and no absolute rule can be laid down regarding this point. The force of the current and the degree of impurity of the water should guide each culturist, in determining the number of collectors he may be able to accommodate in his concession. Whenever mud begins to accumulate at the base of the collectors, the culturist finds an experimental proof that there is not sufficient space between them, and that, consequently, he should decrease their number.

"The first I have upheld, and even to-day, against the general opinion, I still maintain that the concessions are overloaded with collectors. My own concessions contain, in proportion to their extent, many less collectors than those of my neighbors.

"I consider it very necessary to prevent the deposition of mud. I cannot forget that, on the Ile de Ré, oyster culture had to be abandoned, because the concessions became filled up, after having succeeded admirably for several years.

"The space to be left between each group of the bouquet collectors varies also, according to the length of time which they are to remain in place.

"It is evident that the culturist, who leaves his collectors in the water eighteen months, should separate them more in order to prevent the deposition of mud than he who removes them in November of the same year in which they are placed, that is to say, after an interval of only four months.

"In this latter case, the mud has not sufficient time to form a deposit, and the current, after the collectors have been removed, sweeps everything away, during the winter season."

The method described by Dr. Gressy is practiced by all his associates in oyster culture, with various modifications.

For instance, in the parks of the Baron de Wolbock we find groups of from twenty to twenty-four "bouquet" collectors, separated by interspaces of about six and a half feet; they are arranged in rows both parallel with, and at right angles to, the channel. MM. Gressy and Eugène Leroux have their collectors arranged in series, running at right angles to the channel, and formed of rows of "bouquets," each row containing three "bouquets." The series are separated from one another by a passage-way, about six and a half feet wide.

We have already had occasion to state that the principal advantage to be gained by the use of the "bouquet" collectors is that everything can be prepared on land, and the collectors set up in the parks almost on a fixed day, by merely sinking the stakes in the mud.

One can judge of the truth of this by the following statement of M. Eugène Leroux:

"In 1871, I had the use of a large barge, which was very flat and drew very little water; it was about thirty-two feet long and nearly ten feet wide. I could load it with a large number of collectors, and it also had other

advantages. When this loaded boat reached the parks, where the water was only about three feet deep, my men could set up the collectors in

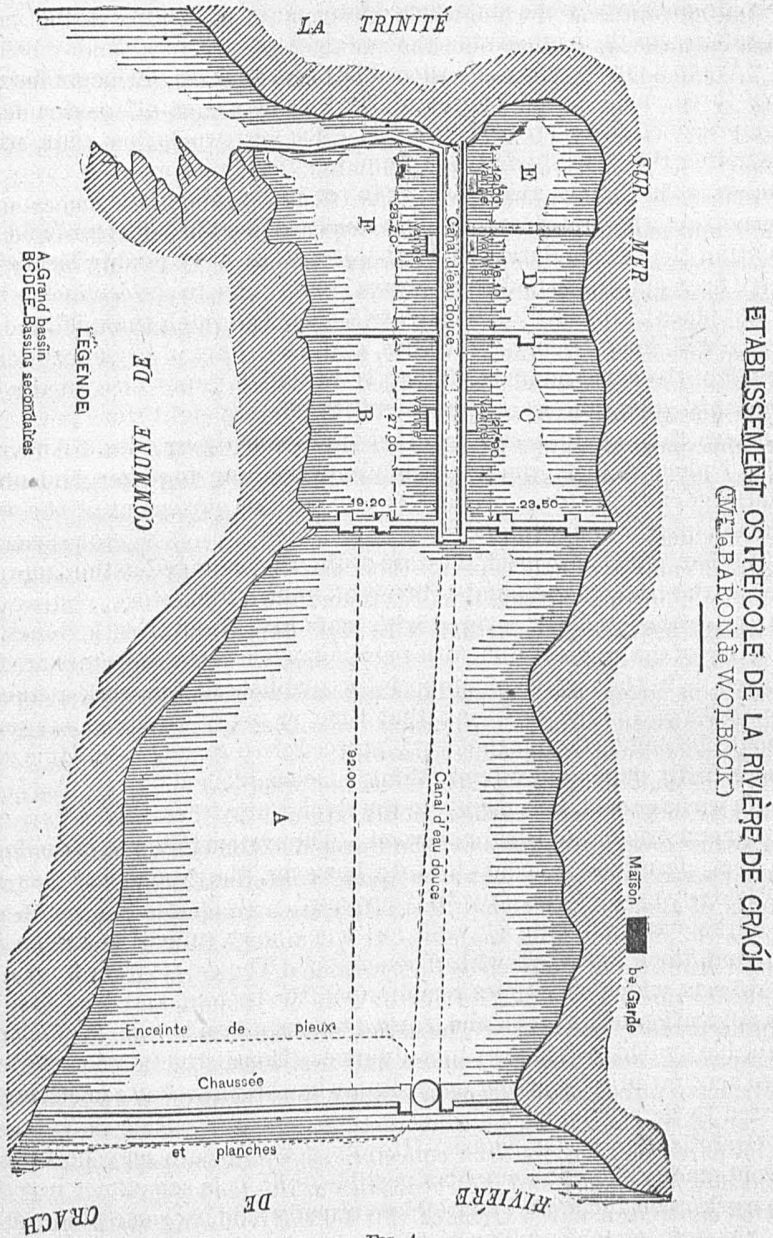


FIG. 4.

the mud from the boat, and were no longer obliged to stand in the water, sometimes at the risk of their health. Moreover, this method was much more expeditious, for I could place twelve thousand tiles in one day."

The stake has this great advantage, that it dispenses with all complicated apparatus and is both easily and rapidly set up. Those culturists who do not employ the stakes encounter many difficulties in the matter of setting up their apparatus.

"When I arrange my collectors," says M. Liazard, "I begin by placing three small horses of rough wood upon a sort of wooden frame, composed of three strips  $1\frac{1}{2}$  inches thick by two inches wide, which, including the laths, furnishes a framework, to build upon, of twenty-six inches. The horses rise from six to ten inches above the bottom, thus permitting the water to circulate freely under the collectors and preventing the accumulation of mud. In certain very muddy localities, I have been obliged to make the horses from twelve to sixteen inches high. I first place a row of tiles, which are fastened through the middle. The frame will hold twenty-eight tiles, and, therefore, a second row, composed of the same number of tiles, is arranged transverse to the first, and this operation is continued until there are eight rows in all. My clusters thus contain two hundred and twenty-four tiles. Above the tiles I place a platform, which binds everything together, and on the platform enough stones are laid to prevent the movement of the water from displacing anything.

"When panels are used, they are ordinarily arranged in the same manner as the tiles, to the number of eight, upon a framework, resting upon three trestles, and are covered with mats loaded down with stones."

"One of the greatest difficulties arising, when many collectors are to be placed, is in the matter of properly accomplishing the work at the two low tides of the Syzgies. At that time, as many workmen as possible should be engaged, and the work proceed with great haste. It is sometimes badly done, and often nothing is accomplished."

As we have said, it is mainly in the river Auray that "hives" are used, either constructed of tiles or of wood. The system followed is analogous to that described by M. Liazard; however, the "bouquet" has been judiciously applied there by M. Thevenard.

Parks arranged with "hives" are much more subject to a deposition of mud than those set with "bouquets." The *débris* from frames and platforms, which sometimes remain upon the bottom, may lead to a serious elevation of its level, and, consequently, a firm bottom is much more suitable for "hives" than an unstable one. This distinction must be taken into account in considering the reason why the "hive" is sometimes preferred to the "bouquet."

*Consolidation of the bottom.*—However much care may be taken to avoid muddy shores as much as possible, still, it is sometimes necessary to work upon them, and as we have already said, in some places a man would sink into the mud up to his neck. A means of visiting the parks without sinking into the mud was, therefore, sought. It was a difficult problem, and all the culturists declare, that, if there had been long to wait for the simple and economical solution which has been found, oyster-cultural attempts at Morbihan would have ended in failures.

To lay small strips of wood in the passage-ways through the parks, would have been expensive in the beginning and useless in the end. Fixed obstacles would have created eddies, and the eddies would have induced a deposition of mud. The desire to examine the oysters would, consequently, have resulted in their being destroyed by the mud.

Then arose the ingenious idea of covering the parks with coarse gravel, such as the shores afford. This gravel partakes of the well known property of sand, in distributing pressure over a large area. Slightly compressed mud is elastic, and vibrations are carried through it in great undulations. These two properties of distributing pressure and of elasticity have been judiciously utilized.

Dr. Gressy was the first to employ this mode of consolidating the mud:

"The first attempt at macadamizing," says he, "were made in my parks. It is effected by spreading over the mud, to be hardened, a layer of sand, varying in thickness according to the softness of the mud. The sand becomes incorporated with the mud and thus transforms it into firm ground. I thus converted into excellent oyster bottom some soft mud, upon which the workmen had refused to work.

"The macadamizing of mud by means of sand is, in my opinion, a discovery of great importance for the future. I call the attention of the commission in a special manner to this question, of which the oyster culturists have not yet understood the importance."

The Baron de Wolbock, who encountered the same difficulty, expresses himself thus:

"Before utilizing the basins, it was sometimes necessary to excavate the rocks, and sometimes to harden the shifting mud, especially in the great basin of Keriolet. This was considered an impossible undertaking; nevertheless this result has been completely attained, by the use of sea gravel, spread upon the surface to be hardened. Put on in layers, from four and a half to six inches thick, this sand or gravel mixes with the mud, which it hardens, forming a sort of mortar, and this without changing the original level of the bottom. After this operation one can move about, and even place heavy loads upon the bottom, where previously both men and apparatus would have disappeared, swallowed up in a short time."

Reverting to the properties of mud and sand already indicated, it will be seen that the consolidation with gravel has the great advantage of causing no modification in the section of the bed, which assumes greater consistency without change of level. The other means employed for the same purpose, such as fascines, which we have examined at the Spanish fort, in the river Auray, are inferior both in effect and result. It is true that the particularly unstable nature of the bottom there may justify the use of fascines, but gravel and sand have such remarkable properties that, when judiciously employed, they are of a nature to bring about the most excellent results in almost all cases.

## CHAPTER III.

## REMOVAL OF THE YOUNG OYSTERS FROM THE COLLECTORS—THEIR PRESERVATION—ENEMIES OF THE OYSTER.

*Attached and freed oysters.*—In well arranged breeding parks, where care has been taken to employ the means previously mentioned, both

as regards the choice of collectors and their arrangement, about the month of August, small yellow spots will be noticed. These are none

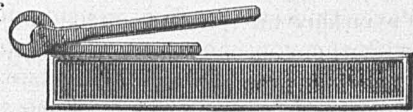


FIG. 6.—Pincers for cutting the tiles in preparing the attached oysters. One-tenth the ordinary size.

other than the newly hatched oysters, which attach themselves to the tiles and develop there. In the earlier experiments it was decided to wait two or three years, before removing the oysters from the tiles. But oysters left to grow upon the collectors assume imperfect shapes. Upon stone or wood they grow very flat, and upon tiles they become distorted and a portion of the young are stifled. Furthermore, when oysters remain for several years upon the collectors, it is impossible to regulate, according to necessity, the care which they demand.

Where there are good raising parks, it would be well to remove the oysters at an early date, so as to allow them to grow under better conditions; but the best course to pursue in the matter of raising oysters has not yet been determined upon, at Morbihan, as the different methods in use will decisively show.

When a young oyster is removed from the collector, the valve by which it adhered is exceedingly delicate, and, notwithstanding the existence of a calcareous appendage, resulting from the calcareous covering of the tile, still the surface of attachment presents a very weak point.

By attacking it from this side, its enemies are able to destroy it, and, therefore, all the proceedings during the first stage of raising are directed toward protecting the recently detached oyster from its foes, while at the same time its growth is going on.

Two principal systems are followed at Morbihan.

The first consists in cutting up the tile, so as to leave each oyster with a fragment of tile adhering to its shell. By so doing, there is no weak surface exposed, to be attacked by an enemy.

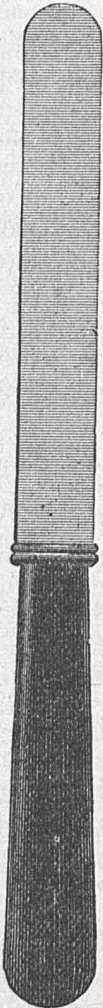


FIG. 5.—Knife for detaching the young oysters, reduced to one-half the ordinary size.

The second consists in shutting the young oyster up in cases, the sides and top of which, being made of wire gauze, permit the action of the air, light, and current, while they present an insurmountable obstacle to the entrance of such enemies as the crabs and shrimps.

These two systems are criticised and defended with equal vigor, and both tend to favor industrial results.

In order to throw light upon the subject, without attempting to completely elucidate it, we should, necessarily, make known the different opinions of the various culturists.

"Some desire to preserve their tiles," says Dr. Henri Leroux, "and so cover them with a thick coating of lime, which they remove every year with the young oysters; others spread only a thin coating of lime over their tiles, which the young oysters soon absorb to their own gain, and thus fix themselves firmly on the tile itself.

"In the first instance, the labor of removal will be much easier and less expensive, and the plastered tiles will be as good as new for the next year. These advantages are very tempting; but at the age of six or eight months the young oyster, separated from the surface upon which it had fixed itself, is flattened, and the valves become very delicate, especially the lower one, which is transparent.

"In this condition, the oyster is without protection, and is exposed to the voracity of its enemies. A lot of forty thousand, exposed in this way, disappeared, in the course of two weeks. This has twice been our experience.

"If, in order to avoid such a disaster, the culturist puts his oysters in basins, he exposes himself to the same dangers; we have seen quite recently, in a basin measuring something like two thousand square yards, more than a million oysters disappear, stifled under the sand, stirred up by crabs and black worms.

"We must, therefore, have recourse to boxes, covered with wire gauze, in order to save the oysters; but should we not consider the expense of this, when there are several millions of oysters to be preserved?

"If, on the other hand, the tiles are kept in the water until the second year, when the oysters will have attained sufficient strength, they will be badly shaped, and the economy in the matter of tiles will become a source of vexation and deception. On the contrary, tiles covered with a calcareous coating appear to us to present much greater security. The preliminary labor is more difficult and more prolonged than in the case of the tile with the thick coating; but the young oyster, adhering firmly to the tile, still remains fixed upon it, even when, with a pair of pincers of our invention, the tile has been easily cut away, into pieces about the size of the young mollusks. Thus placed free from one another in the raising parks, they are in a condition to defend themselves against their greatest enemies (crabs and oyster-devouring fishes), by the weight and strength of the hard tile covering."

To this opinion, which appears to be based upon reasonable and logi-

cal conclusions, we will oppose that of M. Solminihac and M. Mauduy, who have a very important breeding park at the Spanish fort, in the river Auray, which supplies their famous establishment at BÉlon.

Speaking of the first attempts, when the oysters were left to grow upon the collectors, these gentlemen express themselves thus :

“In the months of March and April, the oysters being then two years old, we thought them strong enough to be transplanted, and we removed them. This method gave us results which, if not satisfactory, were at least assuring. Considerable expense and some inconvenience were encountered. The great number of tiles required for the proper growth of the oysters demanded a great deal of space. Our possession, which we had been obliged to crowd, suffered great mortality, and also a large number of young oysters, having been completely deprived of light, scarcely grew at all.

“We tried removing them earlier, that is, in May and June, and then placing them in our parks or floating basins, where the water was renewed every day. The oysters placed in the parks disappeared completely; those in the basins succeeded better, but their development was so insignificant that we thought it best to put them into the parks in the month of August. We preserved about one-third of them. We tried at the same time some boxes of thin wood, which gave but poor results. At this time, M. Coste induced us to try wire cages, such as were used at Arcachon. Of these we had three hundred made, after the model sent us. In these cages, arranged in different parts of the river, and in close proximity to the current, we placed four million young oysters, taken from our stock of 1873, at the Spanish fort.

“These cages, set at different periods of the spring and summer, gave us magnificent results, in spite of the great number of oysters placed in each one. The mortality was very insignificant. We obtained from them more than half a million oysters, measuring from two to two and a half inches; the remainder measured from an inch and a quarter to an inch and three-quarters. These oysters were put into the market in very good condition.

“For us, at the present time, the problem of the collection and raising of young oysters has been solved, and, profiting by the experience resulting from prolonged and arduous efforts, we are convinced that the crop of 1874, at which we are going to work next spring, will give us results superior even to those of last year. Satisfied of the importance of this method of operation, we are having five hundred new boxes made with wire gauze.”

As indicated by these statements, the conclusions arrived at are quite opposed to one another, and this difference occurs everywhere in neighboring parks; M. de Wolbock abandons the method of leaving the shell attached to the tile, while M. Gressy retains it. If we wished to solve the difficulty, we would have to take into consideration the location of each park; for it should be remembered that in the industry now being



discussed there is no universal method of procedure, and from this arises both the difficulties and the dangers. The saying that "what is true on

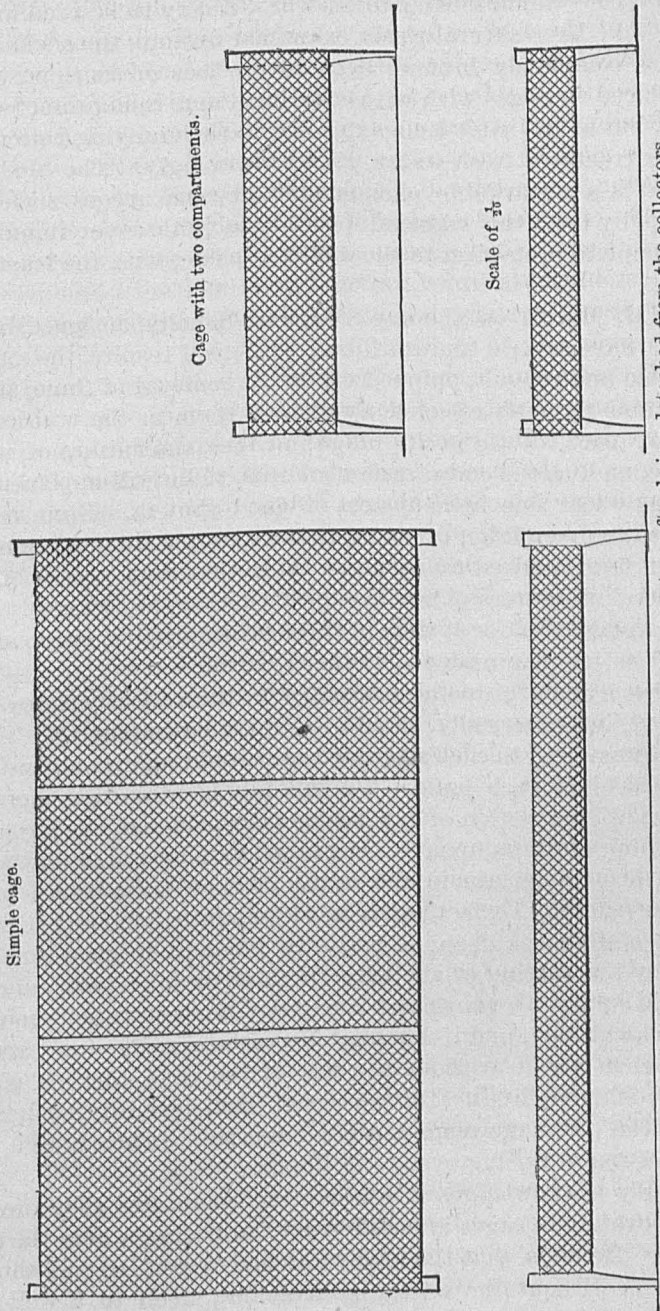


FIG. 7.—Cages of metal wire gauze to receive the young oysters after being detached from the collectors.

one side of the Pyrenees is false on the other," finds serious application here, and progress is hindered with this very diversity of methods.

But, in a general way, it must be acknowledged that the cage is indispensable to the culturist, whether he possesses greater or less numbers of them. They are necessary to his work, if only to be used as "ambulances." We have several times examined oysters, the shells of which had been completely broken, even to the loss of some portions, and which placed in cages with wire coverings, and thus protected against enemies, but at the same time subjected to the vivifying action of light and of currents of fresh water, grew surprisingly. The shell healed, and, what is a remarkable phenomenon, new calcareous scales formed most rapidly over the wounded portion, as if to cover it quickly and afford complete protection to the mollusk inside, with the least possible delay.

The MM. Martin on the one side, and Solminihac and Mauduy on the other, have several times utilized, with good results, the numberless bits of lime and cement, chipped off by the removal of the oysters from the tile, and formerly rejected, by placing them in the wire cages. It suffices to place all these chippings in cages, the meshes of which are quite fine, and, at the end of a few months, there will appear upon this calcareous waste fine little oysters of good growth. From a stock of from three to five million of young oysters, they were quite surprised to find about four hundred thousand saved in this way.

In general, all oysters placed in cages, whether they be newly hatched, the young, small seed, or oysters of three years' growth, improve remarkably, and better than under any other system.

Experience upon this point is conclusive; theoretically the oyster cage is excellent, but practically, should it always be employed? This question, to be answered in each separate case, would require a consideration of the location of each park. We will only mention that there is, first and above all, a question of expense to be considered.

Everything depends upon the increased value given to the oysters, by allowing them to remain in the cage. A cage costs from four to five dollars; is generally six feet and a half long, thirty-nine inches wide, and six and a half inches deep; it needs to be kept in good repair, is destroyed by the rusting of the wire, in three or four years, and, consequently, is subject to continued renewal. Each culturist should make his own calculation, and if he has any certain method of proceeding, with sufficient profit, without the use of the cage, there is no reason why he should employ it. But we repeat that, generally, such is not the case, and the wire cage renders a great service. It furnishes a solution to the question of raising oysters in the first stage.

M. Gressy acknowledges it himself, but maintains that the raising of young oysters in cages is possible only in basins, where the surf has no action. He adds, that the newly hatched oyster, left to itself, will do well enough without the cages, by attaching itself to a well-selected place.

"The location best adapted to the young oyster, not attached to the

tile, is the highest zone of the park, a short distance below low-water mark; higher up they would die from the effects of the sun's rays in summer, and from the cold in winter. Fish and crabs, especially the former, venture less to this height; they frequent, by preference, the deeper region of the park, which is seldom uncovered. It is evident to me that, by placing the young unattached oyster at the height which I have indicated, they are preserved, whereas when placed lower down they may be considered as lost."

The conclusion seems rational to us, in a general way, that at the time of the removal of the young oyster, if it is detached from the tile, it should be placed in a cage. They may be scattered through the upper parts of the park, after they have acquired some size and strength, and may be placed near the lower current, in the lower part of the park, when they are able to offer greater resistance to attacks upon them.

This principle being acknowledged, what is the proper time of removal from the collectors? The oyster culturists of Morbihan admit, as a general rule, that it should be done early, and in this they are right. To leave the collectors in place for one or two years would be to provoke a dangerous deposit of mud, which would have the disadvantage of stifling a part of the crop. The usual practice is to begin the work of removal in March and April; a flexible knife is passed under the coating of the tile, and thus is obtained rapidly, and without harming the oyster, that particular product termed oyster seed by Dr. Kemmerer. In March and April, the growing season begins; oysters grow in the summer and fatten in the winter.

Also, if oysters should be injured during removal, in the beginning of

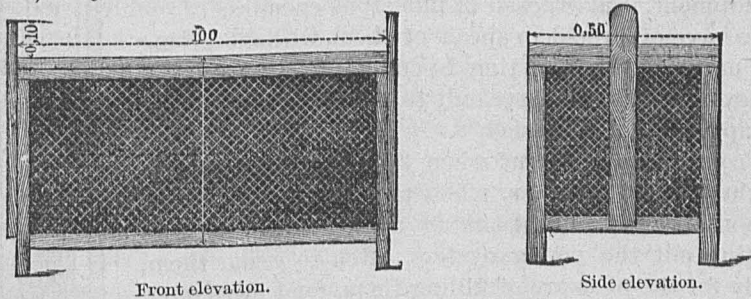


Fig. 8.—Cage for holding the day's work.

spring, they are then in the best condition for healing. Still, there is one very intelligent culturist, M. Alphonse Martin, who begins detaching his oysters in the month of November.

"I have three hundred and fifty cages," says he, "and, therefore, possess the means of placing all my young in them for the winter, thus to protect these unfortunate mollusks, within a restricted area, and save them from crabs and fishes, the accumulation of mud, and the force of the current, which would carry them



Fig. 9.—Scoop.

away. By this method there is also obtained a finely shaped oyster, which does not carry with it a disagreeable impression of mortar, and which is not flat like those left for fifteen months upon the tiles.

The conditions of sale and the facility of raising are the only things which can determine whether the oysters, hatched in July, should be removed from the collectors in October, or not until the following April.

*Clares and submerged basins.*—Whatever may be the time of detachment of the oyster, it is recognized, at Morbihan, as indispensable to have at one's disposition claires or basins, in which the collectors may be placed during the winter season. At that period of the year, great cold is often caused by northerly and easterly winds. During these winds, the sea falls more than when the wind is southwest, often to such an extent that it might leave all the collectors of a park uncovered for several hours. This would suffice to ruin everything. The winter of 1870 was severe in this respect. M. Eugène Leroux declares that he then lost fifteen thousand dollars worth of oysters in one day, and others suffered in like manner.

M. Gressy has wisely distributed claires and basins around his parks, at Cuhan, and warmly recommends all culturists to put their stock under shelter during the winter.

The fine basins of M. de Wolbock are well known, and M. Eugène Leroux has just been having some made. Our oyster culturists cannot be too much encouraged on this point.

*Enemies of the oyster.*—From the time of the removal of the oyster from the collector to the period of its normal development, it is exposed to numerous enemies.

We have often had to speak of them, without giving their names. It is now time to enter into some details, an easy task, since we have only to reproduce the spirited description of M. Chaumel.

“From the spring time, when they put in an appearance, until cold weather, when they leave us, we see these miserable crabs roaming about, searching and ferreting out the young oysters, often to crush them, merely for the pleasure of killing them, for I have often seen them going from one to another, crushing them in their claws, and never stopping until I had seized them and crushed them in turn. With oysters which they cannot break they resort to strategy; stopping near them they watch, without noise or motion, until the valves of the oyster are opened, then they thrust in the elbow of one of their claws, and with the fine extremity of another tear out the oyster, which, in this case, they devour.

If the crab misses its stroke, and gets in only the extremity of its claw, upon which the oyster shuts down firmly, the latter is still a cap-

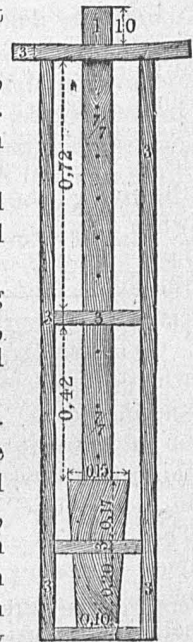


Fig. 10.—Gateway for reservoirs.

tive, for the crab drags it about as a galley-slave does his ball, and it is a damaged oyster for the culturist. But, fortunately for itself and for us, the oyster is not quite so foolish as it seems to be, and is not often taken. I have almost always seen the crab pay the penalty. When they cannot do injury in this manner, they have recourse to another method, which is as follows:

“Whole groups of crabs unite together and dig holes; as large sometimes as a hand-basin, first using their claws, and then, when the holes become too deep to work in in this way, loading the mud or muddy sand upon their bodies and discharging it beyond the hole, thus burying all the oysters in the vicinity. By the action of the waves, oysters are often thrown into these holes and buried in them; this we tried to prevent by means of long-handled rakes. I neglected to state that the basins or holes dug by these sea-moles, the crabs, serve as a shelter for their progeny.

“Since I have spoken of the crabs, I will pass in review the other enemies of the oyster, which are the more to be feared; this is a matter of great interest to all.

“*Murex tarentinus* is furnished with a small apparatus, in the form of a rasp, armed with very sharp points, harder than diamond, with which it pierces and kills the oyster. This is a parasite of the most dangerous sort. I placed some of them upon collectors covered with young oysters, and saw the adults pierce the oysters, one after another. They did not leave the collector until they had killed the last one. Ordinarily it is the young *Murex* that attacks the young oysters, which they can pierce when they are scarcely the size of a pin. The older ones attack the larger oysters, and thus each has his field of destruction. To get rid of these dangerous parasites, they must be driven off at all times, but especially at the spring-tides of April and May.

“A most active search should then be made of the lower levels of the park, where all the stones, tiles, and wood-work should be moved, overturned, and inspected. Even the oysters themselves and the dead shells should be subjected to this examination. In the inspection made at this season, they are always to be found in groups of fifteen or twenty, and searching more closely about these groups, their eggs are often to be found. The eggs alone may even be discovered after the spawning season is over. These eggs look something like large grains of wheat; they are placed in an upright position, very firmly fastened at the base to the solid body upon which they have been deposited. The number of eggs in each cluster often amounts to several hundreds, and each egg contains at least thirty-three embryos. There is no need of my demonstrating further the importance of destroying both the *Murex* and their eggs. After hatching, the cluster of eggs continues to present the same appearance for a long time, and it is only by a close examination that an almost imperceptible opening on the top of the egg can be discovered; then it is too late to destroy them.

“Many persons mention the *Nassa reticulata* as a dangerous variety of periwinkle, quite as harmful as the preceding. My own observations and researches do not lead me to share this opinion.

“I must also speak of the *Thère*, a fish belonging to the family of Rays, and another formidable enemy of the oyster, which it devours after having crushed it in its powerful jaws. When this fish enters a park a veritable devastation follows. The havoc they produce must be seen to be appreciated. During my first year here, I had to suffer from their depredations; but I immediately put in practice the means which I had so fortunately employed at Arcachon, and which consists in increasing the number of pickets in such a manner as to hinder their advance. They always move in an oblique direction, when they sink to the bottom. Can my getting rid of them be ascribed to this contrivance? It is possible that, injuring themselves against the pickets a first time, they are not willing to run the risk again; or do these obstacles inspire them with fear? We are tempted to believe so, when we consider the pusillanimity of the *Thère*.

“Finally, more as a matter of curiosity than otherwise, I am going to mention a singular enemy of the young oyster, and this is the shrimp. But, as this animal requires a certain amount of space for its movements, it is difficult for it to commit great depredations about the collectors; it does some damage, however, in the following manner:

“In order to break off the young oyster, the shrimp proceeds after the manner of a battering-ram. It poises itself some distance off from the point to be struck, and then pounces down upon it with all the speed it can acquire, directing its spur, which is powerful compared with the rest of its body, upon the shell, which it thus penetrates. This attack is renewed, until it only remains for the shrimp to settle down upon its victim and devour it.”

The star-fish, which the English oystermen dread so much upon their oyster banks, is little to be feared along the coast of the department of Morbihan. However, at the county fair of Vannes, Dr. Gressy exhibited a star-fish holding, entangled in its arms an oyster, the edges of which seemed to have been worn away by the file-like surface upon the under side of the rays of the star-fish. It is probable that, whether upon the banks or in the parks, the star-fishes feed upon oysters by seizing and holding them tightly, and filing away the edges, until the mollusk is sufficiently uncovered to be devoured by suction.

Besides these enemies, which may be said to act directly, there are others which cause ravages none the less sensible, because produced indirectly. Thus the sea worm excavates cavities into which the oysters sunk, become swallowed up in the mud, and die. The only preventive against them is to macadamize the muddy or clayey soil with gravel or broken shells.

In speaking of the different zones of the parks, we have had occasion to mention the polyps, which attach themselves to the collectors, like

so many little blisters; without being exactly enemies, they act like the mussels, which also sometimes assume the place of the oyster and develop upon the shell of the young or of the adult. MM. Solminihac and Mauduy had occasion to observe at BÉlon regular invasions of mussels, which, in a certain measure, prevented the growth of the oysters.

The means of preventing this has not yet been discovered, but the disastrous action of the mussels may be, in a great measure, hindered, by keeping the oysters in a state of great cleanliness. In this respect the young in cages may be easily subjected to washings, either by means of the Dutch shovel or with a suction pump. Cleanliness, in general, is the best guarantee against enemies of this kind.

Upon the whole, the enemy most dreaded by our culturists is the crab. In order to get rid of them, many devices have been suggested. M. Liazard's invention has been especially noticed. It is a prism, covered with wire cloth, closed at the bottom, and with an opening at the top. The interior is partly filled with stones, as ballast, and bits of fish, as bait. When the crab once enters at the top he becomes imprisoned. A considerable number are sometimes caught in this way.

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## CHAPTER IV.

### PARKS FOR RAISING AND FATTENING OYSTERS.

*Possibility of raising and fattening oysters along the shores of Morbihan.*—Following the details already given, it will be seen that, in Morbihan, if not *all* the breeding parks, at least the best among them, consist, first, of the shore, along which the collectors are placed; second, of claires, or places where the stock can be protected during the winter; and, third, of cages or other appliances for protecting the oyster recently detached from the collector against their enemies, in cases where a portion of the tile has not been allowed to remain attached to the shell. These parks should be completed by the addition of special places, called raising parks, in which the oysters collected might be allowed to grow.

Unfortunately, raising and fattening parks are not of general occurrence in Morbihan, or, at least, are insufficient for the convenience of the entire stock collected. The efforts of those who understand the importance of the work we are now discussing should, in the future, be directed to this branch of oyster culture. The question of breeding is already understood, but that of raising and fattening is yet to be perfected. As regards the breeding of oysters, we have encountered certain well established practices and principles; but as to raising and fattening there exists an uncertainty, which will be remedied in the future.

Here we again find that the nature of the bottom upon which the oyster grows is all-important in its influences. This mollusk has more the ex-

ternal qualities of a vegetable than an animal. Almost incapable of moving from place to place, it feels to the fullest extent the influence of the soil which serves as its bed. We have seen what difficulties had to be overcome, in order to carry on breeding successfully in the midst of our mud; what will it then be as to raising and fattening? Some persons, influenced by a feeling of timidity, mingled with incredulity, ask themselves whether raising and fattening is possible along our coast. When such questions have been proposed to us we have always answered affirmatively, and it will be useful to make known the reasons upon which our hopes are based.

There exists in the world a privileged country, where the oyster industry occupies a prominent stand; that country is the United States. There, immense fortunes have been made in this industry, the capital of one American oyster dealer having been computed as high as ten millions. Now, if it be true that the character of the coast and the nature of the bottom exercise a preponderating influence, what are the particular features of this coast and what constitutes so favorable a bottom?

From the St. Lawrence to Florida, the American coast is deeply indented. Magnificent bays, like those of Boston and New York, are succeeded by the steep banks of the Delaware, which waters Philadelphia, and of the Chesapeake, whose tributaries pass by Washington and Baltimore, Richmond and Fredericksburg. Farther to the south, along the coast of South Carolina, we find the interior seas, called Albemarle and Pamlico Sounds, which seem like great basins, protected from the high waves by immense breakwaters.

All along the coast, from North to South, the soundings indicate sand, sandy mud, and rich, shelly bottoms. In the coves, mud is found; and the bays, whether large or small, receive an abundance of fresh water, from many streams and small rivers. Sometimes this mixture is effected by small tributaries, as in Delaware Bay, and again by large rivers, which, near their mouths, are quite majestic in character; such are the Potomac and the Rappahannock. When these numerous indentures, these rapid currents, and these seas, which penetrate even into the interior, are studied and examined, one is struck with their similarity to those of the coast of Brittany.

We also have a great gulf, deeply indented and dotted about with islands; we also have large rivers, with brackish water and rapid currents, and shores tranquilly washed by the waters of the sea. If the Americans, thanks to their favorable coast, have a profusion of oysters and cultivate them with care, we may also, since the problem of breeding has been solved, endeavor to raise fair crops, as Providence has furnished suitable localities for so doing within reach of our culturists. To such as have said to us "Breeding is our field, let others attend to the raising," I have always replied, we must not neglect the raising of



oysters, but make a division of labor so as not to neglect fine resources and lose great riches.

The oyster must be raised and fattened upon its own ground, and then it will be unrivalled. This must be insisted upon, and this is the reply to be made to all who bring forward as obstacles to success the mud, the changeable bottom, the sacrifices to be made, and the struggle to be maintained.

*Choice of bottom ; character of the water.*—After what has been said, it will be understood that it is not possible to state principles as positively, with regard to the raising and fattening of oysters, as has been done in the case of breeding.

However, it would appear that the foundation of this special branch of oyster culture is to be sought in the natural action of the bottom and of the currents. M. Charles, one of the oldest oyster culturists in the country, declares that, for the purpose of raising and fattening, nothing is as valuable as the natural bottom, well prepared. The only suitable preparation consists in giving it a little solidity, by incorporating calcareous ingredients with it, when possible. In this manner, a bottom is obtained, analogous to that which exists along the coast of America.

M. de Broca has informed us that the American oyster thrives on a bottom of muddy sand, rich in animal life and sufficiently sheltered against heavy seas; and, he adds, "that the brackish water, occurring at the mouths of certain rivers, constitutes one of the best elements for the success of this industry."

Moreover, so true is this, that only in the last extremity should recourse be had to artificial means. Americans, in order to raise and fatten their oysters, content themselves with planting them in creeks, where the action of the currents is felt, but where they are, at the same time, completely sheltered and where the depth of water varies from three to nine feet, above low-water mark.

M. de Broca, who furnishes this information, adds the following judicious observation:

"In America, parks, as we understand them in France, are unknown. American oyster culture, more simple in its details, consists in planting the mollusks along the shores of the sea-coast. Where there is only sand, they grow but little and do not fatten; where mud alone exists, they contract a bad flavor and are in danger of being stifled; but where the sand is mixed with a moderate quantity of mud, they develop wonderfully, especially if the water be moderately salt."

The choice of bottom is always a delicate subject, because it has so important an influence upon the raising and fattening.

Dr. Henri Leroux states that "the low price of oysters now depends entirely upon the greater or less area given over by the State to oyster-culture."

The great difficulty is that the bottom must be selected and appropriated. At first sight, it would appear that the gulf of Morbihan and

certain portions of our river banks, between low and high tide marks, might be utilized with success. This is an experiment which many of the culturists of Morbihan are disposed to hazard.

Upon this subject we have heard manifested a desire to see in the waters of a raising or fattening park the animal matter, upon which the oysters might feed. This idea should be set aside from the beginning, nothing being required but a firm bottom and tidal action.

As we have said before, the oyster is a remarkable laboratory, where transformations are effected naturally; very little is necessary for the development of this mollusk, and the best is that which is most easily assimilated and which readily escapes our notice.

It is remarkable that the same idea should have prevailed in all countries, where the raising and fattening of oysters has been undertaken.

M. de Broca says: "A belief, which has gained some credit in England and America, is to the effect that oysters may be fattened by scattering a little flour (corn-meal being commonly employed) in the water which covers them. Some oyster-planters in New Jersey," he says, "have tried this, but it is probable that the use of meal has little or no effect upon the oyster, whose stomach is so delicate as to appear incapable of digesting such nourishment."

*Preparation of the bottom.*—Setting aside the possibility of raising oysters artificially, the first thing to be sought for is a firm bottom, and if this cannot be found it must be made. M. Chaumel has accomplished this result in the gulf of Morbihan, and his example may be easily followed. It has been necessary to do the same thing in the river Bélon, which answers for fattening, as the river Trinité does for breeding. MM. Solminihac & Mauduy, who have built a remarkable establishment at Bélon, have had great difficulties to overcome. "The bottom of the river," they say, "is not everywhere favorable to the existence of the oyster. In most places the borders of the channel, which are the only suitable localities, presented slopes of mud in which the oysters disappeared almost as soon as placed there. We had, therefore, to adapt the bottom to our purposes; we removed from eight inches to two feet of mud, macadamized the surface, and thus constructed a bed suitable for the oyster. Our efforts were crowned with success, for the oysters placed upon this artificial bottom in the early spring (as far as possible during the month of March), became completely transformed as to the nature of the shell, and increased very considerably in size, at the same time that the edible portion fattened greatly."

But this formation of bottom is not always possible in the streams and along the shores of Morbihan. In a little river which flows into the bay of Lorient, a culturist has been led into an ingenious system, to which future success would appear to be secured. M. Turlure, to whom a park had been conceded in the river Ter, had for some time contented himself with simply planting oysters along the channel, where they improved greatly and soon became edible. Anxious to

extend his field of operations, he found himself unable to utilize the muddy portions, as the work of consolidating the bottom there would have been very great and expensive. He decided, therefore, to make use of the cups of M. Michel, superintendent of the hydraulic works, in the port of Lorient. These cups, constructed of a kind of cement, are about nine inches square, and are capable of containing about four and a half inches of water.

At first two kinds of these cups were utilized, the one being pierced through the bottom, and the other solid on all sides. The first combined with the second might serve as "ambulances." It would appear that the non-perforated cup is really of practical importance, and destined to become of great service in certain cases.

M. Turlure has now 52,000 of them placed in his park, in elevated places, where raising would have been impossible under any other system. They contain fourteen millions of oysters. The net cost price of this work of solidifying the bottom amounts to about \$1.62 a square yard.

It is impossible, at the present time, to pronounce upon the value of this system, but it deserves to be studied with scrupulous care. From a theoretical point of view, however, it presents the advantage of affording oysters, both large and small, an exclusively calcareous bottom, over which may be spread a fine mud of a good brown color, and which, not containing animal or decomposed vegetable matter, exercises no harmful influence upon the oyster.

The fact must not be lost sight of that, so long as the mud does not become black from the liberation of sulphurous matters, it is, if not favorable, at least inoffensive. After turning black it acts as a poison upon the oyster.

Coste made known the mortality which overtook the oysters in Lake Fusaro, about the year 1820, on account of the appearance of sulphurous fumes, due to volcanic eruptions, and the fatal influence of mud containing sulphur is to-day well known to all the culturists of Morbihan.

In case a deposit of the black mud should form upon the basins in the Michel system, the action of the atmosphere and light would rapidly transform it. It would become brown by the absorption of oxygen, which changes sulphurets into sulphates.

What is most remarkable in connection with the breeding and raising parks of Morbihan is the great diversity in the methods of work, and the attachment of each culturist to his own system. This, on the whole, is praiseworthy, because, with such a multiplicity of trials, the true road to success is more likely to be discovered.

At the mouth of the river Ter, we find the parks of M. Charles, where the method of proceeding is totally different from that of M. Turlure, whose parks are about three hundred yards further up on the same river; and yet the success of M. Charles is assured, and the reputation of his oysters already made.

He has selling parks upon the emergent portions of the banks, a large shipping basin, and in the cove of Kérolé, an excellent basin with a bottom of clayey sand, where the growth is remarkable, even though there is no current. The oyster develops rapidly, and in six months increases in size from a quarter of an inch to an inch and a quarter.

But in the case of M. Charles, as in that of M. Turlure, in Bélon, as well as in Morbihan, it is always necessary to commence by removing the mud, and forming artificially a hard bottom, in order to secure a good increase and insure the fattening of the oyster. All these conditions seem admirably united in the parks of M. Pozzy, at Ludré-en-Sarzeau.

The fine flour-mill of Ludré, situated upon a point projecting into the sea, and which appears like an establishment where human industry has endeavored to seize from nature an important motor power, has an immense reservoir of nearly one hundred acres in extent; on one side, there are walled parks, intended to receive the cars, and on the other, raising basins with a surface of over seven acres. By the action of the waves, a certain current is produced in the parks, and the large reservoir, acting like a storehouse, makes it possible at almost any moment to concentrate upon any of the parks a continuous and steady flow. A careful examination of the functions of the different parts of that most judiciously arranged establishment of M. Pozzy, shows that he possesses, in the parks of Ludré, the means of varying, at will, the action of those natural forces, which are so favorable to the growth of the young oyster. The clayey bottom of the carefully cemented basins can be readily adapted to raising, and the possibility of placing the cars, containing the young oysters, under the vivifying action of the currents, admits of early growth, difficult to obtain in ordinary parks.

Upon the whole, and despite the almost embryonic state of this branch of raising and fattening, we can predict, in a short time, very successful results in parks so favorably situated and so judiciously arranged as those of M. Pozzy, at Ludré.

*Basins.*—It is indispensable that several fattening parks and shipping basins should be added to all raising parks; this is a necessity to which our culturists of Lorient, in the gulf of Morbihan, and at Bélon, have been obliged to conform. Where they are wanting, much is left unprovided for, to the great loss of the industry.

*Care to be taken in raising and fattening oysters.*—Having described the arrangement of the parks, it is interesting to point out the care which should be taken to insure growth and fattening. First of all, the oysters should not be piled upon one another. Coste said the proportion to be followed in distributing them should be a million of oysters to two acres. This is the proportion used at Marennes. In America they are disposed under the same conditions, and all culturists have stated the proportion to be one hundred oysters to the square yard. This point seems to have been settled beyond dispute.

As to the special attentions to be observed, MM. Mauduy and Solminihac have briefly summed them up, in the following terms:

"We take great care of our parked oysters, because experience has shown that the more attention given them, the more satisfactory are the results. These cares consist mainly in removing all foreign matters, which the tides may deposit in the parks, in turning the oysters, in re-arranging those that are badly placed, and in repairing defects in the bottom, after which the oysters may be replaced upon it. These operations require the employment of a considerable number of workmen, all the year round."

The duration of the term of parking for an oyster of salable size, varies from six months to one year. There is nothing which more requires the eye of the master, and constant and active watchfulness.

*Results obtained; turning green.*—The results obtained are in proportion to the efforts displayed. The well-parked oyster upon our shores will assume a closed shell; while before parking it consisted of a chamber containing fœtid water, which spreads throughout the interior when the knife is employed. This defect it loses and assumes a solid and resisting surface. The oyster grows, its flesh loses its brown color and becomes quite white. Everything indicates a change for the better, as pleasing to the palate as to the eye.

One quality, long considered as peculiar to the oysters of Marennes, a greenish coloration, is easily produced in the parks of Morbihan. This singular phenomenon consists in the appearance of a very decided greenish color, affecting especially the breathing organs, that is to say, the four branchial leaves.

Coste had observed this fact at Marennes, and had also noticed that the green oysters always became white at spawning time. "Those," said he, "which previously presented this appearance, became paler, little by little, as fecundation took place and finished by losing the color entirely, at the time of spawning. On the other hand, those which were white when placed in the parks remained so. It is only after the month of August, that they recover from this temporary loss of color, which does not affect the trade, since the color reappears immediately after spawning."

It is now proved that the process of turning green in the parks of Morbihan, is connected with the entrance of fresh water into the parks, and the development of vegetation upon the bottom. It is effected in a few days and has no relation to fattening. What causes the transformation? Some of our culturists attribute it to a disease of the liver, others exclusively to the influence of the bottom.

Berthelot, who carefully analyzed the green oysters, thinks he can ascribe the green color to a metallic oxide, doubtless the oxide of iron.

The blue marl of the Scudre contains analogous elements. This alone indicates that the bed, on which the oysters are placed, exercises so de-

cise an influence upon them, that to improve the bed may be said to improve the oysters.

The presence of oxide of iron in Morbihan is scarcely admissible, hence it must be the green vegetation that produces the color of the oyster. M. Charles has observed that vegetation tends to disappear around the oysters which become green; but he rightly admits that the process of turning is only possible because of particular dispositions of the animal, either illness or otherwise, which disappear at the period of spawning.

However this may be, the fact remains that in the parks of Morbihan the green tinge, so much demanded by lovers of oysters in the south, may be obtained with great facility, and also that the color has nothing to do with fattening, nor with the special qualities of the oyster.

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## CHAPTER V.

### MEASURES REQUIRED TO INSURE THE PROSPERITY OF OYSTER CULTURE.

On the preceding pages, we have endeavored to point out the state of oyster culture in Morbihan. It is important to draw from these details some conclusions, to show what future is in reserve for this industry, and by what measures such a future may be assured.

*Principal cause of the failure of Coste.*—It is evident to all that, in spite of the scientific knowledge, the zeal, and the labors of Coste, his attempts, so far as regards commercial results, were radically fruitless. Nevertheless, he had at his disposition apparatus, boats, auxiliaries as intelligent as devoted, and also, to a certain extent, the resources of the public treasury. Still the reason is very simple. That impersonal being, called the state, is incapable of creating any industry. It sufficed to relinquish oyster culture to the culturists, who, although intelligent and well informed, are, in the majority of cases, neither savants nor academicians, to insure success, where only failure had been predicted.

This is because the state lacks that powerful lever called individual interest. An occupation is not possible unless an assured profit may be realized from it. The merchant alone can be certain of this, from a study of the markets and the demands of consumers. The poorest merchant in France is the state. The state has quite another part to play. Charged with the protection of all, it cannot descend from this elevated sphere of general usefulness into the arena, where opposing interests are contending—an arena which it always leaves defeated and often injured. To abandon its reserve and endeavor, by taxation, to create a national industry is an act of socialism, generous, perhaps, but from which others will derive the benefits.

Napoleon III, in his youth, had a passion for studying these questions, and sometimes lent an attentive ear to these grand socialistic theories; this was why Coste obtained so much support from the Emperor. Led away by his own ardor, he did not notice that he was gliding down a fatal slope, and that he would fall at last, in spite of all his efforts. If, instead of going to the Tuileries, he had addressed himself to an association of capitalists, or to the trade, who could have participated in his confidences, then oyster culture, disengaged from the shackles of the state, would, from the beginning, have taken a higher stand and progressed with surer steps.

We do not wish to underrate the importance of the part played by the state, for we are going to appeal to its aid in another matter; but we think it should be well understood that the two domains, of industry and of government, are totally distinct. By confounding them, powerlessness replaces fertile effort, and the most important work is crowned only with failure.

We do not wish, in any way, to diminish the gratitude due to those, whether functionaries of state or others, who have labored for the creation and development of this industry; but we feel the necessity of proclaiming, in a certain measure, the omnipotence and vigilance of individual interest. We believe that, imbued with this thought, the public administration would desire, even more in the future than in the past, to free from fetters and obstacles the pathway along which this industry must move, in order to attain a high degree of prosperity.

*Necessity of establishing parks for raising and fattening oysters.*—The prosperity of oyster culture will be secured when, in addition to breeding, a matter already of certainty, there is established a methodical system of raising and fattening.

"The oyster," says Dr. Kemmerer, "which is now rather a luxury, would become an article of general consumption. In Paris, in the month of January, 1875, more than 185,635,000 French oysters were consumed, a flattering result for oyster culture. The oyster culturists of Marennes acknowledge that, out of seven millions of oysters, they lose six in their fattening parks, which is a shameful acknowledgment for the industry."

We have no influence over these figures, but we are going to endeavor to roughly sketch out the oyster statistics of the present and of the future, in this interesting department of Morbihan.

According to the statements furnished us by the commissioners of maritime inscription, there are, within the approximate limits of Morbihan, 535 oyster parks, occupying an area of about 1,065 acres. It is difficult to make a division between the breeding parks and the parks for raising and fattening. A careful examination, however, leads to the following classification: 100 acres are used for breeding, and 965 for raising and fattening. It will be prudent to reduce the last figure to 750, because several parks are but little used, and many are almost abandoned.

Since it takes three years to raise an oyster, and since, during the growing and fattening period, about one square yard is required for a hundred individuals, it follows that it would require about  $7\frac{1}{2}$  acres of bottom to raise and fatten one million young oysters. This is the number theoretically, but practically some portions of the concessions are found to be much more favorable than others, and some portions are even unsuitable for raising and fattening. Taking this into account, and adding the space lost in entrance ways, &c., we must double the area, and call it fifteen acres. In the 100 acres set aside for breeding purposes, what does the number of young produced a year amount to? It is difficult to answer this question, and the methods of enumeration vary. Some persons count the tiles, and thus obtain a mean of the number; others try to count the oysters actually produced; the latter approach nearest to the truth.

Deducting for losses, the production really varies from two hundred to a thousand oysters, to a square yard of the area of a breeding park. In some parks there is a square yard of collecting surface to a square yard of the park; others have only a foot or a foot and a half.

Breeding, therefore, along our coast, varies every year in the production of from eighty millions to four hundred millions of oysters, but we believe it is not prudent to accept any figure higher than eighty millions. Dredged oysters are not included in this sum.

If we accept the figure of fifteen acres of raising and fattening parks, for the annual production of a million oysters, it results that a surface of 1,200 acres is required to raise what is produced; the figures given above show that there are only about 750.

Consequently, if the production continues to increase, and if the practice of raising remains at a stand-still, the supply exceeding the demand, prices will be lowered, speculation will interfere, and we shall arrive at a crisis.

Do not accuse us of pessimism. The industry of canning sardines is now passing through an unfortunate phase, on account of an excess of production. It is asked, What will be the effect upon the maritime inscription, if this fishery is given up, if our coasts become deserted? What is there to offset this result? The future does not look bright.

It is to be hoped that no such crisis is in store for the industry with which we are concerned, for oyster culture could not oppose it; once fallen, it would be difficult to raise it; then it would be useless to court inquiry, to make scrupulous examinations, and to ask oyster culturists what ought to have been done. Now is the time to attend to the needs of oyster culture in Morbihan; the way must be prepared immediately, and sufficient space accorded this industry to extend its labors. What is necessary to attain this result? Attend to the raising and fattening, which means, that a great deal more space is required.

For the actual production of 80 millions of oysters, 1,200 acres in parks are required; for the future production of two hundred millions, we



must have 3,000 acres. Where will they be found upon the coast of Morbihan? The shores are muddy; the attempt to utilize them would be to change the order of things; to modify the equilibrium in the beds of rivers, and induce a deposit of mud. On the other hand, if a high rent, which would be justified by a well-established occupation, be imposed upon our culturists, a budding industry will be stifled. The influence of the state should come in between the culturists, who desire to develop their establishments, and the obstacles, opposed to such development. It is incontestable that, to prevent the deposition of mud and the modification of the bed of our rivers, the creation of parks might be combined with a judicious system of damming. But this operation necessitates a connected study of the courses of our rivers, which could not be undertaken by our culturists, who have not the means necessary to bring it to a successful issue.

The state alone, by means of the help employed by the minister of public works, might set on foot the requisite studies to determine at once: first, the surfaces which can be transformed; second, the technical conditions under which this transformation is possible, without injury to the general welfare. This labor accomplished, the result should be brought to the knowledge of culturists, who could then take into consideration the chances of gain or loss, success or failure, which the labor of raising and fattening might offer them.

Would it not be desirable to know to what extent this industry might be developed upon the coast of Morbihan, if this programme could be realized, and these numerous parks established?

At present 80 millions of young oysters a year represent a value of from \$60,000 to \$80,000. If the process of fattening were made practicable, the increased production would place 40 millions of edible oysters at the disposition of consumers, and then the results of the industry might be reckoned at about \$1,200,000, calculating the price to be about \$16 a thousand. The 80 millions of young oysters require 160,000 days' labor, of both men and women; if raising were undertaken, 600,000 days' labor would be necessary. Let it not be asserted in opposition to this that, after all, the fattening of oysters is attended to in other places, and though Morbihan may suffer by not undertaking it, still the general interest would not be the loser. This is an error, because the bottom can be adapted to fattening, and therefore not to utilize it is to neglect a source of wealth.

It is the duty of the authorities of the department of Morbihan to examine the situation well. The preserving of sardines along our coast already realizes about \$2,000,000 annually. Oysters, to the value of \$1,200,000, might easily be put into market, and so the annual amount of the industries of our coast would amount to \$3,200,000. This is a considerable sum, and large enough to warrant the attention of those who believe, that the public wealth is closely allied with individual and local wealth.

*Rent.*—In case our desires were to be carried out, and the study of transformable bottoms made, at what rate should the rental be fixed? Every service must be paid for; this is a principle of economy which enters largely into all our habits. A rent must, therefore, be decided upon. The rate is the only point to be discussed.

The rent, especially in the beginning, should be very small, and of a nature merely to secure the rights of the public domain. It would be a pity to see a fiscal measure trammel upon this industry, which still feels its way along so timidly. It is true that in the present state of our public treasury, and with the debts which weigh upon our country, every source of revenue is eagerly sought for, but yet we must be careful not to kill the goose that lays golden eggs. As Bastia has said, there are two sides to this question, one seen, and one not seen; what is seen is the rent, which may enrich the public treasury; what is not seen, is the fact that by putting an obstacle, even a slight one, in the way of the early efforts of culturists, the progress of an industry might be stopped, the result of which would be a certain reaction upon the public welfare. From this point of view, there is a great service to be rendered to oyster culture. The state, by accepting the proposition, would be playing precisely the part it should, and its intervention could never have more beneficial results.

*Concessions for a long term.*—This question leads naturally to a consideration of the method of granting concessions, now in vogue in already existing parks, and that to be followed in the future.

At present, as is well known, every culturist is entirely dependent upon the administration; the concessions are nominative and revokable; what a minister has given with a stroke of his pen he can likewise take away. We have heard it said that administrative favor might cause trouble to this industry, by arbitrariness or favoritism, but we do not fear this, for we believe that the principles of equity, integrity, and justice, which are the patrimony of the administration, will ever be held in honor. But from another point of view this question deserves to be attentively studied.

A culturist is authorized to found an establishment by a permit which is entirely revokable. He expends a considerable sum of money upon his establishment, but he entirely ignores what the future may have in reserve for him. In case of death, what will become of his industry? Into whose hands will his concession pass? Will his descendants, direct or indirect, have the right of pre-emption? The administration, with a high standard of impartiality, may know how to conciliate all parties; but for most parties this is a simple hope. A hope does not afford that certainty which belongs to an arrangement, known to every one and determined upon beforehand. Besides, how can one calculate the redemption of capital? There can be no stated period of possession; all is absolute uncertainty. An urgent reform is demanded upon two points:

1st. The concession should be made for a fixed period, with the privi-

lege of renewal by the retainer, unless the public interests demand otherwise.

2d. An acknowledgment of the right of pre-emption for the descendants, or of a valuation to be placed upon the park in case of change, and, also, a right of pre-emption, for those who reside along a river, to that which faces their property.

A concession given for a stated period will have the immense advantage of enabling the culturist to calculate a total or partial redemption of his capital, which will afford him some certainty for the future. This certainty will engender confidence, which is inseparable from progress.

On this point, our French oyster culturists have once more given an example of that peculiarity of our national character, exhibiting at times an exaggerated fear and again an incomparable audacity.

It is generally stated that we are lacking in commercial spirit, that the English and Americans, more daring than we, know better how to venture in untrodden paths, and, thanks to these qualities, attain wonderful results in all industrial pursuits.

It will not be rash to assert that neither English nor Americans would have hazarded the establishment of an industry, the existence of which depended upon an authorization, which was revokable from one day to the next. The most venturesome would have held back before such instability; and what proves this is, that American legislation has been categorical in this respect.

Thus, in Massachusetts, where the celebrated Northern oyster is found, the concessions are made for twenty years, the oyster culturist and his heirs having the exclusive privilege of the conceded ground. In Rhode Island, where oysters are extensively cultivated along the banks of Providence River, the shortest concessions are for five years and the longest for ten years. In Connecticut, each authorization indicates the duration of the concession made. Farther still, not only is a stated duration of concession considered indispensable in America, but, in many cases, those who reside upon the banks of a river are acknowledged to have the right of cultivating oysters along the frontage of their own property. This is the case in New York, New Jersey, Delaware, Maryland, &c.

In this manner, legislation has shown that human activity can and should develop itself, not only on the land, but also in the domain of the sea; it has comprehended that the initiative should always be left to those who would engage in any undertaking, both as regards the cultivation of the land and the sea bottom. Without entering into the realm of industry, it has removed obstacles and taken all measures not to hinder the advancement of oyster culture. Here we find both an example and a lesson; an example, for, notwithstanding the wealth derived from the oyster trade in the United States, legislation protects oyster culture, a thing which is wanting with us here in France, where

the need of it seemed to us, a short time ago, as real as irremediable; a lesson, because it is only in making of the sea-coast, not a special domain, but one subject to the ordinary rights of ownership, that we can accustom the people to sea-coast affairs, and thus build up and perpetuate a race of seamen, like that of which America is justly proud.

In England, where there has also been a falling off in the cultivation of oysters, an inquiry has been instituted. The principal conclusion of this inquiry is remarkable, and the duty of the government is marked out in the following terms: "Let it be provided that associations or persons may easily obtain a title of possession, sufficiently secure, to such portions of the bed of the sea as they desire to work, in order that they may be induced to employ the capital necessary to furnish and keep up their fisheries."

No doubt is possible upon this point. French oyster culture will never become an industry destined to thrive, until its future shall be assured. It depends upon the government alone to remedy the evil, by conceding, with guarantees as to duration of lease and facilities of transmission, parks sufficiently extensive for the double purpose of breeding and raising.

What is it they oppose to us? Is it that public interest might necessitate labors which would lead to a dispossession, in the case of concessions for a certified time with acquired rights? That navigation or some other maritime interest might require freedom of the coast, understanding by freedom its remaining entirely in the hands of the state? The answers are readily made, and upon this basis of discussion oyster culture is impregnable. Where there is a will there is a way. It is acknowledged that, so far as concerns the public welfare, the recruiting of our sailors, our marine power and our marine industries should be sustained, at any cost. This is the main point, the end to be attained, and all that is secondary to it should be disregarded. By hesitating, on account of objections in the matter of details, which may, perhaps, have some value, we are led astray, and soon lose sight of the greatness of the object. The state must be constantly reminded of this object; it must be convinced that here is a work which the government alone can undertake, and which we confidently hope it will perform.

*Reforms of detail.*—Besides these reforms and innovations, which we so earnestly desire, there is still a good deal of progress to be realized in detail.

We have shown the importance of the current for reproduction and raising; now, these currents being found in the deeper portions, it must systematically be permitted oyster culture to approach the channels. We have shown how powerful the current is in sweeping away the mud, accidentally deposited in the deeper places, and consequently all facilities for the cleansing of the parks should be fearlessly afforded.

We have shown how great was the solicitude of our culturists for the restocking of our oyster beds; let them be permitted to approach the banks, which will become, for those interested in them, objects of

active watchfulness and attentive care. In fine, we will add that marauding should be severely repressed.

In America, where centralization is little known, and where almost every one protects himself, we have a remarkable example.

In Rhode Island, oyster thefts are punished by fines, varying from \$24 to \$120, accompanied by imprisonment, sometimes for a year.

In Connecticut the fine amounts to \$72, with imprisonment for six months, and in the other States the laws are also severe.

#### CONCLUSION.

In a word, to study and reclaim transformable surfaces; to give concessions for a long term, with acquired rights for the retainers; to extend the liberty of culturists, and to enact severe police measures; such is the conclusion of our studies upon the part to be undertaken by the state in the matter of oyster culture.

The culturists will do the rest; in this respect, the past guarantees the future; their courage and energy will place oyster culture foremost among French industries.

In conclusion, may we be allowed to state how happy we have been to find all our culturists rendering to Coste the honor which is due him; all confer on him the glory of being the founder of oyster culture.

"Let us proclaim it aloud," says Dr. Kemmerer, "because it is true: the academician, Coste, was the founder of this new science."

"I know that certain minds, filled with jealousy, dispute with his scarcely cold ashes these first scientific attempts; but his writings, as well as those of all the oyster culturists of the time, exist to cast ridicule upon these posthumous inventors."

To this cry of indignation, we add the touching words of M. Chaumel:

"In concluding, may I be allowed a souvenir of affection and gratitude to M. Coste, the learned professor of embryology, to whom oyster culture owes everything; for, without him, of that which occupies us here there would be absolutely nothing.

"After having trodden for many years a path bestrewn with thorns, leaning upon my arm, his failing eyes often caught a glimpse of the laurels of the promised land, though he died in sorrow. If, more fortunate than my dear master, it pleases God that I have the honor to gather them, it will be both sweet and pleasing for me to lay them upon his tomb."

We have been pleased to hear this touching unanimity, which should be noted, for our age has given birth to critics, whose sight is easily dazed by glory. It would seem as if they tried to measure everything by their own proportions. But our culturists of Brittany have escaped this contagion. As, for what is solid and true, they have ever had an unvarying devotion, and a fidelity, which is the eternal honor of their race, they have proclaimed their admiration for Coste, gloried in humbly acknowledging themselves to be the disciples of the master, feeling that, if gratitude be a duty, it is also a noble quality.



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