

XXX.—REPORT ON THE CONDITION OF OYSTER CULTURE IN
1875, PRECEDED BY A REPORT TO THE MINISTER OF MA-
RINE AND OF THE COLONIES.*

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REPORT TO REAR-ADMIRAL THE MARQUIS OF MONTAIG-
NAC, MINISTER OF MARINE AND OF THE COLONIES, BY
M. DE BON.

VERSAILLES, *January 23, 1875.*

After a long period of quietude oyster culture has recently made considerable advancement. In the basin of Arcachon, especially, it has rapidly developed since 1870. The practical results attained by the improved methods of work have attracted the attention of all the inhabitants of the basin, have even acquired a great notoriety abroad, and have induced many people to engage in this industry. The demands for concessions of ground have increased to an unusual extent, and at the same time the oyster culturists, already provided with parks, have found themselves much inconvenienced in the establishments they now possess from the lack of room in which to raise the young oysters taken in large quantities from their collectors.

A ministerial decision, published in 1860, reserved for the general fishery quite an extended area in the basin, upon which the establishment of parks was prohibited. The suppression of this area was asked for by some in the interest of oyster culture, but there was also another party, opposed to this plan, according to whom it was not only necessary to maintain the existing reservations, but also to refuse all new concessions, under the pretext that the multiplication of the parks would injure the general prosperity of the basin.

At the beginning of last year Vice-Admiral Dompierre d'Hornoy, then minister, instructed me to proceed to these places in order to ascertain the state of affairs at Arcachon, and to report to him *de-visu*. I returned from this mission convinced that the oyster industry of Arcachon was

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susceptible of important developments; that it merited favorable attention from the administration, and that the greater part of the reserved area could be turned over to oyster culture without any inconvenience whatever to the general interests. The minister, in accordance with propositions which I submitted to him upon this subject, decided on the 28th of January, 1874, that all the grounds of the basin yet unoccupied should be placed at the disposal of private industry, and in addition a certain number of natural oyster-beds, which need to be taken care of, as they constitute breeding centers indispensable to the maintenance of the parks.

In executing this decision, the first work of dividing the old reserved area was effected during the year 1874 and received the sanction of the ministry on the 19th of last December. Seven hundred and twenty-eight new parks were thus authorized at one time, and were added to the seventeen hundred and six oyster-cultural establishments already existing in the basin. A second work of the same kind was also approved by the minister, and a third will soon follow. At the same time concessions of ground were daily granted in all other parts of the basin and the great number of demands was not lessened. Furthermore, this progress in oyster culture is not limited to the basin of Arcachon. In Morbihan industry and capital favor it in a nearly equal degree. There also oyster culturists, finding the condition of the soil, climate, and locations propitious, have, little by little, perfected their methods and obtained remarkable results.

From these two centers of activity oyster culture radiates to a greater or less extent in all directions. It has been permanently established in the bay of Mount-Saint-Michel and on the sandy borders of the Vivier. It seems in a fair way of becoming re-established on the coast of the island of Noirmoutiers and the island of Ré, where it had previously given great hopes of success at the time it was first started there; it is more prosperous than ever on the banks of the Seudre. Finally, it has become in many places the object of attempts which will, without doubt, prove partially successful.

Aware of the deep interest taken in the coast fisheries by the Admiral Marquis of Montaignac, who, in 1850, was one of the commission under the presidency of the Count Chasseloup Laubat to prepare the penal laws of 1852, I have thought that at this time, when oyster culture has received a definite impulse, the minister would read with pleasure a detailed report of its origin, its first phases, and its present condition. I have, therefore, by the aid of documents collected at the bureau of fisheries, prepared this report, which comprises the history of oyster culture and practical descriptions of the most perfected methods of cultivation practiced upon our shores.

I have the honor to submit this work to the minister, and should he find it worthy of his approbation, I beg he will give it to the public as

an aid in extending the knowledge and facilitating the progress of an industry which is still new and full of promise for the future.

I recommend that this report be published in the *Revue Maritime et Coloniale*.

Commissary-general of the marine, director of administrative affairs,
Signed: DE BON.

Approved.

Signed: MONTAIGNAC.

AN ACCOUNT OF THE CONDITION OF OYSTER CULTURE IN 1875.

In addition to the taking of oysters by dredging, there exist two very distinct branches of oyster industry, which have hitherto been carried on to a very unequal extent.

The first consists only in the improvement of oysters taken from natural banks. The oysters are taken, so to speak, ready-made, are deposited in localities calculated to give them certain qualities of flavor, shape, or color, and are then furnished to consumers after they have acquired these qualities, which increase their market value. It is a sort of stock-raising, analogous to that of the farmer who buys lean cattle and fattens them before sending them to market.

The second industry consists in taking the oysters when they are in an almost embryonic state, as soon as they have left the valves of the mother oyster; in favoring the first phases of their development by special care, thus saving from destruction a multitude of germs which would perish if left to themselves; and subsequently in increasing artificially the harvest of these productions which nature lavishes with so much carelessness and prodigality. This latter industry has been compared to agriculture, which multiplies the productions of the earth in order to meet the constantly increasing demands of mankind; hence the name *oyster culture*, which has of late been applied to it.

I.—HISTORY.

RAISING OF OYSTERS TAKEN FROM NATURAL BEDS.

Ancient origin of this industry.—The rearing of oysters by the first of the two methods just spoken of is of very ancient date. Historians relate that a rich Roman, named Sergius Orata, a contemporary of Cicero, at the close of the Roman Republic, conceived the idea of bringing oysters from Brindes, and of parking them in Lake Lucrine, which communicated with the Mediterranean Sea not far from Naples. This plan resulted very successfully, for the oysters of Lake Lucrine soon acquired an unequalled reputation and the originator of the idea derived considerable profit therefrom. This industry appears to have been perpetuated in the country where it began. M. Coste, the celebrated propa-

gator of the methods of fish-culture, during his voyage of exploration on the coasts of France and Italy found it practiced in Lake Fusaro, a short distance from Lake Lucrine. The oysters employed there are taken from the gulf of Tarente and distributed over various portions of the lake, which have been previously arranged for this purpose. This industry is associated there with methods of oyster culture, properly so called, to which we shall refer hereafter.*

Practices in France—Marennes.—In France the improvement of oysters by parking has been known and practiced for a long time. The productions of Marennes have long been famous. The parkers of that district purchase not only the shell-fish taken in the immediate neighborhood, but they also bring them from the coasts of Brittany and the basin of Arcachon. These oysters are put into *ponds*, where they grow rapidly, and into *claires*, consisting of shallow basins, where they acquire, after a more or less prolonged stay, a particular flavor and that green color so much prized by epicures.

Cancalle, Granville, Saint-Vaast-la-Hougue, &c.—The oysters of Cancalle and Granville are also parked, either locally at Saint-Vaast or at Courseulles, where they greatly improve and acquire the faculty of preserving in their valves, for a long time after they are taken from the park, the savory water, constituting one of their principal merits.

Practices in America—Importance of the production in that country.—The same method of raising is practiced in America on a grand scale. The coasts of the United States have, almost everywhere, oyster-beds of extraordinary richness. The consumption of oysters among the Americans attains proportions quite unknown on this side of the Atlantic. In 1859 a newspaper of that country estimated the trade in this mollusk in the principal cities of the Union at 20,000,000 bushels; each bushel contains on an average 400 oysters, making the enormous total of 8,000,000,000 oysters consumed in a single year, without counting those eaten on the spot, or those omitted by the errors of enumeration.† Most of these oysters after being taken are parked the same as in France. The parks are usually near the large centers of population, which in America are almost all situated in the vicinity of the sea. The most favorable places are the estuaries of rivers; for it has been ascertained in all countries that a mixture of fresh and salt water greatly develops the edible qualities of the oyster. In fine, the rearing of oysters is an industry of great antiquity, and is practiced almost everywhere where this mollusk constitutes a common article of food.

OYSTER CULTURE PROPER.

The same is not true of oyster culture. We have said before that this industry consists in collecting by artificial processes the spat of the

* Voyage d'exploration sur le littoral de la France et de l'Italie, par M. Coste, published in 1855.

† De Broca: Industrie huitrière des États-Unis, 1865.

oyster at the time of spawning. Some details of natural history will here be necessary.

Spawning of the oyster.—The oyster is hermaphrodite;* that is to say, each individual possesses the attributes of both sexes, fecundates itself, and produces young. The spawning usually takes place from June to the end of September; but the eggs are not immediately expelled; they remain until hatched within the mantle folds of the parent oyster, enveloped in a mucous substance essential to their development. When the proper time arrives the young sally forth, being furnished with a temporary swimming apparatus, which enables them to go in search of a suitable point of attachment. The swarms of embryos are innumerable, each parent giving birth to not less than one or two millions of young at each spawning. "At the time when all the adult individuals composing a bed void their progeny, this living dust issues like a thick cloud, which, leaving the point where it originated, is dispersed by the action of the water, only an imperceptible portion remaining attached to the parent stock. The rest is all scattered, and if the multitudes carried here and there by the waves do not find something solid to which they can attach themselves they are certain to be destroyed, for those that do not become the prey of other forms of life finally settle upon a locality unsuited to their development, and are often swallowed up in the mud."

Recent origin of oyster culture.—The idea of forming special establishments for the purpose of retaining and preserving some of those innumerable germs is a recent one, or, at least, only a few years have elapsed since it passed from the domain of theory to that of fact. The only oyster cultural practices known of somewhat ancient date are those seen by M. Coste in the parks of Lake Fusaro, to which we have already referred. The keepers of these parks had, from time immemorial, been in the habit of collecting the spat upon stakes driven around their deposits, and upon bundles of fagots suspended from ropes stretched above the water. But this industry was an entirely local one; it had not extended to the other districts of Italy, not even to the adjacent ones, and it was not at all commonly known.

First attempts made at Saint-Servan.—It was in France, some twenty years ago, that oyster culture really had its origin. About the time M. Coste visited Lake Fusaro, in 1853, M. De Bon, then commissioner of marine and chief of the service at Saint-Servan, now director of administrative affairs in the ministry of marine, was directed by the minister to attempt the restocking of the old oyster-beds of the Rance and of the roadstead of Saint-Malo, by means of shell-fish obtained from the beds in the bay of Cancale. In observing the results of these experiments, which succeeded perfectly well, he became convinced of a fact which had, until then, been contested, viz.: that the oyster can reproduce itself even after having been transplanted to bottoms which are

* Coste: Voyage d'exploration, &c.

left bare at each low tide, and on which it has never existed before. He was struck with the facilities thus offered for the obtaining of artificial supplies of spat. He established at Saint-Servan, in the port of Solidor, a sort of experimental park, and commenced a series of experiments to discover means of fixing the spat emitted from the oysters. In the year 1855 he announced to the minister that the question of artificial reproduction was for him definitely settled in the affirmative. In 1858 he asked to be authorized to try in one of the parks at Cancale the system of collecting spat which he had decided upon. It was a sort of floor formed of boards from 15 to 18 centimeters wide (6 to 7 inches), upheld by stakes and placed 20 centimeters (8 inches) above the oysters. Having seen with their own eyes the results of this system, the parkers of Cancale did not hesitate to give it a trial at their own expense during the summer of 1859. The experiment was crowned with complete success. In the month of October of the same year, M. De Bon transmitted to the minister, as a specimen, several boards covered with spat, some from the beds of Cancale and some from the parks of the Rance. His experiments had, moreover, become famous. The prefect of the island of Vilaine had come to pay a visit to the park and had comprehended the scope of the discovery. In pursuance of his advice, M. De Bon sent specimens of the oysters obtained by the new method to a local exhibition which was held at Rennes in August, 1859. These specimens, which were accompanied with a description, attracted much attention, and the jury of the exhibition conferred a silver medal upon the inventor.

M. Coste's share in the introduction of the new industry.—Notwithstanding these satisfactory results, oyster culture would undoubtedly have found difficulty in overcoming the obstacles which prejudice always places in the way of new advances, in attracting public attention and subsequently in securing the costly and persevering efforts necessary to insure its speedy development, had it continued as a purely administrative work, subject to the conditions of prudence and wise reserve which are always imposed upon responsible functionaries. It found in M. Coste a bold champion, who brought to its service his reputation as a man of science, his talent as a propagandist, and the open support of the chief magistrate of the nation, which he had gained by the eloquent ardor of his convictions. Made proficient for this work by reason of his studies on fish-culture, M. Coste had become much impressed by what he saw in Italy, in the parks of Lake Fusaro. He at once conceived the idea of transporting to France the industry which flourished so obscurely near the gulf of Naples. In the report of his explorations, made January 1, 1855, to the minister of agriculture and commerce, he expressed a desire that the same processes might be tried in the salt ponds of the south of France, and also applied to the natural oyster-beds. He proposed to let down over these oyster-beds in the spawning season large wooden

frames to collect the spat, which should be withdrawn at the proper time.

His first missions on the coast.—Two years afterwards, in 1857, the Emperor commissioned him to make experiments in maritime fish-culture. Soon thereafter, having received letters of introduction from the minister of the marine to all the maritime officers of the ports, he began to travel along the coast. He visited Saint-Servan in August, 1857. M. De Bon showed him the already decisive results which he had obtained, both in restocking the beds of the Rance and in collecting spat artificially. This was a practical confirmation of his theories, and in many respects a revelation of the means of executing them, for which he was still seeking. He saw with his own eyes the reproduction of oysters upon ground left bare by the tide, a fact which he had long denied and from which he subsequently derived so much advantage. On the 5th of February, 1858, in the first report addressed to the Emperor on the subject of his mission, he asked that a simultaneous experiment in restocking and in oyster culture might be tried on a large scale in the bay of Saint-Brieuc. He predicted its success, and his vivid imagination, entirely given over to the fondest hopes, already saw the coast of France transformed by the same process into an almost continuous chain of oyster-beds, furnishing inexhaustible supplies of food.

Experiments in the Bay of Saint-Brieuc.—This report, which was printed in the "Moniteur," attracted much attention. M. Coste received from the minister of marine all the means that he required. Three million of oysters, purchased at Cancale and Tréguier, were deposited (April, 1858) at various points in the bay of Saint-Brieuc, with the aid of two small steamers belonging to the government, which towed the entire flotilla of boats carrying the oysters. On these improvised beds oyster shells were previously spread, to serve as collectors, and, for the same purpose, long rows of bundles of fagots were let down and anchored at a height of 30 or 40 centimeters (12 to 13 inches) above the bottom. Other boats were permanently detailed to watch and keep the new beds in order. Success seemed insured from the first. At the close of the spawning season the collectors brought to the surface were covered with spat. M. Coste thought that now he was about to see his plans realized. He proposed to immediately undertake to restock the entire coast, and the report in which he announced his results in the bay of Saint-Brieuc (December, 1858) received the same publicity as the former one.

Attempts at restocking on a large scale.—From this time onward oyster-cultural experiments both by the department of Marine and by private individuals developed rapidly. In the month of July, 1859, a steamer called the "Chamois" was placed at the disposal of M. Coste to convey him to such points along the coast as he desired to visit, in order to direct his experiments, and especially to co-operate in the oyster-cultural works under the charge of the commissioners of the maritime inscription and of the vessels guarding the fisheries. In January, 1860, two

and a half million oysters were purchased at Cancale and distributed through the bay of Saint-Brieuc in order to enrich its bottom. In May and July of the same year two million more were purchased in England and taken to Bordeaux; by the Chamois, whence they were conveyed to Cette by railway for the formation of oyster-beds in the Mediterranean. This lot was divided between the pond of Thau and the roadstead of Toulon. The roadstead of Brest was restocked, and an oyster reservation, supplied by large shipments from England and intended to facilitate the stocking of the surrounding beds, was established in l'Anse de la Forest, near Concarneau. In the basin of Arcachon, explored by M. Coste in October, 1859, there were established by his advice two model parks to serve as breeding beds for the entire basin and for the trial of the different collecting apparatus thus far invented.* Several millions of oysters were deposited in these parks, and a government vessel, together with a coast guard expressly appointed, were charged with their supervision and with the carrying on of all necessary work.

First advances made by private industry.—Private industry followed the impulse given by the state. On the coasts of Normandy and Brittany, on those extending from the Loire to the Gironde, and in the basin of Arcachon, concessions were solicited from the minister of the marine; oyster-parks were established, and the people engaged with eagerness in experiments at artificial reproduction. Capitalists intrusted their funds to enterprises of this kind, conceived on a grand scale. The success in several localities was very marked. In the beginning of 1861, M. Coste, in requesting the minister to grant further extension to his restocking operations, stated that the bay of Saint-Brieuc, where the first experiments had been made, could immediately furnish a harvest of several millions of marketable oysters; that the coasts of the island of Ré had been converted into a vast and richly stocked oyster-bed; that the basin of Arcachon promised a harvest of incalculable richness; that in the roadsteads of Brest and Toulon the success attained, although less pronounced, was still of a nature to justify the most sanguine hopes; that at La Rochelle and at Marenes the production was equally satisfactory; and, finally, that in the pond of Thau, if the oysters had not reproduced they had at least grown and acquired qualities which would cause that pond to be considered a place for improving their flavor.

Numerous failures—Temporary decline of oyster culture.—Unfortunately numerous and bitter disappointments followed in the course of the succeeding years. The artificial beds of Saint-Brieuc were destroyed by inclement weather, the oysters being scattered and the bundles of fagots broken apart and thrown upon the shore; they never rallied from this

* These parks were formed in 1860, on two of the best oyster bottoms of the basin, called the Cés and Crastorbe. In 1863 a third model park was established upon the crassats of Lahillon. These parks, after having rendered much good, ceased to be useful when private industry had made considerable advancement at Arcachon. In 1872 the minister of the marine granted to the Central Life-Saving Society the right to take oysters therefrom, with certain reservations.

disaster. The roadstead of Brest became again impoverished, in consequence of the imperfect reproduction of the oysters deposited there, and the plundering operations of the fishermen. The experiments made in the Mediterranean failed completely. The parks of the islands of Ré and Oléron and of La Rochelle, after a few years of prosperity, rapidly declined and were almost entirely abandoned. It was the same at Cancale and in the Rance, where the attempts at oyster culture, begun by M. De Bon, resulted unsatisfactorily not long after his departure; the majority of the parkers abandoned the work. Finally, the report of the maritime authorities stated that in the basin of Arcachon, at the close of 1865, the government parks were flourishing, but the natural beds were impoverished, and private industry was prostrated because of the failure to collect spat.

Causes of this decline.—What were the causes of these failures, which seemed to indicate the ruin of all hopes based upon oyster culture? They were manifold: in the first place, ignorance or neglect of the natural laws governing the formation and continuance of oyster-beds; secondly, imprudent attempts at restocking, or cultivation under unfavorable circumstances, quite excusable, however, at the outset of a new enterprise; and, lastly, the inexperience of the oyster culturists, all of whom were green hands at the business, the uncertainty which prevailed as to the choice of favorable localities, the methods to be followed, and the apparatus to be used as collectors.

Action of the department of marine.—While seconding the efforts of M. Coste, the department of marine did not share in his illusions. It rightly considered that the renewal and enlargement of our oyster-beds, exhausted by the excessive drain upon them, could not be accomplished either as speedily or completely as he had anticipated. The department was not, therefore, discouraged by the failures it had encountered. It was this department, in fact, that had really opened the way, both by its experiments in restocking, commenced in 1852, and by the promulgation of the decrees of July 4, 1853, concerning coast fishing, which decrees laid the foundation of a rational system of regulations as to the taking of oysters.

The coast-fishery regulations of 1853 with reference to the oyster.—The main features of this system of regulations are the prohibition against taking oysters at times not allowed by the maritime authorities; the determination of the proper time for taking them dependent upon the advice of special commissions that visit the oyster-beds annually; the reservation of beds found to be impoverished or calculated to answer as centers of reproduction; and, finally, the obligation imposed upon fishermen to throw back onto the beds or preserve in parks the young oysters which have not yet attained a certain size. Wherever it has been possible to enforce these rules continuously, and at the same time keep a sufficiently close watch to prevent the plundering operations of fishermen and other people living upon the shore, the marine authorities have

succeeded in securing the prosperity of the oyster-beds, provided they were established upon bottoms naturally productive and not entirely exhausted; the success of enterprises whose object is to reconstruct beds, of which not a trace remains, or to create entirely new beds, is much more problematical. In this latter case the lessons taught by experience have not been lost. Since 1865, the department, without refusing to engage in all attempts at starting new beds, has especially endeavored to maintain the already existing ones, to improve them by timely cleansing or by the additions of shell-fish brought from richer localities, and, finally, to strengthen the watch upon them, which is the best method of preserving them. Thus, in several localities they have been gradually raised from the decay into which they had fallen.

Results of the continued enforcement of these regulations.—Oyster culture, properly so called, has advanced continuously, and in the course of its progress there has been brought to light a fact of prime importance, viz., that the artificial breeding of oysters can scarcely be successful excepting in the neighborhood of the natural spawning-beds. Thus the oyster-park of the island of Ré became sterile as soon as the neighboring natural beds which supplied it had disappeared. The abandonment of the attempts at oyster culture at Cancale was contemporaneous with a prolonged impoverishment of the oyster-beds in the bay of Mont-Saint-Michel; these beds are now becoming filled up again, and oyster-cultural industry has reappeared upon the shores of that bay, at Vivier, where it is increasing daily. It is the same at Arcachon and in the rivers of Morbihan. The oyster propagates well in parks, as was demonstrated by M. De Bon, and perhaps at some future time it will be possible by improved methods to collect the spawn artificially produced in sufficient quantities, especially if the operation be performed in a favorable medium; but at present an abundant supply of spat from large natural beds is essential to success.

Progress made by private industry—Improved methods—Revival of oyster culture.—On the other hand, the oyster culturists, taught by their own experiences and by the results attained through the government experimental parks, became more self-reliant; they improved their implements and their methods of work. It may be affirmed that in the two principal centers in which it is now carried on, the basin of Arcachon and Morbihan, this industry then emerged from its period of uncertainty. The great profits realized there during the past few years have brought oyster culture again into favor and turned toward it a current of labor and capital much greater than that which flowed in the same direction after the publication of M. Coste's report. Requests for concessions of parks are received by the minister of marine from all quarters of the coast. Attempts are being made to reconstruct old and abandoned establishments, while new ones are being started in the majority of localities where others formerly existed. Those seeking grants desire particularly the unclaimed localities in the basin of Arcachon and the rivers

of the marine sub-district of Lorient, certain that they will receive in the future what is promised by the present.

Rapid increase in the number of oyster-cultural establishments at Arcachon.—At the close of 1871 the parks controlled by private parties in this basin numbered 724 and occupied a total area of 588 hectares (1,450 acres); at the close of 1872 they were 1,133 in number and occupied an area of 1,061 hectares (2,625 acres); at the close of 1874 they numbered 1,706 and covered an extent of 1,733 hectares (4,310 acres), not counting the portion formerly included in the reserved zone but now given over for parking. The denomination "Reserve Zone" was applied to a considerable section of the basin in which parks were prohibited in order to retain a common fishing ground which could be frequented by all. In view of the great increase in oyster culture at Arcachon, both to satisfy the claims of the old parkers, who complained that they were cramped for room, and to meet the new demands which were constantly increasing in number, the minister of marine decided, on January 28, 1874, to open up the greater portion of the reserve zone to private industry. The remainder of this zone, positively withheld from private demands, comprises exclusively the natural beds of the basin with their immediate surroundings, which it is important to protect against all intrusion, as the prosperity of the parks depend upon their preservation. In pursuance of the ministerial decision of January 28, the first work of dividing off the sections for distribution was carried on during the year 1874; a decree has just been issued for the formation of 728 new parks, which, added to the 1,706 now existing, will make a total of 2,434 concessions and an extent of 2,669 hectares (6,625 acres) to be occupied by oyster culture. A second work of the same character has just terminated; a third will soon follow.

Prosperous condition of the establishments at Morbihan.—In Morbihan the development of oyster culture is no less striking. The section of Vannes contains nearly 200 oyster-parks, while that of Auray will soon have 300 and requests are still coming in. Thus, persons in all stations of life are engaging in oyster culture, either by investing their capital in it or by laboring for it. Many of them are without experience in the matter and it, therefore, seems proper and opportune to add to this brief historical sketch a few practical remarks concerning the processes now in use for the cultivation of the oyster. A knowledge of the processes which have the authority of success will, perchance, guide inexperienced oyster culturists in the right direction and prevent mistakes; it may also incite others who are still indifferent or timid.

II.—PRACTICAL REMARKS ON OYSTER CULTURE.

Different kinds of collectors.—The first apparatus used to collect the spat of oysters were the plank collectors of M. de Bon, and the bundles of fagots, stones, and shells of various mollusks, as recommended by M. Coste in his first publications. We have seen that the parkers of Can-

cale successfully used the plank collector in the summer of 1859. At the close of the same year the parkers of Arcachon also tried it, having learned through the authorities of the success obtained by its use at the former place. In several other localities private oyster breeders, hearing of the experiments made by the chief of the marine service at Saint-Servan, wrote to him direct, in order to obtain information regarding his method of work. In the great experiment at Saint-Brieuc bundles of fagots and shells alone were used, as the plank collectors would not have withstood the violence of the sea in a position so exposed. Stones, slates, and bricks were employed in the more quiet waters. All of these collecting implements are still in use, and are more or less successful according to the locality; but with regard to this there is no uniform rule. At Arcachon, wooden boxes or hives, 4 meters square, and filled with fagots, were employed in the beginning. These were the invention of Messrs. Lalesque and Lalanne, two promoters of oyster culture in that district; but this system was soon abandoned as being of little avail.

The use of tiles.—It was at Arcachon, and in the parks of Régneville, belonging to Mrs. Sarah Félix, that the use of tiles, which has since become very general, was first inaugurated. The tiles used as collectors are concave in shape, being the same as those which are placed upon the tops of walls to protect them from the rain. They were arranged in the shape of a roof at a short distance above the bottom, being held up by means of stakes. They answered well, but presented a serious inconvenience at the outset; the young oysters attached themselves so firmly to them that they could not be removed, without breaking either the collector or the shell.

Improved methods of preparing the tiles.—Dr. Kemmerer, an oyster culturist of the island of Ré, found means to obviate this difficulty by coating the tiles with a layer of hydraulic cement mixed with water and defibrinated blood. The young oysters adhering to this friable outer coating could be easily removed from the tiles at the proper time. This system was greatly improved upon, or rather simplified, by the parkers of Arcachon; the hydraulic cement, which became very hard by contact with the sea-water, was replaced by a less expensive coating—consisting of ordinary mortar, and made by mixing two parts of sand with one part of an inferior quality of lime.

Olaires, or water parks.—Another improvement consisted in the establishment of claires, which are basins of slight depth, so built and arranged as to retain the water at low tide, in order to protect the oysters against excessive heat and cold during the period of development. They are in imitation of the method of cultivation that has been used at Marennes and in the Seudre since very early times.

"Ambulances," or preservative boxes.—Finally, as the operation of removing the oysters from their point of adhesion often results in injury to their shell, notwithstanding all the precautions taken, and as their

shells are then too weak to withstand the attacks of crabs and other predaceous animals, the parkers of Arcachon hit upon the plan of placing their oysters just detached from the tiles in wooden or osier boxes, furnished with hinges and lids, in which they were left until they had acquired sufficient size to be deposited in parks or claires without danger. These boxes received the significant name of *ambulances*. M. Michelet, a resident of Teste, who took a notable part in oyster-cultural improvements, invented an improved system which he called "*ambulances ostréophile*"; it is a stone basin with the bottom of bricks, laid in cement, raised upon a strong frame-work of wooden joists, which, in turn, rests upon stakes driven into the bottom. A second frame-work placed above the stones is attached to the first by strong iron bolts. On the inside, at a height of about 10 centimeters (4 inches) above the bottom, are fixed screens of osier or wire cloth, on which the young oysters repose. The covering is formed of movable pieces of wood or wire cloth, or simply of tarred netting having a very close mesh, stretched tightly by means of hooks screwed into the upper frame-work. An opening through the stone side, on a level with the bottom, serves to empty the basin when necessary. The entire structure is surrounded by clay masonry which strengthens the walls.

THE COURSE PURSUED IN CARRYING ON THE OYSTER INDUSTRY AT ARCACHON.

Such are the principal improvements which have transformed the cultivation of the oyster into a regular and methodical industry. It is by the following series of operations that it is carried on. We will take as types the processes employed in the basin of Arcachon, because they are the most advanced, and because that region is now the principal center of oyster-cultural activity.

Preparation of the ground.—The parks of Arcachon are established upon bottoms called *crassats*, which are uncovered at each low tide. These regions are covered by a species of fine grass which gives them the appearance of sea meadows, and those having the firmer soil, composed of clay and shells, are best adapted to the reproduction of oysters. The oyster culturist, having taken possession of a portion of *crassat* as the site of a park, commences by clearing it of the long grass and of all foreign materials which may lie upon it; but he takes care not to pull up the short grass, commonly called *moussillon*, for, although the oyster grows more rapidly on bottoms entirely free of all covering, it is less fecund there and more exposed during inclement weather.

Construction of claires, or water parks.—In the highest portion of the park, claires or water parks are established. These are of two kinds: first, those in which the tiles, still covered with young oysters, are placed, and, second, those for the young oysters after they have been removed from the tiles. The height of the water in the former should

be 40 to 50 centimeters (16 to 20 inches), and in the latter from 15 to 20 (6 to 8 inches). Both are dug in the ground to the required depth. The sides are formed of boards held in place by strong stakes and supported on the outside by a bank of clay. Their bottoms are covered with sand and fine gravel. A small sliding door or a mere hole filled up with potters' clay suffices to empty them when necessary. The claires are in general from 30 to 40 meters (100 to 130 feet) long by 4 to 5 meters (13 to 16 feet) wide, and it is advisable to divide them into several compartments by wooden or tile partitions, in order to prevent the wind from agitating the surface of the water too strongly, to the injury of the walls and young oysters.

Construction of "ambulances."—After the claires the parker prepares his *ambulances* as we have before described them. The *ambulance* of stone and brick belonging to M. Michelet forms quite an extensive building, and cost in the neighborhood of 600 francs (\$120). The parkers usually content themselves with wooden boxes 2 meters ($6\frac{1}{2}$ feet) in length, 1 meter ($3\frac{1}{2}$ feet) in width, and from 12 to 15 centimeters (5 inches) in depth. The bottom of these boxes are now covered with wire netting, and the tops also sometimes with the same. Constructed in this manner, however, they are liable to be invaded by mud which passes through the meshes of the netting. Coverings made of boards or of tarred cloth seem to be preferable and are much more economical. The oysters in the *ambulances* should always be covered with water. The boxes are generally placed in claires and fastened upon stakes which sustain them at an elevation of 10 centimeters (4 inches) from the bottom.

Choice and preparation of collectors.—These preparations being completed, collectors must now be arranged. Notwithstanding the predominance of tiles, boards, fascines, and strings of shells are still used at Arcachon. But, whatever may be the kind of collector employed, there is one precaution which is never neglected, and that is to scatter over the bottom, as thickly as possible, oyster and other shells, which offer at slight expense one of the best means of retaining and fixing spat. In order to prepare the tile as a collector, it is coated over with a substance destined to facilitate the removal of the oyster. It is plunged several times into a bath of hydraulic cement and water, and when it is sufficiently dry it receives in the same way a layer of ordinary mortar (one part of lime and two parts of fine sand), which should be from 2 to 3 millimeters ($\frac{1}{16}$ to $\frac{1}{8}$ of an inch) in thickness. Some parkers substitute a second layer of hydraulic cement for the mortar; the advantage claimed being that the tiles are made smoother, are less easily soiled, and retain the spat much better, while they do not need to be cleansed to fit them for use the following year. On the other hand the use of mortar renders the separation easier.

Barges.—The organization of a park is generally completed by the accession of a barge, containing two rooms for the guard, and the purchase of a small boat for communication between the park and the shore.

Arrangement of the collectors.—By way of commencing operations, the oyster culturist first supplies his park with adult oysters, purchased either from the dredgers at the time of collection or from other parkers. The collectors must next be put in place, and it is very essential that the proper time for arranging them should be ascertained, for the spat will fasten to clean and smooth bodies only; and if the collectors are put in place long before spring time they will become covered with mud, algæ, small shells, &c., and the harvest will prove a failure. The oyster spawns earlier or later in the season according as the average temperature ranges higher or lower. The proper time for placing the collectors varies, therefore, according to the latitude of the place and the relative temperature of the season for each year. In the basin of Arcachon the collectors are usually placed the latter part of May. The locality chosen for this purpose is the lowest portion of the park, in order that the apparatus may be under the sea for as long a time as possible. The strings of shells are placed in the dampest places, especially in the natural excavations of the bottom, where some water always remains.

Arrangement in piles.—The tiles are arranged in piles called "hives" (*ruches*). In the first place, there is placed upon the bottom a wooden frame, formed of two parallel beams about 2 meters (6½ feet) in length, 30 centimeters (11 inches) apart, and connected by two short cross-pieces upon which they rest. The tiles are placed in successive layers above the frame, with their concave sides downwards, the tiles of each successive row being arranged alternately parallel with and at right angles to the beams of the frame. The whole is held in place by means of ropes, or, better still, by wire, and sometimes even by a circle of stakes, if from the situation of the park the apparatus is exposed to the force of the waves. In the latter case the lowest hive is also protected by reducing the number of layers of tiles, which may vary from five to nine. The hives should be at a distance of 2 meters (6½ feet) apart; if there are several lines of them they should be arranged in the form of a quincunx, in order that the current may pass through them so as to form eddies at intervals, enabling the spat to become the more easily attached. They should not be brought together in too confined an area, for then they would become filled in with mud, and, from the desire for too rapid gain, all would be lost.

Removal of the collectors—Detaching of the oysters, &c.—The hives remain in their places until October, the spawning season continuing until the end of September. They are then taken apart, the tiles are placed in large claires prepared for the purpose, and the work of detaching commences. This operation, which is usually performed by women, consists in cutting into the coating of the tiles around each oyster, by means of a chisel. The young oysters when detached are placed in *ambalances* or preservative boxes, in piles 3 to 4 centimeters (1½ inches) high at the most. They spend about two months in this place, during which time the parker frequently visits them in order to keep them clean and

supply them with air, by opening the boxes when the weather will permit. They are then conveyed to the breeding-chaire and scattered over the bottom, where they should be placed as far apart as possible, in order that they may become the better developed. The chaires are protected by means of fine mesh nets against the attacks of the various animals which prey upon the oyster; these nets cover or surround the chaires. The water is kept at a height of 20 centimeters (8 inches) above the oysters during the extremes of heat and cold, but during mild weather this height is lessened, so that the oysters may come more directly under the influence of the air and light. When this cannot be done it is well to change the oysters from one chaire to another once or twice a year, placing them in well-cleansed basins, the bottoms of which have been renewed by allowing them to remain unused for several months.

Final care to be bestowed upon the oysters.—After two years of this treatment the oysters have attained an edible size, but before being taken to market they must be accustomed to remain without water. The parker, therefore, at each low tide for a certain length of time, drains the chaire containing the oysters to be sent to market; these oysters gradually acquire the habit of retaining the water within their shells by not opening their valves, and become able to stand a journey of several days without losing their freshness.

Another method.—According to another method the oyster is not separated from the collector to which it is attached, until it has attained the age of eighteen months. Two sets of tiles are necessary in this case, the first remaining in the chaires until the time of detaching, while the second is made ready to receive the spawn of the next season. According to this system the waste is very small, because the oyster is much stronger when it is separated from its point of adhesion. When allowed to remain too long upon the collectors, however, they often become malformed, and this diminishes their market value.

Oysters produced upon the bottoms of parks.—The oysters produced upon the bottoms of parks, or upon the shells deposited there, are easily separated from one another, or from the collector to which they have adhered. They are scattered in grassy places and are taken up from time to time in order to secure those which are marketable, the others being returned to the park. Sometimes, with a view to diminishing the waste, they are placed in chaires, where they are raised like those on the tiles.

USUAGES AT THE PARKS OF MORBIHAN.

Such, in brief, is the manner in which oyster culture is conducted in the basin of Arcachon. The methods of breeding are nearly the same everywhere, with some exceptions rendered necessary by the climate and nature of the soil or water of different localities. Thus, in the district of Auray, the plank collectors succeed perfectly and are much used.

They are especially employed upon bottoms consisting of soft mud. They consist of rude deal platforms, placed one above the other, at a certain elevation, and separated by interspaces whose height is equal to the cross-pieces serving as supports. In order to retain the structure in place and prevent its being carried away by the waves, it is either surrounded by a line of stakes or the upper platform is loaded with stones. The objection to this style of collector is, that the oysters do not adhere to it very firmly, but are easily detached and swept off by the currents. This defect is remedied by a coating of lime like that given to the tiles, for a very different purpose, however. On hard bottoms the parkers of Morbihan prefer tiles arranged in hives, as at Arcahon. They also suspend the tiles from stakes by means of iron wire. The tiles are pierced by a single hole at each extremity, and through these holes an iron wire is passed so as to maintain the tiles in a nearly horizontal position. The ends of all the wires are then fastened to the top of the stake. By this means veritable quagmires can be utilized, which are otherwise unproductive and inaccessible to persons on foot. In Morbihan the collectors are not usually put in place until the beginning of July; but there, as elsewhere, it depends upon the temperature, and the prudent oyster culturist should, before proceeding, make certain that the mother oysters of the natural banks are about to spawn. The preservation of the spat is now the principal question in this region. Many claires are constructed for the reception of the young oysters, which are usually detached from the collectors at the age of nine months; but suitable grounds are not always within reach of the breeding-park, and amends are sometimes made for this by using boxes, whose four sides consist of wire netting.

USAGES AT THE PARKS OF VIVIER.

The collectors which have produced the best results on the shores of Vivier, near Cancale, are slabs of schist and birch screens. The slates, although favorably regarded in the beginning, have been discarded on account of their expense, and for the reason that they cause the oysters to assume a flattened shape, which reduces their market value. The screens are divided into sections, from 5 to 6 meters (16 to 20 feet) long, to facilitate their removal and cleansing; they are fastened to stakes, 5 centimeters (2 inches) in diameter and 66 centimeters (24 inches) high. Being arranged in the direction of the current, they form parallel lines, stretching the entire length of the park, and at a distance of 4 or 5 meters (13 to 16 feet) apart. Between these rows are placed horizontal cross-pieces of wood, raised 20 centimeters (8 inches) above the bottom, on which are fastened slabs of schist, 50 centimeters (20 inches) long by 25 (10 inches) wide, and 15 (6 inches) thick, supported one upon the other at their extremities. In some parks the stones are retained in a vertical position by means of stakes driven into the ground on both sides of them. The latter arrangement is more favorable for the collection

of the spat, but it is also more expensive. The parkers of Vivier place their apparatus during the months of May and June. They have not yet constructed claires in their breeding-parks, but several have obtained grants in the harbor of Roteneuf, a small well-sheltered bay, situated between Vivier and Saint-Malo, where they will doubtless meet with more favorable conditions for the formation of breeding-parks, the indispensable complement of all well-regulated oyster-cultural enterprises. Moreover, the revival of oyster culture in the subdistrict of Saint-Servan is of quite recent date; the establishment at Vivier and those at several other places are still few in number, and the methods employed have not been so much perfected as at Arcachon or Auray.

CONCLUSION.

The foregoing statements will give an idea of the new industry which has already taken firm root in some of our coast districts, and which will probably be established in other localities wherever there are men of enterprise and intelligence. Let us add that, according to the common estimates, the establishment of an oyster-park, such as we have described, with an extent of one hectare ($2\frac{1}{2}$ acres), requires an expenditure of from seven to eight thousand francs (\$1,400 to \$1,600) for the preparation of the ground, the purchase of the various implements and the first expenses of preparation, &c. As to the results obtained, they necessarily vary greatly, according to the more or less favorable character of the locality selected, the skill and care displayed by the oyster culturists, and the abundance of the spawn; with regard to the latter item there are considerable variations from year to year. The oyster culturist who happens to commence during an unfavorable season should not be discouraged at the ill success of his first efforts. The parks of the basin of Arcachon and those of Morbihan were severely tried at first, but the fruitful years which followed have made ample amends for the early losses; with a gain in experience the inequalities of the different years will doubtless be less sensibly felt in the future. Everything tends in this direction; the constant improvement in the means of transportation will facilitate the sale of the excess of production during certain years, while the multiplication of claires and breeding-parks will render it possible to store up richer harvests and preserve them for times of scarcity.

The part devolving upon the administration—Supervision.—It may also be relied upon that the marine authorities will not fail in the proper discharge of their duties, the importance of which is better realized now than ever. They will take special care to preserve the natural oyster-beds, the sources of present prosperity and the pledge of future development. Already, thanks to their incessant watchfulness, and to the reservation of important sections of the bays of Granville and Cancale, the restocking of these regions, formerly so prolific in oysters, is progressing favorably in the vicinity of Cancale, where, during a few low tides last season

(1874), the dredgers obtained oysters valued at 900,000 francs (\$180,000), which result will be exceeded in 1875. There is, moreover, a fact full of significance, which observation has most clearly demonstrated. It is as follows: If the bottoms which supply the parks produced oysters naturally, the latter return to the natural beds a portion of what they have received from them. An interchange of germs between them therefore ensues, which is a further guarantee of their common prosperity. The basin of Arcachon is an illustration of this. Since the increased development of oyster culture in that locality, the natural beds have become enriched to such an extent that, although they were only open to the public during a few hours at the close of the month of November, 1874, still they yielded a harvest of 40,360,000 oysters to the 8,500 persons engaged in taking them. An examination of these beds, made after the dredging had ceased, indicated that that enormous and unprecedented catch had not exhausted them. Very many of the oysters taken were purchased by the oyster culturists of the neighborhood, who placed them in their parks, so that they will still further contribute to the general fertility of the basin.

Dissemination of information and encouragement.—The second aim of the authorities is to disseminate information concerning oyster culture, and the methods of conducting it in districts where this industry is still hampered by the ignorance or prejudices of the people. Early in 1874 the minister of marine instructed the maritime authorities to examine such points within their districts as promised favorably for the procuring of spat by means of collecting apparatus. At Cancale, where the fishermen have little sympathy with the oyster culturists of Vivier, at Granville, Tréguier, Paimpol, and in the vicinity of Sables d'Olonne, in the bay of Bourgneuf, on the coasts of the island of Ré, and in other places, small breeding-parks were created in accordance with the orders of the ministry. These attempts are of such recent date that it is as yet impossible to form a correct idea of the probable results. The department of marine aids them with the appropriations at its disposal. These appropriations, when wisely managed, suffice for the essential services which they have to render, and it is by their aid that it is possible to continue, or resume, when necessary, the experiments started by the department twenty years ago; to maintain the oyster reservations upon which depend the future prosperity of certain localities; to form new reserves; to pay the expenses of the special supervision in the most important oyster districts; and, finally, to encourage labor favorable to the progress of oyster culture. It is for private interests to do the rest. The path is now marked out and a beginning has been made. We hope that the zeal of our oyster culturists will not diminish, and that this industry will become, through a continuous and rapid development, an abundant source of wealth to our country, where it originated.

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