

# XVI.—REPORT TO THE MINISTER OF THE MARINE RELATIVE TO OYSTER-CULTURE UPON THE SHORES OF THE BRITISH CHANNEL AND THE OCEAN.\*

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MONSIEUR THE MINISTER: You did me the honor to charge me with the mission of ascertaining the condition of oyster culture upon the coast of the English Channel and the ocean.

I return from this mission with the profound conviction that this new industry, so peculiarly French, has, after some unsuccessful attempts in the beginning, arising from the novelty of the enterprise, entered upon a stage of development and progress so well defined that we dare affirm nothing can arrest it.

The ever-increasing demands of consumption, stimulated by the promptness and facility of traffic and the more general diffusion of wealth, have engaged public attention for more than thirty years.

Agriculture was first to make the effort to supply these increasing necessities, but the ever-recurring demands for a sufficient food supply not permitting any of our natural resources to be neglected, the rivers and the seas have been placed under tribute and constrained to furnish their share. In a few years our coasts and our water-courses were exhausted. Then arose, as an economical question of the first rank, the necessity of re-peopling the waters and placing the fisheries (*domaine de la pêche*) under regular conditions of production.

Such was the origin and *raison d'être* of pisciculture and oyster-culture, two industries which have been created in our own time.

Previously, in 1872 and 1873, M. the Minister of Public Instruction had confided to me the double mission of studying fluvial pisciculture in France and abroad. I had occasion to recognize and to note with regret that while in many neighboring states the main rivers and their tributaries were being successfully restocked with fish, in France, where pisciculture originated and where it had its first scientific laboratory, and where the six hundred water-courses which furrow its surface afford a working field of not less than 600,000 hectares, it was not an object of regular or general pursuit. To-day we may, with some pride,

\* *Rapport au Ministre de la Marine relatif à l'ostréiculture sur le littoral de la Manche et de l'Océan, par M. Bouchon-Brandely, Secrétaire du Collège de France. Extrait du Journal Officiel des 22, 24, 25 et 26 janvier 1877. Paris, Librairie des publications législatives.*

A. Wittersheim et C<sup>o</sup>, Quai Voltaire, 31, 1877.—Translated by MARSHALL McDONALD.

point these people—our masters in the art of cultivating the waters—to the progress which oyster-culture has made upon our coast.

Undoubtedly the cultivation of the oyster was practiced long ago, and wherever this shell-fish holds a position more or less important as a food resource, its artificial rearing has engaged attention, but it has not become, as with us, a systematized industry.\*

It is fitting I should declare that the Department of the Marine has dowered France with the industry of oyster-culture. To it belongs the credit of the first attempts and of perseverance in the enterprise, as well as the honor of the results to which this report bears testimony.

The idea of establishing special devices to arrest and preserve the spawn which the oysters permit to escape into the water during the period of gestation is comparatively recent. It originated with a distinguished officer of your administration, who has given to it practical realization.

In 1851, when M. Coste visited the oyster establishments of Lake Fusaro and found in progress there some timid and irregular attempts at oyster-culture, M. de Bon, then Commissioner of the Marine and chief of the service at Saint-Servan, was engaged in the re-establishment of the oyster-beds at the mouth of the Rance and in the roadstead of Saint-Malo, by means of oysters brought from the natural beds in the Bay of Cancale. He carried on these attempts with great perseverance and his efforts were crowned with success. He demonstrated a fact of the greatest importance to the new science, and which up to that time had been doubted, viz, that the oyster was capable of reproducing itself in locations which were laid bare at low water (*terrains émergents*), and that it was possible to obtain a harvest of spawn from them. To confirm this discovery M. de Bon himself established a *parc* for experimental investigation, in which he conducted a series of experiments to ascertain the best means of securing the spawn. He devised apparatus for collecting it, and very soon he forwarded to the minister a spawn collector of his invention covered with young oysters. A detailed report accompanied it and afforded a demonstration that was unanswerable.†

The complete success of these experiments was announced by M. Coste in a report dated February 5, 1853, and inserted in the *Moniteur* of the 28th of June following.

It is proper here to give an account of the part borne by M. Coste, professor in the College of France, in the inauguration of the new industry.

In traversing the coast upon a mission of the Emperor, who had directed him to conduct a series of experiments in regard to marine pisciculture, this illustrious embryologist visited Saint-Servan in the month of August, 1857. There he found the cultivation of the oyster

\* Report of M. de Bon, Commissary-General of the Marine, on the condition of oyster culture in 1875.

† See the note inserted in the *Moniteur Universel* of October 8, 1859.

begun. He saw the decisive results obtained by M. de Bon as well in the restoration of the natural beds as in the securing of spawn. Here was the practical confirmation of his theories, and, moreover, the revelation of the means of carrying them into effect, which he was still seeking for. His lively imagination was filled with enthusiasm at the discovery of M. de Bon. To popularize it he brought to bear the prestige of his high position in the College of France, his distinguished reputation, his scientific knowledge, and the declared support of the head of the state.

Means of action were placed at the disposal of M. Coste, and considerable sums of money were devoted to attempts at restocking upon a vast scale. Private industry demanded to share in the movement and followed the impulse given by the Government.

We know what bitter disappointments attended these first attempts. They seemed to compromise forever the future of the oyster industry. But the administration of the marine was awake. The control of it passed into the hands of M. de Bon, who had taken to heart the success of the enterprise, and who never lost courage.

The strict observance of the decrees of 1852 in the conduct of the fisheries may be regarded as having contributed largely to the actual prosperity. These decrees, the wisdom and opportuneness of which the event has demonstrated, were intended to stop the spoliation and exhaustion of the oyster-beds and to subject their exploitation to strict and rational regulations.

These decrees M. de Bon had prepared the way for by his reports and his experimental researches.

The persevering application of these measures, the care unceasingly renewed, the encouragements and the example, which the administration of the marine continually gave, resulted in bringing about the restoration of the natural beds, which were approaching exhaustion, and in provoking a revival of oyster-culture by private individuals.

These, deriving instruction from their own observations and the experiments conducted by the state, have improved and almost perfected their methods. After a rapid revival, we now find this industry yielding remunerative returns to those engaged in it, and not without profit and honor to the whole country.\* But we must not forget that administrative guidance is as useful now to assure its success as the solicitude and the encouragement of the state have been necessary in the past to prepare the way and guide its first steps.

In the course of this report I will doubtless have occasion to state contradictory facts, for in practice divergences in the application of processes constantly arise. This is due to a variety of circumstances. Methods cannot be invariable; they must possess sufficient flexibility to adapt themselves to all natural conditions, and these conditions vary

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\* The number of persons who derive their support from the oyster industry may be estimated at 200,000 at least.

greatly with the region, the climate, the nature of the soil, the composition of the waters, the direction and strength of submarine currents, etc.

Doubtless some phases of this long practical study should be examined and studied separately, but in this report, the only object of which is to make known the condition of oyster-culture upon our coast, it is not necessary to disengage and discuss them. I will content myself, therefore, while making from time to time some observations, with stating my mission in the order I have accomplished it, and describing the industry in each locality just as I have seen it.

**COURSUELLES-SUR-MER.**—Situated in the vicinity of the natural oyster beds of the English Channel and the plantations of Dives, at the mouth of the river Seulle, from which it borrows its name, Courseulles is one of the points upon the coast of Normandy where the industry of oyster-culture is practiced with success and profit.

The oysters sent from this station have long enjoyed in the markets a well-deserved reputation. Nevertheless, Courseulles is not a place of production. The planters (*parqueurs*) who have established oyster ponds (*viviers*) there, possess, at Saint-Vaast-la-Hougue, bedding-grounds (*étalages*) devoted to the growth of the oyster, and the parcs at Courseulles are used only to fatten them and prepare them for market. The oysters handled there are generally obtained from the beds of La Manche where the fishermen collect them to sell to the dealers.

These oysters would not be held in such esteem by the consumer, if they were not previously subjected to a special training (*éducation*) which is the peculiar industry of the planters of Courseulles. This is designed to impart to them that delicacy of flavor for which they are famed, and the ability to bear transportation without losing their freshness.

The oyster parcs of Courseulles are excavated behind the sand hills, and have communication with the sea through the mouth of the Seulle.

Disposed in order along the banks of this water course, they communicate with each other by means of canals through which, twice in a fortnight, and for several consecutive days, the cool waters from the sea are borne in all directions.

Each parc is provided with a gate which serves either to retain the water or to empty the reservoir, when the tide runs down, and also gives passage to fresh water when it is necessary to fill the pond. In the last case the gate is not opened until the tide has risen above the level of the water in the reservoirs.

It is at this time that the waters are the purest; earlier they hold in suspension the mud stirred up from the bed of the river, and the earthy matters that the waves have washed from the banks.

The parcs excavated in an argillaceous soil, occupy an area of 15 or 16 hectares, a space which may be enlarged in the future. They are from 80 to 100 meters in length, 12 wide, and have a mean depth of 2 meters.

The sloping banks form with the bottom an angle of forty to forty-five degrees, and are covered by a layer of gravel two to four centimeters in thickness.

About the middle of August the oysters of Saint-Vaast-la-Hougue begin to arrive at Courseulles in quantities as needed by boats appropriated especially to this work.

Only those are brought which are of the prescribed size, since, from the lateness of the season, as well as the nature of the formation in which the ponds are excavated, it is not expected that they will increase much in size in their new home.

Before leaving La Hougue, and, again after arriving at Courseulles, they are washed, assorted, and carefully cleaned from the mud and the marine plants which are attached to them, and from all parasites which may mar the beauty and regularity of the shell or depreciate its value.

The process of training (*éducation*) is very simple. The subjects are left to recover from the fatigues of the voyage. Then those which are to be sent first to market are spread evenly on the shelving sides of the reservoir. With the aid of a rake, or even by hand, the rest are scattered over the clayey bottom and remain there for a time, when in their turn they are transferred to the sloping banks.

It is necessary to accustom the oyster to do without fresh water, and for as long a time as possible to hold the water retained in the shell. To accomplish this the oysters are left uncovered by the water morning and evening. The first few days the duration of the exposure is only half an hour or an hour, but the period is increased by degrees until, after some time, the oysters may remain exposed to the air the entire night.

By this time the oyster has really been taught to keep its valves closed, and may be transported long distances without opening or losing its freshness. As regards the fattening, this is not the object of any particular care. This condition occurs naturally at a certain period, and, moreover, the *parqueurs* attribute to the commingling of the fresh waters furnished by the Seulle with the salt water that peculiar disposition to fatten which characterizes the oysters of this locality.

During the summer and in the beginning of autumn the exposure out of water should cease a little before sunrise and be resumed in the evening after the temperature has fallen. At this period also the handling of the oysters should be repeated oftener to prevent them from becoming milky, which renders them unfit for consumption.

In winter, on the other hand, it is not so necessary to inure the oyster to this discipline of privation, and the continued handling is less indispensable. The temperature being lower, evaporation takes place less rapidly, and the mollusk does not feel the need of fresh water so often. But if the winter is severe and the period of frost threatens to last a long time, the oysters are sent back to La Hougue, where the *parcs* are less exposed to the frost.

Courseulles furnishes annually for consumption from 20 to 30 millions

of oysters. These are sold in conformity to a classification based upon their size; (1) *La grosse*, (2) *la marchande*, (3) *la belle*, (4) *la petite moyenne*, (5) *la perlot*. The price varies greatly and depends upon the success of the dredging.

**GRAND-CAMP.**—The station of Grand-Camp is not less favorable to the cultivation of the oyster than Courseulles, which is near by. But the rough sea and heavy surf renders impossible the establishment of parcs under ordinary conditions. It is necessary to overcome the difficulties presented, by engineering skill, a result successfully accomplished by MM. André (François) and Fébvre.

It will not be necessary to describe both of the establishments founded in 1874 by MM. Fébvre and André. Both were organized on the same principle. I will examine more particularly that of M. Fébvre, in the founding of which M. François André also co-operated. This establishment is situated upon sloping ground about one kilometer from Grand-Camp, upon the other side of the Downs. It covers an area of five hectares and is surrounded by high embankments which shelters it from winds and storms. It is divided into 32 parallel basins, which are for the most part 45 meters long, 15 wide, and  $1\frac{1}{2}$  in depth.

The sides are constructed of stone without mortar, and the basins are separated by roads for the convenience of the workmen. The service of each basin is completed by a wherry, which the employés manage with readiness. The water to supply the basins is admitted at the old Fort Samson, distant about 50 meters from the nearest parcs. It is stored in two reservoirs, and may be renewed at every flood tide. The water is conducted to the principal establishment through a subterranean caual, having a width and depth of about  $1\frac{1}{2}$  meters.

The distribution is regulated by means of strong gates, which at the same time serve to keep the reservoirs full when the tide runs down. A feed canal traversing the length of the establishment divides it into two parts, and provides for the supply of all the basins, each of which is furnished with sluice gates, by means of which the water may be either introduced or drawn off.

The parcs being established upon a gently sloping surface, and communicating directly with each other, a current through the interior may be produced whenever desired.

I should add that several small springs have their sources in the basins, and serve to temper the saltness of the sea water. The bottom of the parcs is a stiff clay.

Between Fort Samson and the establishment are erected the work rooms, where are conducted the different operations required in oyster culture, such as the singling (*detroquage*) of the dredged oysters, the sorting, packing, etc. In these operations fourteen women find occupation for almost the entire year.

What is the purpose of these 32 basins? What are the processes employed at Grand-Camp by MM. Fébvre and André in handling the spawn, and in the growth, fattening, and greening of the oyster?

The two semicircular reservoirs situated in Fort Samson, and which first receive the sea water, are devoted to the preservation of the spawn.

A part of one of these two compartments serves at the same time for some experiments undertaken by M. Fébvre in regard to the artificial fattening of the oyster according to methods employed by oyster-planters in America. These experiments have given no useful result.

The operations which precede the marketing of the oyster, viz, the washing and disgorging, are conducted in a basin lined with asphalt, in the principal establishment, which is reserved for this purpose.

Finally, in the other parcs the oysters are classed according to age and size. All the spawn treated at Grand-Camp is brought from Brittany. The young oysters begin to arrive in the month of April, and are at once placed upon metal trays 1 meter long and 50 centimeters wide; from 4,000 to 5,000 are placed on each. The use of these trays greatly abridges the time required to clean the spawn. To free it from the sea mud it is only necessary to take the tray by the two handles with which it is provided, and to agitate it gently in the water.

After a few months the growth of the oysters is such that it is necessary to double the number of trays. But the basins of Grand-Camp being too small to contain the number of oysters which M. Fébvre raises each year, a part of them are sent to Saint-Vaast-la-Hougue. The rest are inclosed in boxes having an area of two square meters, which are covered by wooden bars placed at intervals, so as to permit access of water.

These boxes are submerged in a parc situated near the shore, and in the vicinity of the establishment.

The oysters having attained a marketable size, they are, about the month of November, returned to the shore parcs (*parcs de terre*) and are either spread upon the bottom or upon the trays, in order to fatten them. The greening takes place at the approach of winter, at which time the basins are carpeted with a green moss, the appearance of which is the signal of the greening of the oysters, which takes place here as at Marennes.

The oysters sent from the parcs of MM. Fébvre and André rival in in quality and in form the very finest produced anywhere.

The shell, small, thin, translucent, and well rounded, recalls the oyster of Ostende, which they also rival in table qualities. What especially distinguishes the oysters of Grand-Camp is their resemblance in flavor to the oysters obtained from the natural bed of Guinehaut, which are held in such high repute. This bed is situated at the mouth of the river Isigny, and unfortunately produces very few.

To give some idea of the extent of the establishments at Grand-Camp, I would state that M. Fébvre is prepared at the present time to send to market three millions of oysters.

SAINT-VAAST-LA-HOUGUE.—From time immemorial the fishermen of Saint-Vaast-la-Hougue have coupled with their proper vocation that of

cultivating the oyster. But with the exception of some new oyster cultivators the most of the enrolled maritimes (*inscrits maritimes*) who farm (*exploitent*) the parcs granted by the state content themselves with keeping for a very short time the oysters obtained from foot-fishing (*la pêche à pied*) and from the dredging, to which, during the open season, the greater part of the population of this section devote themselves.

About the 1st of September the seafaring men betake themselves to the natural beds to fish for oysters. The foot-fishing is only productive at the time of the spring tides. It is pursued by women and children, who only obtain the oysters which have been torn from their natural beds by the violence of the waves.

The oyster grants of Saint-Vaast-la-Hougue, located on a miry-clay deposit, comprise both *dépôts* or bedding-grounds and parcs. The first, to the number of forty-eight, occupy an area of 46½ hectares, and extend over that part of the seashore called Couleige. These are reserved for the young oysters which have to grow before attaining merchantable dimensions. The second, which are appropriated to the preservation of eatable oysters, are situated in the Toquaise, and are, for the most part, sheltered from the sea by the little island of Tatihou. They number 137, and occupy an area of 39½ hectares.

The *dépôts* or bedding-grounds are only uncovered during the spring tides. They are inclosed by walls of loose stone from 15 to 25 centimeters in height.

The parcs are also inclosed with walls of loose stone from seventy-five centimeters to one meter in height, and have a thickness of from two to three meters.

Upon the approach of winter, after the small oysters from the bedding-grounds have been transferred to the parcs, in order to shelter them from the rigors of the cold season, a layer of clay mixed with straw is rammed into the interstices of the walls, which prevents the water from draining out of the parcs at low tides, and the volume of water which covers the oysters shelters them from the influence of the cold air and protects them from freezing. The expense of maintaining these walls is borne equally by the riparian proprietors. The bedding-grounds (*dépôts*) and the parcs are cleaned once or twice a year. This is necessary in order to remove the slime that the sea has deposited, and the marine vegetation which has invaded them.

The oysters which succeed best in cultivation come from the Bay of Cancale, or the natural bed of Dives; nevertheless experiments made with the oysters of Arcachon and Brittany have given good results.

The cultivators of La Hougue are of the opinion that the parcase of the oyster should not be prolonged beyond two years. The first year they grow 3 or 4 centimeters. During the second the rate is slower, but the oyster grows thicker and fattens. Indigenous oysters, or rather those obtained in a very circumscribed radius, may be kept a longer time.



The processes of cultivation employed at La Hougue consist chiefly in cleaning, and frequently shifting the oysters to prevent them from being buried in the mud, or covered by parasitic growths, which by attaching themselves to the valves prevent them from opening, and finally cause the oyster to perish by stifling it. These manipulations are repeated two or three times a month in the parcs, and oftener if made necessary by the quantity of sediment deposited by the sea, or by the abundance of the marine vegetation.

During the winter it is not so urgent to repeat the manipulations so often, for independent of the difficulty of such operations at this season, the marine confervæ, the presence of which in the parcs constitutes a serious danger, have disappeared.

The young oysters placed in the *dépôts*, to attain their growth, are not, during the six or seven months they remain there, the object of any treatment. The *dépôts* being situated at some depth in the sea, the water which covers them is purer, and the marine algæ are less abundant.

The only attention required is to wash them when they are transferred to their winter quarters, and when they are removed from them.

I should record here an observation made by some of the oyster planters of Saint-Vaast-la-Hougue. They observed that certain parts of their planting grounds became unsuitable for the purpose, and seemed to be exhausted. To remedy this condition of things they adopted the plan of allowing those portions to lie fallow (*de mettre en chômage*) for a year, to the end that these water fields might have time to improve and return to their first condition. I may add that they have had every reason to be satisfied with the results of this method.

Too many questions are involved in the consideration to permit us to study fully the many causes which contributed to bring about this exhaustion. The two principal ones seem to be the following:

1st. The allotment of too many individuals to one parc.

2d. The constant shifting of fetid mud derived from the decomposition of vegetable matters, which is borne by the water in all directions.

In the first case the oysters receive insufficient nourishment; insufficient, because if in a certain volume of water which can furnish sufficient food for only 1,000 oysters, we place 50,000, starvation and disease must be the result.

In the second case death is directly the result of poisoning; but I am free to declare that this condition of the parcs of La Hougue is much exaggerated; nor is there anything alarming about it.

On the contrary, I am happy to give the assurance that the importance of the oyster industry is constantly on the increase. Many abandoned parcs have been taken up again and are being cultivated with profit. It is sufficient to say that 300 persons find occupation each day in the concessions of Saint-Vaast-la-Hougue, and at each spring-tide this number is at least doubled.

GRANVILLE.—It is upon that part of the French coast washed by the

British Channel, and between Saint-Malo, Cancale, Granville, and Regnéville, that the most productive natural beds of oysters are found.

In the neighborhood of Granville alone we may count eleven natural beds of oysters ["Oyster rocks," Chesapeake Bay.—TRANS.], viz: Foraine, Hagnet, Trou à-Girou, Saint-Marc, Bout-de-Rive, Saint-Germain, Géfosse, Sénéquet, La Costaise, Le Ronquet, and Le Pirou.

It would be difficult to estimate the number of the inhabitants of this coast who live by the oyster fishery. It is quite large, but within the last few years has sensibly diminished, for the reason that the fishing is less productive than formerly.

With the view of competing with the English oystermen in the working of common waters, the proprietors of the beds of Granville and Cancale were authorized to depart from the rule which prohibited them from remaining in their boats after sunset. The result has been that, under the pretext of dredging concurrently with the English on common grounds, they have found it more profitable to plunder the reserved beds of the territorial sea, and have ruined them. Wise measures have been taken to prevent a recurrence of these depredations.

By means of strict supervision, and through the discretion allowed the maritime administration to prohibit fishing at any point for one or two years, if the necessity of it has been recognized by the commission whose duty it is to ascertain the condition of the oyster beds; and, lastly, by means of the state reservation, where fishing is absolutely prohibited, and from which the spawn is scattered in every direction, these oyster beds have been re-established.

In fact, this work of restoration could not have been accomplished in so short a time, allowing for the extraordinary fertility with which the oyster is endowed, did not the places which receive the spawn present the conditions indispensable for its development.

These conditions are not always found upon grounds which have been exhausted by unrestrained fishing. In such cases suitable conditions must be created or re-established before we can expect success. The industry of oyster-culture proper is carried on at Granville in 85 storage parcs (*parcs de dépôts*), which serve only to shelter the oysters fished from the neighboring beds until the time when the cultivators of Courseulles and La Hougue, who usually obtain them, come to take them away. They are all inclosed by a double wall of wicker-work, from 70 to 80 centimeters in height. The interval between the two walls is filled with clay, kneaded up with straw or simply with mud.

This arrangement has for its object to prevent the oysters stored in the parcs from being displaced and dispersed by the impulse of the waves, and at the same time retain the water at low tide, and thus protect the oysters from the injurious effects of heat or cold.

I should add that the sea is so often rough at Granville that although there are in the immediate neighborhood inexhaustible centers of repro-

duction, it would be extremely difficult to fix collecting apparatus along the shore.

REGNÉVILLE.—Although but a short distance from Granville, the station of Regnéville is very favorable to the cultivation of the oyster.

Near the apex of the angle formed by the Norman coast and the coast of Brittany opens an immense harbor, which, commencing at Point Agou, extends along the shore upon which Regnéville is built. The swell of the ocean fills it at each tide.

The Sienne, a small stream of fresh water, having its sources in La Baleine, empties into this bay and mingles its waters with those of the sea, tempering their saltness and giving them those precious characteristics so sought for by cultivators, and which I have already referred to in speaking of Courseulles.

Just below the mouth of the Sienne is situated the oyster-cultural establishment founded by Madame Sarah Felix, of which I shall give a brief description. I will barely refer to the ancient parcs now disused, since the fishermen carry elsewhere the fruits of their fishing, and the bedding grounds (*dépôts*), more ancient still, which were called "The parcs of the river Passevin", and which are now abandoned. These bedding grounds were arranged in the same manner as those at Courseulles, and served only to furnish an asylum for a longer or shorter time to the oysters collected by the fishermen of the country, which passed into the possession of the proprietors of those planting grounds. They were fed through a subterranean canal communicating with the sea, and admitting the water only during the spring tides.

Before Madame Sarah Felix established herself there, no serious attempt at cultivation had been undertaken at Regnéville.

The parcs of Madame Sarah Felix are excavated in a calcareous formation, and occupy an area of 5 hectares. A secure dike, 6 meters in height, constructed of the earth removed from the basins, intermingled with large stones, protects them from the assaults and the violence of the sea. The side facing the water is revetted with large bowlders, against which the waves spend themselves, and which can be neither undermined nor displaced.

The water is introduced by means of an open canal, which starts from the level of low water. Upon reaching the establishment, the water is received and distributed through a large gate, moved by geared wheels. The bottom of the opening is several feet below the level of high water during the neap tides. It was indispensable to adopt this arrangement in order that only perfectly pure waters might be permitted to enter the reservoirs after the tide had attained its greatest height. There is around the whole extent of this harbor a vast amount of calcareous sand, which is lifted by the rising tide and swept along by the currents.

A principal supply canal traverses the establishment and distributes the fresh waters into 24 basins. The depth of these basins is about  $3\frac{1}{2}$  meters, and the depth of water in them about  $2\frac{1}{2}$  meters. Each division

communicates with the canal through a small sluice gate, which serves to admit the water and to retain it when required.

Quite a large spring rising within the limits of the property gives the means of tempering the saltness of the sea water.

What results have been obtained in these parcs of Regnéville?

After a number of preliminary experiments had demonstrated the possibility of carrying on successfully the growing and fattening of the oyster in the parcs that had been organized, Madame Sarah Felix undertook, in 1865, some experiments upon the reproduction of oysters in confinement.

Adult specimens, taken from the bed of La Costaise, which furnishes the finest and most esteemed products of this section, were placed in a compartment, in which was arranged collecting apparatus made of boards and also of tiles. At the usual time the oysters emitted their spawn, which attached itself to the collectors. The result was not completely successful. It was learned during the progress of the experiment that the basin lacked sufficient depth, and that the waters were not sufficiently renewed. The experiment was, however, very encouraging.

A large number of the young oysters, which they were successful in preserving and which remained attached to the collectors, exhibited a rapid and marvelous development.

Shortly afterwards, new experiments were made with one hundred thousand oysters. Oyster-culture was then in its inception, and they had not yet learned how to coat the collecting apparatus in order to facilitate the removal of the oysters which became attached to them. In order to remedy the difficulties which had been experienced, the tiles were covered with paper which had been coated with a thin layer of cement. By this device the removal of the oysters was readily accomplished. Moreover, by suitable arrangements, a regular and ample supply of water was secured in the basins.

Success was complete. The collectors became loaded with young oysters; their removal was easy, and the subsequent development of this new generation, born in the parcs of Regnéville, was accomplished under the most advantageous conditions.

For some time afterwards, the parcs, the maintenance of which involved costly labors and continued repairs, were on the point of being abandoned. In 1873, Mr. Vallé placed in them, to grow and fatten, 83,000 young oysters, originally brought from Vivier-sur-Mer, and having a mean diameter of from 2 to 3 centimeters. A year later, 65,000 of these were sold, having then attained a diameter of 7 to 8 centimeters. Since this period, Madame Sarah Felix has made some improvements which she has decided upon, so that fresh water can be introduced into the establishment at all stages of the tide. This was not practicable before the level of the gate had been lowered and the basins excavated to a greater depth.

There is every reason to think that, with these well-planned improve-

ments, this fine establishment, the first of its kind, will respond to the legitimate expectations that the first successes had awakened.

I will conclude by repeating the opinion which I expressed in the beginning, viz, that the station of Regnéville presents all the requisite conditions necessary to make it an important center for oyster-culture, not only from its situation, but because it unites all the natural elements for the successful prosecution of this industry.

The extent of surface which may be put to use is very great, and the cultivation of it would prove easy and lucrative.

CANCALE.—Among the products of oyster-culture most highly esteemed, the oysters of Cancale occupy the first rank. They are distinguished as well by their fine flavor as by the good shape and depth of their shells. The animal is thick without being too large. It keeps fresh for several days out of the water, and holds for a long time the sea water which the valves inclose. These qualities are due to its origin and to the variety of the oyster as much as to the methods of cultivation.

The processes of education pursued at Cancale are very nearly the same as those employed by the cultivators of La Hougue.

The oyster beds of the Bay of Mont-Saint-Michel, whence these delicate oysters are obtained, are the most productive of beds of the British channel. They comprise the beds of Corbière-ô-les Chaudières, Le Bas de l'Eau, Le Vivier-ô-le-Mont, L'Orme-ô-le-Moulin, called La Raie, Saint-Georges, Le Beauveau-ô-le-Mont, and finally the reservation made by the state, and which serves to separate the beds of Granville from those of Cancale.

Cancale is not only a place of deposit. All the processes of cultivation are carried on there, from the period when the oysters are gathered by the fishermen from the beds in the open sea, or gleaned upon the strand, to the time when, their education completed, they have acquired those qualities which make them sought for for the table.\*

The concessions granted cover an area of 172 hectares. This is divided into 1,276 parcs and bedding grounds (*étalages*). The latter are situated low in the sea, and each season their walls of wicker work are covered with spawn. In these are placed the small oysters the dimensions of which do not permit their being sent to market. The oysters which have attained marketable size are placed in the parcs and remain there until they have completed their preparation for market.

All the concessions are fenced in by a double row of palisading, which shelters them from the destructive effects of the strong currents.

Throughout the whole bay of Mont-Saint-Michel there are two ever-

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\* By the terms of the regulations concerning oyster fishing, individuals taken upon the natural banks, and which have not attained the required dimensions of 5 centimeters, must be thrown back into the sea. When the fishing is over, the oysters are sorted, the smallest being placed in the parcs. It is the same with the oysters picked up on the beach by the foot-fishermen (*pêcheurs à pied*).

imminent elements of destruction, against which the cultivators must continually struggle: the winds and the mud.

The winds from the ocean—the violence of which is such that often the oysters are shifted from one parc to another or scattered in the tide-ways—blow usually during the winter, and necessitate the exercise of incessant daily care to maintain the planting grounds in good condition, the incursions of mud and sand being increased by the roughness of the sea. At each tide, when possible, the cultivators must visit their parc and proceed to the cleaning, the necessity for which is constantly renewed.

Four thousand persons are employed each day at this work. The oysters never remain more than two or three years at Cancale. This period of time is sufficient to give them the development necessary before sending them to market.

Moreover, it is not to the interest of the cultivators to keep them for a longer time.

Besides the oyster merchants, properly so called, who profit by the provisions of article 338 of the decree of July 4, 1853, in order to obtain grants, many of the enrolled maritimes, in consideration of the abatement of rent by the provincial administration, pursue the oyster industry upon their own account. The poorest content themselves with keeping for one season the oysters they have gathered from the beds, or which their families have collected along the shore. Before the administration of the marine had put in force those protective measures which are the safeguard of our oyster beds, the foot-fishing (*pêche-à-pied*) was becoming each year more unproductive. To-day it is prosecuted by companies of from 500 to 1,000 persons, women as well as children, who find in it an assured means of subsistence.

It remains for me to say a word in reference to the attempts made under the auspices of the administration to collect, in spite of the violence of the sea, the spawn which is each season thrown out from the oyster beds.

The parc which the administration has devoted to these experiments is 40 meters square. The side which faces the open sea and the opposite side are completely open, in order to give free access to the waters freighted with spawn. The other two sides are protected by palisades.

Tiles arranged in bunches, fascines of birchwood, and slabs of schist are all employed as collectors. The spawn arrested in great abundance, but by the time winter comes the violence of the sea has succeeded in displacing the larger part of the generation which had established itself.

The end sought by the administration, viz, to demonstrate that the spawn is just as abundant at Cancale as at Le Vivier, has been attained. The rest will be accomplished by private enterprise.

It is hardly necessary to state that the measures of surveillance instituted by the department of the marine for the preservation of our oyster beds have also served to shelter the parcs from the cupidity of maraud-

ers. In addition to the usual police supervision exercised by the agents of the administration, seven guards, paid out of the funds derived from the rents of concessions, two general guards, who receive an allowance from the funds of the society of fishermen, and four sworn guards, appointed and paid by the marine, are charged with this service.

Moreover, a syndicate, composed of the commissioner of maritime inscription, as president, the mayor of Cancale, the inspector of fisheries, the syndic of seafaring men, the cashier of the society of fishermen, and two of the parc guards (*un garde-parc et un garde d'étalage*), determine each year the assessments to be paid by those holding concessions, and the amount thus obtained is appropriated to the common expenses, such as the wages of the guards, the repair of roads, channels, etc.

In conclusion, I have had the satisfaction of learning that almost all the grants are now being worked. Ten years ago more than half of the parcs were abandoned.

LE VIVIER-SUR-MER.—The parcs of Le Vivier-sur-Mer were founded only seven years ago, under conditions analogous to those existing at Cancale. Before this, fishing was almost the only water industry familiar to the inhabitants.

The beach of Le Vivier greatly resembles that of Cancale. There is the same miry soil, only a little more calcareous, the same rough sea, and the same difficulties to overcome in order to protect from the violence of the waves. But the methods pursued are different, Le Vivier-sur-mer being more particularly engaged in the propagating of the oyster.

Development upon the collecting apparatus succeeds there, however, and it would seem that this shore is even more favorable for the rapid development of the mollusk than that of Cancale.

Before giving the details of the methods of cultivation of the oyster, I will recall briefly the circumstances under which oyster culture originated in this locality.

The experiments upon reproduction made at different points upon the coast attracted the attention of certain persons, who attempted to capture the swarms of embryos (*flot de semence*) which the oysters emit in the spring, and which up to that time were wasted in consequence of being smothered upon the muddy bottoms.

The first collecting apparatus placed upon the strand of Le Vivier belonged to M. Barbet. It consisted of slabs of schist and of hedges of wicker-work, running in the direction of the currents. This first attempt was quite successful. The year following, M. Meury de Villers, having obtained from the Minister of the Marine, who gave every encouragement to the experiments, the grant of one hectare of land, constructed parcs, and placed in them logs, resting upon which, in an inclined position, were slabs of schist of a size large enough to resist the force of the currents. Hedges of closely woven basket-work, from 3 to 4 meters in length and 60 centimeters in height, completed the arrangements. This year spawn was abundant, but when the cold and the

frosts came, the sea, urged by the impetuous winds of winter, bore off part of the harvest. The disaster was augmented by the frosts.

Only the oysters attached to the under side of the slabs of schist were spared. They produced specimens remarkable for their form, their quality, and their development.

Many other persons saw in this first essay reason for hope rather than discouragement. The sea, though often disturbed, was not always turbulent, and the frosts rarely occurred at the same time as the spring tides, the only ones by which the parcs of Le Vivier were exposed. New grants being asked for and obtained, the shores of Le Vivier were rapidly covered with parcs.

The winter of 1870-'71, of such unhappy memory, was even worse, and almost put an end to the infant industry. The collectors retained so little spawn that many of the cultivators abandoned the work. But succeeding years brought fruitful compensation, and this oyster-cultural station, born but yesterday, has to-day a promising future as a place of reproduction.

The *parquage* of oysters is very difficult, if not impossible, at Le Vivier, and they are left upon the collecting apparatus to grow until they are ready to be sent to market.

The only collectors used are bundles of twigs and slabs of schist. Madame Sarah Felix, however, has found it profitable to replace the old system by a new apparatus, consisting of sheets of roofing slate, which usually are kept immersed from the middle of June to the middle of July. The fascines require to be often renewed, for they are rapidly destroyed by the sea. Moreover, the barnacles, which are very abundant in these parts, cover them in the spring and render them unsuitable for the spawn to settle upon. These parasites are not the only enemies to be combated. The mussels, much more to be dreaded, are scattered over the parcs of Le Vivier in such abundance as to form a layer from 15 to 25 centimeters in thickness. They have here neither the time to bury them, as is done in the island of Oléron, nor to collect them, though they are edible. The reason is that the parcs of Le Vivier are situated at some depth in the sea, and being uncovered only during the spring tides, the period of low water is employed in detaching the oysters upon the collectors, in gathering those lying loose upon the bottom, and in removing and repairing the palisading. It is difficult, in the short interval when work is possible, to collect laborers enough to meet the most urgent demands.

The number of oysters contained in these parcs is estimated at 5,000,000. The number is certainly small; but we should not forget the consequences of the winter of 1870-'71, and the discouragement which was the result of it, and we should remember that ten years ago Le Vivier-sur-Mer was absolutely unknown as an oyster-cultural station.

As regards the growth of the oyster, it is truly wonderful, and in the



course of my investigation I have seen only one station, Les Sales d'Olonne, which can be compared with it in this respect.

I have myself detached from a fascine an oyster fifteen or sixteen months old which did not measure less than 7.08 centimeters.

It remains to describe briefly the happy transformation effected by M. de le Gervinain. He made use of a mill-pond, fed at each tide by sea water. Into this he introduced oysters to attain their growth. The pond also received the waters from a small brook of fresh water. The development of the shell and the corresponding growth of the animal were without precedent, and they were attributed not only to the introduction of the fresh waters, the influence of which was of course favorable, but also to the abundant nutritive elements brought down by the brook.

FOSSE-MORT, NEAR SAINT-MALO.—In 1878, M. Camac obtained from the Minister of the Marine a grant of three hectares, situated upon the river Rance, near Ménéhic.

The Rance formerly contained several oyster-beds, and recently, as I have stated already, M. de Bon has succeeded in re-establishing them.

In the beginning M. Camac succeeded badly, but the more difficulties multiplied, the more resolutely M. Camac, who is an American, exerted himself to overcome them.

The upper part of the concession rises like an amphitheatre, and is 150 or 200 meters from the bed of the river. The sea covers it at every tide, except during the neap tides. Here were excavated claires, 40 meters long, 10 meters wide, and 60 centimeters in depth, which served for the first experiments. The oysters and the spawn employed were brought from Auray. Upon arriving, the young oysters still attached to the collectors were detached and placed in frames made of galvanized-iron wire, which were placed in the claires. They made no progress during the whole summer, and the cold of winter destroyed the most of them, while oysters eighteen months old, inclosed in similar frames and lowered into the sea, developed to very good proportions. In October the frames containing these oysters were transferred to the upper ponds, which are, as I have already stated, covered and laid bare by almost every tide. There they quickly fattened and became green, but when winter set in disease invaded them. It was no better in the succeeding summer, and of the 15,000 started with, hardly 3,000 survived. This succession of reverses was fruitful of suggestions, which did not escape the attention of M. Camac. He at once concluded that the more elevated part of the concession did not afford the conditions necessary for the growth of the mollusk.

After attempting, without any better results, to change the form of his boxes, he decided, the following year, to transfer all of his oysters to the borders of the river, at a point which is uncovered only during the spring tides, and where the water is 30 meters deep (*à 30 metres de profondeur*) during high water. At the succeeding spring tides he found

that the oysters had made sensible improvement, and in October had acquired dimensions he was far from expecting.

In the year just passed 3,000,000 of fry have been brought from Auray to Fosse-Mort. They were placed in the claires without being removed from the tiles, and remained there until April of this year, when they were detached. Then the young oysters were placed in 350 nursing-trays (*caisses ostréophiles*) established in the lower part of the concession. Each month the trays are overhauled and thoroughly cleaned from the sediment which has settled over the interior, and from the marine vegetation which, by attaching itself to the wire gratings, impedes or prevents the free circulation of water. By the last of August of the current year the shells had attained a diameter of from 2 to 2½ centimeters. In spite of the losses incurred in previous years, M. Camac expects to market this season from 270,000 to 300,000 oysters having a diameter of from 7 to 9 centimeters.

Fosse-Mort belongs, both by its methods and its climatology, to the Normandy group of oyster-cultural stations.

Were I to attempt in a few words, before passing to the coast of Brittany, to convey the impression made upon me by the establishments already passed in review, I should say that each seems to supplement the others.

Each corresponds to one of the phases in the cultivation of the oyster. Le Vivier produces spawn, Grand-Camp busies itself especially with the early growth of the oyster, the maturing and fattening engages La Hougue and Cancale, and Courseulles trains them to bear transportation.

BREST.—The maritime province of Brest contains the largest number of natural oyster beds. But here, as elsewhere, these beds were at one time wellnigh exhausted by the improvidence and cupidity of the fishermen.

In the roadstead of Brest alone, where there were formerly twenty-seven oyster beds, there are to-day only seventeen, as I learn from official documents obligingly communicated to me by Commissary-General Dauriac, and of these there are but six in which are found any evidences of reproduction. This condition of impoverishment, well advanced in 1857, attracted the attention of M. Coste, who, with the view of remedying it, caused a large number of fascines to be immersed in the bay. The sea swept them all away, and the attempts were abandoned.

Is it right to say that the fishermen were the sole authors of this ruin? Doubtless they were chiefly concerned in it. But natural conditions concurred to render it complete. At one period the boring whelks (*Bigorneaux perceurs*), MUREX, which are so destructive to the oyster, invaded most of the oyster-beds of Brittany, and did incalculable damage; some of them were utterly destroyed.

In the roadstead of Brest another cause has co-operated with those already mentioned. In some years the bottom is covered with a red

sea-weed, the presence of which exerts an injurious influence upon reproduction.

However, every disaster has its compensations. The same conditions which covered the bottom with sea-weeds established beds of broken coral in the vicinity of the old beds. Subsequently young oysters were found attached to the branching stems of coral brought up from the bottom.

This fact is full of promise, either for the restoration of the old beds or the establishment of new ones. We should not forget that the supervision of the oyster beds is very difficult in this little sea. The roadstead of Brest has not less than forty miles of coast line. This is broken by numerous creeks, in which the marauders, signaled by their confederates who are on the watch, find refuge from the pursuit of the fishery guard. Being provided with boats of very light draft, and possessing a perfect knowledge of all the creeks and coves, they quickly take refuge where the government vessels cannot follow them.

The administration of the marine has exerted all its influence to persuade them that to fish without restraint is to destroy the harvest that the future would yield, but the facilities offered by the railroads for the quick sale of the fruits of these marauding expeditions have caused these wise counsels to be disregarded. The measures of coercion employed to repress their rapacity have likewise proved ineffectual. Such was the condition of things a few years ago; at present it is a little better. Moreover, the number of marauders is not so large, for they do not now find in the pursuit of their unlawful industry the means of subsistence.

As regards oyster-culture, the roadstead would seem to lend itself in a marvelous way to the operations for which this industry gives occasion. Yet the sea is very rough during the stormy season, and swift currents traverse it in every direction. We recall, too, the unfortunate experiments made by M. Coste in 1857. Since that time no one has sought to bring into cultivation this splendid expanse of water which apparently is so tranquil.

In 1874, M. Thomas, an engineer, a man of strong convictions, and imbued with novel ideas in regard to collecting the spawn in deep water, and in regard to the development, growth, and *parquage* of the oyster, obtained from the Minister of the Marine the grant called Le Moulin-Blanc. This part of the bay receives a small stream of fresh water, which may be utilized with advantage. M. Thomas established parcs and stocked them with oysters. The experiments undertaken were based upon views peculiar to him. They are still too recent for us to form an estimate of their result. Up to the present time the experimenter has worked at it rather as a scientific question than a business enterprise. He has studied the roadstead of Brest, its waters, their usual temperature, the winds that ordinarily blow, and the direction of the currents; every influence, favorable or otherwise, which may affect

results. He carefully records the observations of each day, and I entertain the hope that such painstaking endeavor will not be lost, either to the conscientious experimenter or to oyster-culture.

**BÉLON, NEAR QUIMPER.**—The establishment created by M. de Mauduit and M. de Solminihac in the river Bélon is one of the most interesting I have visited during the progress of my mission. The grant embraces about 5 hectares. It extends along the right bank, and borrows from the other shore an extensive estuary, shaped like a horse-shoe.

I have rarely seen oysters artificially grown, or even taken from the natural beds, of so beautiful a shape or of so exquisite a flavor. The shell is fine grained, thin, translucent, hard, and the interior surface is pearly, whilst the exterior exhibits sharply defined but delicate dentations, which are the characteristic indications of the vigorous growth and perfect health of the animal inclosed.

Many things concur to assure to the establishment a high price for its products. These are the exceptional situation of the establishment, the favorable nature of the ground, the influence of the currents, the composition of the water, and the continual intelligent care bestowed upon the oysters under treatment.

Situated at 4 kilometers from the common mouth of the rivers Pont-Aven and Bélon, the parcs of M. de Mauduit and M. de Solminihac are constantly bathed by the living waters of the ocean, which are aerated by dashing against the cliffs which guard the shores of this wild and picturesque coast. Their situation offers the same advantageous conditions as the bottom of the open sea, where are the natural beds of oysters, and they are moreover sheltered from the violence of the tempests.

The bed of the river is composed almost entirely of shell sand, very rich in lime. The ebb and flow of the ocean keeps the water in incessant motion and establishes perpetual currents. The grant is divided into:

1st.—Parcs furnished with frames containing the fry, and which are only uncovered at the spring tides. These are for the most part situated in the deeper parts of the river.

2d. Parcs in which are placed the merchantable oysters either to grow more, or to fill out and to fatten. The bottom of these is every year covered with a layer of shell sand, containing about 80 per cent. of calcareous material.

3d. Submersible basins receiving water at every tide. These are designed to shelter the frames during the winter, and also serve as *dépôts* for the oysters being prepared for shipment. These basins communicate with each other and can be readily emptied and cleaned at low water.

4th. A large reservoir constructed in a bend of the river and not subject to overflow, in which are contained other frames or pits walled with

cement, which are suitable for the storing and the cultivation of the oyster.

The spat (*naissain*) is brought from Auray from the breeding ponds (*parcs de reproduction*) which MM. Mauduit and Solminihac have established at Fort Espagnol. Upon its arrival it is emptied into the nursing frames, which are supported at a distance of 25 or 30 centimeters from the bottom, upon stakes driven into the mud, or upon wooden frames maintained in position by stakes. The young oysters remain in the frames in the open sea from the month of April to the month of October, when they are transferred to the reserve basins to pass the winter.

The following spring they are evenly spread over the bottoms of the ponds appropriated to their fattening. The average growth of the oyster each year is from three to four centimeters; with the larger oyster it is not quite so much, but it never amounts to less than from  $2\frac{1}{2}$  to  $3\frac{1}{2}$  centimeters. The rate of growth also varies with the source from which they are obtained and with the ponds in which they are placed. The oysters which increase in size most rapidly are those brought from Quimper. Of the oysters obtained by dredging at Auray many become sulky and refuse to grow the first season, but during the following season they make up for lost time.

The oysters in frames are left undisturbed during the fine weather. In handling them often there is danger of injuring the new growth which forms during this period. Then, before consigning them to their winter quarters, they are passed through riddles in order to classify them according to their dimensions. The spawn and the small oysters obtained in dredging are subjected to this sorting, consequently all those in a frame have the same dimensions.

The oysters nearly ready for market are placed flatwise on the bottom and often displaced and cleaned. The workmen charged with this duty, at the same time fill up with sand the excavations produced by the washing of the water or made by the crabs, so that the shells rest upon a perfectly smooth, even bottom.

MM. Mauduit and Solminihac have made in their *parcs* some interesting observations which should find a place in this report. Where the object to be attained is the fattening of the oyster, they have observed that they do better the oftener they are handled. They have also noticed that the oysters in frames increase more especially in length and breadth, while on the other hand with those bedded in the ponds the increase is mainly in the thickness. Lastly they have demonstrated that the growth is more vigorous and sensible in proportion as the oysters are brought nearer to the channels where there are continual currents.

Attempts at propagation made in the upper parts of the concession and in the vicinity of some *parcs* filled with oysters have not been unfruitful. This season they could count upon each tile from 70 to 80 fry. MM. Mauduit and Solminihac began operations at Bélon only

five or six years ago, and in spite of the hesitation and the disappointments inseparable from first attempts they are prepared to market 2,500,000 of perfectly beautiful oysters and still retain 6,500,000 in their parcs. In fine, they have endowed their country with a model oyster-cultural establishment, and overthrown many prejudices by utilizing localities which a few years ago would have been considered unsuitable for the culture of the oyster.

LORIENT.—The natural indications at Lorient show that the oyster industry will prosper there.

The Blavet, or river of Hennebont, which empties into the roadstead, not long ago contained oyster beds the products of which were much sought after. It was evident therefore that the mollusk ought to find in this bay a medium suitable for it.

It is at Kermélo, upon the river Ter, at a point a little below Lorient, that the MM. Charles and M. Turlure have founded their establishments.

After having made unprofitable attempts to collect the spawn emitted by the oyster beds of the river Hennebont, the MM. Charles changed the character of their operations and directed their attention to the growing and fattening of the oyster.

The Ter is a river with muddy bottom. Of its moderate width there remains but a narrow channel at the low water of the spring tides. The available locations are therefore very limited. A storage pond situated a little above allows fresh waters to escape into the river as needed.

There were moreover formidable difficulties to overcome in order to render profitable this portion of the maritime domain. Before attempting to establish oyster plantations upon the soft, yielding mud, it was necessary to consolidate it. The MM. Charles succeeded in effecting the consolidation of the bottom by spreading over it a layer of sand and gravel.

M. Turlure has attained the same result by other means. Thinking that the labor necessary for consolidation would involve, in his concession, too much expense, he had recourse to a system of pits lined with cement, invented by M. Michel, engineer, by means of which he is able to utilize all that part of his concession laid bare at low tide.

These pits are 50 centimeters long, from 34 to 40 centimeters wide, and are arranged in rows, between which are intervals to permit the circulation of the workmen. The advantages secured by this arrangement are, that the oysters contained in the pits are protected from excessive heat by being always covered by a stratum of water from 10 to 12 centimeters deep, even when the surface is left bare at low tide.

The oyster-cultural society, of which M. Turlure is the superintendent, has sixty thousand of these pits. The number these receptacles can accommodate varies with the size of the oysters. Of the fry and oysters less than one year old they will contain 300. Of those in their second year, 150; and of those in their third year, 75.

The parcs of the maritime domain are not the only ones included in the establishment directed by M. Turlure. In rear of the workrooms and store-houses are two large basins lined with asphalt. These are 80 meters long and 21 wide, and are used for the reception of oysters and to prepare them for shipment. They are subdivided into seven compartments, in which the oysters are placed according to their size and their origin. These basins are connected with the river by a canal, and the water in them can be renewed at pleasure.

For some years this establishment has been of real importance. According to the statement of M. Turlure, there are in the parcs and in the river 10,000,000 of oysters.

The establishment of the MM. Charles, which I have previously described, is completed by other ponds excavated in the dune which separates the private properties from the public maritime domain. A supply canal leads from the sea to the ponds and carries the water necessary for the establishment, the distribution of which is regulated by a sluice-gate at the extremity of the canal. The water may be renewed nine or ten days out of every fifteen.

The basins are not all devoted to the same purpose. One is appropriated to oysters, which are being subjected to the disgorgement which is usual previous to shipment. The others contain the frames and trays with open wire bottoms in which are placed the fry, or more frequently the oysters which are nearly ready for the table. These same areas of water serve during the winter to shelter the spawn bred in the river, and which it is necessary to protect from the cold.

The reservoirs communicate with each other, but, although supplied with the same water, they give very different results.

In one of them, that most remote from the mouth of the canal, the bottom of which is composed of mud and clay, the oysters readily increase in dimensions from  $4\frac{1}{2}$  to 5 centimeters in a season.

The neighboring parc, which is separated from the first only by a narrow tongue of land, can scarcely nourish the individuals confided to it. These anomalies are to be explained by the greater or less amount of food afforded directly by the soil, and by the percolations of fresh water, which are quite abundant in the parc in which the development of the mollusk is so pronounced.

During 1875 the MM. Charles sold 5,500,000 oysters, of which 2,500,000 were ready for the table.

The spawn raised here is brought from Auray, and I will add that it produces, in the plantations of Lorient, individuals distinguished alike for the delicacy of their flavor and the fineness and lightness of their shells. I have seen many of them that were in no respect inferior to oysters of Ostende.

AURAY AND LA TRINITÉ.—Auray and La Trinité are, with Archacon, the most important oyster centers of our coast. They are more particularly engaged in propagation.

The oyster deposits of the river Auray are fully three leagues in length. They extend from the mill of Poulben and the chapel of Saint-Avoye to the canal leading into the salt marshes of Coat-Courzo, and form an unbroken series of beds covering an area of more than three hundred hectares.

In the river of La Trinité, near by, which is also called the Crach River, are also found numerous beds of oysters, but the accumulations here are not so extensive.

The beginnings of oyster-culture in this part of the Morbihan date back a dozen years. The development which has taken place in this time is not to be attributed to private enterprise alone. The part played by the administration has been considerable. The legislative restrictions enacted encountered at first much opposition among the fishermen, for their principal object was naturally the preservation of the beds which were being pillaged without restraint and without discretion.

What would have become of the oyster industry at Auray and La Trinité if these beds, which to-day make the fortune of the parqueurs, had disappeared?

As has been so judiciously stated by M. Platel, who has published a most complete and accurate account of oyster-culture in the Morbihan, from which I have derived most valuable suggestions, we cannot too often recall how necessary was the perseverance and the solicitude of the maritime administration of Lorient, Vannes, and Auray, in order to preserve the foundations of this wealth scattered in the rivers of the Morbihan.

My report upon Auray would certainly be incomplete if it did not bear testimony to the zeal of M. Coste, the Commissioner of Maritime Inscription, whose praise is in every mouth. This distinguished functionary, prompted by the spirit of his official instructions, has everywhere lavished encouragement and advice.

It would be impracticable for me in this brief narrative to review all the establishments of the River Auray. I will take as a model the establishment of M. de Thévenard, one of the most complete and the best organized as regards reproduction, and which I have perhaps studied more carefully than the others.

**ESTABLISHMENT OF M. DE THÉVENARD.**—The site of the establishment of M. de Thévenard, the mayor of Auray, is at a place called Le Rocher. The concession comprises parcs for reproduction and claires for the growing and sheltering of the oyster. The parcs are established, some upon bottoms where the mud is three or four meters in depth, and the others upon firmer soil.

Buildings erected upon the banks of the river serve as workrooms where the processes of separating and assorting the oysters and coating the tiles with whitewash is carried on, and also as storehouses for the nursing frames.



In front of the buildings, and at a distance of a few meters from the shore at low water, water-tight pits have been excavated in which are placed during winter the fry bred the previous season, to protect them from the cold.

The collectors made use of by M. de Thévenard vary with the nature of the soil. Upon miry bottoms they are formed of a bunch of ten tiles superimposed two and two, successive rows alternating in direction, and are suspended to a stake two meters high.

A plank nailed to the stake about 30 centimeters below the tiles prevents the apparatus from sinking into the mud. This very ingenious system, which permits the collectors to be established upon the miry bottoms of all the rivers of the Morbihan, was invented by M. Eugene Leroux. M. de Thévenard perfected it, by adding a second plank above the first.

Where the foundations are firmer they use the common straw collectors (*ruches*), or simply content themselves with placing tiles one above the other on wooden frames. Sometimes also they use collectors made of boards.

Before immersing the collectors they are covered with a coating of mud, to which hydraulic lime is added to give it cohesion. The method pursued by M. Martin of the River Crach, which has been adopted by M. de Thévenard, is as follows:

Into a large vat filled with salt water is stirred mud, to which is added one-tenth its volume of hydraulic lime. It is necessary that the mixture be thin enough to spread easily, then the collectors are immersed in the bath, and remain three or four hours; afterwards and before the coating is entirely dry they are immersed in another vessel containing only hydraulic lime in suspension in sea-water.

The collectors are put in place early in the month of June, when the emission of the spawn begins. The spawning season is prolonged to the month of August, or even later in the river Bono. They are withdrawn at the beginning of winter in order to detach the young oysters.

M. de Thévenard effects the removal of the collectors by means of a barge upon which is erected a lever or sweep, to one of the extremities of which is attached a cord and hook. This is fastened to the collector, which by means of it is readily lifted from the water. This method saves a great deal of time, for the collectors can be readily and easily lifted at all stages of the water. The removal of the young oysters from the board collectors is effected in November and December, and from the tiles in the month of March following. The oysters detached before winter are collected in nursing-frames, and when no further danger is apprehended from the cold these frames are lowered into the river, where their growth is more rapid.

ESTABLISHMENT OF THE BRÉNÉGUY.—Not far from the river Auray, behind Locmarquer, a very interesting establishment has been created by the society of which M. d'Argy is superintendent. This

establishment occupies an area of forty-five hectares in the haven of the Brénéguay.

Lying in an indentation of the shore, and separated from the sea on the west by a natural embankment not subject to overflow, it communicates with the ocean through the bay (*anse*) of Kerlud. Another embankment, 145 meters long, built of earth and masonry, and provided with two sluice-gates, closes in the basin on this side, protects it from the storms, and maintains the level of the Brénéguay at high-water mark. This vast pond contains 900,000 cubic meters of water, and its depth varies from one to three meters.

The sluice gates are only opened during the spring tides, consequently the waters are renewed but twice in a month. The winds, which blow without ceasing upon the coast of Morbihan, effect the aëration of the water and prevent it from becoming impure. The soil is granitic. In some parts a thin layer of mud covers the bottom.

It is hardly necessary to state that the oysters grown in this establishment, commenced only two years ago, are obtained either at Auray or La Trinité. The fry are placed in metal trays supported in frames of wood, and the larger individuals, which are not liable to be destroyed by the crabs, are spread over the bottom. The oyster grows very rapidly in the basin of the Brénéguay, acquiring qualities like those which characterize the products of Bélon.

As at Bélon, also, the dredged oysters, when cultivated, quickly change their form and assume better proportions.

M. d'Argy proposes to perfect his establishment, already so complete in its details, by attempts at reproduction upon a grand scale. My conviction is that this establishment, which at the present time is prepared to deliver several million oysters to consumption, is destined to great development in the future.

Among the different establishments upon the river La Trinité, I would direct special attention to that of Doctor Gressy, to whom we owe various improvements introduced in the methods of cultivation.

The island of Cuhan, upon which the establishment is situated, contains basins excavated in the solid rock, and in which, in consequence of their elevation, the water is renewed only twice in seven days. In these basins M. Gressy has experimented with the object of effecting the greening of the oyster. The end desired has been obtained, but in transportation the oysters lose to some extent the color which is characteristic of the oysters of Marennes.

The methods pursued in the cultivation of the oyster are very nearly the same at La Trinité as at Auray. Nevertheless, some cultivators upon the river Crach find it preferable to detach the young oysters from the collectors at the beginning of winter. They give as a reason for this premature detaching, that the fry grow much more rapidly in La Trinité, and the shells are at this period strong enough to bear the operation without injury.

Some of the cultivators of this locality have a peculiar system of *détroquage*. Instead of detaching the young oysters from the tiles, these are broken into fragments, one oyster being left adhering to each fragment.

The object of this method is to enable the cultivators to dispense with the nursing-frames. Its advantages are as follows:

1st. The young oyster, protected by its firm adhesion to the fragment of tile, cannot easily become a prey to its enemies.

2d. The fragment of tile adhering to the shell increases its weight and prevents its being shifted by the currents when placed in situations to which the currents have access.

I would also refer to the very fine submersible ponds of the MM. Leroux, constructed in the open river, where the oysters are kept until fully grown; also, to those of M. Martin, and the grand establishment of M. le Baron de Wolboeck, nor must I forget the parcs of the Sea-fishermen's Association of La Trinité.

In 1869 the administration of the marine, with the view of promoting the development of practical oyster-culture, which has for its object the collection of spawn, distributed 150,000 tiles as well to this association as to individuals holding concessions from the marine which they cultivated on their own account. The association has prospered, and by reason of its success, which continues to increase, it has greatly augmented its commercial importance.

The river Saint-Philibert, between Auray and Crach, the river of Vannes, of which I shall shortly have something to say, and Morbihan Bay (*la mer intérieure du Morbihan*) are localities suitable for the breeding and the cultivation of the oyster. It will be sufficient to mention the establishments of the society of Sainte-Anne, those of MM. Eden and Fardin, at Peningtoul, those of M. Pozzi, and those of M. Leclair, which are in full operation.

What is the actual condition of oyster-culture in the district of Auray? I may affirm without fear of contradiction that it is prosperous. The one thing needed is an outlet for its products. The oyster-cultural stations of Normandy and the few establishments of Brittany, which are devoted to the cultivation of the oyster, are not sufficient to give room for the hundreds of millions of young oysters which are collected each year in those wonderfully productive rivers, Auray and La Trinité. The collection of fry in 1876 will be still more considerable than for the preceding years. At first they were well satisfied when they succeeded in fixing 20 or 25 spat upon a tile. Now the number averages from 250 to 300. Some tiles are found upon which there are more than 1,000 individuals.

The following statistics, which I owe to the courtesy of M. the Commissary of Auray, will furnish the information necessary to complete this part of my report:

The total number of oyster-cultural establishments for which land

has been granted and which are in operation is 297, classed as follows : parcs, 277 ; claires, 20.

During the season of 1875-'76 were introduced into the parcs 4,401,400 oysters, obtained by dredging ; their approximate value was 118,425 fr. 18 cent. [\$23,685]. During the same period there were sent out from these parcs 7,538,150 oysters, having a value of 202,801 fr. 60 cent. [\$40,560]. The difference between the number received and sent out is accounted for by the fry raised by the planters themselves.

The number of fry sold during the same period, either to establishments in the vicinity or at a distance, was 26,176,300, representing a value of 102,385 fr. 95 cent. [\$20,477]. All of these were collected upon tiles.

In 1874, from the collecting tiles, numbering 2,580,370, there were obtained 110,563,750 fry, after deducting losses from handling. Of this number Auray is to be credited with 66,195,900. There still remained in the parcs on January 1, 1876, 97,348,950 fry, of which more than 60,000,000 were in the establishments of Auray. These statistics are derived from the holders of the state lands granted for oyster-cultural purposes, whose figures are generally too low, and we may safely estimate the number of fry still to be disposed of at 120,000,000.

Without counting the associations of fishermen, who work themselves and are at little or no expense for hired labor, the number of days' labor performed in the parcs during last season was as follows : By men, 35,819 days ; by women, 51,709 days ; by children, 2,150 days ; in all, 89,678 days.

The result of this labor has been that the natural oyster-beds, being well cared for and protected, and worked with moderation, have become more and more fertile ; and the fishing of these beds, which there seemed to be reason to fear would disappear forever, has, on the contrary, become more productive.

We may add that, in those households which are willing to work, comfort has succeeded to want, and we should not forget that the Auray district (*quartier d'Auray*) is but just beginning its development.

**VANNES.**—Before the collection of spawn became in the Auray district a considerable branch of industry, the oyster-culturists on the river Vannes and in the gulf of Morbihan gave their attention solely to the cultivation in parcs of the oysters obtained by dredging from the once fertile beds of this bay. It had, however, some years ago, occurred to M. Chaumel to make some attempts at propagation, but they were without results.

The beds of Morbihan were exhausted many years ago, and the dragnet fishing (*la pêche au chalut*), pursued without intermission, prevented the fixing and growth of the few embryos that the few remaining oysters still produced. The administration of the marine realized that these oyster beds, which had been unproductive for fifteen years at

least, could only be rescued from total destruction by close supervision and restriction of the drag-net fishing (*pêche au chalut*). Measures were taken with this view, and the restoration of the beds was attempted. To accomplish this one hundred and thirty thousand parent oysters, having a large number of young ones attached to their shells, were transported from the beds of Auray to the inland sea of Morbihan [Morbihan Bay], and distributed over the site of the old beds. This was followed with the best results, the attempt being crowned with complete success, especially upon the bed of Bernon. To day, the condition is much improved; spawn has appeared at various points, and we may reasonably expect that in less than ten years, perhaps, the gulf of Morbihan will have recovered its former productiveness.

I will now invite attention to the condition of oyster-culture in the maritime quarter of Vannes. There is progress—progress that cannot be disputed. In 1874 land had been granted by the state for 140 parcs, and the number has since risen to 356. Two branches of the oyster-cultural industry are practiced at Vannes, propagation and rearing. The work of propagation has not attained important proportions. The cultivation of the oyster, on the other hand, has been carried on with encouraging results.

The immense tracts in the gulf of Morbihan, which are left bare at low tide, offer most favorable conditions for cultivation. It is true that the sea is often turbulent, but the numerous currents which traverse it in every direction prove but another element of success when durable parcs have been once established.

Three hundred thousand tiles, intended to catch and fix the spawn, have this year been placed at different points in the river Vannes. The number of spat adhering to each is estimated at from 30 to 60, depending upon the location.

Among the establishments which have been founded in the neighborhood of Vannes I may mention that of MM. du Chélas & Co., situated upon the island of Bailleron, and having attached to it two parcs, one on the isle of Lerne and the other on the isle of Illure; and those of MM. Chaumel, Vincent and Liazard, de Lamazelle, and Paul.

As an experiment five thousand tiles were immersed by the MM. du Chélas & Co. in the vicinity of the beds of Bernon and Bailleron in 1876.

**ESTABLISHMENT OF M. POZZI.**—The establishment of Ludré, which M. Pozzi organized, with the assistance of M. Dalido, in 1874, may be regarded as one of the best arranged in Brittany. It is situated near Sarzeau in the Gulf of Morbihan. It embraces—

1st. Storage parcs, having an area of 5 hectares. These were formerly salt marshes which have been adapted to the purpose for which they are now used.

2d. A feeding reservoir (*Une reservoir de décharge*.)

3d. Two submersible basins. It also has connected with it parcs, situated upon the islands of Kistinic and Lerne, for the growing of the oyster and its preparation for transportation.

The basins designed for the winter quarters of the oysters are fed upon one side by a vast pond having an area of 40 hectares and receiving water at each tide, except during the neap-tides. Upon the other side is a sluice-gate which permits the entrance of the rising tide and through which the water is drawn out when it is desired to empty the basins. The bottom is composed of mud and sand and is for the most part firm.

The system of cultivation which has served as the basis of the labors of M. Pozzi is the system of continuous currents. In carrying out this plan M. Pozzi has simulated the conditions under which the natural beds of oysters are placed and has had every reason to be satisfied with the method. During the first year, 1875, the results were marvelous. The present year they have surpassed all expectations. By means of the pond of forty hectares and the sluice-gate on the opposite side he was able to maintain a constant circulation of water in the parcs.

A portion of one of the storage basins, that one in which the oysters are spread over the bottom to thicken up (*epaissir*) during the winter, is asphalted. Such an exclusive appropriation would hardly be profitable in an establishment less extensive than this. In this case it has been rendered necessary by the presence upon the bottom of these transformed salt marshes of decomposing vegetable matters.

This parc has an area of 2 hectares. It is divided into five parallel compartments, having each a length of 200 meters and a breadth of 15 meters. Each is in direct communication with the feeding pond, by an independent water conduit. This subdivision was adopted by M. Pozzi with the view of securing a rapid current through all the compartments. Without this precaution—had the water been introduced into the pond through a single channel, the force of the current would have been lost in the vast extent of the two hectares of surface, and neither the oysters upon the sides nor upon the bottom would have profited by its beneficent influence. As may be seen, the practice of M. Pozzi has been consistent with the principles upon which he has founded his operations.

In the arrangement of the submersible basins he has carried out the same ideas.

These basins are excavated in rock, and surrounded with walls of stone, laid in cement, which have a thickness of 60 or 80 centimeters, and rise to a height of 80 centimeters above the surface of the ground. They are situated at the extremity of a small peninsula, in close proximity to the workshops. The two basins are nearly equal in size, and have an aggregate area of 50 meters by 28 or 29 meters. They receive water at every tide. Each compartment contains 200 frames, aligned in the direction of the current, and separated by intervals of 50 centimeters. Each frame is numbered, in order that a record may be kept of the fry obtained from different sources, and its progress noted. The frames are ballasted by heavy stones to keep them in position.

The interior of each frame is divided into five or six compartments.

by means of wooden cross-pieces, in order that the young oysters may not be displaced by the action of the sea. Under the influence of these currents, the fry undergo extraordinary development. For example, I have seen young oysters removed from the collectors the present season which in the space of three months had increased in dimensions from 4 to  $4\frac{1}{2}$  centimeters.

The "sulky" oysters, which have been obtained by dredging or raised artificially, are not slow under this treatment to take on vigorous growth. During the present season M. Pozzi placed 70,000 of these sulky oysters in the tail-race of his mill, and by regulating the flow of water subjected them to the action of a swift-flowing current. In forty days these oysters, which had a mean diameter of 3 centimeters, had attained the dimensions of 6 or 7 centimeters.

The submersible basins, the parc at Kistinic, and those upon the Isle of Lerne, are appropriated to the cultivation of oysters in frames. However, those portions of these last parcs, where the current is sluggish, are reserved for bedding (*étandage*); oysters which have already attained a diameter of 4 or 5 centimeters being subjected to this treatment. The increase in dimensions of individuals bedded upon the bottom is not more than 2 centimeters, but the shell becomes broader and deeper and of better shape, and the animal, without being fat, completely fills the interior. The fattening of the oysters is not the end sought by M. Pozzi; he has rather aimed to put to profit the exceptional advantages which his field of exploitation offers for the growing of the oyster.

The following are the operations of M. Pozzi, and they comprise what in Brittany is technically termed oyster breeding or rearing. For example, the young oysters (*naissain*) purchased by M. Pozzi in March, 1876, were spawned at Auray in August of the previous year. In March, 1876, they were removed from the collectors (*détroqué*). In April they were transferred to the Isle of Kistinic, and at once placed in frames. After two months a part were sent to the principal establishment at Ludré and placed in the submersible basins.

The sale of these young oysters took place in the month of September of the same year, at which time they had obtained a diameter of from 4 to 6 centimeters. If the purchaser cannot remove them at once, or if all the stock is not sold, the young oysters are transferred to the storage parcs, where they pass the winter.

The oysters are usually purchased by merchants from the Isle of Oléron, Marennes, and La Tremblade.

The extensive parcs of M. Pozzi permit an annual production of 6,000,000 or 7,000,000 oysters. This number will be doubled when the work of converting the salt marshes into parcs, which has been undertaken at Ludré, shall be completed.

LES SABLES D'OLONNE.—It is only in the last three or four years that oyster-culture has been held in esteem at Les Sables d'Olonne.

Prior to this there existed only *dépôts* or holes in which the merchants deposited the oysters they had purchased at Noir-Moutiers until a favorable opportunity occurred to sell them. It is due to the example set by the administration of the marine that the *parqueurs* have at length determined to put under cultivation the productive submersible areas of the haven of Les Chasses and convert them into *parcs*.

The haven of Les Chasses has an area of 64 hectares. Of this only 25 hectares are suitable for the cultivation of the oyster. It is overflowed by the tides only once a week, but for two or three consecutive days. The bottom consists of sand mixed with mud and clay.

The water which enters the inclosures (*claires*) is thickly loaded with the earthy matters taken up in the harbor. This necessitates the frequent cleaning of the *parcs*, in which it is absolutely necessary to prevent any accumulation of ooze or sediment.

These *parcs*, or "claires," as they are termed at Les Sables, have an average superficies of 250 square meters. The area varies according as the inclosures are more or less sheltered from the winds. The water is retained in the *parcs* by earthen embankments. These are of such height that when the tides run, out only such a depth of water is retained as is necessary to protect the young oysters from too great heat. It is not necessary at Les Sables d'Oloune to observe any precautions against cold.

I am assured by the *parqueurs* that the shallower the *claires* are, and consequently the more the oysters are subjected to the influence of heat and light, the better they do.

The rearing and fattening are the familiar phases of oyster-culture to the planters of Les Sables. Their methods are based on theories directly opposed to those of M. Pozzi at Ludré. At Les Sables, in fact, there are no currents, and the waters are very slowly renewed only once in eight days. Last year, by reason of some constructions undertaken in the harbor, the water remained unchanged in the *claires* for an entire month, with no injurious results to the oysters. Truly, one is astounded at the rapid and really surprising growth of the mollusk under such conditions. In a single spring tide the increasing diameter amounts sometimes to a centimeter. Sometimes in the course of forty-eight hours a young oyster, injured in the process of detaching from the collectors, will reconstruct its shell so strongly as to afford secure protection from its enemies. The young oysters (*naissain*) are brought from Auray. They are transported in boxes enveloped in damp seaweed. Some planters have them transferred without being detached from the tiles, place them aside, and do not effect the removal from the collectors until a later period. At first they are placed in nursing frames, where they remain from fifteen to thirty days in order that the injured ones may have time to heal; then they are scattered over the bottom of the *claires*. In two years at most the young oysters are fit for the table.



The following measurements, showing the increase in the dimensions of oysters reared by M. Mounier, will prove of interest:

An oyster, said to represent a fair average, which was spawned at Auray in 1875, and was detached from the collector in January, 1876, had a diameter when placed in the parc, the following April, of  $2\frac{1}{2}$  or 3 centimeters. Early in September of the present year its diameter had increased to 7 centimeters 8 millimeters. Another, spawned in 1874, and placed in the parc in April, 1875, measured, about the 1st of September, 1876, just  $9\frac{1}{2}$  centimeters. Finally, a specimen spawned in 1873 had acquired in September, 1876, the enormous diameter of 11 centimeters 4 millimeters.

Like results have been obtained at the establishment of Dr. Leroux. In the month of March of the present year M. Leroux transferred from his parcs at La Trinité some of the fry of 1875, which had been detached from the collectors in January, 1876. At the period of my visit to Les Sables, these oysters had attained diameters of 7 and  $7\frac{1}{2}$  centimeters.

The method of treating the oyster is the same at Les Sables as elsewhere. The manipulations are neither more nor less frequent. Care is taken that they shall not become covered with mud. The parcs are carefully maintained in repair. The confervoid growth is removed as it forms. Placing too great a number of oysters in one inclosure is carefully guarded against.\* In the intervals between the necessary manipulations the parcs are left undisturbed.

Although the concessions at Les Sables d'Olonne are of very limited extent, they raise there each year about 10,000,000 oysters, hardly one-tenth of which are obtained from the dredging. It is not to be presumed that this is the limit of production.

The conversion of the salt marshes adjacent to the oyster parcs into claires will be accomplished in a very short time.

ISLE DE RÉ.—In the Isle de Ré the breeding and rearing of oysters is carried on to some extent, but this industry is not very important. The areas suitable for the cultivation of the oyster are not extensive, and moreover it is not possible to utilize the western shore of the island on account of the violence of the sea, which is there called "*mer sauvage*."

Among the parcs which are maintained, I will mention those of M. Dupeux-Boyer. They were established about fifteen years ago in the premises of an old mill. They are situated at Martray, in the face of the sea ("*mer sauvage*"), but protected from its violence on one side by a sand-dune, on the other by the Bay of Bier-d'Ars, the waters of which are conducted to them by a canal.

The concession is divided into claires averaging 50 to 60 meters in length and 20 to 30 meters in width, which are separated by earthen embankments from 25 to 30 centimeters high. These claires receive water at every tide.

\* A claire having an area of 150 square meters, for example, should not contain more than 6,000 to 8,000 oysters.

M. Depeux-Boyer, an experienced oyster-culturist, has observed in common with the *parqueurs* of Les Sables d'Oléron, that the less water there is in the *parcs* the better the oysters seem to do.

The bottom is a clayey loam, the surface of which is covered by a layer of mud from 20 to 30 centimeters in thickness, but of sufficient firmness to prevent the shells from sinking in it. The *claires* of Martray, which are cleaned only once or twice a year, are appropriated to the rearing and fattening of the oyster.

The oysters handled there are either brought from Arcachon or are obtained from the *parcs* of reproduction which M. Dupeux-Boyer possesses in another part of the island, at the place called La Moulinatte, or in many cases they are collected along the shore, by the foot-fishermen (*pêcheurs-à-pied*). Although for many years the oyster beds of the vicinity have been exhausted, there still exist isolated oysters, the spawn of which catches either upon the rocks or the pebbles that the waves roll upon the beach. The oystermen call them native or vagabond oysters. The shell is coarse, but regular and deep.

In the *parcs* of reproduction, where it would be impossible, on account of the violence of the sea, to employ the usual forms of collectors, the spawn is allowed to catch upon the shingle of the beach. The detaching of the young oysters is consequently an operation of some difficulty.

Two or three years are necessary to prepare the oysters brought from Arcachon for the market, in the *claires* of Martray. The native oysters are less liable to mortality; they grow more in the same period of time; the shell becomes deeper and the animal larger.

The *parcs* of Martray, like those at Marennes, have the property of greening the oyster. Some individuals, however, in the *claires* of the Isle de Ré, never assume the green coloration, which in most cases manifests itself about the time of the September equinox.

ISLE D'OLÉRON.—Oléron, which may be regarded as an appendage of Marennes, engages in the rearing and fattening of the oyster and in its reproduction. In 1873 the season was bad; the spawn did not catch upon the collectors, and the discouraged planters (*éleveurs*=breeders) abandoned their *parcs*.

The administration of the marine intervened to prevent total ruin. It established model *parcs* and brought from Arcachon 250,000 breeding oysters and placed them in "*la Courant*." It endeavored by every means to restore the courage of the *parqueurs*, who had given way to unwarranted apprehensions. The counsel of the administration of the marine was heeded. The *parcs*, which had been invaded by mud and the mussels, were soon restored to good condition. Since then the cultivation of the oyster has succeeded so well that no one thinks now of abandoning oyster-culture.

In 1875 the *parqueurs* of Arcachon established themselves in the island of Oléron, and the quantity of oysters they brought with them was so large that the collectors were covered with spat. The same

season there was an abundant setting of spat in the experimental parc established by the administration of the marine. Oysters and collectors were also placed in "*la Ourant*," to form the basis of a natural bed, to serve as a center of reproduction.

There are at Le Chateau, the point where the work is principally carried on, 2,000 parcs; at Saint-Trojan, 700; at Dolus, 300; in all, 270 hectares are under exploitation. These localities are situated opposite the mouth of the Seudre. At Le Chateau the parcs begin at 1 kilometer from the line of high water and extend back a distance of 4 kilometers.

The present year 300,000 tiles have been placed out. These collectors have not been covered, as usual, with sand and cement, as the coating would not be permanent in consequence of the storms and intense cold to which this coast is subjected.

The cultch (*naissain*) from Brittany, which is reared on the island, usually does better than that of Arcachon. According to the cultivators, the oysters which are brought from the north have a tendency to grow more rapidly in the south. While this probably is due to the effects of climatic influence, we know that the rule is by no means absolute; for example, the oysters of Portugal, although native to a country much warmer than ours, far from dwarfing in our waters, acquire there an enormous size.

The younger the oysters are when they arrive at Oléron the more rapid is their development. Nevertheless, some of the parqueurs assert that the oysters obtained by dredging grow more rapidly than those gotten from the collectors. The reason given by them is that this oyster, accustomed to live at the bottom of the water, is more sensitive to the action of light and heat, which stimulates in them an energetic circulation.

The mussels are the most fatal scourge of the parcs of Oléron. They multiply in so great a number that if the parqueurs neglect to visit the inclosures each time that the tide permits them, these mollusks soon cover the bottoms to a thickness of from 20 to 40 centimeters.

I will here mention briefly the efforts of M. Gaboriaud, who has happily transformed some of the salt marshes into rearing-ponds (*claires d'élevage*). His experiments are, however, very recent, and need confirmation.

In order to give an idea of the unexpected development which the oyster-cultural industry has taken in the case of Oléron, I will say that the parcs of the present year contain more than 70,000,000 oysters fit for the table. As to the number of young oysters which have not yet attained the prescribed size, and fry still attached to the collectors, it is not possible to form even an estimate.

MARENNES.—The oysters of Marennes have a universal reputation. They owe their popularity to the peculiar taste contracted in the green-*claires*. There is no point along the whole coast where the green-

ing of the oyster takes place so readily and so rapidly as here. There are divers opinions as to what causes we must attribute the change which occurs in the color of the mollusk in the month of September. Some think that it is due entirely to the clayey soil of Marennes, to the brackish waters of the Seudre, or to oxide of iron. Others are as well assured that it is to be attributed to a sort of vegetation which covers the claires at the approach of winter, and disappears in the springtime. According to them, the oyster owes its color to the absorption of the chlorophyll with which the waters of the claires are saturated. A fact of common observation is that the oyster takes on its green color when the claire becomes green, and loses it as soon as the claire is deprived of its vegetable growth.

Although Marennes is very near Oléron, the experiments in reproduction which have been attempted there have not given any satisfactory result. This is not, as certain of the cultivators (*éleveurs*) assert, because the captivity of the oyster impairs its generative faculties. The oyster, whether it be in claire or parc, emits its spawn in the spring. We must, therefore, believe that the spawn does not encounter in the water of Marennes, heavily laden with earthly matters, and perhaps too sluggish, the conditions necessary for its existence.

The areas under cultivation comprise *viviers*, *dépôts*, and *claires*. The *viviers* are small establishments, having an area of about 400 square meters, surrounded with walls of dry stone 20 centimeters in height, situated upon the strand, and submerged by the sea at each tide. The *dépôts* are established upon the muddy flats along the shore. They are inclosed by branches of tamarind stuck in the mud, which also serve the purpose of showing the lines of demarkation between different proprietors. The *claires* are basins, from 30 to 35 centimeters in depth, excavated along the banks of the Seudre.

The earth which has been excavated from the bottom of these serves to form a bank, the top of which is about one meter above the bottom of the reservoir. They are divided into deep and shallow claires. The shallow claires, placed nearer to the shores of the Seudre, receive the water more frequently. The deep claires, being further from the shore and excavated in a surface which is more elevated, receive fresh water but four or five days each spring tide.

The greater number of the claires are surrounded with a ditch, which is independent of the supply canal, in which they throw the muddy deposits which the sea brings in.

As I have already said, the deepness of the claires varies from 30 to 35 centimeters, but in the autumn the depth of water maintained is only from 24 to 30 centimeters. When the cold weather approaches their depth is increased, for the frosts and the snow are very much to be feared, and if the reservoirs chance to become covered with ice it is immediately broken up.

The shallow claires become green first. This condition lasts from the

month of September to the month of February. The deep claires begin to become green in the month of November, and lose their color about the month of April.

The oysters which are bred at Marennes are either produced in the parcs of Oléron or they are brought from Bretagne and Arcachon. Arcachon especially disposes of the greater part of its products as soon as they are salable.

The young oysters, when received, are first spread out over the bottoms of the *viviers* or in the *dépôts*. In November, after remaining here from six to seven months, they have attained a diameter of from 7 to 9 centimeters. According to circumstances, from fifteen days to a month is sufficient time for subsequent exposure in the claires in order that they may attain those qualities which permit them to be marketed or sent *au couteau*, using the expression employed by the *parqueurs* of the Seudre.

Before being sent from the parcs it is necessary, however, that they should be subjected to a last preparation, with the object of accustoming them to bear transportation without injury. To accomplish this, they are transferred to a compartment, the bottom of which is asphalted or covered with sand, and into which is admitted the purest and freshest water. The oyster remains some days in this reservoir, until it disgorges; then it is washed and shipped.

Some of the riparian land-owners, among others MM. Blanchard, Jourdes, and Le Beau, have converted into oyster claires the salt marshes situated outside of the maritime domain. The success of this enterprise is of lively interest at Marennes. The areas at the disposal of the administration are all allotted, and nevertheless numerous applications are received every day.

We may assert without contradiction that the success of this transformation is assured.

The oyster-cultural industry at Marennes has made considerable progress since 1873. Large *parqueurs* have come there and organized establishments complete in every detail of arrangement and administration. That of M. de Faramond, of Lafayole, which is one of the most recent, deserves some words of description.

The site of his establishment is at the mouth of the Seudre, in the Bay of Sinche. This establishment, which is very intelligently arranged, is composed of twelve claires, each about 40 meters square, six on each side of an embankment 2 meters wide. Upon this embankment M. de Faramond, who wished to avail himself of the most recent improvements, has constructed an iron railroad, with service trucks, in order to accomplish the rapid and inexpensive transportation of his oysters from the vessels to the claires, and at a later period to the disgorging ponds (*degorgeoirs*), and from there to the packing houses, situated at one end of the concession. He finds it advantageous to keep in each claire oysters of all qualities and all dimensions. Consequently he has but a single compartment to enter to get whatever kind is in

request, and he avoids the great inconvenience of draining several ponds at times when it would be impossible to refill them. M. de Farmond has completed his packing establishments by an assorting machine, so ingeniously constructed as to permit two women to assort 30,000 or 40,000 oysters in a day.

In conclusion I present the following statistics:

In 1873, according to the register of maritime fisheries, the number of shell-fish establishments was 2,564; in two years it has risen to 13,526.

The claires occupy upon each side of the Seudre a strip 20 kilometers long and 1 kilometer broad. The area exploited, therefore, is 4,000 hectares.

The number of oysters estimated to be contained in these concessions is 80,000,000.

In fine, we may say that oyster-culture makes the fortune of the majority of the inhabitants of this region. Almost all the families are proprietors or renters of a *parc*, a *vivier*, or a *claire*, which they cultivate themselves. Those of the working class who are not tenants or proprietors find occupation in the large establishments, and gain from two to four francs for two hours of work during the high tides. We may also add that the administration of the marine has addressed itself to the question of dividing in a more equitable manner those lands which are under its control.

LA TREMBLADE.—La Tremblade, situated upon the left bank of the Seudre, as regards the methods of production, cultivation, and greening pursued there, may be classed with Marennes. It has the same soil, the same processes, and the same systems of culture, with scarcely a shade of difference.

I would abstain from making any special mention of the oyster industry at this station if I had not collected some supplementary observations to those made at Marennes, which I will briefly sum up.

There are, as at Marennes, *viviers* and *claires*. The *viviers* are at the mouth of the river, and are exposed only at the season of high tides. In these the cultch is placed in order to grow.

The *claires*, situated at a higher level, in the case of a large number of the cultivators, who do not possess *viviers*, serve at the same time for the growth, the fattening, and the greening of the oyster.

La Tremblade grows largely the spawn of Bretagne, which, placed in the *parcs* about the month of March or April, when they measure from 2 to 3 centimeters in diameter, soon become edible oysters.

The greening occurs in a very short time. When a *claire* is "in humor," two weeks are sufficient; but it is necessary to guard with great care against emptying the *claire*, for it would be necessary then to wait an equally long time before it would recover its green color.

Northwest winds retard the greening, whilst those from the southwest favor it. These last being warmer and more humid, the oyster opens more frequently.

The claires are of contracted dimensions; and it has been remarked, especially in the case of the deep claires, which are submerged only three or four days each spring tide, that the smaller these are the better the oyster greens.

It has also been noticed in the parcs where the influx of fresh water is sometimes too abundant, that the development undergoes arrest, and the animal emaciates and quickly dies; while, if this water be absolutely wanting, not only does the oyster cease to grow or fatten, but it does not green.

Le Mus-de-Loup is the locality most favorable to the greening. It is generally agreed that this is due to the presence of fresh water. The reed grasses, which cannot grow in salt water, flourish upon the banks of the claires.

The cultivators of La Tremblade do not hesitate to attribute the greening of the oysters as much to the influence of fresh water as to the nature of the soil.

Some collectors have been placed in the viviers, but there has been no fixation of spat except in the case of the Portugal oysters.

LE VERDON.—Oyster-culture here is still in its infancy. The first attempts date from 1874, and were made by MM. Péponnet and Tripota. They succeeded badly; but we must not therefore conclude that the oyster-cultural industry cannot prosper in the roads of Verdon. Recent experiments under better auspices are announced; and if they succeed in excluding the fresh waters and the mass of sand which the Gironde accumulates, and which are the sole causes of failure, Verdon will be, on the other hand, a station admirably situated for the oyster business. Eighty hectares at least along the strand are susceptible of being put under cultivation.

In the course of this report I have several times referred to the oysters of Portugal, proposing to revert to this matter when I had arrived at Verdon. I did not think it necessary to speak of them at greater length in previous references. The oyster of Portugal has made its appearance in the last two or three years in our markets. It has entered into public consumption, and replaced for persons of moderate means our French oyster; the price of which is too high.

These oysters were originally derived from an immense bed found at the mouth of the river Tagus. The shell is rough and distorted, but it is generally well filled. This mollusk, whilst susceptible of acquiring a large development in our waters,\* resists better the vicissitudes of weather, bears transportation better, becomes acclimated in localities where our indigenous oyster could not prosper or live, and accommodates itself to all sorts of water. We are assured that its fecundity exceeds that of our native oysters. Its spawn, endowed with a strong vitality, can resist injurious influences for a long time, and be transported

\* I have seen at Arcachon a Portuguese oyster which, after five or six years of sojourn in a parc, measured 28 centimeters from one extremity to the other of its shell.

to considerable distances by the currents without losing its vitality. Often the spawn of these foreign oysters is transported from the Gironde to La Rochelle, where, having attached itself to any hard body with which it comes in contact, it grows, fattens, and reproduces. It originates from the natural bed, which is formed not far from the Verdon, upon the old bed of Richard or Goulée, 9 miles from the mouth of the Gironde.

Only five or six years ago a vessel loaded with Portuguese oysters, in danger of sinking, discharged its cargo in order to repair damages. A part of the oysters supposed to be dead were thrown over into the river. Since that time these oysters have multiplied to such an extent, and the bed has become so extensive, that they dredge it without intermission during the season when fishing is permitted, without exhausting it or impairing its fertility. In fact, this oyster bed is a veritable fortune for the fishermen of the region, who gather each year from it an abundant and certain harvest.

ARCACHON.—Among the most important oyster stations along the whole coast of France, Arcachon is without a rival anywhere in the number of oyster beds exploited, the value of the oyster-cultural establishments, and the extent of business to which this industry gives rise.

The immense extent of salt water which bears the name of the Bassin d'Arcachon is excavated in the midst of a sandy plain, and is in permanent communication with the Atlantic only by a narrow channel opening. This little inland sea, into which many rivulets pour their fresh waters, so valuable an auxiliary in the cultivation of the oyster, is subjected to the same fluctuations of level as the ocean. It is traversed by currents which cross it in all directions and keep up a continual agitation. These currents circulate in channels of variable length, and of a depth which sometimes reaches from 40 to 50 meters. Between these channels are flats, known by the name of "*crassats*," which are laid bare at each tide. Upon these flats, thickly covered with *parcs* and *claires*, are established the most extensive oyster-cultural industries that are in existence.

The oyster industry at Arcachon was not created "out of whole cloth." It was called into existence by the presence of natural beds, to the number of nineteen, scattered through different parts of the bay. These beds, after having, like the oyster beds of the channel, and from the same causes, passed through a period of decay, which at one time excited an apprehension of their utter destruction, have revived, and are to-day of enormous fertility. The quantity of spawn which escapes, mingling with the embryos furnished by the oysters preserved in the *parcs*, is so very considerable that the mass of the waters of the bay are filled with it from the month of June to the month of August. The collectors are loaded with spat; and, upon tiles suitably placed, 1,000 or 1,500 individuals may sometimes be counted. If the whole generation that each year sees born attained adult condition, the Bassin d'Arcachon would be soon insufficient to contain so prolific a population.



Although these natural deposits are considered as centers of reproduction, and as such are under the strict control and supervision of the administration of the marine, yet every year for a few hours the dredging of them is authorized in order to remove the excess of production. In this short space of time vast quantities of oysters are collected and sent to market or laid down in the parcs. The oyster from this locality, called also native oyster, or "*gravette*," is very much sought for. It is distinguished by its peculiar form and its light thin shell from the channel oyster, which is less agreeable to the eye, and has much greater thickness of shell, and less delicacy of taste.

Arcachon possesses over all other oyster-cultural centers this advantage: that the mollusk receives his whole education there. He is born there, grows there, and from there passes directly into the hands of the dealer.

The study of the Bassin d'Arcachon would require long labor in order to be complete. It would be difficult for me in this summary report to pass in review all the industrial establishments there located. The number of them is too great, and their description would exceed the limit that you have permitted to me, Monsieur the Minister, and it would be fatiguing by its monotony, for in most of the concessions of the same group there is very little departure from the established methods and processes of the station. To carry out your wishes I have studied more in detail some of the establishments which have appeared to me to present most of interest, and which give an exact idea of oyster-culture as practiced at Arcachon.

ESTABLISHMENT OF THE OYSTER-CULTURAL UNION.—The Oyster-Cultural Association, at the head of which is placed M. Venot, has under cultivation an area of 42 hectares in the Bassin d'Arcachon, comprising, upon the one hand, the concessions granted by the administration of the marine to the Central Society for the Assistance of the Shipwrecked, and, upon the other, some lands situated near the light-house and the parcs of the Jacquets.

Le Cès is a place of natural reproduction. It consists of 11 hectares of land exposed at low tide and covered with herbage like a meadow. The soil, although sufficiently firm, necessitates, nevertheless, the employment of large "*patins*," the use of which prevents either the breaking or the burying of the shells in passing over them. They term the oysters which are obtained native oysters, or "*gravettes*."

This peculiar phase of the oyster-fishing is practiced by squads of ten women arranged in single file. Two file leaders, placed at the ends of the line, direct the march. The women, separated from each other by an interval of one meter, are each provided with four pouches attached to their belts, in which they place the oysters as they gather them. Those who follow detach these pouches when they are filled and empty them into baskets. The shells which are concealed from sight are collected by the assistance of a small rake, which is drawn over the ground in the direction in which the grass lies.

The fishing terminated, they stake out the square space over which it has taken place, in the first place in order not to expose it to being fished a second time, and in the second place to be able at a later period to cover it with shells of cockles and oysters, which are the natural collectors employed by them in order to maintain in these localities continued fertility.

The duration of the fishing in certain portions of these *crassats* does not exceed two hours or two hours and a half each spring tide; but as they employ 40 or 50 persons for this work the result is about 60,000 oysters for the day.

When the tide has driven off the workmen, each squad, by means of the *tillole* with which it is provided, goes to the ship *Le Travailleur*, which is the headquarters of the exploitation. The collections of the day are poured upon long tables, and the women proceed then to the singling and sorting of the oysters. They have such skill at this work and their eye is so well trained that they rarely have occasion to make use of measures in order to classify the shells by their difference in size. This operation completed the oysters are sent to the different parcs, to Lahillon in order to grow, to Crastorbe in order to fatten and to be put in condition for market.

LAHILLON.—The parcs of Lahillon are ancient oyster beds, from which they removed the grass in order to transform them into propagating claires (*claires de pousse*). Amid the marine grasses the growth of the oyster is less rapid than on the bare soil. A square space has, however, been left in its natural condition, and such is the quality of the ground of Lahillon that the oyster grows more quickly there than in the beds of Le Cès. The mean diameter of oysters fifteen months old is from 2 to 4 centimeters.

The claires measure 45 meters in length by 6 in breadth and have a depth of 30 centimeters. They are separated from each other by embankments 1 to 2 meters wide, formed by clods of clay, such as is found in the Ile des Oiseaux, and sustained by tiles placed on end.

One hundred thousand oysters may be planted in each of these claires. The subjects which are handled here are small oysters culled from the *crassats*, which must attain a larger growth before being fattened, and the spat obtained from the tiles, which, however, is only introduced after having remained in the nursing frames till about the month of April, and after the very dangerous tides that occur about the time of the vernal equinox are over.

The native oysters, which have undergone arrest of development, are placed in claires reserved for the purpose. In a short while in their new home they recover their normal rate of growth and gain in six months an increase of from 2 to 4 centimeters in diameter.

As it is essential not to lose an inch of this valuable exploitable ground, the shores west of the crassat of Lahillon are used as open parcs, but, in order to facilitate access to the claires behind, spaces have been left at intervals of 20 meters, by which the boats may reach the water.

ILE DES OISEAUX (PARCS OF CRASTORBE).—The Ile des Oiseaux is the largest of the *crassats* of the bay, and the planters regard it as the most favorable ground for the cultivation of the oyster. The Oyster-Cultural Society possesses there 11 hectares of *claires*. The bottom of these *claires* has been transformed before being brought into use. It originally consisted of mud several meters in thickness, and of so little consistency that one could scarcely pass over it even by using very large *patins*. A consolidation of it was effected in the following manner: At first there was spread over the space a layer of shell and sand, such as is common in the Bay of Arcachon. Upon this layer, the thickness of which varied according to the greater or less consistency of the mud, there was spread another layer of pebbles as large as nuts, the material being brought from the quarries of Gazinet, near Bordeaux. These *parcs* being exposed to strong currents, it was necessary to surround them with pickets. They are emptied by a gate, which also serves to retain the water at low tide, when they would otherwise be left bare. In order to avoid the damage that the rising tide might cause, the gate is left shut until the sea has already filled the *claire* half full by filtering through the sides.

This portion of the establishment of the Oyster-Cultural Society is devoted to the fattening of the oyster and its preparation for shipment.

No oysters are marketed from the Ile des Oiseaux which have not attained a diameter of 6 centimeters or more, and although they grow deep and round there, they increase in diameter only about 2 centimeters a year.

The oysters cultivated at Crastorbe are obtained either from the natural bottom or from the tile collectors. A few of them have spent a portion of their time at La Tremblade; but in general their early growth is effected at Lahillon. I will add that the borders of the *parcs* of Crastorbe have retained the condition of natural oyster grounds.

MM. Venot & Co. cultivate both the native oyster and that obtained from tiles. Reproduction upon collectors is common everywhere at Lahillon and in the *parcs* of the Jacquets. Tiles alone are employed and are placed in position sometime in May or June, according to the mean temperature of the spring, which, moreover, regulates the time of the emission of the spawn. They are removed about the month of November. The detaching of the shells from the tiles is performed upon [the vessel] *Le Travailleur*, generally before winter approaches. The young are placed in frames soon after, upon which they pass there the cold season and repair the damages that the *detroquage* has caused to the shell. When transferred in the spring to the *parcs* of Lahillon they have become sufficiently strong to defy their enemies.

The Oyster-Cultural Union the present year immersed 110,000 tiles, and its *parcs* contain about 30,000,000 of oysters. Sixty persons are

continually occupied in this vast exploitation, and the number is increased at busy periods to 80 or 90.

Experiments have been made by M. Venot upon American oysters. Of four lots of spawn forwarded from America two arrived in good condition, and the surviving individuals were placed in the parcs of Cras-torbe, and promptly recovered from the fatigue of their long journey. Their development was rapid. We can best compare them with the oysters of Portugal, which these American specimens resemble in a great many respects. The American oyster has been little appreciated in our country. Its rearing has been abandoned.

As with almost all the principal oyster-culturists, and especially M. Montaugé, whose establishments are conducted on a grand scale, the oysters issuing from the parcs of the partnership of Venot & Co. are not immediately sent to market. They are first transported to basins convenient to the warehouses, where they are permitted to disgorge. Then they are washed and sorted again. The sorting is done by means of machines, which render this service easy. A single woman can sort in one day from 20,000 to 30,000.

THE ESTABLISHMENT OF SAINT JOSEPH.—Among the principal planters on the Gironde, who, in addition to the conduct of their business, have devoted themselves to experiments with a view of perfecting oyster-cultural methods, I may cite the brothers MM. de Montaugé, who have organized upon the road from La Teste an experimental laboratory in their great establishment of Saint-Joseph.

This laboratory, to which will be very shortly annexed a cabinet of research and observation provided with microscopes, consists of a basin having an area of 1,500 square meters and a depth of 1 meter, which is divided into two compartments, one of which is devoted to the preparation of the oysters which are to be shipped, the other to experimental work. The bottom of the first compartment is asphalted; the bottom of the second has been excavated, and the material removed replaced by a layer of clay rammed and puddled, surmounted with another layer of sand and shells. These arrangements have been made in order to prevent any infiltration of water derived from the springs which rise in the grounds of the MM. de Montaugé, the metallic ingredients of which are injurious to the oyster.

The basin is fed by means of a great sluice gate, which is opened by the rising tide and closed when the tide returns. This gate is placed at the head of a canal, the entrance to which is in the mouth of a small stream of fresh water. At the beginning they exercised the greatest care to prevent these fresh waters from mingling with the water of the sea during the renewal of the supply in the basin.

MM. de Montaugé studied in one of their experiments what aptitude the captive oyster had to produce spawn capable of developing. For three years the adult oysters placed in the reservoir of observation apparently did not emit any embryos. They even became emaciated. The ex-

perimenters attributed this waste to the too great saltness of the water, which had reached such a point that it deposited crystals of salt upon the marine plants contained in the basin. The failure was notorious. The experiments were abandoned, the oysters removed, and the area of water converted into a fish pond. From this time they neglected to prevent the mixing of the fresh waters of the brook, to which I have referred, with the sea-water in the canal. Some time afterward, in raking over the bottom, they found some forgotten oysters. They perceived that they had grown most surprisingly. There were found traces of spawn in the vicinity of the gate and of the springs which burst out here and there upon the edges.

This event, entirely accidental, was a revelation which put the MM. de Montaugé upon the way to the truth. Some hundred oysters were again deposited in the basin, and collecting apparatus arranged around them became loaded with spawn.

It has been denied that these embryos came from the specimens that were the subject of experiment. From what source, then, could they have come? No pare of reproduction existed in the neighborhood. The waves, which in such case must have served as the vehicle for their transportation, traversed several kilometers of *crassats* before penetrating this establishment, and on this long passage across tide-flats under the summer sun, the sea-water is so heated that spawn loses all vitality there. Again, they have objected that if these waters were too warm to present to embryos the normal conditions of existence, how could they serve to preserve the spawn of captive oysters. The explanation of this is not difficult to find if we remember that they permitted the fresh waters from the brook, already referred to, to flow into the canal of the establishment, and these by their coolness lowered the temperature of the salt water.

In a second experiment, the MM. de Montaugé, with the object of determining what was the influence of the heat of the sun upon the development of the oyster, placed in a portion of their basin earth extracted from the parcs of Oléron. Oysters of the same size and age were placed upon this earth and others by the side of them upon the ordinary soil of the bottom. The result was that the growth of all of them was very nearly equal; but the first were in better condition, were more wrinkled and more strongly ribbed.

All oyster-culturists know that very great cold and frost are to be esteemed among the most terrible enemies of the oyster. The proprietors of the establishment of Saint Joseph possess a basin containing 200,000 oysters. The basin having been frozen over, the MM. de Montaugé immediately caused the water to be renewed and the reservoir to be covered with straw and hay. This means succeeded, and only 100 of the oysters were affected by the freezing.

I may not leave the establishment of Saint-Joseph without noting an observation which is of peculiar interest. In the parcs much exposed

to the storms they turn the oysters over during the bad season and place them on their flat side. This ingenious arrangement renders the animal less susceptible to the action of the cold, gives a better bedding to the shell, and prevents it from being too easily shifted from its position by the inflow of the coming and the suction of the receding wave.

MM. Grangeneuve & Co. also possess an establishment which deserves special mention. M. Grangeneuve has solved the difficult problem of raising the oyster in nursing-frames from its birth up to the time when it is ready for the table, thereby reducing the very large expenses which are incident to the practice of this method. His establishment is a very fine one, and nothing has been neglected to make it one of the most complete at Arcachon.

The establishment of M. Grenier presents equally as much interest. M. Grenier is one of the oldest planters of the bay, and has rendered more than one service to the industry which he has pursued for so long a time.

MM. Brown and Goubie have introduced into their parcs an innovation by building the bottoms and sides of their claires of cement, which diminishes greatly the expense of maintenance necessitated in ordinary claires. These are costly to construct, are very strong, and are especially good in those localities where they are exposed to the violence of the sea.

M. Vidal, on the contrary, employs for the construction of his claires neither tiles, nor planks, nor cement. He has succeeded in establishing with mud and clay rammed and puddled embankments sufficiently consistent to resist the waves. It is true that the parcs of which M. Vidal is the proprietor in the Ile des Oiseaux are very much sheltered, and the application of this system, evidently economical, would not be possible for most of the concessions in the Bassin d'Arcachon.

Besides his parcs of production, M. Fillon controls a shipping-house very skillfully arranged, and in which he has made numerous and interesting experiments. M. Fillon is, moreover, one of those planters who conduct the oyster-cultural industry on a grand scale.

It remains for me yet to mention M. Surette and M. Gaston de Faramond, who give their unceasing efforts to the progress of oyster culture.

Before summing up with some statistical tables, I pause a moment to say that the products of Arcachon are not all as we see them commonly in our markets. Those minute oysters that the parqueur, impatient to realize on, sends to market as soon as they attain the prescribed dimensions of 5 centimeters, are to be regarded as subjects which have not attained their complete development.

There exist in the Bassin d'Arcachon 3,317 parcs, giving employment to 3,394 persons, and occupying an area of 3,836 hectares. The pro-

ducts during the season of 1873-'74 rose to 42,542,650 oysters of 5 centimeters in diameter; during that of 1874-'75, to 112,705,233 oysters of the same dimensions; and during that of 1875-'76, to 196,885,450. The value of the oysters sold in 1875-'76 was 3,941,309 francs.

I have now arrived at the end of my work. I have doubtless sometimes forgotten to notice establishments well worthy of interest, and localities where, as at Tréguier and at Paimpol, the oyster-cultural industry is prosperous, without, however, offering to the observer any new facts to study or any useful indications to report. I would not say more, but I do not wish to close without referring to the realization this year of the fruitful idea which the department of the marine, always in quest of wise progress, has steadily pursued—the idea of the transformation of the salt marshes into claires for the growth of the oyster. If, Monsieur the Minister, the attempts that your administration has so happily undertaken at Croisic have an issue definitely favorable—and the success of this first season causes me to hope for it—a new and brilliant future is reserved for oyster culture.

The conversion of salt marshes into oyster establishments will, in fact, insure a large outlet to that excess of production which embarrasses each year the oyster-culturists of Arcachon and of Bretagne.

It will be a beneficence, moreover, which our western population will owe to the marine, which has already done so much for them; and our whole country will find some profit, when these marshes which the salt industry has abandoned recover in a new way their ancient prosperity.

Permit me, Monsieur the Minister, before closing this report, to address my grateful thanks to MM. the commissaries and agents of the marine, with whom I have been brought into intercourse. I owe this public testimony of having always found in them the most zealous desire to facilitate my task, joined to that refined courtesy of which the marine has preserved the tradition.

With the expression of my gratitude, be pleased, Monsieur the Minister, to accept, etc.

PARIS, *December 29, 1876.*





# INDEX.

	Page.		Page.
American oysters .....	44	Clairens at Marennes .....	36
André, François, oysters at Grand-Camp ...	6	Martray .....	34
Apparatus, collecting, at Le Vivier .....	15	Sables d'Olonne .....	32
Arcachon .....	23, 84, 87	of cement .....	46
oyster-culture at .....	40	mud and clay .....	46
most extensive .....	40	bottom transformed .....	43
statistics .....	46	Collecting apparatus at Le Vivier, success ..	15
supply to La Hougue .....	8	Collectors, method of counting .....	26
Assessments at Cancale .....	15	removal of .....	25
Association of La Trinité, Sea-fishermen's ..	27	used at Le Vivier .....	16
Auray .....	17, 18, 21, 23, 24, 25, 26, 28, 29, 31, 32, 88	by Thévenard .....	25
oyster-culture at .....	23	Coste, M., experiments of, in 1857 .....	18, 19
condition .....	27	his part in new industry .....	2, 3
statistics .....	27	report of, in 1858 .....	2
spat brought from .....	21	visit to Lake Fusaro .....	2
Barbot, M., collecting apparatus .....	15	zeal of .....	24
Barnacles at Le Vivier .....	16	Couleige, bedding grounds at .....	8
Bélon .....	26	Courseulles .....	11, 18
oyster-culture at .....	20	Courseulles-sur-Mer, oyster-culture at .....	4
Bernon, oyster-bed at .....	29	oyster-culture, produc- tion .....	5
Bior-d'Ars, Bay of .....	83	Crach River .....	24
Blanchard, M .....	37	Crastorbe .....	42, 43
Blavet, oyster-beds of .....	22	Croisic .....	47
Bon, M. de, oyster-culture, report in 1876 ..	2	Cuban, Island of .....	26
(note) .....	2	Cultch at La Tremblade .....	38
success .....	3, 17	from Brittany .....	35
spawn-collector of .....	2	D'Argy, M .....	25
Bouchon-Brandely, G., report on oyster-cult- ure .....	1	Dauriac, Commissary-General .....	18
Brénéguy, establishment of the .....	25	Decrees of 1852 .....	3
Brest, oyster-culture at .....	18	Depots at Marennes .....	36
Bretagne .....	37, 47	formerly at Sables d'Olonne .....	32
Brittany, cultch from .....	35	Detaching young oysters .....	27
oyster-breeding in .....	31	Difficulties in oyster-culture .....	9, 10, 14, 15, 16, 18 34, 35, 44, 45
spawn to Grand-Camp .....	7	Dives, supply to La Hougue .....	8
supply to La Hougue .....	8	Dolus, parcs at .....	35
Brown, M .....	46	Drag-net fishing for oysters .....	28
Camac, M .....	17, 18	Dupeux-Boyer, M .....	33, 34
Cancale .....	2, 10, 18	Eden, M .....	27
oyster-culture at .....	13	Enemies of the oyster .....	9, 14, 15, 16, 18, 34, 35, 45
difficulties .....	11, 15	Exhaustion of planting grounds .....	9
number engaged .....	14	Experiments of Madame Felix upon oyster reproduction .....	12
relative rank of oysters .....	13	Faramond, M. de .....	37, 38
supply to La Hougue .....	8	Faramond, Gaston de .....	46
syndicate to fix assessments .....	15	Fardit, M .....	27
Central Society for the Shipwrecked .....	41	Fattening of oysters at Sables d'Olonne ..	32
Charles, MM .....	22, 23	Fébyre, M., at Grand Camp .....	6, 7
Chaumel, M .....	28, 29	Felix, Madame Sarah, oyster parcs of .....	11
Chélas & Co., establishments of .....	29	experiments upon oys- ter reproduction .....	12
Claire, number of oysters contained (note) ..	33		
Clairens at La Tremblade .....	38		
Lahillon .....	42		

	Page.		Page.
Felix, Madame Sarah, new apparatus.....	16	Les Sables d'Olonne.....	31, 32
Fillon, M.....	46	Le Travailleur, ship.....	42, 43
Fish culture in France, success of.....	1	Le Verdon.....	39
Fort Samson.....	6, 7	Le Vivier.....	12, 14, 18
Fosse-Mort, oyster-culture at.....	17	oyster-culture at.....	15
Fusaro, visited by Coate in 1851.....	2	Liaizard, M.....	29
Gaboriau, M.....	35	Lorient.....	24
Gervinais, M. de le.....	17	delicacy of oysters.....	23
Gironde.....	40	oyster-culture at.....	22
Gouble, M.....	46	Ludré, annual oyster production.....	31
Grand-Camp.....	18	establishment of.....	29
oyster-culture at.....	6	oysters sent to.....	31
spawn from Brittany..	7	McDonald, Marshall, translator.....	1
quality of oysters.....	7	Mauduit, M. de.....	20, 21
Grangeneuve & Co.....	46	Marennes.....	31, 34
Granville.....	13	oyster-culture at.....	35
oyster-culture at.....	9	Martin, M.....	25, 27
protection.....	10	Martray.....	83
oysters furnished.....	10	claires of.....	34
roughness of sea.....	10	Michel, M., engineer.....	22
variety of oysters.....	10	Monnier, M.....	33
Greening of oysters at La Tremblade.....	38	Mont-Saint-Michel, Bay of.....	13
Marennes.....	35	Montaugé Bros.....	44
Martray.....	34	Morbihan.....	24, 27, 28
causes.....	36	supervision at.....	29
favorable locality.....	39	Moulin-Blanc, Le.....	19
in shallow claires.....	36	Moulinatte, La.....	34
Grenier, M.....	46	Murel.....	18
Greasy, Dr., establishment of.....	26	Mus-de-Loup, favorable to oyster-greening.....	39
Growth of oysters at Bélon.....	21	Mussels at Le Vivier.....	16
Sables d'Olonno.....	32, 33	the scourge of Isle d'Oléron.....	34, 35
Guinebaut.....	7	Noirs-Moutiers.....	32
Hennebont, River of.....	22	Observations of M.M. Mauduit and Solmin- ihac.....	21
Île des Oiseaux, oyster-culture at.....	43	Oléron, island of.....	31, 34
Illure, Isle of.....	29	Ostende.....	7, 23
Isle d'Oléron.....	31	Oyster-beds at Brest, supervision of.....	19
oyster-culture at.....	34	Granville despoiled.....	10
Isle de Ré, oyster-culture at.....	33	breeding in Brittany.....	31
Jacquets, parcs of.....	41, 43	depots at La Hougue.....	8, 9
Jourdes, M.....	37	enemies of.....	34, 45
Kerlud Creek.....	26	fishing at Le Cés.....	41
Kistinic, Isle of.....	29, 31	foot-fishing at Cancale.....	14
La Costaisac, oyster-bed of.....	12	La Hougue.....	8
La Courant.....	34, 35	greening at Cuhau.....	26
Lahillon, oyster-culture at.....	42	Grand-Camp.....	7
La Hougue.....	13, 18	La Tremblade.....	38
oyster-culture at.....	7	Marennes.....	35
oyster bedding-grounds.....	4	Martray.....	34
planting-grounds exhausted.....	9	causes of.....	36
oysters sent to Couraoules.....	5	in shallow claires.....	36
La Manche, oysters sent from.....	4	most favorable locality.....	39
Lamazelle, M. de.....	29	native or vagabond.....	34
La Rochelle.....	40	Oyster parc at Cancale.....	14
La Trinité Association.....	27	of M. Pozzi.....	30
oyster-culture at.....	23	parcs at Bélon.....	20
La Tremblade.....	31, 43	Couraoules described.....	4
oyster-culture at.....	38	Grand-Camp described.....	6
Le Beau, M.....	37	Granville described.....	10
Le Cés.....	41	La Hougue.....	8
Le Chateau, oyster parcs at.....	36	Le Chateau.....	85
Leclair, M.....	27	of Mad. S. Felix.....	11
Lerne, Isle of.....	29, 31	production at Oléron.....	35
Leroux, MM.....	27	reproduction, experiments at Le Vivier.....	15
Eugene, invention of.....	25	reproduction in confinement.....	12
growth at establishment of Dr.....	33		
Les Chasses.....	32		

	Page.		Page.
Oyster reproduction in shallow tide-water . . . . .	2	Oysters at Courseulles, classification . . . . .	6
spawn, collection of, at Cancale . . . . .	14	fattening . . . . .	5
device to preserve . . . . .	2	training . . . . .	5
treatment of, at Grand-Camp . . . . .	7	Granville, variety . . . . .	10
spawning in captivity . . . . .	44	La Hougue, growth . . . . .	8
system of, pits . . . . .	22	Le Vivier, growth . . . . .	16
training at Cancale . . . . .	13	number . . . . .	16
unusual growth at Le Vivier . . . . .	17	Lorient qualities . . . . .	23
Oyster Cultural Union . . . . .	22, 41, 43	Sables d'Olonne . . . . .	33
Oyster-culture, a model establishment . . . . .	22	number produced . . . . .	33
at Arcachon . . . . .	40	detaching the young . . . . .	27
complete . . . . .	41	injured by saltness . . . . .	44
statistics . . . . .	40	solar heat . . . . .	45
Auray . . . . .	23	most productive natural beds . . . . .	10
condition of . . . . .	27	poisoned by mud . . . . .	9
methods . . . . .	24, 25	Portuguese . . . . .	35, 39, 44
Bélon . . . . .	20	preparation for transporting . . . . .	37
Brest . . . . .	18	protection . . . . .	3, 10, 13, 14, 15, 19, 24, 29
protection . . . . .	19	removal from tiles . . . . .	12
Cancale . . . . .	13	"sulky " . . . . .	21, 31
difficulties . . . . .	15	turned over for storms . . . . .	45
number employed . . . . .	14	Paimpol . . . . .	47
Courseulles . . . . .	4	Parcage, length of, at La Hougue . . . . .	8
Fosse-Mort . . . . .	17	Paul, M . . . . .	29
Grand-Camp . . . . .	6	Péponnet, M . . . . .	39
Granville . . . . .	9	Platel, M., account of oyster-culture at Morbihan . . . . .	24
number of men employed . . . . .	10	Portuguese oysters . . . . .	35, 39, 44
Ile des Oiseaux . . . . .	43	great size of (note) . . . . .	39
Isle d'Oléron . . . . .	34	introduced into France . . . . .	40
Isle de Ré . . . . .	33	Pozzi, M . . . . .	27
Lahillon . . . . .	42	establishment of . . . . .	29
La Hougue . . . . .	7, 9	oyster parc of . . . . .	30
La Tremblade . . . . .	38	system of oyster-culture . . . . .	30
La Trinité . . . . .	23	Protection of oyster beds at Cancale . . . . .	13, 14, 15
methods . . . . .	26	Granville . . . . .	10
Le Vivier . . . . .	15	Quimper . . . . .	21
Lorient . . . . .	22	Rance, oyster-beds in mouth of . . . . .	2
Ludré . . . . .	29, 31	re-established . . . . .	17
Marennes . . . . .	35	Rearing of oysters at Sables d'Olonne . . . . .	32
since 1873 . . . . .	37	Regnéville . . . . .	10
statistics . . . . .	38	natural elements of success . . . . .	13
Regnéville . . . . .	11	oyster-culture at . . . . .	11
Sables d'Olonne . . . . .	31	Removal of oysters from tiles . . . . .	12
Vannes . . . . .	28	Report relative to oyster-culture, etc. (title) . . . . .	1
two branches . . . . .	29	Sables d'Olonne, oyster-culture at . . . . .	31
Verdon . . . . .	39	depots, formerly . . . . .	32
disappointments at first . . . . .	3	Sainte-Anne, Society of . . . . .	27
fostered by Government . 2, 3, 10, 13, 14, 15, 19, 24, 29	2	Saint-Joseph, establishment of . . . . .	44
in France, progress of . . . . .	40	Saint-Malo . . . . .	10
most extensive . . . . .	2	oyster-beds in roadstead of . . . . .	2
number engaged in 1876 (note) . . . . .	3	Saint-Philibert, river . . . . .	27
on the British Channel . . . . .	1	Saint-Servan, visited by Coste in 1857 . . . . .	2
origin of . . . . .	1	Saint-Trojan, oyster parcs at . . . . .	35
renewed by private persons . . . . .	3	Saint-Vaast la-Hougue . . . . .	4, 5, 7, 9, 13, 18
success of M. de Bon . . . . .	3	Saltiness injurious to oysters . . . . .	44
Oysters, all kinds together . . . . .	37	Sea-fishermen's Association of La Trinité . . . . .	27
American . . . . .	44	Seudre, river . . . . .	37
at Arcachon, native . . . . .	41	Siennes . . . . .	11
Bélon, growth . . . . .	21	Sinche, Bay of . . . . .	37
number produced . . . . .	22	Society for the Shipwrecked, Central . . . . .	41
qualities . . . . .	20	of Sainte-Anne . . . . .	27
Oysters at Cancale, protection . . . . .	13, 14, 15	Solminhac, M. de . . . . .	20, 21
		Spawn-collector of M. de Bon . . . . .	2
		Statistics of Arcachon . . . . .	46

	Page.		Page.
Statistics of Auray.....	27	Tarlare, M.....	22, 23
Marennes.....	38	Vallé, M.....	12
Sulky oysters, fattening of.....	21, 31	Vannes.....	24, 27
Sun's heat injurious to oysters.....	45	oyster-culture at.....	28
Surette, M.....	46	Venot, M.....	41, 44
Syndicate to determine assessments at Can- cale.....	15	Venot & Co.....	43
Tagus, Portuguese oyster from.....	39	Verdon, oyster-culture at.....	39
Ter, river.....	22	Vidal, M.....	46
Thévenard, M. de, establishment of.....	24	Villers, Meury de.....	15
Thomas, M., experiments of.....	19	Vincent, M.....	29
Tiles, removal of oysters from.....	12	Viviers at La Tremblade.....	38
Toquaise.....	8	Marennes.....	36
Trays for oyster-spawn at Grand-Camp.....	7	Vivier-sur-Mer.....	12, 14, 15, 18
Tréguier.....	47	Whelks, boring.....	18
Tripota, M.....	39	Wolbock, Baron de.....	27