XXXI.—A REPORT ON OYSTER-CULTURE IN THE MEDITERRANEAN.*

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OYSTER-CULTURE IN ITALY.

It is to Italy we are indebted for the idea of establishing in France that branch of industry, so flourishing at the present time, known as oyster-culture. The Romans were the first to engage in the cultivation of the oyster, and their methods, inherited by the Italians, have come down to us without any modification. The method of cultivating this mollusk at Tarente to-day is the same as that practiced in the time of Sergius Orata. In 1853 M. Coste visited Fusaro, and from that remarkable journey of scientific exploration, it is said, he brought back the elements of the new industry to which science has assigned general rules that have since been improved upon by practice. But if, prior to that time, an exceptionally fine flavor was given to the precious bivalve at Marennes, Courseuilles, and Cancale, by a special treatment, we were still ignorant of the processes of taking the spawn and of supplementing the loss occasioned by the continued impoverishment of the beds on our coast, the sources of production which had formerly been erroneously supposed to be inexhaustible.

Oyster-culture, properly so called, is carried on in Italy in only one locality, Tarente. The celebrated Lake Fusaro, to which I will devote a few words hereafter, has become sterile and has been abandoned. The oysters consumed in Italy, beyond those received from Tarente, come from the gulfs of Genoa and Naples, from the coasts of the Adriatic, and from the ponds of Corsica.

The Gulf of Genoa produces small and delicate oysters, which are

* Rapport au Ministre de l'Instruction publique sur la Pisciculture en France et L'Ostréiculture dans la Méditerranée, par M. Bouchon-Brandely, Secrétaire du Collége de France. Paris: A. Wittersheim et C^e^., Quai Voltaire, 31, 1878, (Extrait du Journal Officiel des 16, 17 et 18 Mai 1878.) small 8 vo. pamphlet, pp. 103. Only that portion of the report devoted to oyster-culture in the Mediterranean (pp. 45–103) is reproduced here.

held in high repute. At Naples, near the rocks of Castel, and in other deeper parts of the gulf, oysters similar to those of Genoa, are still found, which are designated, scientifically, under the name *Ostrea plicatula*. At neither Genoa nor Naples are the banks sufficiently well stocked to permit the use of the drag, with profit, in gathering oysters. The fishermen take them by hand, sometimes at a considerable depth. The products of this fishery are entirely consumed in the vicinity. Rome, Florence, and the large towns of the peninsula receive a part of their supplies from Brindisi and Venice, at which places some natural beds exist. The oysters from these beds belong to the common Mediterranean species (*Ostrea edulis*).

LAKE FUSARO, NEAR NAPLES.

There is no necessity of our entering here into a retrospective examination of the industry of Lake Fusaro. M. Coste, in the learned report he has published concerning his mission to the shores of the Mediterranean, has performed this task better than I could do it. But I have thought it proper not to leave Naples without first endeavoring to ascertain the causes which have occasioned the sterility of this ancient lake and the loss of its secular industry. The principal cause, as well as the oldest and most incontestible one, which has at all times occasioned the greatest disasters, results from sulphurous emanations arising over certain portions of the bottom during the eruptions of Mount Vesuvius. At such times as these all of the inhabitants of the lake are imperiled, but shell-fish suffer most because of their inability to get out of harm's way. At various periods of eruption the oysters of Fusaro have been very nearly exterminated, but so great has been their fecundity that only a few years were required to enable the lake to recover its normal productiveness. In addition to this natural and inevitable cause, there are others of more recent origin and less extent, among which may be cited: (1) the accumulation of vegetable and animal refuse which has fouled the bottom; (2) the too extensive cultivation of mussels; (3) the excessive saltness of the water; and (4) the insufficient supply of fresh water. Finally, in 1856, the Neapolitan Government, with a view to rendering Lake Fusaro more healthy—as its marshy water propagated the malady so common in certain parts of Italy, viz., malaria—caused a new canal to be dug at the extremity of the lake, in order to secure, to the greatest possible extent, the renewal of the water. It is claimed that this work hastened the decay of Lake Fusaro. The contact of this new current with the old resulted in the stirring up of the materials that had been accumulating in the lake for many years. Sands were brought down by the current, thus changing the nature of the bottom. The oyster-culturists, after vain endeavors to overcome this new misfortune, abandoned their concessions, and in the year 1869 the last oysters disappeared from Lake Fusaro.

TARENTE.

From the earliest times the maritime population of Tarente has busied itself in the cultivation of oysters and mussels. This industry is carried on in salt ponds which border the city on the west, and to which the name of "Little Sea" has been given. Being connected with a roadstead or open sea, by means of a narrow channel, sufficiently large, however, to insure the renewal of the water, the Little Sea (*piccolo mare*) presents the most favorable conditions for the production of shell-fish. The productiveness of this portion of the coasts of the Ionian Sea is proverbial; fish and shell-fish of all kinds occur there in abundance, and in addition to the species which are also common to the Mediterranean and the Atlantic coast of Europe, it likewise possesses certain other varieties peculiar to itself. The Little Sea, which is quite well sheltered from the sea winds by the eminence on which the city of Tarente stands, is also protected against the winds from the interior by the range of hills in the midst of which it lies. It measures twelve miles in circumference, and is six miles wide in its broadest part, that is, from the gate of Naples to the convent of San Francisco (*Battentiere*). Its waters are pure; the bottom is composed of calcareous sands, and the shores at intervals are covered with sea-weed, which the fishermen do not molest, and in which many different species of fish come to spawn and find shelter. The depth of the Little Sea is relatively great and its shores are narrow. In its deepest part it measures 17½ to 18 meters (about 55 feet). At 2 or 3 meters from the shore (6½ to 10 feet) it is about 1 meter (3¼ feet) deep, and thence it gradually deepens until at 200 meters (650 feet) from the shore it is about 6 meters (19½ feet) deep. Seven small streams whose sources are near at hand flow into the Little Sea, five into the upper part and two into the lower. The most important of these are the Galésio, the Oro, so called from the particles of gold brought down by it, the Battentiere, and the Adeja. The Little Sea receives, moreover, the waters of submarine springs, one of which, the Citrello, has been pointed out by geographers and is very well known; it rises nearly in the middle of the sea at a great depth, but with such force as to agitate the surface over a space more than 100 meters (325 feet) in diameter. The quantity of water supplied by this spring must be considerable, and it is even conjectured by some to be a veritable river which rises there. It is these bodies of fresh water that insure the prosperity of pisciculture; for during the months of July and August the heat is so great at Tarente and the evaporation so rapid in the Little Sea, that the water would soon become too salt for the oysters to live in it.

The temperature of the water in the Little Sea rises in summer to 27° and 28° C., and even higher at times; on the 15th of September, at 7 o'clock in the morning, my thermometer indicated 25° C. Its density varies greatly, according as the examinations are made near to or at a

distance from the places where the fresh water enters; three or four hundred meters (975 to 1,300 feet) below where the Citrello emerges I found the hydrometer indicated 2¼°, while over the oyster and mussel parks it marked from 2¾° to 3°; in the roadstead, which likewise receives the fresh water of the Citro, and near which are situated the oyster beds that furnish the young oysters, I found an indication of 3°. It was not without astonishment that I became convinced that oysters could live and thrive in water as warm as that of the small sea of Tarente; for it had generally been admitted that their preservation was impossible in water exceeding 23° or 24° C.* In support of this assertion it was customary to refer to the oysters of Lake Fusaro, which died in large numbers whenever the temperature of the water reached such a height as this. But in reply it may be argued that the oysters of Lake Fusaro die rather in consequence of the action of volcanic emanations, or of sulphurous gases, which, under the influence of a high temperature, escape from the decaying animal and vegetable remains accumulated at the bottom of the lake. From this fact it is evident that the heat of the water on the French Mediterranean coast is not as insurmountable an obstacle to the establishment of oyster parks as has been asserted.

The Little Sea of Tarente is leased by the city to a company that pays for it an annual rental of 38,000 francs ($11,600). The oyster and mussel parks are situated in the lower part, where the currents unite, always bringing with them fresh nourishment and an ever-changing supply of water. They are thirty-five in number, twenty-one for oysters and fourteen for mussels. Each oyster park measures from three to four hundred paces on each side. The mussel parks are much more spacious, their extent equaling from two to three times that of the oyster parks. The latter are farmed out by the company to the fishermen, who devote themselves to the culture of the mollusks, at the rate of one franc (20 cents) per seven palmes (about 6 feet). All concessions are marked off by strong posts driven into the bottom. In the spaces included within this first line of division there are other parallel lines of posts, arranged at intervals of fourteen palmes (about 12 feet). Of their uses we shall hear more further on.

MUSSEL-CULTURE.

Bouchots are entirely unknown at Tarente; and it is even doubtful whether they would yield favorable results in the sea at that place. The larval mussels are gathered on the spot by means of cords arranged horizontally very near to the spawning mussels, which lie on the bottom and are connected by slight agglomerations. This reserve is placed, as nearly as possible, in the most suitable location for it, and where it is least liable to suffer from the encroachment of mud. It is also necessary to avoid placing it at too great a depth, for mussels will not repro-

* Professor Oronzio Gabrielle Costa, Del Fusaro.

duce deep down in the water. From time to time, as the mussels increase in size, the reproducers are changed for others which the fishermen get from the crop of each season. The cords used to gather the young mussels are made from rushes or "alfa"; each of their extremities is fastened to a stake, and their length depends upon the depth at which they are to be immersed, it being required that the tangent of the arc which they describe should lie close above the bed containing the reproducing mussels.

The mussel spawns in March or early in April, and reproduces so rapidly that the cords used as collectors soon become loaded with young ones. The collectors are allowed to remain down six months before they are taken up to make a selection, the object of which is to remove the mussels when they attain the size of a small almond. Those selected are then interlaced, either in bunches or singly, with the strands of the ropes, and these ropes are fastened to others stretched horizontally between stakes placed at suitable distances apart, so as to fall vertically into the water.

In selecting the mussels from the collectors, those which have not yet attained the required size are allowed to remain, and the collectors are thrown back into the water. The following season these will have grown large enough to serve as food. The rearing places are in deep water; parks even are utilized which extend eight or nine hundred meters (2,600 or 2,925 feet) into the sea; the cords bearing the mussels are also sometimes nearly forty palmes (about 30 feet) long; so that, at least as regards Tarente, breeding may be well accomplished in shallow water, while the rearing should be carried on where the depth is greater.

The little sea of Tarente produces two kinds of mussels, the common mussel and the red mussel (*Modiola barbata*). The latter is preferred, and is much more valuable. The red mussel and the white mussel multiply and abound in nearly equal proportions; nevertheless it would seem that the white mussel is endowed with greater fecundity, and can be kept fresh, out of water, for a longer time. A park will furnish, on an average, from four to five hundred quintals of mussels every year, the wholesale price of which is 11 francs ($2.20) per quintal.

OYSTER-CULTURE.

The arrangement of oyster parks is like that of the parks for mussels, with this difference, that they do not generally extend quite so far into the sea. Beyond certain depths oyster culture presents great difficulties and entails great expense. These parks are divided by stakes into equal squares of fourteen palmes (12 feet) on each side. They are entirely devoted to the raising of oysters. Breeding cannot succeed there on account of the large quantity of mud brought down by the current into the lower part of the Little Sea. Nevertheless, the adult oysters accomplish their generative functions there; but the young ones, on leaving the mother oyster, do not find collectors suitable to receive them and fall

down upon the muddy bottom; the stakes of the parks and the cords which they sustain are speedily covered with a thin layer of mud, which prevents the young oysters from adhering. Moreover, in the upper portion of the Little Sea isolated oysters, called "horse-feet," are sometimes found in the natural state, and these seem to leave traces of their spawning, doubtless on account of the purity of the water and the cleanliness of the bottom. But these mollusks are constantly displaced by the currents, and it would be quite hazardous to count upon a regular harvest of young ones. This kind of oyster, which is still found in very small numbers in the roadstead, is highly esteemed by the Tarentians, who sell them for 15 to 50 centimes ($\frac{3}{4}$ to $2\frac{1}{2}$ cents) apiece. The beds near which the oyster-culturists of Tarente have placed their collectors are situated in the large sea. It is not known whether these beds are of large extent or merely small aggregations; their exact limits as well as their actual situations are unknown. In the month of May the fishermen submerge fascines about two miles from the shore to serve as collectors. Stones attached to cords serve to keep them down at a suitable depth in the water, and they are found and recognized by means of pieces of floating cork. The fascines are examined fortnightly or monthly. Those which do not have a sufficient quantity of young oysters upon them are returned to the water after they have been cleaned of the mud that may have collected between the branches, and of all parasites which may have grown thereon, by leaving them exposed, for one or two days, to the heat of the sun. Those, on the contrary, on which the young oysters have attached themselves in large numbers, are immediately transferred to the parks of the Little Sea.

The spawning season in the Gulf of Tarente is of exceptional length; it begins early in May and does not end until the close of September; and the yield, dependent upon the character of the year, may be abundant either at the beginning, at the middle, or at the end of this period; there is nothing fixed as regards this. Upon their arrival at the park the fascines are suspended from cords stretched from one stake to another, and kept in the water at a depth of one, two, or three meters (3 to 10 feet). After having been there six months, the young oysters have already attained a length of two or three centimeters (about an inch). The time has now come to give them more space, and to place them under more immediate oversight; the fascines are untied, the branches taken apart, and those bearing oysters are placed between perpendicular cords similar to those used for mussels. The young oysters which are detached during this operation are placed either in baskets, on screens, or in nets suspended from the horizontal ropes, but never on the bottom. This system of breeding avoids general mortality. At least every four months the cables and other apparatus carrying the young oysters are taken up and examined. Those oysters which have become large enough to sell are removed, and advantage is taken of this opportunity to give those which ought to remain some time longer in the park the cleaning and

care which they need. The growth of the oyster takes place rapidly and regularly; from two to two and a half years suffice for the young oysters to reach a diameter of from 7 to 8 centimeters (about 3 inches).

The oyster of Tarente is of good growth; its shell is usually rather thick, this being due to the great amount of calcareous matter contained in the sea-water. This peculiarity, however, in no way impairs the regularity of its form.

The number of oysters obtained each year from the parks of Tarente is estimated at about 10,000,000. Before forwarding them they are exposed to the air for twenty-four hours, in order that they may be the more easily cleaned afterwards. The sale of oysters is absolutely free, whatever may be their size, or the season. But it is unnecessary to state that during the summer, the period of gestation, oysters are never sold. It is, moreover, to the advantage of the fishermen that their oysters should have attained a good size before being offered for sale.

The prosperity of the fishermen of Tarente is, unfortunately, disturbed from time to time. From a volcanic excavation situated below the convent of Saint Antoine, and which is obstructed during long periods of time, surges sometimes a boiling sulphurous spring, which flows down into the Little Sea. As soon as this phenomenon manifests itself, consternation spreads among this population of ten thousand fishermen, who live exclusively upon the products of the sea. The Little Sea then takes a reddish tint; the water of the springs, lighter than that of the sea, is rapidly transported by the currents. The fish are able to flee from this pest, but the oyster, the mussel, and shell-fish in general are quickly poisoned. When the water is in this state the fishermen call it "the sea of blood." This fortunately happens only at rare intervals; but, nevertheless, within the past twelve years it has taken place twice; formerly it had become almost a legend, for it had not occurred within the memory of man.*

* OYSTER-CULTURE IN NORWAY.—The work lately undertaken in Norway by Lieutenant-General Wergeland, formerly minister of war, enables us to further extend the comparative study of the methods of oyster-culture in the different seas.

There are remarkable differences between the processes in use in the Mediterranean and in the ocean, but these differences can only be the more sensibly realized if we go as far as the North Sea. Hitherto, Vivier-sur-Mer, in the bay of Mont-Saint-Michel, seemed to be the most northern limit where oyster culture assumed all its phases, for, if at certain more northern points on the Norman coasts, and at a few stations on the southern and eastern coasts of England, young oysters have been taken by the aid of scientific appliances, the means of preserving the spawn are still to be discovered and these experiments have not been practically applied.

Considering the latitude of Norway, the intense cold which prevails there during a large part of the year—cold so intense that sometimes the spawning of the oyster on the natural banks is without results for several seasons; and, moreover, considering the distance of Norway from those countries from whose experiences she might profit, and from which she might obtain information, it will be readily seen how numerous are the difficulties to be overcome in the establishment of oyster culture on the shores of Norway. General Wergeland was not deterred by these obstacles. After carefully consulting works relating to oyster culture which had been published in foreign coun-

TOULON.

The roadstead of Toulon presents, on first examination, most favorable natural conditions for the cultivation of oysters, mussels, and edible shell-fish in general. All the edible species common to the Mediterranean occur there, and it produced, moreover, in the early part of the present century, very fine oysters. Gradually, however, the exhaustion of the natural beds there began to be felt, as was the case with most of

tries, and procuring exact data from M. Théodore Soelfeldt, who had come to Paris to study the French industry, he resolutely set to work in the month of April of last year.

Various circumstances appeared to him encouraging: first, the presence of the oyster in the North Sea; second, the small amount of salt contained in the water of that sea; third, the favorable influence of the Gulf-stream on the climate of these regions, and finally, the ease with which shelter may be found in the numerous *fjords* which cut into the shores of the peninsula of Norway. A bay situated a few leagues from Christiania (toward the fifty-ninth degree of north latitude) was the spot chosen for the experiment. It was necessary to guard against the inconveniences resulting from the early setting in of winter, from the slight rise and fall of the tides, which at the sysygies rise but a foot or a foot and a half, and from the violence of the storms which sometimes displace a volume of water more than 7 feet in depth. On the arrival of winter in Norway, that is to say, toward the beginning of September, the young oysters are still too young to resist the shocks and sudden changes of temperature. It was, therefore, of the greatest importance that they should not come into contact with the outer air. These difficulties were surmounted in the following manner: In the upper part of the establishment a supply reservoir, fed by a pump, worked by wind, was dug. Immediately beneath, within a house which protected it from the rigor of the cold, was placed a basin for holding the eggs, measuring 8 meters (26 feet) in length by 6 meters (19 feet) in width. A leaden conduit, furnished at its upper part with a grating fine enough to stop the passage of harmful fish, and in its lower part with faucets to regulate the supply of water at will, brought the two reservoirs into connection with one another. This tube took several windings and passed through an inclosure filled with water, which could be heated when necessary so as to maintain the water supplied to the hatching basin of a nearly uniform temperature. The level of the water in this latter basin was regulated by means of a tube, the opening of which was covered with a filter to prevent the escape of the young oysters. In this basin 2,200 female oysters were placed at the commencement of the season, and, although they had undergone the fatigue of a long journey, they emitted such a quantity of spawn that it was found upon the collectors by which they were surrounded.

This first experiment, as will be seen from the above, succeeded well, and the system invented by General Wergeland for obtaining larval oysters in inclosed places could be developed to any desired extent. The General intends to try and obtain the spawn of free oysters, if the season be mild enough to permit, by surrounding with fascines a natural oyster bed that has been recently explored. He proposes subsequently to inclose the young oysters in floating preservative boxes, and to raise them on the spot.

The labors, works, and schemes which I have just explained are due to the initiative taken by General Wergeland, whose laudable ambition it is to render to his country the same services which M. Coste has rendered to France. He is now engaged in restocking by means of pisciculture the large and beautiful lakes of Norway. If he succeeds, as there is every reason to believe he will, his country will be indebted to him for the introduction of a branch of industry for which there is a great future in store.

the banks along our coasts, and the deposits which had been of considerable importance were speedily exhausted. The oysters now taken at Toulon are isolated ones found in the crevices of the rocks.

Did the ruin of these banks arise from excessive and unlimited fishing, or must we attribute it, as at Brest, to the successive transformations which the submarine soil must have undergone, in consequence of the great works performed in the bay, and the repeated dredgings which stirred up the sand and the mud, and covered up the solid objects to which the oysters might have attached themselves? All have, doubtless, contributed to this result; but it is certain that at the same time the oysters disappeared, several other edible shell-fish, the mussel, for instance, became rare, and certain migratory fish which usually visited the shores of Toulon, as well as some stationary species, deserted the coast. This state of affairs aroused the solicitude of the marine administration. The labors of M. Coste had just then been meeting with great favor in France. Numerous attempts to introduce into our waters the oyster-cultural methods, brought by that gentleman from Italy, were repeated at various points along our sea-coast. The task of renewing the oyster banks of the roadstead of Toulon, and of making oyster-cultural experiments there, was confided to M. Coste about the year 1859. He proceeded in the following manner: Spawning oysters, with which he hoped to accomplish the restocking, were brought from England and Arcachon, and planted, some at points that had been previously explored, and found to be most favorable for the preservation and increase of the mollusk, especially near Seyne, the others in suspended baskets. Collectors, consisting of fascines or pieces of wood, were placed around the reproducing oysters. The oysters distributed in the improvised parks and those contained in the baskets acted differently; the latter spawned abundantly, and grew rapidly during the entire summer; the others spawned but little, or at least their spawn was without vitality; they thrived miserably during the season following their spawning, and finally perished. This was the fate of them all. This result, though not a negative one, having been deemed unsatisfactory, the experiments were, too hastily perhaps, abandoned.

In order that the fatal influences should not always exist as a check to oyster culture in the Mediterranean in the future, it is expedient to seek the causes that have led to them. In the first place, it must be remembered that M. Coste could not do everything. He had charge, simultaneously, of the attempts at oyster culture in the ocean and the restocking of our fresh-water streams; he was organizing a model fish-cultural establishment at Huningue, at the same time that he was pursuing in his laboratory at the College of France scientific researches, which he afterwards made known in his lectures; finally, he was engaged in the preparation of interesting reports. He was thus unable to observe with all the necessary assiduity the different phases of the experiment, to watch its progress, and to modify it in case of need. Notwithstanding

the zeal and activity displayed by the persons to whom he had given his instructions, were they competent to fill the place of the master? Secondly, would it not have been preferable to choose as reproducers oysters from the Mediterranean, instead of the English oyster, whose fine quality and powers of rapid growth and fattening were incontestable, or the "*gravette*" of Arcachon, with its fine shape and exquisite flavor? These oysters being accustomed to the waters of the ocean, which differ greatly both as regards saltness and temperature from those of the Mediterranean, it could not be expected that they would become acclimated without difficulty, and that the regularity with which reproduction took place in their native water would not be interrupted. The proof that these oysters were not suited to this place is the fact that no trace of them now remains there, while the indigenous kind, although few in numbers it is true, has survived. It has been objected that the varieties may have become confounded in one type, or, that those planted at Toulon may have become transformed and have acquired the character of the native oysters.

The first objection is very easily refuted. It is probable that the foreign variety may have undergone some modification, but this could not have been great enough to have deceived the experienced eye of a naturalist.

From these facts it must not be inferred that the acclimation of foreign oysters is neither possible nor advantageous. There are precedents which demonstrate the contrary, and it will be sufficient to remind the reader that the American oyster (*Ostrea virginiana*) has prospered well in the basin of Arcachon; that the Portuguese oyster (*Ostrea angulata*) now reproduces naturally in the lower Gironde, just as it does at Arcachon, and that it does not suffer from its forced residence in the parks of Saint Vaast-la-Hougue, where the water is very considerably colder than it is at the mouth of the Tage, of which this oyster is a native. In the third place, some indispensable precautions had been neglected. Thus, when the oysters were immersed, instead of being distributed and separated from one another, they were piled up in thick layers in the parks. It is known that the accumulation of too many individuals at one point is disastrous, unless the conditions for aerating the water are exceptionally favorable. The spawning oysters were also exposed to many other dangers. First, their habitation was soon invaded by mussels. This is by no means of rare occurrence; it takes place whenever the oyster and mussel are brought too near together. In the next place, on account of the difficulty of keeping the place of experiment perfectly clean, owing to the absence of tides in the Mediterranean, the mud and sand, constantly kept in motion by the currents, accumulated by turns, and the reproducing oysters which suffered at the outset, as shown by the small development which they acquired in their parks, finally perished. It is the opinion that this experiment should not be considered as decisive of what can be done in oyster culture upon our southern shores. I think

that if it were tried again with the more certain methods now employed the results would doubtless be encouraging. It is private enterprise, however, that should take the initiative, for to that in large part is due the great progress realized in the ocean, and the creation of oyster culture in France.

As I have before remarked, two varieties of oysters live naturally in the roadstead of Toulon.* First, there is the *Ostrea plicatula*, which also occurs at Genoa, Naples, and on the coast of Africa; and, second, the common Mediterranean oyster found at Narbonne, Port-de-Bouc, Aigues-Mortes, in the inclosures of Leucate, as well as at Tarente, and in the Adriatic at Brindisi and Venice. The first is a small oyster, which lives isolated or in groups attached to the rocks. It never forms, however, what is known as an oyster-bed; at least none are known on the coasts of France and Italy. The shell is small, rough, and irregular, seldom exceeding a large walnut in size. Its interior is pearly and of a slightly greenish tint, and the lower valve is very deep. This oyster is of an exceptionally fine flavor, which causes it to be much sought for. It is quite uncommon at Toulon. The second, if it were carefully parked and cared for, would not, as regards fineness and quality, be inferior to the best on our ocean coasts, and might compare favorably with the oysters of any region. The oysters of the pond of Leucate, the very rare ones taken at Narbonne and in the vicinity of the islands of Hyères, with those of the roadstead of Toulon, are the finest and best furnished by the Mediterranean. When properly cared for in a park they attain a size of from 10 to 12 centimeters (4 to 4¾ inches). The shell becomes light, translucent, hard, and well enameled on the inside; it emits a sound like crystal upon being struck. The lines of growth are indicated on the exterior by slight and delicate tubular folds. The oyster is well shaped, without being too large or too fat, and its exquisite flavor has earned for it a great reputation among the people of the south, a reputation which would not be merely local if oyster culture was in favor in the Mediterranean. Finally, I will add that between the Quimper oyster, which is excellent and of high repute, and the oyster of Toulon or Leucate, there exists the greatest analogy.

PENINSULA OF GIENS.

ESTABLISHMENT OF MESSRS. GASQUET.

Messrs. Gasquet were the first to seriously attempt putting into execution the happy idea of cultivating other shell-fish than the oyster and mussel, and the experiments which they have been making, with the most painstaking and laudable efforts, since the beginning of the year 1877, on the north coast of the peninsula of Giens, deserve to be made

*It is pretty generally admitted that the oyster called the "Pied de cheval" does not constitute a distinct species. It is supposed to be a common oyster that has grown old and large.

known. The oyster and the mussel are also among the mollusks raised at Giens. This marine establishment has been founded on the banks of a concession, measuring not less than 10 hectares (25 acres). The shores slope gently, and the sea-weed, with which they are almost everywhere covered, converts them, as it were, into marine meadows, similar to the "*crassats*" of Arcachon, which are known at Toulon by the name of "*mates*." The soil is formed of a mixture of clay, sand, and calcareous deposits. The proximity of aquatic plants for the raising of shell-fish and other fish offers undeniable advantages, particularly in the Mediterranean. In the ocean the breeding parks are, at times, almost entirely uncovered, and the tide furnishes them with well ærated water. The tide also brings to the shell-fish confined there abundant and fresh food from all directions. The case is different in the Mediterranean. At less than 50 meters (160 feet) from the shore, except during storms, the bottom is never brought into contact with the outer air, and the animals which have not the power of locomotion are forced to feed on little else than what grows upon the bottom within a very restricted area. But in the present case aquatic plants tend to render less noticeable the effects resulting from the absence of tides. They always set free a small quantity of oxygen and produce multitudes of microscopic insects, which furnish food to other animals. These were not the only considerations which induced the Messrs. Gasquet to establish themselves on the peninsula of Giens. The numerous kinds of shell-fish which took refuge in the gulf and the fine oysters occasionally found there were indications of the possibility of success.

In connection with the experiments of acclimation which the Messrs. Gasquet have made on the shell-fish brought from Cette, experiments which have given the most favorable results, I have thought it would be interesting to make known the chemical composition of the waters of the breeding-parks. The following is an analysis made in the laboratory of M. Schutzenberger, a professor in the College of France:

Sodium and potassium	11.02
Chlorine and bromine	21.61
Magnesia	3.03
Sulphuric acid	5.12
	40.78
Residuum for 1 liter (about 1 quart—61 cubic inches)	41.28

With some slight differences, the water at Cette resembles that at Giens. This fact must be borne in mind, for it shows that the acclimation of foreign species can only be obtained without difficulty, when the medium whence those species are taken closely resembles that in which they are to be placed. The water of the roadstead has a density of 3° by the hydrometer; its temperature is very variable; it attains, and even exceeds, 24°. This is not, however, an unfavorable condition. Under the action of the heat and the beneficial influence of the rain-water, the shell-fish rapidly develop.

The industry of Messrs. Gasquet consists in the breeding and rearing of the following species: the oyster, the common mussel and the red mussel, the "double *praire*" (*Venus verrucosa*), the "simple *praire*" (*Cardita sulcata*), the "*clovisse*" of Toulon (*Tapes decussata*), and the "*clovisse*" of Cette (*Tapes texturata*), the edible sea-urchin (*Toxopneustes lividus*), and the "*violet*" (*Ascidia cynthia*). The products of the sea are generally much relished by the inhabitants along the Mediterranean coasts. All marine animals that serve as food and cannot be classified as fish are called by them "fruits of the sea." The people of Toulon have a marked predilection for the *praire*, and esteem it as highly as they do the oyster. The average-sized double *praire* sells at Toulon at from 1 franc to 1 franc 25 centimes (20 to 25 cents) per dozen; if of large size, it brings as high as 2 francs (40 cents); the simple *praire* is worth a little less. The red mussel has a delicate flavor, and, like the *praire*, is eaten raw. The *clovisse* is, perhaps, less appreciated by epicures, but is universally eaten throughout the south. "One year, at Marseilles, the *clovisse* disappeared from the port, and desolation was general among the inhabitants. The magistrates took a generous initiative and had large quantities of the best quality brought from a distance. These were thrown by the basketful into the place which since that time has been known as the 'Reserve.'"*

The sea-urchin (*Toxopneustes lividus*) is sought after by many of the natives of Provençaux. The *violet* also has its partisans. Many of the southern people like it because of its somewhat high flavor. It sells at Toulon from 5 to 25 centimes (¼ to 1¼ cents) apiece.

As we see, the industry which the Messrs. Gasquet are attempting to create has an economic bearing, for it supplies a demand. The parks on the peninsula of Giens are all surrounded by stakes driven into the bottom, and to these hurdles are attached. This kind of inclosure serves the double purpose of presenting an obstacle to the waves, which beat on the coast, and of acting as a collector or place of refuge for the spat of the shell-fish. Within the parks have been placed other collectors, consisting of stones and tiles covered with a coating of hydraulic cement, which renders it possible, when the time has arrived, to remove the oysters from the place of attachment; this may be accomplished without the slightest difficulty.

The oysters which Messrs. Gasquet have introduced into their concession came from Arcachon; the largest, on their arrival, measured about 4 centimeters (1½ inches) in diameter; the others were still attached to the collectors. They were imported and parked in the spring of last year, and at once rapidly grew to be one centimeter in size. But since the manifestation of this first growth, until the month of September, at which time I visited the establishment at Giens, they had remained stationary, and moreover had given no signs of reproducing. There is nothing strange in this, for it must be considered that these oysters, which were

* Note sur la praire double (*Venus verrucosa*) par M. Charles Bretagne. Extract from the Bull. de la Soc. d'acclim., 1863.

still rather young for spawning, had, besides, undergone the fatigue of a long journey; the time they have taken to recover themselves coincides precisely with that of their growth and spawning. It is also necessary to add that a drier year than that of 1877 has been rarely seen. During more than four months the water of the roadstead of Giens, naturally salt, has not received the slightest addition of rain-water. In spite of this fact very few oysters have perished. This is important and promises well for the future.

Messrs. Gasquet, like practical men, do not propose to limit their experiments to the oyster of Arcachon; this year they are going to obtain a supply of Portuguese oysters and of oysters native to the ponds of Corsica. They have taken advantage of the winter season to make important improvements in their parks. Having learned of the excellent results obtained by distributing shells and sand over the bottom of the parks, they have, like Messrs. Mauduit and Solminihac, at Belon, carried calcareous sand mixed with clay to that part of their establishment where the young oysters are to be quartered. Boxes, such as are agreeable to the fry, ingeniously arranged, have been constructed to receive the young oysters and other valuable shell-fish, whose small size would expose them to the attacks of their enemies. If in the experiments made at Giens nothing conclusive has been decided as regards the oyster, mussels have succeeded perfectly. They have grown very large during the past year, and have multiplied in a large proportion. Their spat was so abundant that it was found attached in quantity to a net several hundred meters (a meter is 3¼ feet) from the breeding beds. The hurdles surrounding the park and the slates which served as collectors were also well covered with them.

In order to further extend this branch of their new industry, Messrs. Gasquet propose soon to establish *bouchots* made on the model of those used in the cove of Aiguillon. It is also desirable to mention the success obtained with the double *praire*, both as regards propagation and growth. The *praire* is a bivalve of nearly oval shape, with deep, hard valves which are concentrically ribbed. It may attain a maximum size of from 7 to 7½ centimeters (2¾ to 3 inches). The animal is plump and of a whitish color; it fills its shell so completely that a *praire* of average size is at least equal to a good-sized oyster. It is found in the ocean and in the Mediterranean; the Mediterranean form is preferable as regards flavor, and its reputation would have spread beyond the limits of Provence, were it not for its tendency to disappear from the southern shores. It usually lives in water ranging from 1 to 4 meters (3 to 13 feet) in depth; it is fond of a sandy bottom and sometimes penetrates from 8 to 12 centimeters (3 to 5 inches) into the sand. Like many other mollusks, it seeks the vicinity of fresh water. In the month of April, 1877, *praires* of all ages and sizes from the roadstead of Toulon were placed in the parks of Giens. The place chosen for this deposit was a sandy and somewhat clayey bottom, where a few tufts of marine seaweed grow.

Their growth was apparent during the whole of last year, and it was also observed with satisfaction that they had propagated. I, myself, found some very young ones on the cords of tunny-nets. It is thought that the spat of this mollusk floats freely in the water, until it is stopped by some obstacle, to which, however, it does not adhere; it remains free in the interstices which have received it. As soon as it becomes more developed, it leaves its place of refuge, where it found neither the food necessary to its growth nor the protection it needed against its enemies, and settles in the sand or among the vegetation. The name simple *praire* has been improperly given to the *Cardita sulcata*, for it is neither the parent nor the congener of the double *praire*, but belongs to a distinct species. The simple *praire* does not exceed in size the cockle (*Cardium edule*), which, as regards its shell, it strongly resembles; its flesh, however, is of a reddish color and has a rich flavor. When placed in the same parks as the double *praires*, they have gone on reproducing their kind from the first year of their introduction. By digging in the sand on the shore, and as far out as the ropes of the tunny-net (*madrague*), we found some that measured from 5 to 7 millimeters ($\frac{1}{4}$ inch) in diameter, as early as the month of September. The fishermen say they had never previously found this mollusk on this part of the shore of Giens. The acclimation of the simple *praire* is now an accomplished fact, and shell-fish culture cannot but be benefited thereby.

The *clovisse* of Toulon and Cette have also increased much in size during the past summer. Indications of their spawning have been found near where they are located, and still more abundantly on the ropes supporting the nets of the *madrague*. In autumn the new generation had attained a size of from 10 to 12 millimeters (about $\frac{1}{2}$ inch).

The *clovisse* of Toulon, which has a dark and hard shell, lives in limpid waters and on a sandy bottom. The *clovisse* of Cette, whose shell is thinner, more tender, and lighter in color, lives in less pure water and on more earthy bottom. I will relate, simply for the sake of recording the fact, an observation made at Giens, which it is difficult to explain, regarding the manner of reproduction of the shell-fish in question and their well-defined characteristics. It would appear that the *clovisse* imported from Cette has a tendency to resemble the *clovisse* of Toulon; that is to say, to borrow from it something as regards shape and color. Although the possibility of a crossing may be contested, it must be admitted that the bottom on which the *clovisse* from Cette now lives, and the quality and nature of the food which they find there, may have caused the modifications to which I have just referred. At all events, it is proved that after a very short sojourn in the parks at Giens, they have acquired the flavor peculiar to the native variety. There is another fact to which it seems proper to call attention. It was observed that the spat had particularly sought out the ropes of the tunny-net (*madrague*) at considerable distances from the concession. In the beginning of winter, when the *madrague* was taken up from the water, some of the ropes were so

covered with these little shell-fish that Messrs. Gasquet thought best to immerse them in the park in order to allow the young ones time to grow.

Is not this indication calculated to put shell-fish culturists in the way of an improvement in the processes and methods to be employed in collecting spat? It is not right to attribute to chance alone, or to the mere influence of the currents, the preferences which these young animals seem to have for this sort of collector rather than for the hurdles by which they are surrounded, or the aquatic plants of the shore. Have not the fishermen of Tarente, who have carried on their industry for a long period of time, always used, and do they not use still, horizontal ropes as collectors? At all events, the observation is worthy of note.

The edible sea-urchin is common on the coast of the Mediterranean. At Marseilles, Toulon, &c., it is largely consumed. It is also found in the ocean, but a very serious difficulty stands in the way of its artificial propagation there. It spawns below low-water mark, so that its progeny may not be exposed from a lack of water at low tide. In the Mediterranean it propagates on the spot where it is found, which renders its culture possible in such places. The sea-urchins preserved in the park of Messrs. Gasquet propagated last summer, and in September I saw some ten or twelve young ones, of the size of hazel-nuts, collected round a couple of adults, which had been isolated for observation and had evidently given them birth.

The *violet* (*Ascidia cynthia*) is not considered edible by all the inhabitants of the sea-coast. Nevertheless, those found in certain localities on the Mediterranean possess remarkably fine qualities. The ancients were very fond of these *ascidians*, and ate them prepared in vinegar, with green or raw mint seasoned with vinegar.* Before the fishermen had devastated our shores with their drag-nets *ascidians* were not uncommon in the roadstead of Giens. They are now almost unknown, and Messrs. Gasquet are right in seeking to bring about their increase. It appears from the observations made by these experimenters that this *ascidian* is fond of rather deep places, those, for instance, ranging in depth from 1½ to 2 meters (5 to 6½ feet); it seeks localities where there are seaweeds to furnish it with food, and there it establishes itself permanently. In default of aquatic plants it attaches itself to any stable body. It does not dislike water but little salt or even slightly muddy. Like the sea-urchin, the *ascidian* has thrived at Giens, and will now, no doubt, continue to exist there, as it has a tendency to grow and multiply in the parks where it has been planted.

Such is the result of the fortunate experiments made by Messrs. Gasquet in their marine establishment at Giens. If, as it is to be hoped, shell-fish culture comes to take its place among the new industries, to them will be due the honor of having taken the initiative and of having marked out the path to be followed.

*Docteur Ozenne, Essai sur les mollusques.

BERRE, CARONTE, THAU, LEUCATE, AND AGAY.

In view of the large extent (20,000 hectares (50,000 acres)) of water known as Lake Berre, it is astonishing that human industry has not yet taken possession of this little sea, which, in many respects, is to the Mediterranean what the basin of Arcachon is to the ocean. By its situation and close proximity to large centers, which would afford a market for its productions, and by the richness of its marine fauna, Lake Berre would seem destined to occupy an important place in fish culture. The astonishment which I express is shared by a large number of persons, and it is asked what are the reasons that have retarded the use of this lake for the cultivation of marine animals. One of the principal reasons, to which I cannot call attention too strongly, for it is essential that it should be correctly viewed, is the lack of success which has attended a majority of the attempts at shell-fish culture made in the Mediterranean, which lack of success has given rise to doubt and discouragement in the minds of those who are disposed to undertake the cultivation of marine animals. There is another matter which cannot be considered too seriously, viz.: that at the time the experiments were commenced, our knowledge of fish culture was still in a rudimentary state, and yet the results obtained, as is apparent from what I have said concerning Toulon and shall have to say further on in speaking of Lake Thau, were not of a nature to wholly justify these discouragements.

In the ocean it has not been without uncertain groping; without the efforts of individual enterprise; and above all, without sacrifices on the part of the administration of the marine, that the prosperous state has been reached, which I am sure will manifest itself at the Universal Exposition. The solicitude of the minister of marine and of M. Coste has been extended with equal favor both to the Mediterranean and the ocean, but private industry has been less persevering on the southern coast than on the western.

Lake Berre presents the best conditions for the breeding of edible shell-fish and other fish. The *clovisse*, the *praire*, &c., live there naturally; mussels of an excellent quality are sufficiently abundant to make it profitable for forty boats to spend a large part of their time in fishing for them. Nor is the oyster a total stranger to this locality, for some were formerly found there, and in the neighborhood, near Port-de-Bouc, very fine ones still exist. The shores are formed of shell sand, very rich in lime, and in many places are covered with marine plants common to the most fertile oyster-cultural stations of the ocean, such as Marennes, Tremblade, the island of Oléron, &c. The lake receives several streams and rivers, and numerous pure and fresh springs are found on its banks. Its water, which is neither too salt nor too fresh, never attains an excessive temperature so as to endanger the life of the aquatic animals which industry might confide to it. Its density is very variable; in the

month of October, 1877, towards the center of the lake it ranged from 2°.8 to 3°, and on the banks it was about 2°.5 to 2°.6.

Lake Berre would not, however, in all its parts serve for the culture of shell-fish or for the establishment of fish-cultural reserves; in the first place those localities must be excepted which are too deep, or at too great a distance from the shore, and those in which such violent currents prevail as to render it impossible, as shown by experience, to maintain there pieces of apparatus, and, finally, the localities which are most exposed to the northwest winds. But there are to the west some sections of coast where violent winds and currents rarely prevail, and it is on one of these that the commissioner of maritime registry at Martigues has established a park, by way of experiment, to attempt the acclimation, breeding, and raising of oysters. The experiments are still in their infancy, but they promise a successful issue. The oysters that have been used were taken in the vicinity of Port-de-Bouc. They were first placed in baskets submerged at a suitable depth, quickly attained great vigor, and soon lost the salty and somewhat muddy taste which they had on leaving the sea; but still more important, not a single loss occurred. The experiment was made only with reference to the oyster, but an incident occurred which leaves no doubt as to the possibility of artificially cultivating the mussel in the lake of Berre. The baskets in which the oysters had been imprisoned, when placed in the water, at spawning time were covered in a few days with small mussels.

Let us seek to discover then, (for it cannot require a great deal of time or money), the apparatus to be used in Lake Berre in order to collect and preserve the spat of this mollusk: let the system of ropes which is used at Tarente and Fusaro with so much success again be tried, if, in this case, the crawls and the rafts do not succeed, and when the proper apparatus shall have been found there is a strong probability, not to say certainty (as is proved by what I have said above, especially if the rational rules which have been pointed out by science and practice be observed, and if suitable localities be chosen), that mussel culture will be established there, and attain all the prosperity which has been attained by the sister industry, oyster culture, at Arcachon and in the sea of Morbihan.

Below Lake Berre is Lake Caronte, as rich in shell-fish and other fish as the first named, and finally Port-de-Bouc, where oyster-cultural experiments were made by M. Viand; but a dry summer coming, the oysters all perished. Since Caronte and Port-de-Bouc were placed in more perfect communication with Lake Berre, however, the fishermen have remarked that certain kinds of edible shell-fish which had become very scarce have reappeared in large numbers.

Of the section reaching from the gulf of Fos to Lake Thau there is nothing to be said. In the latter, in 1865 and in 1866, M. Coste caused oysters to be placed at points chosen by himself. He wished to restore to these fine sheets of water the oysters which had disappeared from

them, and to make Lake Thau an adjunct of the basin of Arcachon. M. Coste had analyzed the water and found its composition to be favorable. The first result did not deceive his expectation. The oysters soon attained a large size and acquired strength and flavor. They propagated perfectly, and the spat attached itself to the fagots arranged for that purpose and to a central rock, which became covered with them. I will remark in passing that the breeding of the *clovisse* has been very successful there. It is, therefore, an established fact that the oyster is capable of living and multiplying its kind in Lake Thau. How does it happen, then, that private industry has not been induced to come there also by the success of this first attempt, and that it should have forsaken a work so full of promise? It would, in the future, receive compensation for its labors there.

Among the other maritime stations where it would seem oyster culture might be profitably carried on, I will mention Lake Leucate, which has already been pointed out by Messrs. Coste and Gerbe as likely to become an oyster-cultural center, and where, not long ago, there were well-stocked oyster-beds, producing splendid oysters of rare beauty and delicacy of flavor, the finest, perhaps, to be found in the Mediterranean.

The waters of this lake, a large portion of which is sheltered from the winds, is mixed to a suitable extent with fresh water. The soil is rich in lime, and shell-fish of all kinds abound. But the level of Lake Leucate is not always constant; according as there is a drought or freshet its extent varies from six to eight thousand hectares (15,000 and 20,000 acres). It would, therefore, be necessary to take every precaution to prevent the inconveniences that would result to the oyster culturists from the changes in level.

Retracing my steps I will pass abruptly from the shore of Languedoc to that of the farther Provence. I will mention, as a reminder merely, the gulf of Saint-Tropez, where M. Coste made unsuccessful attempts, which may be tried again some day. Then I will stop at a little station which I particularly noticed in the course of my mission, and which seemed to me to unite all the natural conditions desirable for new and decisive experiments in oyster culture in the Mediterranean, namely, the bay of Agay. It is not surprising that it had escaped the attention of M. Coste in his explorations, for at that time it was far removed from all lines of communication, and frequented only by the fishermen of that section, or visited by barks in distress. Now it is on the line of the railway that connects Marseilles with Genoa. The water of the bay of Agay extends into a locality where it is protected from the northwest and north winds. As it communicates with the sea through a narrow entrance it is likewise protected on that side from the south winds, which are so terrible in autumn. A stream brings into it a tribute of fresh water, thus increasing the chances of success. An experiment made at a given point in the bay of Agay, with selected oysters, suited to the nature of the water, a park well arranged, well kept, and well

watched, an experienced man to follow up with attention and perseverance the various phases of this experiment, would show definitely, I think, what might be obtained by oyster culture on our southern coasts. If the experiment was successful, as there is every reason to suppose it would be, it would form a starting point of information, calculated to establish oyster-cultural industry in the Mediterranean.

CONCLUSIONS.

Last year I stated with legitimate satisfaction that the industry of oyster culture in the ocean, although in its infancy, was in a flourishing condition and secured the existence on our shores of a maritime population of 200,000 souls. What a different spectacle is presented between Port Vendres and Marseilles. At the former place it is the picture of a commercial life asserting itself—the dawn of prosperity. I have seen an entire fishing population engaged with indefatigable activity in all the labors demanded by the culture of the mollusks, certain of finding there the reward of their efforts. At the latter one sees barren lakes, a deserted beach, and an impoverished sea.

The causes of the decadence of our southern shores are extremely numerous and varied, and it is not for me to examine them all. The principal causes are doubtless geological ones. The alluvium transported by the rivers flowing into the gulf of Lyons, the total volume of which exceeds 20,000,000 cubic meters (705,600,000 cubic feet) per annum, has caused a displacement of the shore line, the formation of lagoons, their progressive filling up, and their transformation into marshes which have become hotbeds of dangerous fevers. The fish, whose spawning grounds were constantly buried beneath the mud, sought a more stable shore, and man finally was obliged to flee from its pestilential atmosphere. Now the general situation is daily improving. The direction and the place of deposit of the alluvium is known, the portions of the shore which must be abandoned to the geological phenomena have been circumscribed, and engineers are successfully resisting the filling up of the lagoons. Many marshes, moreover, have disappeared through the action of time, and man has dried several. The influence of the marshes has diminished in intensity since then ; and the laws of hygiene now better understood renders it possible to combat more effectually the paludal poisoning. Thus the reclaimed lands are beginning to be peopled again, but the population is exclusively agricultural. It is useful, doubtless, to bring these shores, which have been reclaimed from the water, under cultivation, with a view to rendering them healthy, and rescuing them from sterility. But why not open a yet larger field to the activity of the people, who never fail to improve every new source of making a fortune, and give them these aquatic fields, which, like the land, can receive seed and yield a harvest? Does not the sea support multitudes of creatures which man may utilize as an important part of his food, provided he knows how to apply them to his use, not only by maintain-

ing them under his hand, but, also, by encouraging their growth and multiplication according to well-known laws!

Reasons of the greatest importance, especially in view of their relation to the public maintenance, impose upon us daily more and more the necessity of placing under a regular system of cultivation the domain of the fluvial and maritime waters. As regards the rivers and streams, this necessity was long ago made known, and the art of cultivating fish is not unknown to us; whereas maritime fish culture, properly so called, has as yet received no attention. I desire, therefore, to call public attention to the subject of restocking the lagoons by fish culture, as well as to the necessity of restocking our rivers.

Oyster culture in the Mediterranean does not seem to me to promise so brilliant a future as on the Atlantic coast, although some stations seem to offer all the conditions recognized as indispensable to success. Mussel culture, however, might be profitably carried on there. So many places along the coasts resemble Tarente and the cove of Aiguillon. The mussel furnishes nutritious food, and is, by reason of its cheapness, accessible to the majority of the people. Neither the south nor the west can produce enough to meet the demands of consumers. One-half of the mussels eaten at Paris are sent there from Belgium.* Another branch of fish culture, the breeding of small shell-fish (*praires, clovisses*, &c.), would probably be profitable. The people of the south are very fond of these *sea fruits*, as the Italians call them, and would pay a good price for them.

I hasten to pass on to maritime fish culture, which seems to me to be the true industry suitable to these regions, and their natural conditions. Geographers have pointed out the striking resemblance existing between the delta of the Rhone and that of the Po; the alluvium tends in the same easterly direction, there are the same lagoons and the same marshes produced by the deposits of the river. The lagoons of Ferrare, Comacchio, and Venice may be compared to Leucate, Thau, and those of Aigues-Mortes. The inhabitants of the shore, however, have derived great benefit from these salt lakes, and in this no parallel can be drawn between the two. Whilst on the French side nothing but solitude and neglect† is seen, the Italians have not allowed to be lost the teachings in the art of cultivating the sea which were transmitted to them by the ancients. If, in the south, they practice oyster culture as in the last days of the Roman republic, along the Adriatic and in the Sardinias they have applied themselves to the breeding and preservation of sea fish.

At Comacchio fish culture has from time immemorial furnished ma-

* Maxime Du Camp, "Paris, ses organes, ses fonctions et sa vie."

† The average annual yield of the fisheries in Lake Thau amounts to 300,000 francs ($60,000). This is an indication of a certain activity. (Lenthéric, Villes mortes du Golfe de Lyon.)

terial for a large export trade, and fisheries are numerous in all the lagoons of the coast.

This is the example to be followed—a profitable business, in which one can engage without doubt of success. The soil, the climate, the water being the same in the Gulf of Venice as in the Gulf of Lyons, the processes need not be sought for anew. The Italians succeeded with them: why not apply them upon our Mediterranean shores? They might be speedily tested at little expense, and if found imperfect in any way they could be quickly improved, just as were the oyster-cultural processes brought from Fusaro by M. Coste.

Let it not be forgotten that the number of fish brought to our market is constantly diminishing. A part of the north of France is dependent upon foreign countries for its fishery supplies; in the south, fish of fine quality would be unknown if the coasts of Corsica and Sardinia, which are still prosperous, did not furnish their quota. The native fishery is insufficient to satisfy the demands of a market which increases day by day, in proportion as railroad communication becomes more extended. It can with great difficulty furnish Paris with a little more than half the fish consumed there, and still fresh sea-fish are considered the favorite article of food; a gale of wind is sufficient to deprive Paris of its supply.* It is apprehended on all sides that the time will arrive when fish, other than preserved fish, will be a luxury which the rich alone can afford. This situation demands a prompt remedy. It has seemed to be my duty to point out where it might be found.

* Maxime Du Camp, *loc. cit.*

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