

to be that atomic "magnetic" power in the battery which produces magnets at the will of the operator, by his voluntary mechanical agency; and that *magnetism* is the primary power and action through which the line operates. Electricity being merely a conditional effect of the polar reciprocal action of the magnets, both poles being positive, under different conditions, and not one positive and the other negative, as is generally supposed, all that is required of a telegraph line is that its wire be "solid" in length, and thoroughly insulated from the moist earth, as the present Atlantic cables appear to be. Yet a telegraph cable that will gradually lose the iron may thus be of less weight and dimensions where the water deepens, and can still have these two properties; it would thus avoid all the difficulties met with in the frequent attempts to lay the Atlantic cables, that were finally surmounted by strictly *mechanical force*, in preference to their being avoided by an examination of the *natural* law and force of the material, and applying that law to those lines before attempting to lay them. The operation of which *law* on such material, I am now prepared to illustrate and explain to you by experiment, for your observation.

ART. V. OYSTER CULTURE IN FRANCE. BY T. F. KNIGHT.

(Read February 3, 1868.)

IN the application of science to industry France has long afforded a distinguished example, partly through the scientific genius of the nation, and partly through the encouragement which is given to scientific progress by the French government; and in no branch of scientific industry has she more excelled than in the art of Pisciculture. In France, it is well known, the first successful experiments were made to revive the ancient practice of breeding fish from the ova taken from the living animal; so that by a process of cultivation, from small beginnings, so greatly did the art of artificial propagation succeed, that valuable fisheries that had declined, were restored to fertility; and new localities were stocked with young, that soon teemed with the fruits of natural increase.

But science has been equally successful applied to the propagation of the most valuable of the edible mollusca—the oyster, (*ostrea edulis*,) and at the present day oyster fields present as busy an aspect, and are as skilfully managed, as a well cultivated farm. The activity visible in one of the basins or bays where oyster cultivation is most extensively carried on, is thus described: “On all sides, the oyster banks exposed at low tide, and the *pontons* dry; over the parks, the oystermen may be seen, with their wives and their children, covering these domains, resembling groups of gleaners in a field. In reality, the cultivation of oysters bears a close analogy to that of the soil. A knowledge of the most suitable soil, its preparation, the seed from the mother oysters, their distribution over other grounds, the destruction of enemies which have the power to injure them, establish a striking resemblance between submarine agriculture, and agriculture properly so called. An oyster is cultivated as a grain of wheat.”

The paper which I have hastily prepared for the Institute is mainly a grouping of facts obtained from two authorities:—

1. An interesting pamphlet, in the French language, by Monsieur le Docteur J. L. Soubeiran, Secretary of the Imperial Society of Acclimatization of France, kindly forwarded to me by the author.
2. The Harvest of the Sea, by James E. Bertram, an English author. The former is dated 1866; the latter 1865—both recent works.

“About fifteen years ago,” writes Mr. Bertram, “there was scarcely an oyster of native growth in France.” The beds had been so exhausted from over-dredging as to be unproductive; and the people were consequently in despair at the loss of their favourite luxury, and had to resort to other countries for their supply. It was under these circumstances that M. Coste instituted that plan of oyster-culture which has proved so successful. To prepare the way for a reference to M. Soubeiran’s paper on the oyster-parks of Arcachon, let me continue to condense Mr. Bertram’s description of French oyster-culture. At the instigation of the French government, M. Coste made a voyage of exploration round the coasts of France and Italy, in order to enquire into the condition of the sea fisheries; and to see

how these fisheries could be artificially aided, as the fresh water fisheries had been aided through the re-discovery by Joseph Remy of the long forgotten art of pisciculture. It was from observing the process of oyster-culture at Lake Fusaro in Italy, that M. Coste conceived the project of introducing oyster-culture into France. The mode of oyster-breeding at this place was, to erect artificial pyramids of stones in the water, surrounded by sticks of wood, in order to intercept the spawn, the oyster being laid down on the stones. Faggots of branches were also used to collect the spawn.

In this place I may describe the manner in which the spawn or "*spat*" of the oyster is collected, and its further development secured. Oysters do not leave their ova, like many other marine creatures, but incubate them in the folds of their mantles, and among the *laminae* of their lungs. There the ova remain surrounded by mucous matter, which is necessary to their development, and within which they pass through the embryo state. The mass of ova, or *spat* as it is familiarly called, undergoes various changes in its color, meanwhile losing its fluidity. This state indicates the near termination of the development, and the sending forth the embryo to an independent existence; for by this time the young oyster can live without the protection of the maternal organs. The animated matter escaping from the adults on breeding banks (the oyster is considered to be an hermaphrodite) is described as resembling a thick mist being dispersed by the winds—the *spat* is so scattered by the waves that only an imperceptible portion remains near the parent stock. All the rest is dissipated over the sea space; and these myriads of animalculæ, tossed by the waves, either attach themselves to solid bodies, or fall victims to the larger animals which prey upon them. The spawn, as found floating on the water, is greenish in appearance, and each little splash may be likened to an oyster nebula, which resolves itself, when examined by a powerful glass, into a thousand distinct animals. By the aid of the microscope, the young animal can be seen with its shell perfect, and its holding-on apparatus, which is also a kind of swimming pad, ready to clutch the first solid substance that the current may carry it against: hence the economy of artificial

appliances for collecting them. At the age of three months an oyster is not much bigger than a pea; and the age at which reproduction begins has never been accurately ascertained, but it is thought to be three years. Oysters are usually four years old before they are sent to market. At the age of five years it is at its prime; and its average duration of life is said to be ten years.

To return to M. Coste and his experiments. The Lake Fusaro system of cultivation was therefore, at the instance of their *savans*, strongly recommended for imitation by the French Government to the French people, and experiments were at once entered upon with a view to prove whether it would be as practicable to cultivate oysters as easily among the agitated waves of the open sea, as in the quiet waters of Fusaro. In order to settle this point, it was determined to renew the old oyster-beds in the bay of St. Brienne, and notwithstanding the fact that the water there is exceedingly deep and the winds very violent, (situated opposite the English coast west of the old sea-port of St. Malo,) immediate and almost miraculous success was the result. The fascines laid down soon became covered with seed, and branches were speedily exhibited at Paris, and other places, containing thousands of young oysters. (A half a million is on the average the amount of spat which an oyster can "brew" in one season.) In less than six months the success of the operation in the bay of St. Brienne was assured, the fascines being so thickly coated with young oysters that an estimate of 20,000 for each fascine was not thought an exaggeration.

While M. Coste was, however, exploring the coasts, and studying Italian oyster culture, and in giving a practical direction to the knowledge he acquired; a shrewd observer, a mason named Bœuf, began simultaneously to think of oyster-culture in France. He began by trying the experiment on a small scale, so as to obtain a practical solution of his "idea," and with this view he enclosed a small portion of the foreshore of the island of Re, by building a dyke of about eighteen inches in height. In this park he laid down a few bushels of growing oysters, placing amongst them a quantity of large stones, which he gathered out of the surrounding mud. This initiatory experiment was so suc-

cessful, that in the course of a year he was able to sell £6 worth of oysters from his stock. He continued to increase the dimensions of his farm, so that by 1862 his sales had increased to £40. Bœuf's neighbours witnessing his good fortune, soon ceased to ridicule his enthusiasm, and began to cultivate for themselves. The system soon extended over the foreshore of the island, so much so, that what were formerly a series of enormous and unproductive mudbanks, occupying a stretch of shore of about four leagues in length, are now so transformed, and the whole place so changed, that it seems the work of a miracle. This island, which may be designated the capital of French oysterdom, has now 4000 fish-farms upon its shores, more than all the rest of the coast put together, and the people may be seen as busy in their fish parks as the market gardeners in the *environs* of a populous city.

The marked success that had attended the efforts of these pioneers in the art of oyster-culture, stimulated the friends of national industry, with the aid of the government, to apply the experiment to the restoration of the old oyster grounds, which had seriously declined in their yield. The most important of these were in the Basin of Arcachon on the south-west coast of France, in the Golfe de Gascoigne or Bay of Biscay, situated about 100 miles south of the famous Ile de Re. It is upon the subject of the revival of the oyster fisheries in this locality, that the pamphlet I have referred to treats. The basin of Arcachon had produced from time immemorial considerable quantities of oysters, greatly esteemed owing to the peculiarity of the soil upon which they were propagated. "For many years," remarks M. Soubeiran, "the Basin of Arcachon was the *Eldorado* of oysters. The basin contributed amply to the wants of the country; and numerous vessels were employed in transporting them to neighboring countries. But by reason of trespass during the spawning time, when dredging was prohibited by the laws, and by reason of furnishing oysters to all France, England, Holland, and other countries, they had exhausted the mine which they thought to be inexhaustible; and in consequence, suddenly (in literal French, *un beau jour*—one fine day) they found the harvest so diminished as to become

almost insignificant. They had killed the fowl for the sake of the golden eggs!

This basin at high tide has the appearance of a small interior sea of about 100 *kilometres* (57 miles) in circumference, partaking of the flow and ebb of the ocean. It furnishes two sorts of oyster grounds—the *crassats*, or exposed lands, and the *chenals* (channels), which are never exposed. It appears that two prominent causes of the decline of the oyster fishery in this basin, were the accumulation of mud on the neglected banks, which is destructive to the oysters, and the ravages from the Bigornian borers (*Nassa reticulata*—(whelks) Buccinidæ), which are so numerous, that in a single tide of two hours, twelve sailors of the government vessel have taken at a season when they are most abundant, (March), 14,600 of them in a space of 40 *hectares* (20 acres). (M. Soubeiran remarks in a foot note, that the smallest Bigorneaux, placed upon shells garnished with 15 to 20 young of the oyster, pierce them one after another, and do not quit the shell until they have finished the last. They pierce in a half hour an oyster of one month; they are more formidable even than the adult Bigorneaux, which take eight hours to perforate the shell of an oyster of three years, and which do not make war upon oysters of a greater size.)

The oyster grounds are thus described:—“Upon the half of this vast bay, on the eastern side, are seen about a hundred floating habitations, above each of which rises a column of smoke like that from the chimney of a little steamboat. These are (*pontons*) which serve for the lodging of the keepers of the oyster depots. Ordinarily they are located in the centre of these narrow but rich domains, composed of about (4 *hectares*) two acres. A buoy bearing the number of the *depot* or claim, painted large so as to be easily seen, in white on a black ground, is placed at one of the extremities of each proprietary, and remains visible at high water. Stakes of branches of pine, distributed from point to point, and describing either circles, or irregular rectangular figures, fix the limits of each park.”

Towards restoring the oyster-fisheries of Arcachon to their ancient fertility, the Government, upon the suggestion of M. Coste, established *experimental or model parks* at three

points of the Basin, at *Grand-Ces*, *Crastorbe* and *Lahillon*, and these model-farms have given results so wonderful that they must soon furnish more oysters than the entire basin furnished before, and give the assurance that the whole bay will easily be rendered fertile. These facts are verified by the report of *M. Chaumel*, the Commander of the Government vessel employed in replenishing the banks, and overseeing the oyster-grounds. Two of these *Imperial parks*, embracing a total surface of 22 hectares, were established in 1860 upon *crassats* where oysters already existed. From that time to 1866, a million of oysters were thrown over the parks, 100 cubic metres of shells of *Sourdon* (*Cardium edule*) were laid, and one hundred and ninety-seven *collectors* distributed over the flats. These collectors, besides the shells of the *Sourdon*, became covered with spat, and although from 1862 to 1865 eight millions of oysters had been removed to supply various localities near and remote, there remained in the parks, in large and small oysters, about sixteen millions. This result was the experience of six years, where about one million of oysters only existed. Including the million of oysters that were added to these, the increase in six years was 1150 per cent., or twenty-two millions. The third *Imperial park*, *le parc de Lahillon*, was established upon a part of a *crassat* of about *twenty acres* in size, and occupied about two acres. When they commenced their labour, the oysters were so few that a premium was offered for every oyster that could be found. During 1863 and 1864 they sowed 178,000 oysters. At the same time they placed 250 tiles and a quantity of oyster shells and of *Sourdon* shells to serve as collectors. In the first year the result was very satisfactory; for they counted about sixty spat per shell, and an average of one hundred per tile. In 1865, they completed the number of 500,000 oysters sown, and replaced those they had sold by the same number taken from one of the other parks. They also laid a large number of tiles and other collectors. The result of this year showed—

Young oysters on the tiles,	1.259.248
do. on the <i>Huitres meres</i> ,	2.680.000
do. on the shells and stakes,	1.246.000
	<hr/>
	5.185.248

The facts that I have adduced prove undeniably that oyster-culture on a favourable soil, and pursued with zeal and perseverance, is attended with extraordinary success. It remains now but to refer briefly to one or two special points that may elucidate further this interesting branch of industry.

1. *The Collectors.*—I have already described the *fascines* that were first employed; but beside these, and the oyster and mussel shells that are used for this purpose, another kind of collector was constructed for the Imperial parks. These collectors were formed of eight planks of 2 metres long, 25 centimetres wide, and sustained 25 centimetres above the soil by uprights with cross-pieces. These planks were covered on their under side with bushes to collect the spat, or with shells fixed on with resin. The tiles are also supported above the soil by cross-pieces of wood.

2. *The work of the cultivators.*—There is constant employment on an oyster-park; and the diversity of the seasons only varies the nature of the labour. It is true that the labour all the year through is not of the same amount and importance. Augmented at the period of sowing (April and May), and chiefly at the harvest time (September and February), there is a period of comparative rest in the spawning season (June, July and August.) During these months it is the care of the *ouvriers* to prevent the ground from being disturbed, and to protect the spat from the enemies that prey upon it. But the principal labour begins in September and is prolonged until May. A general inspection of the whole park is the signal of the arrival of the busy season. The soil is then purged of all useless and injurious matter; hurtful plants are removed, and the soil is brought to a fit state for cultivation. After the preparatory labour the barren oysters are removed, and the remaining ones in some cases transported to other spots. Each age has its compartment. At about ten months old, the spat are removed from the collectors,

and sown in squares. At this period the shells are of a consistence to permit them to be detached from the collector without endangering the life of the mollusc. Occupations of this nature require many employees. The overseer surveys the whole, directs them, and distributes to each his *role*. The wives assist their husbands in all the lighter labours. Some cleanse the collectors, others remove the *debris*; some sow the seed-oysters, others sort the mass, separating those that are merchantable, and disposing them in baskets, others carry them to their destination; while all wage war against the enemies of the precious mollusc, as ducks, fishes, crabs and whelks—the two last terrible enemies from the union of their attacks.

3. *The productiveness of the system.*—Mr. Bertram remarks, “A gentleman from Jersey, who explored the oyster-beds in the bay of Arcachon, was informed by one man who had laid down 500,000 oysters, that they had increased in three years to 7,000,000. And at Ile de Re the inspectors counted 600 full-grown oysters to the square metre,” and he adds, “seeing that 630,000 square metres are now under cultivation, it follows that the oysters in this tract of desert mud are worth from six to eight millions of francs, the total crop being (at the time spoken of) 378,000,000 of oysters.”

4. *Cost of production, and profit.*—Monsieur Soubeiran gives as a short harvest ascertained from the results at Arcachon, 4000 francs per *hectare* ($\frac{1}{2}$ acre) at a cost of 750 francs (500 per cent.); and Mr. Bertram gives a statement of the results at Brienne in 1860 that is almost incredible, viz:—60,000 francs for an expenditure of only 221 francs. This, however, must have been an extraordinary spatting year.

Much might be said, and that of an instructive character, as to the economic value of oyster-culture as a branch of national industry; and on this subject our French author has some admirable remarks, recommending this industry, as affording employment to the maritime portion of the people, and augmenting the sources (*de l'alimentation publique*) of food for the whole population.

As to the application of oyster-culture to other countries, much depends upon the nature of the soil. Muddy ground is

excellent for the *growth* of oysters; they grow in such localities very quickly, and become saleable in a comparatively short space of time; and this is the kind of soil that is so productive at Ile de Re and at Arcachon. Dry rocky ground is not so suitable for the young oyster, as it does not find a sufficiency of food upon it, and consequently languishes and dies. Marl is the most esteemed, as the oyster finds plenty of food, constant heat, and perfect quiet.

Whether oyster-culture may be successfully practised in Nova Scotia is a question that I have not treated upon, but it is worth a trial; it has done much, very much for the poor fishermen of France, having placed upon the shores of that country 7000 marine farms, affording employment to a very large proportion of the population.

ART. VI. ON THE METEOROLOGY OF THE CALEDONIA COAL MINE, LITTLE GLACE BAY, CAPE BRETON, IN 1867. BY HENRY POOLE.

(Read February 3, 1868.)

THE Caledonia Mine is situated in the County of Cape Breton and Province of Nova Scotia, in North America, latitude $46^{\circ} 12'$ north, and longitude $59^{\circ} 57'$ west from Greenwich.

It is on the eastern side of the Island, about one mile distant from the shore, and the house at which the observations have been recorded is at an elevation of sixty feet above the sea.

The tides have an average rise and fall of four feet. There are no high lands in the neighbourhood. The land extends from the east by south round to the north-west, while from the north and east the influences of the Atlantic storms and currents are felt in full force. Drift ice retarding the vegetation of spring, and the Arctic currents lowering the normal temperature of summer and autumn; while the higher temperature of the sea, and perhaps a partial influence of the Gulf Stream, keeps a milder temperature in the early part of winter, and our Bay open for navigation much longer than I have observed at Pictou and other places in the same latitude but further removed from the ocean's influence.