

## XXXV.—OYSTER-CULTURE AS SEEN AT THE LONDON FISHERIES EXHIBITION.\*

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Judging from the great importance of oyster-culture, a much larger number of exhibitors was looked for. The countries which were well represented were England, Holland, America, and Spain. France had remarkably few exhibitors.

In speaking of apparatus used in oyster-culture and in the oyster fisheries I shall have special regard to those which might possibly be introduced in Norway and which are adapted to our circumstances.

Among the English exhibitors the Whitstable Oyster Company deserves special mention, as it exhibited a complete and very instructive collection of everything relating to the oyster fisheries on the company's beds. In Whitstable, a small town on the south bank of the Thames, this trade is of very ancient date, and the company referred to acquired the full ownership of these beds by an act of Parliament as early as 1763, and had even carried on these fisheries for some time previous to that date. These oyster-beds are always under water, and are of considerable extent. The gathering of young oysters on artificial collectors is not carried on here; but those young oysters which have been deposited on natural objects outside the oyster-beds, as on stones, oyster-shells, &c., are collected by means of bottom-scrapers, sorted, and planted on beds outside the town. The limits of the beds are carefully defined, and are constantly guarded by three or four watch-ships, which lie at anchor on different parts of the banks. This gathering of young oysters is carried on all the year round by about one hundred small vessels on those banks where the oyster fisheries are free. These vessels are not owned by the company, but belong to different persons, some of whom are shareholders. The young oysters are sold to the company, which plants them on the banks mentioned above, of which it is the sole owner.

As the consumption of oysters during the last few years has increased so much that it was found impossible to satisfy the demand in the manner described above, the company has for several years imported millions of French oysters, which are raised on the Whitstable banks, and

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are sold when they are three or four years old. The oysters which are to be sold are taken from the beds with bottom-scrapers by the so-called dredgers, and are sorted on board. Those which are too young for the market are, of course, again placed in the water; and as the beds are arranged in such a manner as to have oysters of different ages separate, young oysters can very easily be taken up and planted, which aids the work considerably.

Besides models of vessels, bottom-scrapers, and other apparatus, the company also exhibited a very fine collection of oysters of different ages, of sponges and algæ found on the beds, and of various enemies of the oyster. As the oyster fisheries with us are carried on in a very different manner from what they are in England, and as our fisheries will, owing to the different nature of the bottom, hardly undergo any change in the near future, a description of the apparatus exhibited by the Whitstable Company will scarcely be of interest to the Norwegian public.

Lord Scott, the owner of beds and basins for young oysters on the Isle of Wight, exhibited models of two basins. They were both dug out of the ground and surrounded by strong embankments, held together by piles and wicker-work, clay and stones being placed between the layers of wicker-work. The inside of the basin is lined with birch branches. They are connected with the sea by a pipe having a knee, which when the tide is out is turned aside, so as to receive the superfluous water and carry it out into the sea, whenever it is desirable to change the depth of water. It is said that experience has taught that in this manner the water is easily renewed without occasioning any considerable loss of young oysters. On account of the heavy swell on the English coast, the basin is filled in the same manner, when the tide comes in, simply by bending the pipe in one or the other direction.

One of the basins occupies an area of three-fourths of an acre and the other 1 acre. Their depth varies from 4 to 6 feet. When the water is low, both basins can be emptied completely. These basins are used exclusively for gathering young oysters. Near to them are the beds which are used both for keeping and fattening the mother oysters and for raising young oysters.

Towards the end of May there are gathered from the beds and planted in the basins a suitable number (generally from 15,000 to 20,000) of mother oysters. They are laid on the bottom, between the scaffolding of laths on which the collectors are placed. The scaffolding is 30 centimeters high [about 12 inches], 1 centimeter broad [about four-tenths inch], and of the same length as the basin. It rests on the bottom, and on it are placed laths, on which the bricks are laid. The bricks used here are generally flat, it being asserted that the oysters can more easily be taken off than from the long and bent bricks used at Arcachon. Before the bricks are laid on the scaffolding they are dipped in a mixture composed of eight parts sand and two parts lime. In this mixture

they are dipped thoroughly, so that the lime is evenly distributed, and the brick is then dried in the sun for several days. As sand from fresh water frequently contains clay, which would be apt to make the surface of the collector slimy, sea-sand is used exclusively. This covering of lime is put on the brick, so that the young oysters can more easily be removed from it. I have heard it stated that the brick is covered with cement, but as far as England and Holland are concerned this is a mistake.

When the collectors are set out, in June, there is only just enough water in the basin to cover the mother oysters, but after all of the collectors have been put in position the basin is again filled to its edge. The collectors remain in the basin till September, when they are taken up and placed in open boxes, which are sunk out in the sea, in water deep enough to secure the young oysters against injury from ice and heavy waves. At the same time the mother oysters are taken from the basin and placed on the beds; this finishes the work of the year in the basins. In May, the collectors, covered with young oysters, are taken out of the boxes, and the oysters are removed from the collectors, sorted, and placed in low, floating wooden boxes, with lids and bottoms of galvanized-iron wire. The oysters are not put on the beds until they have reached the size of 3 centimeters. The bricks which have served as collectors are dried and dipped anew in the lime mixture referred to above, and can thus be used for many years.

In Lord Scott's basins, during the short time they have been worked, there were produced—

Years.	Number of young oysters.
1880 .....	25,000
1881 .....	300,000
1882 .....	1,500,000

Besides models of these basins, Lord Scott exhibited a number of the apparatus used by him, such as tongs for holding the bricks while they are dipped in the lime mixture; a wooden funnel, 1 or 1.25 meters high, used in removing the young oysters from the collectors; knives, with semicircular blades, employed in this process, &c.

G. Dillnot, of North Hayling, England, placed on exhibition collectors made of sackcloth extended on a framework and covered with a lime mixture; and also "hospitals," whose sides consisted of perforated boards, 15 centimeters broad, with a bottom of wire netting and a lid of sackcloth, being 2 meters long and 1 meter wide.

From the large Essex oyster-beds exceptionally fine oysters were placed on exhibition. These beds have a stone bottom covered with oyster-shells, where the young oysters are deposited. By a quick blow on the stone or the shell to which the oyster adheres it is separated

from the collector. These beds supply a great many fattening beds along the coast with young oysters.

Percy H. Russ, of Sligo, Ireland, who owns fattening beds near Cullenamore, Cullenduff, and Lufferton, exhibited Arcachon oysters which he had fattened on his beds. As his attempts to gather young oysters had failed, he now confines himself exclusively to the fattening of French oysters. The months of March and April are said to be the most favorable for transplanting oysters from the French beds. Four-year-old French oysters fattened on Irish beds were sold this year at 14 shillings per 120 oysters, or about \$2.83 per hundred.

Several English oyster-dealers exhibited American and Portuguese oysters (*Ostrea angulata*). These oysters, however, are but little sought either in the English or the continental markets, and it would therefore be folly to stock waters which have no oysters with these inferior varieties. Some in this country have spoken in favor of the American oysters, but as a general rule they are not liked. There is, however, reasonable hope that our own beds will soon be able to furnish all the oysters needed for stocking our waters. If, nevertheless, it should be deemed necessary to import mother oysters, it seems to me that they should be imported from Holland or France, in order to make a practical test as to how these oysters will flourish in our waters and climate.

The French department was not very well represented. Alphonse Martin, of Auray, placed on exhibition oysters in different stages of development, and also some apparatus used in oyster-culture, the following of which deserves special mention:

1. A collector made of boards. It consists of ten shelves, arranged one above the other. Each shelf consists of ten boards, 7 or 8 centimeters broad and 1 centimeter thick. The distance between the shelves is 5 centimeters. At both ends the collector is inclosed by a belt of thin laths, whose prolongation forms the four legs of the collector. When the collector is full, and the young oysters are to be taken off, the belt is loosened and the shelves come apart. The entire collector is covered with a mixture of lime and sand. This collector is expensive, but deserves to be recommended, because on its different shelves it will gather a large number of young oysters. It can easily be kept clean, as the light falls only on the upper shelf, where a vegetation of confervæ will principally be found.

2. A "hospital" for young oysters, resembling a common bed, with bottom and lid of galvanized iron wire and wooden sides. The lid is fastened to the frame by wooden pegs which pass through the prolongation of the legs. Formerly floating "hospitals" were often used, while now they are generally placed at the bottom, to which they are held fast by four rectangular iron hooks, one of which spans each corner of the "hospital."

3. A trough-shaped sieve of tin, 10 centimeters deep, 50 broad, and

60 long, with two handles and twelve holes, each hole being 6 centimeters in diameter. This apparatus is used in sorting oysters.

4. A hollow spade of peculiar shape, used for spreading the oysters over the beds. This is a very practical instrument, and deserves to be introduced in Norway.

The same firm also exhibited tongs used for dipping the bricks, knives for scraping off the young oysters, and a number of the peculiar wooden shoes used extensively in France by persons engaged in oyster-culture. Owing to the soft bottom of the oyster-beds, these shoes have under the sole a contrivance shaped like a trough, longer and broader than the shoe itself.

Another French exhibitor showed live oysters in different stages of development, and also boards from the above-mentioned shelf collector thickly covered with young oysters. The one year's oysters measured 2 or 3 centimeters in diameter, two years' 5 or 6, and three years' 8 or 9.

Spain made an exhibit of a fine collection of different kinds of oysters. Those from Rio Santa Marta bore a striking resemblance to our deep-water oysters from Ostravig. The oysters from Ferrol and those from Galicia had a very uneven shape, while some young oysters that adhered to tiles and willow branches were particularly well-shaped. The oysters from Rio de Zumaya had a stronger and finer appearance and a better shape than those previously mentioned, and were of the grayish-violet color peculiar to our Norwegian oysters.

In 1877 the Government established some model oyster-beds on the Rio Santa Marta. The young oysters are brought from Arcachon, and thus far the experiments have been exceedingly successful. Several private individuals have also established oyster-beds, especially near Marta di Ostigueira, and as there are in these waters very few radiates, which are the worst enemy of the oyster, everything promises well for the success of these establishments.

From the north coast of Cuba there were sent oysters of a long, deep shape, resembling the American oysters, 8 or 9 centimeters long and 4 or 5 centimeters broad. The inside edge of the shell was of a violet color. All these oysters adhered to branches with a thick bark which had been laid on natural beds.

The Americans exhibited oysters and the various implements used in the American oyster-trade, but as they are not of special interest to our oyster-culturists we pass them by. China, Peru, and Australia exhibited merely specimens of oyster-shells, and oysters put up in hermetically sealed cans.

The best collection in this department came from Holland. The Dutch oyster-culturists, under the name of "*Maatschappij tot bevordering der Oestercultuur*, Bergen-op-Zoom" (Society for Promoting Oyster Culture, Berg-op-Zoom, Netherlands, exhibited everything relating to oyster-culture, from excellent models of Dutch oyster parcs to small implements. For collectors the Dutch generally use tiles, treated in all es-

essential points as in England; also long, curved tiles like the French, 40 centimeters long, 15 centimeters broad, and 8 centimeters thick. A third collector, of a new construction, consisted of two iron frames, 2 meters long and 80 centimeters broad, placed against each other so as to form a roof. Each frame is filled with iron wires running parallel with each other, and on these wires there are strung brick beads 3 centimeters long and 1.5 centimeters in diameter. The principal advantage of these collectors consists in the fact that these beads, after the young oysters adhere to them, can easily be taken off the wires. As the oysters remain on the beads during the entire period of their development, much tedious work is avoided which is otherwise connected with the removal of the young oysters from the bricks or tiles. I am of opinion, however, that this collector is both too expensive and on the whole not very practical. As it is comparatively new, it has not yet been very generally introduced in Holland, and will scarcely meet with general favor, as the oysters developed on these beads will have a very singular shape.

All the "raising-boxes" were of the same system; generally 1.8 meters long, 0.9 meter broad, and 0.1 meter high; either entirely of steel wire (tarred or galvanized) or with a wooden frame and wire bottom and lid. These boxes are, strictly speaking, a French invention. In Holland they are used for the young oysters until they have reached a certain size, often till they are eighteen months old.

The bottom-scrapers exhibited by England and Holland were of the old, well-known form. As they show nothing new, and are not likely to come into use here, I shall pass them by. I must mention, however, an iron rake with long prongs, which will be very serviceable for taking up loose oysters in places where the bottom is so uneven that the scraper cannot be used. This rake is 50 centimeters broad, the prongs are 30 centimeters long and 1 centimeter thick, and the distance between the prongs is 4.5 centimeters. To the head of this rake there is attached a bag (size of the meshes 3 centimeters), intended to receive the oysters, which are taken off the bottom and fall into the bag between the prongs.

The scrapers which are used for cleaning the bricks after the young oysters have been removed look like a curved, flat pick-ax, the stem being 15 centimeters long and the blade 25 centimeters long and 6 or 7 centimeters broad. The Dutch knives and tongs resemble in all essential points the well-known English and French knives.

In connection with my visit to the exhibition I also paid a visit to the Dutch oyster establishments, which are now all located on the eastern branch of the Schelde. I was received with the greatest kindness by the public and private officials with whom I came in contact, especially Mr. A. A. W. Hubrecht, professor of zoology at the University of Utrecht, and I was thus enabled to study oyster-culture even in its most minute details.

Until the year 1870 the oyster fisheries in Holland were free; they were then carried on principally in the Zuyder Zee, and in the eastern and western branches of the Schelde. Fish of prey had reduced the stock of oysters to a minimum, so that it became evident that nature had to be aided if the oyster was not to disappear from the fauna of the Netherlands. During the same year a railroad dam was constructed between North Brabant and South Beveland, whereby the east and west branches of the Schelde were completely separated, the former being transformed into an immense salt-water basin, whose narrowest entrance is between Gorishoek and IJersekindam. The basin is bounded on the north by Tholen, on the west and south by South Beveland, and on the east by North Brabant. The Dutch at once saw the great advantages of this basin for oyster-culture. With a view to assisting the oyster industry, all oyster-fishing was prohibited on the coast of Holland, which could easily be done, as the Government is the owner of the entire coast, and as a special license is necessary in order to use the beds and other localities suited to oyster-culture.

The basin of the Schelde is divided into about 300 square parts, which are rented out at public auction to the highest bidder for a period of fifteen years, the annual income from the rents of the entire basin amounting to 21,000 florins [\$8,442]. Since that time oyster-culture has made very rapid progress, and is now exclusively concentrated around the east branch of the Schelde.

During the period from 1876 to 1882 there were exported from the Netherlands the following quantities of oysters:

Years.	Number of oysters.*
1876 .....	36,580,000
1877 .....	9,679,200
1878 .....	7,193,200
1879 .....	11,110,005
1880 .....	10,548,918
1881 .....	21,844,672
1882 .....	15,632,450

\* 1,200 oysters are generally calculated to make 84 kilograms.

These figures show great progress since 1877. The last year alone shows a decrease; but the reason for this must be sought in the circumstance that the oysters, from various causes, were much smaller than usual. The published reports state that during the year 1882, barrels intended to hold a thousand oysters held from 1,200 to 1,600. The average price during the last few years was 60 florins [\$24.12] per thousand.

Already during the summer of 1884 the area which would become free in 1885 was sold at public auction. The portions were then rented out for the next five years, that is, until March 31, 1890. The new renters, however, have the privilege, under certain conditions, of renewing their

contracts after 1890, so that they may hold them until March 31, 1915. In future this area will yield the Government an annual revenue of 363,270 florins [\$146,034.54].

This shows that the Dutch, in spite of the decrease in the oyster yield in 1882, are by no means discouraged, but that, on the contrary, there is the most lively competition for vacant portions, it being generally considered an exceedingly good investment. It should also be remembered that the Dutch, through an experience of fifteen years, have gained a very thorough knowledge of every portion of this area, and by their innate business tact and thrift have learned to appreciate its value and the excellence of the methods employed in oyster-culture. This also explains the enormous difference in the rents from 1870 to 1885. I may mention, by way of illustration, that the rent for lot No. 162 (12 acres) in 1870 was 1 florin [40.2 cents] per annum, while the rent paid at the last auction was 2,425 florins [\$974.85]. In 1870 lot 163 (same size) rented for 1 florin; but from 1885 on the rent will be 2,725 florins [\$1,105.45]. Lot No. 176 (same size) in 1870 rented for 270 florins, [\$108.54], but at the last auction it was rented for 6,100 florins [\$2,452.20]. Lot No. 138 (12 acres) rose in price from 222 florins [\$89.24] in 1870 to 9,150 florins [\$3,678.30] per annum. The rents for other lots have advanced or declined according to their value for oyster-culture as shown in the past.

The following table will show the sale of oysters during the different months of the year:

Months.	1881.	1882.
	<i>Kilograms.</i>	<i>Kilograms.</i>
January .....	151,002	140,372
February .....	273,418	84,008
March .....	453,515	42,008
April .....	85,729	8,114
May .....	88,734	562
June .....	1,118	
July .....		
August .....	1,152	1,670
September .....	61,148	56,914
October .....	72,720	167,929
November .....	125,294	377,441
December .....	183,435	227,907
	*1,547,831	†1,107,290

\*Equals 21,844,072 oysters.

†Equals 15,682,450 oysters.

In the year 1882 there were exported from the Netherlands to—

Countries.	Kilograms.
Belgium.....	189,165
Germany.....	346,333
England.....	571,801

I visited the more important places on the Schelde, such as Tholen, Berg-op-Zoom, IJerseke, IJerskendam, and Wemeldinge, in order to



get a thorough knowledge of the Dutch oyster industry. The three last-mentioned places are villages in South Beveland, and have derived all their importance from the flourishing oyster industry, while the former two are old towns. The Beveland villages were formerly of no importance whatever, while now new and beautiful buildings are rising every year. Each house has its garden in front, and from poor fishermen people have become well-to-do house-owners. This is principally caused by the oyster industry, which furnishes regular and remunerative work to all members of the family.

All that the Government has to do with this industry is to appoint and maintain a superintendent, with a suitable staff of assistants and a number of vessels, enabling him to collect the rent and attend to similar duties. This superintendent has also to supervise the other fisheries (such as the mussel, anchovy, and eel fisheries) in the Schelde and the other streams in the province of Zealand for which some rent is paid. On the area rented by him the renter can make whatever arrangements he pleases. As a matter of fact, all arrange their fisheries in the same manner, that is to say, in the manner which has been found to be the most practical and remunerative, and which I will now briefly describe.

It is well known that the tide rises and falls several feet on the coast of the Netherlands, so that large portions of the Schelde basin are sometimes under water and sometimes dry. One would expect that a large quantity of young oysters would be carried out to sea by the current, but it has been proved by experience that the young oysters which are carried out by the tide are again brought back to the basin six hours later when the tide comes in. Each lot is marked by piles. Shallow lots are used for gathering young oysters and deep lots for fattening and raising oysters. Oyster-culturists, therefore, generally rent several lots, some deep and some shallow. Along the dikes which protect the coast of the Netherlands there are oyster parcs, some dug out and others surrounded with dikes and fascines. These parcs can be laid dry, and are used for storing the collectors full of young oysters during winter, so as to protect them against ice and frost, and for storing the so-called "hospitals," in which the young oysters are kept until they are large enough to be planted on the beds. They are also used as storehouses for those oysters which are kept for sale. Of these parcs there are two kinds, completely protected ones, and incompletely protected ones. In the former the sea never goes over the dike, but the necessary water is taken in through a sluice, while in the latter the dikes are so low that at high water the sea goes over them, the daily supply of water being thus furnished without the aid of sluices. The bottom and the lower part of the sides are generally of brick-work, and each parc is generally divided into several parts by brick partitions which also serve as rests for the boards which bear the "hospitals." These parcs are often of considerable extent; generally, however, their

area varies from 2 to 4 acres. At Weimeldinge very expensive excavations are being made at the present time for an enormous parc in the most fertile ground inside the dikes. Its bottom and sides are of brick laid in cement. The water will be supplied by two pumps, worked by steam, one of which will introduce fresh water into the basin, while the other will carry off the water. As the basin is subdivided by zigzag-shaped partitions, the water which is pumped in has to go through all parts of the basin before it flows out. This is in several respects an interesting experiment. The principal object is to become to some degree independent of the state, as it is supposed that this basin, besides receiving the collectors with young oysters, and the "hospitals," will also be used for fattening oysters, where they will remain until ready for the market.

The most striking objects in these Dutch oyster towns are the large quantities of bricks, some red and others covered with lime. In the course of the winter the bricks are burned in the numerous brick-kilns in the neighborhood, and during spring and far into June people are busy covering them with lime. It is very important that the lime should be perfectly dry before the bricks are laid on the beds. Last year from 15,000,000 to 16,000,000 of bricks were used as collectors in the basin of the Schelde, a single firm in Berg-op-Zoom alone using in 1882 1,200,000; and it is probable that at no very distant period bricks will be used exclusively for collectors.

In the Netherlands the bricks are covered with lime in the following manner: If the brick is new, it is first dipped into a thin lime mixture ( $\text{CaO}$ ), so as to cover up the fine pores of the brick. When this cover is dry the brick is dipped in a mixture of one part lime ( $\text{CaO}$ ), one part carbonated lime ( $\text{CaCO}_3$ ), two parts sand, all of which is well stirred until it has the consistency of mush. As it is important that the cover should be as even and smooth as possible, both the lime and sand are sifted through fine sieves. The brick is then carefully dried in the sun.

In June and July there may be seen in the small Dutch towns whole fleets of flat-bottomed boats or small vessels taking in full cargoes of these bricks. At high water they sail into the lot for which they are destined. Here the bricks are thrown out holter-skelter, and as soon as the water is low they are arranged in regular rows. The bricks are placed on their edge, the long side downward, one close to the other; and as every brick runs to a point, there will be a space of from 1 to 2 centimeters between every two bricks. There is nothing to prevent several such rows of bricks being laid one on the top of the other. Formerly the bricks were laid with the flat side downward, one layer above the other, but the present method has been found to be more practical, as in this way the bricks are better protected against *cou-fervæ*, sand, and impurities.

Where the water is so deep, even at low water, that the collectors cannot be arranged by hand, they are let down from the boats in small

piles, each containing about twenty bricks. In that case they are held together by a galvanized-iron wire, which is passed through a couple of holes in each brick and tied into a knot at the top, by means of which the bricks are laid and taken up again.

The collectors are left in the water till September, when the small vessels again come to the beds and remove them to the parcs, where they are kept during the winter. In April the young oysters are taken off the collectors by means of axes with a semi-circular blade, a small groove being made in the lime all round the oyster, which is removed by a pressure from the side. The young oysters are then placed in the so-called "hospitals," where they are kept until they have reached the length of 3 or 4 centimeters, when they are removed to the deeper beds, where they remain till they are ready for the market, generally for two or three years. In spite of the practical manner in which the Dutch manage all their business, and in spite of the utmost care, the official Dutch reports state that 80 per cent of the young oysters are lost before they have reached a salable size; 10 per cent are lost in the parcs, 40 per cent in the "hospitals," and 30 per cent on the beds. The oysters are taken from the beds by small vessels, by means of bottom-scrapers of the same shape as those used in England. During this operation a war of extermination is of course waged against all enemies of the oyster.

In the Netherlands science goes hand in hand with practice, and it must be acknowledged that the results of this co-operation are truly astonishing, and that in many respects it deserves to be imitated in other countries. The traveling zoological station, which this year was located at Tholen, has done a great work by solving many problems hitherto considered insolvable, and by correcting many errors. During my stay in the Netherlands five young, energetic Dutch scientists were engaged at this station, which is in operation all through the summer until September. I was received by these men with the greatest kindness, and was thus enabled to get an insight into the work performed at the station, and observe their scientific and practical experiments. This year's experiments were made with young oysters in inclosed basins. A firm in Tholen for this purpose placed a large parc at the disposal of the station. By a close board fence the parc had been divided into two parts. Mother oysters and collectors of every kind were placed in both, and in order to supply the water with the necessary amount of oxygen one division of the parc was furnished with a net-work of tin tubes, through which the water was impregnated with compressed air. Into the other division oxygen was introduced by means of long axes to which a number of shovels were attached, and which were constantly kept in rotary motion by a steam-engine. When I left the Netherlands no results had as yet been obtained, but I hope to be able to communicate some at some future time. The station is supplied with experimental aquariums, scientific instruments of every kind, and a large library.