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**GILL-NETS IN THE COD-FISHERY: A DESCRIPTION OF THE NORWEGIAN COD-NETS, WITH DIRECTIONS FOR THEIR USE, AND A HISTORY OF THEIR INTRODUCTION INTO THE UNITED STATES.**

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[TWELVE PLATES.]

SYNOPSIS.

A.—INTRODUCTION.

	Page.
Cod gill-nets introduced by United States Fish Commission in 1878.....	3
Information obtained at International Fishery Exhibition .....	4
Preparation of report .....	4
Acknowledgments due.....	4

B.—CONSTRUCTION AND RIG OF THE NETS.

1.—NORWEGIAN METHODS.

Twine .....	4
Size of mesh .....	4
Size of nets .....	4
Method of hanging.....	4
Methods of preserving the nets by tanning, &c.....	5
Floats .....	5
Sinkers .....	5
Anchors.....	6
Buoys .....	6

2.—NEWFOUNDLAND METHODS.

Twine .....	6
Size of mesh .....	6
Size of nets .....	6
Method of hanging.....	6
Methods of tanning, &c .....	7
Floats .....	7
Sinkers .....	7
Anchors.....	7
Buoys .....	7

## 3.—AMERICAN METHODS.

Twine .....	7
Size of mesh .....	7
Size of the nets .....	8
Method of hanging and tanning .....	8
Dutch method of tanning cotton nets.....	8
Floats .....	8
Sinkers .....	8
Anchors.....	8
Buoys .....	8

## C.—THE FISHERIES.

## 1.—THE NORWEGIAN FISHERIES.

Date of introduction of cod gill-nets .....	9
Where nets are most extensively used.....	9
Season when nets are mostly used.....	9
Boats used in the net-fisheries .....	9
Number of men to a boat.....	9
Number of nets to a boat.....	9
Methods of setting the nets.....	9
How and when the nets are hauled .....	10
Results of the fisheries .....	10
Statistics of the Lofoten Island fisheries.....	11
Comparative earnings of the net-fishermen .....	11
Increase of the net-fishery .....	11
Quality of the netted fish.....	11

## 2.—THE NEWFOUNDLAND FISHERIES.

Where the nets are mostly used.....	11
When and how the nets are used .....	12
The catch.....	12

## 3.—THE AMERICAN FISHERIES.

Introduction of cod gill-nets .....	12
Causes which led to the use of nets in the cod-fisheries.....	12
The method of underrunning nets introduced .....	13
Where the nets have been used .....	13
Kind of boats employed .....	13
Number of men to a boat .....	13
Number of nets to a boat .....	13
Methods of setting the nets .....	14
How and when the nets are underrun .....	14
Results of the net-fishery for cod .....	14
Quality of cod taken in nets.....	15
Advantages that may result from the use of nets by bank cod-fishermen.....	15

## D.—EXPLANATION OF PLATES.

## A.—INTRODUCTION.

Although gill-nets have long been used in Norway as an apparatus for the capture of cod, and are considered quite indispensable by the fishermen of that country, they have never until recently been introduced into the United States. In 1878 Prof. Spencer F. Baird, Commissioner of Fisheries, knowing how profitably these were employed by the Norwegian fishermen, decided to make experiments with them at Cape Ann, with a view to their introduction among the cod-fishermen of this country. He accordingly secured a set of the Norwegian nets, which were sent to Gloucester and there tested by the employés of the Commission.

Experiments were made when the winter school of cod were on the shore grounds, but the results obtained were not entirely satisfactory, owing chiefly to the fact that the nets were found far too frail for the large cod which frequent our coast in winter. This was apparent from the numerous holes in the nets, which indicated plainly that large fish had torn their way through, none being retained excepting those that had become completely rolled up in the twine. The current also swept them afoul of the rocky bottom, which injured them still more, so that they were soon rendered nearly unfit for use. The nets were invariably in bad order when hauled from the water, but even under such unfavorable circumstances nearly a thousand pounds were caught on one occasion. This seemed to indicate that nets of sufficient strength might be used to good advantage, at least on some of the smoother fishing grounds, along the coast and on the outer banks.

These preliminary trials, therefore, having demonstrated that nets could be used to good advantage in the American cod-fisheries, Professor Baird availed himself of the first chance that offered for obtaining definite knowledge of the methods of netting cod in Norway, with the intention of disseminating this information among American cod-fishermen.

The opening of the International Fishery Exhibition at Berlin, Germany, in the spring of 1880, presented a favorable opportunity for accomplishing this purpose. Professor Baird having appointed the writer as one of the commission to attend the exhibition on the staff of Prof. G. Brown Goode, desired that a careful study should be made by him of the foreign methods of deep-sea fishery as represented at the exhibition. The method of capturing cod with gill-nets, as practiced by the Norwegian fishermen, was mentioned as a subject which should receive especial consideration, and it was suggested that it might even be desirable to visit Norway, so that the practical operation of this fishery might be observed.

It is probable, however, that the information on this subject that has been obtained at the exhibition and elsewhere will be sufficient to enable our fishermen to use gill-nets for cod with success.

It was the original intention of Professor Baird that a report of the observations made at the Berlin exhibition should be published as soon after the return of the commissioners as possible, but circumstances delayed for a time its preparation.

The use of gill-nets in the cod-fisheries at Ipswich Bay the present winter—an account of which will be given—has resulted in complete success, and there is strong probability that they will be introduced into the bank-fisheries, as well as those along the coast; therefore, Professor Baird has suggested the preparation of this pamphlet by the writer, and it is hoped that it may serve the purpose for which it is intended, by supplying information that may lead to the more profitable prosecution of the American cod-fisheries.

Acknowledgments are due to Mr. Frederik M. Wallem, the Norwegian Commissioner to the Berlin exhibition, for information furnished concerning the gill-nets and their use in the Norwegian cod-fisheries. The account of the Newfoundland cod gill-nets, methods of fishing, &c., is given largely on the authority of Capt. Solomon Jacobs, of Gloucester, Mass., who is a native of Newfoundland, and has had considerable experience in the cod-fisheries along the east coast of that island.

## B.—CONSTRUCTION AND RIG OF THE NETS.

### 1.—NORWEGIAN METHODS.

The nets used in the Norwegian cod-fisheries are usually made of hemp twine, of two, three, or four threads, but occasionally of flax or cotton. The three-layered hemp twine, which is the most common size, weighs a pound to 400 or 420 fathoms. It is mostly spun on the spinning wheel by the fishermen's families, and the nets are almost exclusively made by the fishermen and their wives and children. Some of the hemp twine, however, is furnished by the factories of Norway and Great Britain, which also supply all of the cotton and linen twine.

The size of the mesh varies somewhat, according to the locality where the nets are to be used, as it is necessary to make the mesh correspond to the size of the fish that frequent different parts of the coast, or make their appearance at different seasons. The smallest mesh is about  $5\frac{2}{3}$  inches ( $2\frac{7}{10}$  inches square) and the largest 8 inches (4 inches square). Those exhibited at Berlin were 7 and 8 inch mesh.

The length of the nets varies from 10 to 20 fathoms, the average length of those used at the Lofoten Islands being  $15\frac{1}{4}$  fathoms, when hung, and they are from twenty-five to sixty meshes deep. Nets about thirty meshes deep are generally used, while those of sixty meshes are employed only where there is little or no current. The nets are hung both to single and double lines, and these vary somewhat in size. Those ex-

hibited were hung to double lines, each being  $\frac{7}{16}$  of an inch in circumference, while Mr. Wallem says that 2-inch rope when single, and 1-inch rope when double, is the size commonly used at the Lofoten Islands. Some of the nets are hung to lines only at the top and bottom, having none across the end, while others have them on the ends as elsewhere. This last method is said to have been recently introduced, and is considered an improvement when the line is a little short, so that the net will be a trifle slack or baggy. About one-third of the net is taken up in hanging; that is, if a net is 30 fathoms long, stretched out, before it is hung, it will be about 20 fathoms long afterwards. They are hung with twine about the same size as that of which they are made. The end of the twine is first made fast to the hanging line, then hitched to the upper part of one of the meshes, the distance between the line and mesh being equal to one side of the mesh; then back to the line again, around which a clove-hitch is taken, thus forming one-half of a mesh, as shown in Plate I. This method of hanging is thought by the Norwegian fishermen to be superior to any other for large-mesh nets. They are generally prepared for use in Norway by tanning, and will last, when so prepared, from one to five seasons.

The nets are supported upright in the water by floats of wood, cork, or hollow glass. At the Lofoten Islands, where nets are more extensively used than elsewhere, the glass floats are preferred, it being said that they replace to great advantage the old wooden ones, which failed to prevent the nets from settling on the bottom. The fishermen from Söndmör, however, who fish on banks where there is a strong current, prefer wooden to glass floats, since, it is said, the latter are so much more easily carried away by the tide, causing the loss of many nets; while the principal objection to wooden floats is that they are so easily waterlogged. But this is thought to be the lesser evil of the two, since they can, at the worst, only sink to the bottom with the nets, whence they may easily be recovered. From this experience of the Norwegian fishermen, it may be inferred that while glass floats are preferable for general use, they are not so suitable as either wood or cork buoys where there is a strong tide. The glass floats are about 5 inches in diameter, with a covering of tarred marlin or spun-yarn hitched over them, to which is attached an eye. In this eye is bent the small rope that holds them to the net. When so prepared for use these floats are quite strong, and break far less frequently than might be supposed. They withstand the pressure of water when submerged better than anything that has been tried, but are sometimes filled with water—"drunken," it is called—when set in deep water. Plate II is intended to show the glass float and the way in which it is attached to the net. The small ropes with which these are held vary in length from  $1\frac{1}{2}$  to 6 feet.

Oblong-shaped stones, from 3 to 5 inches in length, are used for sinkers. By experience the fishermen learn how large these should be to sink the nets to the desired depth. From ten to twelve are fas-



tened to the bottom of the net at equal distances apart, being held in a double string, as shown in Plate III.

Large stones are used instead of anchors to hold the nets to the bottom. These weigh from 72 to 144 pounds, the heavier one heading the current, and the smaller being on the other end of the gang, containing twenty to thirty-five nets. Besides these "mooring rocks," there are others of smaller size that are held to the nets by a foot-line, one end of which is fastened to the stone which lies on the bottom, and the other to the rope that connects the lower part of the nets together. The larger stones are generally slung with rope, but sometimes with a band of iron around them, with an eye or ring to which the foot-line can be fastened. Iron anchors are not used, as the nets are liable to be torn on them should they settle on the bottom. Plates VI and VII show how the mooring rocks and the other stones are attached to the nets.

Buoys of different kinds are used by the Norwegian fishermen, but, according to Mr. Wallem, at the Lofoten Islands glass buoys, having a capacity of about three to five gallons, are the most common. These are generally egg-shape and are covered in the same manner as the glass floats. Sometimes a buoy is made by fastening several of the latter around a staff, as shown in Plate X. The glass buoys, of both kinds, are employed in the trawl as well as the net-fishery; they will rise to the surface again after having been under water for several days, an advantage not possessed by other kinds, and it seems that buoys of this description might be profitably used by our bank-fishermen, who frequently lose large quantities of gear on account of the wooden ones bursting and filling with water when they are submerged to any considerable depth. Hard-wood, iron-bound kegs are used by some of the Norwegian net-fishermen. From two to four glass floats, such as are on the nets, are fastened to the bight of the buoy-line, at different distances from the buoy, for the purpose of keeping the slack or scope from going on the bottom when there is no current. Where there is a strong tide, and a probability of the large buoy being drawn under the surface of the water, a number of the glass balls are attached to it with a line, these serving as "watch-buoys" for the other. Plate V shows how the glass floats are fastened to the buoy-line and buoy.

## 2.—NEWFOUNDLAND METHODS.

The nets employed in the Newfoundland cod-fisheries are usually made of hemp twine one size smaller than salmon-twine, which is also occasionally used. The size of the mesh is generally about 6 inches (3 inches square), a large mesh not being required for the small fish that frequent that coast. The nets vary in length from 50 to 80 fathoms, and in depth from 3 to 4 fathoms. They are hung to the lines in the same way that the Norwegian nets are, the foot-line being  $1\frac{1}{4}$ -inch rope, while small-sized double lines, of opposite lays, are the hangings for the top and ends. Rope is used on the lower part of the net, because,

when set close to the bottom, small line would probably be bitten off by ground-sharks, thereby causing the loss of a portion of the net.

To preserve the nets the Newfoundland fishermen make a mixture of tan and tar, which is thought better than either used separately. The tan is commonly made from spruce buds, fir bark, and birch bark (hemlock bark is not used), which are boiled together until it is sufficiently strong, when the bark is removed, and tar added in the proportion of five gallons of tar to two hundred gallons of tan, the whole being stirred well together. Some care is necessary in applying this, or else it will not be evenly distributed on the net. The custom of mixing tan and tar has doubtless been introduced from England, as it is known that the Cornish fishermen do this, pouring out their tanning liquor into large vats with coal tar, and this mixture is found to preserve the nets much longer than simple tanning. The Newfoundland nets, when prepared in this manner, generally last about four seasons.

The floats are made of the best bottle-cork, when obtainable. Before being used they are dipped in hot pitch or tar, after which it is said they will stand for four weeks at the bottom in 50 fathoms before getting water-soaked. The fishermen have two sets of floats—one, when soaked, being replaced by the other.

The sinkers most generally in use by the Newfoundland fishermen are made by tying small rocks in a bag of old netting or cloth; but lead sinkers, similar to those on seines, are occasionally attached to the nets. The sinkers weigh from 1 to 2 pounds, are about 13 feet apart, and are fastened close to the bottom of the net.

Anchor, rocks, and stone killicks are used for moorings to the nets. The former weigh from 20 to 25 pounds each, while the killicks and rocks vary from 25 to 60 pounds, the heavier heading the current, and the lighter being on the opposite end of the net or gang.

The buoys are generally made of dry fir poles, 6 to 8 inches in diameter, are usually from 3 to 4 feet long, and sharpened at one end, through which is a hole for the strap that the buoy-line bends to. Kegs are also used for buoys.

### 3.—AMERICAN METHODS.

The nets that were first tried in Ipswich Bay were made of twine about the same size as that used in Norway; indeed, part of them were Norwegian nets that had been lent to Captain Martin by the United States Fish Commission. These were found, as in the previous trials made by the Commission, entirely too weak for the purpose, and were soon badly torn, not, however, before it had been proved that suitable nets could be very successfully used. The nets that have since been constructed for this fishery are made of Scotch flax twine, twelve-thread, of the size represented in Plate IV. The twine is very strong, and is found to be well adapted for the capture of large cod. The nets are 9 inch mesh ( $4\frac{1}{2}$  inches square), that size having been found well adapted

for taking the large winter cod in that locality. Smaller-meshed nets are, however, being prepared for the bank and summer shore-fisheries.

The size of the nets depends somewhat on the locality where they are used, and also on the movements or habits of the fish. In some places where the cod keep close to the bottom, long shoal-nets are probably the most suitable, while at other points, as at the Lofoten Islands, where they are often found in the greatest numbers some distance from the bottom, deeper nets are required.

The nets made for Captain Martin were 50 fathoms long and 3 fathoms deep, but as nearly all the fish were caught near the bottom, other parties have since had shoaler and longer nets; the most of those lately made for the shore-fleet are 100 fathoms long and 2 deep.\* These are hung to small double lines of opposite lays, and they are tanned before being used. It may be well to mention here the Dutch method of tanning cotton herring-nets, which is thought better than any other by those foreign fishermen, and may, perhaps, be applied with equal advantage to other nets, when made of that material. The tan is made by boiling catechu in water in the proportion of one pound of the former to two and a half gallons of the latter. When it is sufficiently strong the nets are soaked in it for twenty-four hours, after which they are dried. They are tanned and dried three times, and then soaked in linseed oil. A pound of oil is provided for each pound of net, and they are allowed to remain in it as long as any will be absorbed. They are then well drained and spread out on the ground to dry, after which the process is completed by tanning them once more.

Glass floats, similar to those of Norway, have been used on the American nets.† These cost about 30 cents each, when covered, and twenty-five of them are attached to a 50-fathom net. Bricks are used for sinkers, one of which is fastened to the foot of the net directly beneath each of the floats, they being held in the same manner that the stone sinkers are, as shown in Plate III. It is probable that suitable metal sinkers may soon be devised, and perhaps desirable improvements may be made in the floats as well. The cost of nets 50 fathoms long, with floats attached, is about \$18.

Fourteen-pound trawl-anchors have been found quite suitable for Ipswich Bay, one being attached to each end of a gang of three nets, but it is quite probable that heavier ones will be required where there is deeper water and more current.

The buoys are common quarter-barrels, rigged in the same manner as for trawling.

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\* These nets have been principally made by the American Net and Twine Company, and H. & G. W. Lord, Boston, Mass.

† These are made at the glass factories in Boston.



## C.—THE FISHERIES.

## I.—THE NORWEGIAN FISHERIES.

The method of taking cod with gill-nets is said to have been introduced into Norway about 1685, and nets are now employed extensively at the principal fishing stations along the coast of that country, but more than anywhere else in the great winter cod-fisheries that are carried on at the Lofoten Islands. These islands are situated on the west coast of Norway, north of the Arctic circle, and the banks in their vicinity are the favorite resort of immense schools of cod that gather there to spawn. Toward the latter part of December the first schools appear upon the grounds along the outer side of the Lofoten group, and soon the "coming-in" fish are taken on those banks lying inside, in the West-fjord. The arrival of these fish, which are the forerunners of the countless millions that invariably follow, is hailed with great delight by the fishermen, many of whom resort hither from other parts of the country to engage in these fisheries, so many often being congregated here in the winter that at some points they are quite crowded.

The bank which is the principal resort of the fishermen from Nordland extends along the coast of Lofoten from the island of Röst to the Strait of Raft. This is from three to twelve miles from the land, and has a depth varying from 40 to 80 fathoms.

The fishing is at its height in February and March, while the fish are spawning. At this period, especially during the latter month, the cod are said to be very restless and disinclined to take the hook, and are usually caught in nets, the catch being increased and a better quality of fish obtained by using them. The experience of the Norwegian fishermen shows that the fatter the fish the less it is inclined to take the bait; therefore the most skillful fishermen are provided with nets as well as trawls.

The fishing is carried on in open boats. The net-boats, which, as a rule, are larger than those used for trawling, are from 35 to 40 feet long, 9 to 10 feet wide, and 3 feet deep. These are provided with a single mast, on which is set a large quadrangular sail, and each boat has also ten or twelve oars, by means of which the crew can row rapidly even against the wind. The crew of a boat fitted for the net-fishery varies from six to eight men, and the number of nets from sixty to a hundred. These are not all in use at the same time, but the greater part are kept in reserve to supply the place of such as may need repairs or drying, or that may be lost. From twenty to thirty-five nets are fastened together and set in a gang by each boat on a specified part of the fishing ground. Where so many are fishing at one place they are obliged to adopt some rule for setting the gear to prevent its fouling, since that would result in loss to all and soon render a valuable fishery practically worthless. A certain part of the fishing ground is therefore assigned for the nets, and an-

other part for the trawls, as it is evident they should not be set together. The nets are prepared for setting by fastening them together at top and bottom, attaching the sinkers, and bending on the large anchor-stones in the manner already alluded to, and which is shown in Plates V, VI, and VII. The nets are so arranged that they will set close to the bottom or some distance above it, according to the position of the fish.

The cod in the vicinity of the Lofoten Islands are said to be somewhat erratic in their movements, and it frequently happens that they are found in the greatest numbers quite a distance from the bottom. The fishermen therefore set their nets at a depth where they think the fish are most plentiful, and several expedients are resorted to to find this out, such as trying with a hand-line, and setting a gang of nets with one end at the bottom and the other some distance from it, as represented in Plate VI.

Nets are occasionally set floating, but this method of setting is practiced but little except at the stations east of Sorvaagen. One experienced in fishing soon learns at what depth the most fish can be taken, and places his apparatus accordingly.

The fishermen all start in the afternoon at a given signal to set their gear, both nets and trawls being thrown out simultaneously to prevent them from becoming tangled, though this is sometimes unavoidable on account of the strong winds and tides. The nets are set with or across the current. As soon as they are out the boats return to the shore.\*

At the Lofoten Islands the fishermen start out together in the morning to haul their nets; in the darkness of the long nights they enter their boats, for the brief daytime, often shortened by gloomy skies, would be far too short for the work which has to be accomplished. They regard neither cold nor storm as long as the waves are not too high, so as to make fishing impossible. Hauling the heavily weighted nets, sometimes from a depth of 80 to 100 fathoms, is a task requiring the united strength of the boat's crew. The nets are hauled into the boats and taken on shore, where they are cleaned and put in readiness to be set again. But it must be remembered that in this region stormy weather often continues for weeks at a time during the winter months, making it impossible for the fishermen to go out to the banks, and as a rule fishing cannot be carried on more than two days in the week.

The daily fishing varies from a few scattering cod to several hundreds. A catch of four to five hundred to a boat is considered very satisfactory, although six hundred are often taken when everything is favorable, even when they will not bite, and lines or trawls cannot be used. If more than six or eight hundred are caught, the fishermen are obliged to leave a part of the nets out until afternoon, as the boats can rarely carry any more, especially in rough weather.

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\*At Söndmör, where the banks lie some distance from the coast, the fishermen sometimes stay out over night during the month of April, when the nights have already become quite clear. Usually, however, these men haul their nets and return them again to the water, while they start for the shore to dispose of their catch.

The total catch of cod at the Lofoten Islands in 1878, according to the report of the superintendent, was 24,660,000 in number. Of these, upwards of 14,000,000 fish were caught with nets, 9,250,000 with lines, and 1,250,000 with deep bait.\* The men and boats engaged were divided as follows:

	Fisher- men.	Crews.	Boats.
Net-fishing.....	13, 168	2, 154	*2, 430
Line-fishing.....	7, 258	1, 689	1, 977
Deep-bait fishing.....	2, 297	844	†844
Hired men.....	3, 311		
Total.....	23, 034	4, 687	5, 251

\* 269 of these also occasionally used lines.

† 701 of these used no lines, and 143 used lines.

There was an *increase* from the year before of 2,542 in the number of net-fishermen, an *increase* of 417 in the number of deep-bait fishermen, and a *decrease* of 1,504 in the number of line-fishermen.

Highest total sum earned by net-fisherman.....	\$214 40
Lowest total sum earned by net-fisherman.....	48 24
Highest total sum earned by line-fisherman.....	120 60
Lowest total sum earned by line-fisherman.....	32 16
Highest total sum earned by deep-bait fisherman.....	85 76
Lowest total sum earned by deep-bait fisherman.....	42 88

The superiority of the nets over lines and trawls, as shown by the respective earnings of the fishermen, has, as might be expected, led to an additional increase in that branch of the fishery, and in 1879 it is stated that 2,532 boats, with crews numbering 14,322 men, fitted out for the net-fishery. The larger amount earned by the net fishermen is due to the better quality of fish taken by them more than to the increased catch, though this is also generally obtained. It has been found that the largest and fattest cod do not bite at the hook, but must be sought after with gill-nets, and it therefore follows that netted fish furnish a very superior article of merchandise. It sometimes requires but 210 cod caught in a net against 360 taken on a hook to furnish the same amount of liver, about 26½ gallons, and the livers of the netted fish yield much more oil to the gallon than those of the trawl or line fish. In conclusion, it may be added that pollock are taken in gill-nets as well as cod. During the winter season large schools of these fish visit the coast between the sixtieth and sixty-second parallels of latitude, and in the summer and fall are found on the coasts of Nordland and Finmark, where enormous quantities of them are taken by nets, trawls, and hand-lines.

## 2.—THE NEWFOUNDLAND FISHERIES.

Gill-nets have long been used in the Newfoundland cod-fisheries, especially on the east and south coasts of the island, but the exact date of

\* Trawls are probably meant by lines, and hand-lines by deep bait.

their introduction is unknown. It is asserted, however, that this method of fishing has been pursued since early in the present century, and is still carried on to some extent.

The coast of Newfoundland is indented with many large bays, which are favorite feeding grounds for the cod. In the early summer they make their appearance in pursuit of the capelin that gather in immense numbers along the shores to spawn, and generally remain from three to five weeks. During this time the cod usually keep near the surface of the water and the nets are set floating, but later they are set at the bottom, for when the capelin leave the shores the cod move into deeper water. Plates VIII and IX show the methods of setting at the surface and bottom. The nets are set singly or in gangs of three to seven. Two anchors are generally attached to a gang of floating nets, as represented in the plate, but where there is a current one is sometimes found sufficient. They are usually set in the afternoon and hauled in the morning. Owing to the comparative lightness of the anchors, fewer men are required to haul these than in Norway, as a single fisherman will sometimes take in one or more nets, though in most cases two or three go in a boat. The net-fishing is far less productive than that of Norway, but sometimes a large catch is made. Captain Jacobs states that on one occasion he took from four nets 2,000 cod, but says that this is rarely equaled. These fish are what are known in the American markets as medium cod.

### 3.—THE AMERICAN FISHERIES.

Mention has been made of the introduction and trial of cod gill-nets by the United States Fish Commission in 1878, but no attempt was made by the fishermen to use them until the fall of 1880, when Capt. George H. Martin, of Gloucester, Mass., master of the schooner Northern Eagle, fitted out with them for the winter cod-fisheries off Cape Ann and in Ipswich Bay. The immediate cause which led to this trial was the difficulty of procuring a supply of bait, which is a source of considerable trouble to our shore-fishermen, and its cost, even when obtainable, is such a heavy tax on this branch of the fishing industry that often the fishermen hesitate to engage in it, fearing that it may result in loss rather than gain. It was to obviate this difficulty about bait, and to render our cod-fisheries more valuable in consequence, that led Professor Baird to bring the cod gill-nets to the notice of the American fishermen. The bait principally depended on by the shore-fishermen in the vicinity of Cape Ann, during the fall and early winter, is young herring (*Clupea harengus*), known as the "spirling." The appearance of these fish about the cape is somewhat uncertain; sometimes large schools remain for several weeks, and at other times but few can be taken. There was so little probability of getting a supply of bait in the fall of 1880 that Captain Martin hesitated about fitting out, fearing that the cost and difficulty of securing a supply of this article, which is indispensable to the trawl-



fishery, would render the undertaking profitless. While the matter of fitting out was under consideration, gill-nets were suggested by the father of Captain Martin, an employé of the Fish Commission, as a means to solve the perplexities of the bait question. He thought the idea a good one, and, together with several of his crew, visited the station of the Commission at Gloucester, looked at the Norwegian nets that were there, and consulted with the agent in charge as to the probabilities of success and the methods of fishing with them. The result of this interview was that he decided to fit out and give them a thorough trial, and nets were therefore obtained for this purpose, part of them being supplied by the Fish Commission. Before the trial trip was made, the writer met him in Gloucester, and briefly explained the Norwegian methods of using the nets. It was thought, however, by Captain Martin, that they might be "underrun," as trawls are sometimes, which would enable one man to handle a gang of nets for which an entire boat's crew, six to eight men, is required in Norway.

Ipswich Bay, where the nets have been tried the present winter (1880-'81), lies north of the prominent headland of Cape Ann, which divides it from the waters of Massachusetts Bay on the south. A sandy beach extends along the northern and western sides of the bay, and the bottom sinks gradually from this, only reaching a depth of 25 to 30 fathoms at a distance of several miles from the land. The bottom of the bay is a vast sandy waste, with only here and there small patches of rocks or clay, supporting but a small amount of animal life that may serve as food for the cod. It is therefore a spawning rather than a feeding ground for these fish, and large schools visit the bay for this purpose during the winter, generally remaining until late in the spring. The nets are usually set along the northern part of the bay, but a few miles from the shore, in about 15 fathoms of water, where there is less current than at some points along the coast. They have been found much less liable to chafe than trawls, the latter being badly damaged during a storm, while the former, which were suspended by the floats, were not injured.

The common dory has been used for fishing the nets, each vessel having from seven to nine of them, according to the number of the crew. The men go singly, one in each dory, and, while out, either setting or underrunning, the vessel is kept under way, the captain and cook managing her and picking up the crew when the work is completed. Each one of the Northern Eagle's crew, except the captain and cook, is provided with a gang of three nets, which are fastened together at top and bottom when set, these forming a wall at the bottom of the sea 150 fathoms long and 3 fathoms deep, being held in position by an anchor at either end. The anchor-lines are 50 fathoms in length, and one end of each is bent to the upper corner of the nets, as represented in Plate XI.

Under favorable circumstances one man can set a gang of nets, by

letting the boat drift with the wind or tide and throwing them over as it moves along, but, as a general rule, two men can accomplish this much better. When setting for underrunning, the anchor is first thrown over, and 25 fathoms of the line paid out, when the buoy-line is bent to it.\* The buoy and line are then thrown over, and the remainder of the anchor-line, the end of the latter being made fast to the nets, which are the next to follow. A middle buoy is attached to the center of the gang. When the nets are all out, the other anchor-line, with the buoy-line attached, is veered out, and last of all the anchor is thrown over, which finishes the work. The nets are usually set in the afternoon, and allowed to remain setting for several days, unless for some reason the vessel leaves the fishing ground. Even then, when forced to seek the shelter of a harbor during a storm, they have sometimes been left out. The distance at which the gangs of nets are set apart is said to be about 40 fathoms, but this is a matter to which no rule can be applied, as surrounding circumstances will cause many variations. But few fish are caught except at night, and, consequently, the nets are underrun only in the morning, unless the men are detained by the weather until later in the day. In underrunning, the fisherman goes to one of the buoys on the end of his gang of nets, takes it in the dory, and hauls away on the buoy-line, the buoy being thrown out on the other side and the line allowed to run out on one side as fast as it is hauled in on the other. When the anchor-line (underrunning line, as it is sometimes called) is up, it is taken across the dory, and the fisherman hauls along towards the nets. These are underrun by pulling them in one side of the dory, and, as fast as the fish are removed, allowing them to pass over the other side into the water, the anchors, which remain firmly fixed in the bottom, holding them in position until the work is accomplished. When the end of the gang is reached it is thrown off the dory, and the nets remain setting as before, needing no further attention until the next day. When underrunning they may be taken across either the forward or after part of the dory, as circumstances may require. Both of these methods are represented in Plate XII.

The time occupied in underrunning depends somewhat on the smoothness of the sea, but more particularly on the amount of fish taken. When the catch does not exceed more than 4,000 to 5,000 pounds to the vessel, it is done in about two hours, but when 15,000 to 18,000 pounds are caught, about four hours are required.

The success that has resulted from the use of nets in Ipswich Bay has been quite remarkable, the catch being much more than that of the trawlers fishing on the same ground. The amount taken for the first three trials, with unfavorable weather and with inferior nets, was 4,000, 6,000, and 7,000 pounds, respectively.

On a trip ending January 11, 35,000 pounds of cod were taken by the

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\* It is probable that a better way would be to fasten the buoy-line to the upper corner of the net where the end of the anchor-line is attached.

Northern Eagle, 8,000 pounds of which were caught in a single morning. Two other vessels, which were absent the same length of time, fishing at the same place with trawls, got only 4,000 and 8,000 pounds, respectively. Since that time she has made another trip, taking the same amount, 35,000 pounds, in four days' fishing, 18,000 pounds of which were caught in one day. On this day the schooner Christie Campbell, of Portsmouth, set ten trawls (each trawl having 1,000 hooks) close to the nets. The 10,000 hooks caught about 2,000 pounds of fish to the 18,000 taken in the nets.

Captain Martin began fishing with the nets November 27, 1880, and up to the 20th of January, 1881, had caught 111,000 pounds of cod. None of the trawlers took more than one-third of that amount, though fishing at the same place. The netted fish are larger than those caught on trawls, averaging, during the first six weeks' fishing, 23 pounds each. Among these were individuals which weighed 75 and 80 pounds apiece, but no small fish, such as are frequently taken on trawls, and can be sold only at a reduced price. In addition to the advantages already mentioned, no bait is, of course, required for net-fishing, and not only is the expense for this article saved, but the loss of time and trouble incident to securing it and also to baiting trawls is dispensed with. In consideration of these facts it is not strange that quite a lively interest has been manifested in the fishing communities, and that many vessels, both of the shore and bank fleet, are being supplied with this kind of apparatus for the cod-fishery. The advantages that may be secured by our bank-fishermen from the use of these nets can hardly be overestimated. It is altogether probable that they may be profitably employed on most of the larger fishing grounds, especially the Grand and Western Banks, and Banquereau. There is no good reason to doubt the practicability of underrunning nets on these banks, especially on the shoaler parts. They surely may be set and hauled on any part where cod are now taken. The use of these would obviate the necessity of leaving the bank before a trip had been secured, as must now be done by trawlers, in order to obtain a supply of bait. It is the general custom of the trawl-fishermen to use fresh bait, and since this will not keep longer than two to three weeks, it is easy to see that much time must be lost in seeking for it. Indeed, the supply is at all times so uncertain that some vessels are not actually engaged in fishing more than one-half of the time, and it may be safely said that bank-fishermen do not spend much more than two-thirds of their time on the fishing ground, the remainder being occupied in the search for bait. Again, a large sum of money is paid for bait, and, all things considered, it is quite apparent that even if the daily catch should be smaller than when trawls are used, the profits of the trip would be much greater.

As has been mentioned, however, nets have been found to work much better than trawls at Ipswich Bay, both on account of the quantity and quality of the fish taken. Since these facts are established, there is no

reason to doubt that similar results may be obtained on the banks. The difficulties of the bait question will then be done away with, and we may therefore confidently anticipate a marked improvement in the American cod-fisheries as a result of this change in the methods of fishing, and an emancipation of our bank-fishermen from their present dependence upon Canada for supplies of bait and ice.

#### D.—EXPLANATION OF THE PLATES.

PLATE I.—Method of hanging cod gill-nets in Norway.

1. Hanging rope or line.
2. Hanging twine.
3. Clove-hitch around the rope.
4. Upper part of the net meshes.
5. Open knot, showing how it is made.

PLATE II.—Manner in which the glass floats are attached to the top of the nets.

1. Glass float.
2. Eye of the float-covering.
3. Small rope holding the float to the net.
4. Eye-splice in rope C, and way in which it is fastened to the net.

PLATE III.—Way in which the sinkers are fastened to the bottom of the nets.

1. Sinker-stone.
2. Double line holding the sinker.
3. Foot of the net.

PLATE IV.—Size of twine of which the American nets are made.

PLATE V.—Norwegian method of setting the nets at the bottom.

1. Nets.
2. Large rocks used for moorings.
3. Buoy.
4. Buoy-line.
5. Glass floats attached to buoy-line.
6. Watch-floats.

PLATE VI.—Way in which nets are set at different depths to ascertain the position of the fish.

1. Nets.
2. Foot-lines by which the nets are held to the bottom.
3. Stone moorings to the nets.
4. Buoy-line.
5. Buoy.

PLATE VII.—Manner in which the ends of a gang of nets are attached to the stone anchors and buoy-line in Norway; also showing the position of the glass floats and sinkers.

1. Net.
2. Glass floats.
3. Sinkers.
4. Large stone anchor or mooring.
5. Anchor-line, called foot-line by the Norwegian fishermen.
6. Short rope, one end of which is bent to the lower corner of the net and the other in an eye of the buoy-line.
7. Short rope, one end having an eye-splice in it through which the buoy-line passes, and the other end bent to the upper corner of the net.
8. Buoy-line. The dotted lines show the probable position of the end of the net, buoy-line, &c., when swept back by the current.

















































