

43.—FISH NETS: SOME ACCOUNT OF THEIR CONSTRUCTION AND THE APPLICATION OF THE VARIOUS FORMS IN AMERICAN FISHERIES.

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We know of ten distinct devices for the capture of free-swimming fish—the spear, the snare, the hook, the dip net, the cast net, the seine, the pound, the gill net, the trammel net, the beam trawl. We think that any appliance called by any other name whatever will be found to embody the basic principle of one of these ten.

When, and in what order, and by what kind of fishermen these various methods were first conceived and brought into use we do not know. If we would trace their development from the beginning we must draw upon our imagination, for they are old devices; so old that history affords but little information as to their first conception. We know that certain birds and animals are expert fish-catchers, and we may imagine that the first fisherman imitated the salmon-catching bear, taking his piscatorial food from the water without other implements than those provided by nature in his strong arms and nimble fingers.

But it is an accepted fact that no fisherman was ever quite satisfied with his achievements, and we may assume that the primitive fish-catcher soon began to look with covetous eyes on the gamier fish; that he was sorely exasperated to see the finest specimens elude his grasp and swim with tantalizing dignity into the depths beyond his reach. Possibly it was one of these earliest fishermen who originally told how "the biggest fish got away," and it may have been the significant exchange of glances among his aboriginal cronies which fired him with determination to capture that biggest fish by fair means or foul in order to maintain his reputation for veracity.

What sort of an implement would be devised under such circumstances? Probably a spear; and it is not unlikely that for a long period of time after the introduction of this device our pioneer fishermen were to be seen furtively stealing about the banks of streams and the shores of the sea and lakes, practicing the "gentle art" by jabbing these cruel instruments into the flesh of their victims, or, when not thus engaged, devising improvements in the shape, style, and quality of their tackle—employing their time very much as fishermen do in the nineteenth century.

The snare has been referred to, not because it is now of any importance, but because it is a means of taking fish different from any other. It is one of the crude devices which would naturally suggest itself to a man without implements of any kind who should see a fine old fish lying between the rocks just beyond his reach: The nearest sapling would supply him with a pole, some twisted grass or bark fiber with cord to form a loop, careful adjustment of this to the tapering end of the pole, a little

cautious manipulation of the tackle, the loop encircles the fish, is tightened by a sudden pull, and the victim landed flopping on the bank. We know from personal experience that nature has produced fish stupid enough to be taken in that manner.

Along with the spear and the snare some sort of a hook may have been devised, but we imagine that it was in the form of a gaff, and that the fishing industry was in a more advanced condition before the fish-hook, as we now know it, came into use.

The habit of many slow-moving fishes to rest lazily on the gravelly beds of shallow rivers, and of others to congregate at the head waters of streams in spawning season, and of still others to take temporary shelter in quiet nooks behind the rocks while ascending rapids, must have suggested the use of the dip net—first made, we may suppose, of woven grass attached to a bent sapling, afterward of leathern thongs or some stout vegetable fiber twisted into cord of suitable size and knotted into meshes.

All of these methods contemplated the capture of such fish as might be found in shallow water and in plain sight of the fisherman. Then we imagine arose the genius who first conceived the idea of luring the fish out of the safe places and inviting him to destruction by the offer of tempting food. We may suppose that bait was first used to attract the fish within range of the spear, and that afterward, as the result of another inspiration it was attached to a hook which the victim might take into his mouth. This was a tremendous advance in the development of fishing methods. Surely the catches increased enormously and intelligence of the new device must have spread rapidly among the tribes. We may confidently believe that at this time some of the old men seeing the jubilant and heavily laden fishermen returning day after day from the fishing-grounds originated the remark which has been handed down through the ages and which in its simplest form runs about like this: "If this thing keeps on the good fish will all be caught out of the water in about three years." Yet notwithstanding the dire predictions of disaster there was probably no appreciable diminution in the supply of fish, and the ingenuity of the fisherman continued to exercise itself in devising ways and means to still further augment the catch. It occurred to some one to apply the lure, or bait, in combination with the dip net; that is, to set a baited net of similar shape in the water resting on the bottom, to be suddenly raised when a number of fish had collected above the netting and were busily dissecting the food.

The time came when the possibility of capturing by one operation a large number of those fish which periodically visit the coasts and rivers in immense schools attracted the studious attention of the ambitious fisherman. These fish would not go to the bottom to feed on bait deposited in his dip net. Then, instead of spreading the net beneath them, why not throw it over them? This clever idea resulted in the device known as the cast net, which, from all the references to fishing nets in ancient writings, we believe to have been one of the earliest devices used by those to whom fishing was a means of livelihood. Yet it is not by any means one of the simplest devices, for the successful application of it requires great skill.

Another fisherman who seems to have lived before people began to record important events, devised the sweep seine. This form of apparatus may have been adopted either as a means of stopping and encircling large numbers of school fish passing along the coast, or as a method of capturing such fish as might be feeding upon grounds easily swept or dragged by a net of its character.

It was perhaps observed by some of the earlier seine fishermen that the immense schools of fish journeying along the coasts at certain times and seasons were often

below the surface and invisible, and that they were intermittent, passing at unexpected hours when the fishermen were telling yarns or were asleep in their bunks; and from this observation the idea of the appliance which is known as the pound, or weir, may have originated. There is a belief current among our fishermen that the pound is of recent origin, but it is said that the American Indian used such a device, constructed of poles and brush, before the advent of the white man, and if that is true who can tell for how long a period this apparatus had then been employed. The belief that an aperture could be made opening into the pound which would not also be freely used by the fish as a means of exit, must have been founded upon a considerable knowledge of the nature of fish, and surely it was one of the distinctly original ideas in the history of fishing methods. It has been utilized in the construction of innumerable minor nets, among which are included a great variety of fykes and pots, although in the pot the idea of the funnel is applied in combination with the lure, and not with the leader; that is, the fish are attracted to it by bait, not driven in by obstructions to their natural progress.

In the net we have referred to are found pretty effectual means for the capture of all fish which swim near to the land, either in the sea or in the rivers. For those which inhabit waters of great depth, the gill net, quite distinct from all other nets, was devised and brought into extensive use. In this net the fish is not surrounded and dragged to the shore, nor lured by the use of bait, nor drawn from his course and led into captivity; he is required merely to run his head blindly into the meshes, which are composed of the finest twine or thread it is practicable to use in order that they may be as nearly as possible invisible.

A method differing from all the others referred to is found in the use of the trammel net. Like the gill net, the trammel may be stationary or allowed to drift with the current, but unlike the gill net it is so constructed as to catch fish varying greatly in size.

The shore fisheries having thus been provided with most effective apparatus, and the gill net devised for the high swimming ocean fish, there still remained for the attention of the net fishermen those fish which inhabit the deep waters, but do not rise far above the bottom. The beam trawl met this particular long-felt want. It is, however, an apparatus more familiar to the fishermen of Europe than to us. There the beam-trawl fisheries equal in importance those of any other method, while here such experiments as have been made with them have proved unprofitable, and their use in the commercial fisheries is so limited as to hardly warrant consideration.

Now, if our attempt to account for the introduction of the various forms of fishing apparatus seems too fanciful, and does not accord with established facts, we are anxious to be enlightened by any one who knows better. The interesting fact is that all of the distinctive methods known at this time are of ancient origin; and it is a fact scarcely less noteworthy that every one of the appliances referred to, except the snare (and perhaps we should apologize for mentioning this device at all) is employed to some extent in the commercial fisheries of the United States even to this day.

The principle of the spear is applied in the whale and sword-fish fisheries. The spear in its simplest form is a common device successfully employed on fresh-water lakes in winter fishing through the ice, and in taking eels from the muddy beds of the shallow creeks and harbors along the seacoast.

The dip net in its original form yields profit to the Indian fishermen in certain salmon rivers on the Pacific coast. The finest whitefish served at the hotels in

Sault Ste. Marie, Mich., are taken by the same primitive device by the native Indian fishermen, whose birch canoes may be seen at almost any time far out in the foaming rapids, manned by two men, one poling the canoe steadily up stream, the other standing in the bow dexterously scooping the fish from the quiet pools behind the bowlders and rocks. In South Carolina also this form of net is used to capture shad in very much the same way as the Pacific coast fishermen take the salmon, that is, by continually plunging the net at random into the swift-running current, from a position on the bank of the stream, in such a way that one or more of the large numbers of fish passing upward to the spawning grounds may run into it.

The Columbia River salmon wheel is an application of the dip-net principle; and the dip net used in combination with bait you may find in all sections of the country. Scores of them are in operation all summer long from docks about Chicago, supplying anglers with fine strings of perch for exhibition purposes at very reasonable prices.

The hook we all know is more extensively employed than any other device in the commercial fisheries, notably in the cod fisheries.

The cast net is found in common use along the southern coasts, more especially in Florida and the Gulf Coast States. Seines; pounds, and gill nets are three forms of apparatus of paramount importance in the American fisheries.

The trammel net is used chiefly in the great rivers flowing into the Gulf of Mexico. It forms one of the most important means of capture in the market fisheries of the Mississippi. The fyke is used in the same section of the country perhaps more extensively than in any other part, but this net is to be found on all the seacoasts and in the lakes and rivers.

The beam trawl, as we have intimated, has not been profitably employed here, but its use is known, and the same principle is applied in the oyster dredge. It is not our purpose, however, to discuss the methods employed in the shellfish fisheries.

Having referred generally to the various kinds of nets used in American waters, and supposing that all here present are familiar with the principles employed in their construction, it may nevertheless be proper to describe, very briefly, those which are of most importance.

Seining has been applied in America, as we believe it has nowhere else, to the offshore deep sea fisheries, by means of a contrivance for pursing the net. In the mackerel, menhaden, and salmon fisheries the purse seine is most extensively employed.

The menhaden purse seine is from 150 to 200 fathoms in length, and from 50 to 75 feet in depth. It is hung to double lines at the top and bottom, one right and the other left laid. The top line is fitted with corks sufficient in number to sustain the weight of the seine and float at the surface. At intervals along the bottom of the net iron or brass rings, about $3\frac{1}{2}$ inches in diameter and a little less than one pound in weight, are attached to the hanging line. The purse line—Russia bolt rope, $1\frac{3}{4}$ inches in circumference—is passed through these rings. Two seine boats are used in operating the net, half of which is stowed in each boat. The boats are towed behind the fishing steamer, while cruising about in the waters where menhaden are known to be, until a school of fish is sighted at the surface, when they are manned and put off.

Having reached a proper position near the school of fish, the boats are rowed around it in a circle, starting in opposite directions, the seine being paid out as they proceed. When the fish are surrounded the crew of one boat enters the other, and all hands proceed to purse the seine—that is, to close the circle formed by the lower

edge of the net by means of the purse line and rings, as the mouth of a bag would be closed by a puckering-string. The pursing is accomplished with the aid of a heavy, bell-shaped leaden weight dropped over the side of the boat, and having two blocks attached on opposite sides, through which runs the pursing line to the boat davits above. But it is quite impossible to describe this operation intelligibly without the aid of a sketch or model. When the seine has been pursed it is hauled aboard the boats until the fish are gathered into the bunt, when the steamer comes alongside and the fish are taken aboard by means of a bucket and derrick rigged on deck for the purpose.

This illustrates the principle of the purse seine. The difference in methods of application in the other fisheries is chiefly confined to the boats and vessels employed. A seine fashioned on this principle is said to have been operated off the coast of Rhode Island as early as the year 1826. It was a small net, and apparently was not a marked success, as nothing more seems to have been heard of purse seines until about 1860, since which time they have been in general use.

The pound, introduced into the commercial fisheries in Connecticut about the year 1850, and soon afterward adopted by the New England fishermen, has come to be very generally employed. On the Great Lakes it is found in the form which is perhaps most effective where the use of a tunnel is practicable. The leader of the lake pound is from 50 to 75 rods in length, the two heart webs each 9 rods in length, the pot 30 feet square, and the tunnel, running from the end of the heart into the pot, is of a length proportioned to the depth of water. The tunnel at the mouth is 30 feet wide, and of the same depth as the hearts, tapering to about 3 feet square at the small end, which extends 8 or 10 feet into the pot. The netting is hung in manila rope one-half inch in diameter. All the parts are held in position by poles driven into the bottom of the lake. The nets are set in the water varying from 15 to 75 feet in depth, and in a few cases they have been made to set from 90 to 100 feet deep. The upper lines of the leader and heart are even with the surface of the water. The pot extends 3 or 4 feet above the surface. In some minor particulars, such as the size of the lines, the opening in the tunnel, etc., the construction of the nets in some fisheries may differ slightly from the description we have given.

In the ocean pound, which has to contend with stronger currents and with floating seaweeds, the tunnel does not seem to be practicable. In its stead a second small heart is sometimes constructed, the converging point extending into the pot, leaving an opening from 2 to 10 feet wide between the poles.

In the weir, extensively used along the coast of the Eastern States, we have the same principle differently applied—round pots or bowls taking the place of the ordinary square pot, and the net being held in position by poles together with an elaborate system of guy ropes and anchors.

It is not practicable to give here more than these general particulars regarding the pound. The details of its construction vary in a hundred ways, according to the nature of the fishing-grounds and the ideas and whims of the fishermen.

Gill nets are employed in the fisheries in great variety. In the large rivers flowing to the ocean gill nets are used for the capture of those fish which ascend to the head waters in the spawning season. These river drift nets are employed chiefly for the capture of shad and salmon, and the methods of operation in taking the two kinds of fish are much alike. The nets, fitted with corks, buoys, and bottom weights are

stretched across the river and allowed to drift with the current, following one another at frequent intervals. Drifting or floating gill nets have been used from the earliest times in the ocean fisheries for the capture of mackerel and herring.

Gill-net fishing on the Great Lakes is a very different operation. Here the nets are only about 4 feet in depth. They are hung to light cotton lines, heavily weighted, fitted with cedar floats to keep them in an upright position, and sunk to the bottom in water of any depth, varying from 10 to 75 fathoms. In the larger fisheries they are operated from steam fishing boats, each boat having an outfit of nets which, if fastened together and all set at one time, would stretch to a continuous length of from 20 to 30 miles. Gill nets of different proportions, but operated in a similar way, are employed in the cod fisheries of the seacoast States.

The mullet and shad gill-net fisheries of the Southern States have in recent years become very important, and from Florida to Maine the gill net is used to some extent for nearly all varieties of high-swimming marketable fish.

In the first half of this century the American fisheries, so far as they were carried on by the use of nets, were limited in extent. Gill nets and sweep seines were the principal means of capture employed, and they were operated along the Atlantic coast extensively enough to supply the local markets with fishery products, but except in the New England States they were not of great importance.

During the latter half of the century the development of net fisheries, encouraged by the growth and spread of population, with the consequent extension of markets, and by the perfection of transportation facilities, has been marvelously rapid. Gill nets stretch their interminable lengths throughout all the waters inhabited by edible fish—in the oceans east and west, in the rivers flowing into them, and in the great fresh-water lakes. Sweep seines, although for the most part abandoned in the great New England fisheries, find profitable employment in other localities where they are better adapted to the fishing-grounds. They are to be found in large numbers and of great size on the Pacific coast. They form practically the only means of capture in the important net fisheries of the Gulf of Mexico. The capacity of the modern sweep seine is greater than the earlier fisherman would have believed possible. In the bays of North Carolina the seine sweeps several miles of fishing-ground at one operation, being paid out from the deck of a steamboat and hauled by steam power stationed on the land. The purse-seine steamers cruise about in the inexhaustible field afforded by the deep waters of the ocean. Wherever you may view a great expanse of water the black poles of the pounds, traps, and weirs attest the universal presence of these appliances. In its special field of operations the trammel net is numerously employed. Fykes, pots, small seines, and traps of multifarious form abound everywhere.

If it is true that during this period of remarkable expansion of the commercial fisheries no entirely new principle has been introduced in methods of capture; it is also true that the elaboration and application of old methods have been sufficiently progressive, and the observation of these changes is within the special province of the net and twine manufacturer, who views the whole field of operations and who is compelled to adapt his business to every new condition. Fishermen now living recall the time when half a dozen sizes of hemp twine of a rather ordinary quality sufficed for the requirements of all of the American fisheries. In the year 1893 there are between eighty and ninety different kinds and sizes of twine in constant use as material for netting, and the variety is increased to more than a hundred kinds and sizes if we include such as are used for gill-net hanging lines.

Previous to 1840 it had not occurred to anyone apparently to supply the fishermen with ready-made nets. In the twelve months of the present year the netting manufacturer whose business extends through all the fishing districts will have been called upon to supply more than three hundred distinct varieties of netting; that is, as many kinds as can be made up by the use of every conceivable size of mesh, duplicated in from two to thirty different sizes of twine.

More than thirty sizes of mesh and forty kinds and sizes of twine are required for the gill-net fisheries alone, the meshes varying from $1\frac{3}{4}$ inches (extended measurement) to 13 inches, and the twines from the size of a single horsehair to 36-thread cotton, which is nearly one-eighth inch in diameter. Of the great variety in sizes and twines referred to, all but a few are made of cotton, no hemp twine being used in our fisheries, and linen only where the yarn must be spun to extreme fineness, as in the gill-net fisheries of the Great Lakes.

The substitution of cotton for hemp twines in the American fisheries was a matter of very considerable importance, for its results were far-reaching, affecting the great fisheries of European countries hardly less than those of our own. The incident which led to this important step is here related:

Some time in the year 1844 a fisherman, known to history as Mr. McCarthy, while away an idle hour at a small store in Boston, where he bought his fishery supplies, expressed an opinion that somebody in this country might turn an honest penny by getting up a twine especially designed for nets, and better adapted to the purpose than the imported hemp twine then used. This proposition was discussed in the presence of Mr. James S. Shepard, who was then engaged in the manufacture of cotton yarns at Canton, Mass., and he very soon afterward submitted to Mr. McCarthy, the fisherman, a cotton twine which the latter made into gill nets and submitted in turn to the herring family of fishes for a final verdict. It was pronounced a satisfactory twine by Mr. McCarthy and was at once adopted by the fishermen, but candor compels us to say that the fisherman of the present day would not accept it as a gift. The best that can be said of it is that it was an improvement upon the hemp twine.

Soon afterward the popularity of cotton twines for both gill-net and seine fishing induced Mr. Shepard to devote his whole time to their manufacture and improvement. The product of his factory was taken by the proprietors of the store we have alluded to, who for some years had been supplying fishermen in a small way with nets made by hand knitters in and around Boston. This concern was the nucleus of the present American Net and Twine Company, and included Mr. Shepard in its membership a few years after the events narrated.

Aside from the introduction of the new twines, methods of manufacture did not undergo any considerable change for some years. Seines and gill nets continued to be the chief forms of apparatus, and the netting was made by hand, men, women, and girls being employed to do the work. The variety and sizes of twine and mesh were very small. The fishing industry was attaining considerable proportions, however, and the use of cotton twines stimulated a demand for them which induced other yarn manufacturers to engage in their production.

In the year 1853 the net and twine company referred to imported the first netting machine used in this country. It was a hand-power Scotch machine, the only kind then in existence. The Scotch machine was not then, and, we believe, it never has been adapted to the manufacture of heavy netting, so that after its importation all netting except that composed of fine twines continued to be made by hand. For light

netting, however, the company built in their own factory several machines of the Scotch pattern.

The limitations of this netting machine led the Net and Twine Company to expend a very considerable sum of money in attempting to develop two or three inventions designed to overcome the difficulty of knitting heavy twines, but none of them proved satisfactory. In 1862 a newly invented machine, quite different in principle and well adapted to heavy work, was put in operation. Some years afterward an ingenious native of the State of Connecticut, Mr. Squire, invented a machine for knitting fine threads which possesses many advantages over the Scotch machine.

The larger netting companies are using the Scotch machine which has been improved somewhat in construction, and the 162-power machine, and the company we have spoken of use also the machine of American invention in the manufacture of fine thread netting, they having purchased the rights of the inventor.

The extensive introduction of these different machines was, of course, a process of gradual accomplishment, and while it was taking place the fisheries were undergoing that wonderful expansion which we have little more than indicated in this paper. Without the machines it would not be possible to produce the great variety of twine and netting used, and it is true, no doubt, that the ability of the netting factories to supply about everything imaginable has induced the fishermen to adopt a great many sizes of mesh and twine which would not otherwise be considered necessary.

We know quite well that what we have said about fish nets covers only a small part of the subject, and perhaps not the most interesting part. A chapter might be devoted to a description in detail of the methods of operating the various nets, to the multiplication of forms in nets having the same general principle, and to the frequent attempts, more or less successful, to apply new devices in parts of nets, such as the tunnels of traps, bags or cods in sweep seines and so forth. It is also proper to consider the effect of the multiplication of nets upon the supply of fish, but that is a matter which we are content to have discussed by those who are equipped with such knowledge of aquatic life—of the habits and nature of fishes, and of their capacity for self-propagation—as to make their opinions valuable. Unfortunately this equipment is not possessed by many who engage in public discussion of this subject; but we hope that much trustworthy information may be disseminated by those who take part in this congress.