VII.—SHORT INTRODUCTION TO THE PROPER CARE AND MANAGEMENT OF THE BALTIC FISHERY.

By H. Widegren, *Stockholm*, 1874.*

THE FAUNA OF THE BALTIC.

The fish living in the Baltic are either such as live and propagate exclusively in salt water, *e. g.*, the herring, the small herring, the codfish, the flounder, and others, or such as must properly be considered as fresh-water fish, but which can live and propagate in the but slightly briny water of the large and small bays and inlets of the Baltic. The fresh-water fish which are also found on the coast of the Baltic and form the principal objects of the fisheries, are the perch, the pike, the roach, the bream and other carp-like fish, as well as the burbot. Besides these, there are found in the Baltic several kinds of fish, which, like the salmon, the grayling, the gwiniad, and the eel, must chiefly be considered as migratory fish, staying sometimes in salt water, and at other times, principally during the spawning season, in fresh water.

In consequence of the character of the fish-fauna of the Baltic, the fisheries carried on in its waters are not only sea-fisheries in the proper sense of the word, but also such fisheries as are carried on in our Swedish lakes, with which many of the inlets of the Baltic—especially those which only through narrow and shallow sounds are connected with the outer coast—show the greatest similarity in regard to those conditions which have an influence on the fisheries.

As we are going to give a short introduction to the care and management of the Baltic fishery, we will first consider the fishery carried on in the inner bays and inlets of the Baltic, and which, to distinguish it from the herring and other sea fisheries, is by the fishermen called "rock-fishery" or "coast-fishery." In this treatise we shall chiefly make use of the latter name as more expressive of the idea, as this name mentions the locality where this fishery is chiefly carried on, viz, the coasts of bays and sounds.

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I.

THE COAST-FISHERY ON THE COAST AND IN THE BAYS OF THE BALTIC.

In order to carry on the coast-fishery in the proper manner, the first thing required is an exact knowledge of the mode of life of those fish which are to be caught; and, secondly, an intimate acquaintance with all the fishing-implements employed at different seasons of the year. To do full justice to the subject would require more space than can be allowed in a short introduction; we shall, therefore, only give the most important points which should be known and observed by a successful fisherman.

Kinds of fish caught by the coast-fishermen.—The principal fish found on the Swedish coast of the Baltic and in its bays and sounds are, the perch, carp, crucian, tench, roach, chub, *Cyprinus vimba*, bream, pike, salmon, trout, gwiniad, *Salmo albula*, burbot, and eel. As useful either for bait or as food for larger fish we must mention the ruff, the stickleback, the minnow, the bleak, and the smelt.

Mode of life of the above-mentioned fish.—All the above-mentioned fish have this in common, that at certain seasons of the year they visit certain places on the coast and the coast-waters, and that every year during the spawning season they go to such places as seem specially suited for propagating. Although all of them may in a certain respect be more or less called migratory fish, it has been observed that each one of them in those waters in which it lives confines its migrations to certain limits, that, for instance, the perch and the bream, &c., each only visit their certain bay (and this a bay near to the deep water), and that they scarcely ever extend their migrations beyond this, the limits of their wandering and spawning, unless the spawning-places are disturbed or other natural causes lead to a change. This characteristic trait of the fish, to confine its migration to certain limits, and each kind and school to select that spawning-place where it was born, is especially striking with the migratory fish properly so called, the salmon, carp, gwiniad, and others, which generally go up certain rivers and streams for the purpose of spawning. By marking young salmon which were on the point of leaving the river where they were born, it has been proved that these fish, which of all our fish wander away farthest from their regular place of sojourn, nevertheless return to it regularly. It has moreover been proved that if a whole school of fish, for example, gwiniad, &c., having its spawning-place in a small stream, is caught, no fish of this kind will ever return to this stream, although the nature of the water has remained the same, and although they will continue to go in streams close by, where the fishing has not been of so destructive a character. On the other hand it has been found that fish have left such streams which, by draining, cultivation, or other agencies, had their natural character changed so as no longer to offer a

suitable place of sojourn. Every experienced fisherman knows, moreover, to what a degree the placing of fagots and the preparing of artificial spawning-places attracts fish and induces them to spawn in a certain place.

Rules for carrying on the fisheries, made in accordance with the character of the different kinds of fish above mentioned.—The experience which has been gained regarding the migrations of fish, their extent, and the conditions under which they are undertaken, is of the greatest importance to the practical fisherman.

In the first place it must not be expected that the fisheries will be equally productive every year, unless, especially during the spawning season, fishing is carried on in such a manner as always to leave a certain quantity of fish in the water, so that the propagating process may go on undisturbedly. It is wrong, therefore, as is sometimes done with us, to use large seines and catch the entire school of fish coming to a certain bay, in the hope that other schools from other parts of the Baltic will soon replace it. Such a change from their regular route is entirely at variance with the nature and habits of fish. From what has been said above, it will be seen that in order to count on continued good fisheries, the nature of the water should be kept unchanged as much as possible, and in fact it should in every way be made still more suitable for the various kinds of fish. Care should therefore be taken not to disturb vegetation in those places where fish spawn in spring, and as regards the fish of the salmon family, which spawn in streams during autumn, it will be necessary to keep the gravelly bottom, which these fish like, free from mud, shavings, &c. As for keeping the natural conditions undisturbed, it must be mentioned that by excessive fishing—which unfortunately is too often practiced with us—certain smaller kinds of fish, *e. g.*, the bleak and the smelt, are not entirely destroyed, but that larger and finer kinds of fish are thereby deprived of their natural food, and are thus forced to eat their own fry, which of course seriously endangers the future of the fisheries. If a man wishes to improve his fishery, and does not to a certain degree spare the small fish which are of no use for the table, he would make the same mistake as he who stocks water with fine fish without supplying them with the necessary food. It is moreover well known that in spring the fish generally go on grassy bottoms and in small brooks and streams for the purpose of spawning; that after this they go in deeper water, and later in summer stay at a certain depth; that in autumn they again seek sandy or grassy bays, and finally in winter either gather in certain deep basins of the sea or near currents. From this knowledge it follows, that in order to make the fisheries successful, one should attentively follow the migrations of the different kinds of fish all the year round, observe the exact time of their wandering from one place to the other, and finally examine the nature of the bottom and the depth of the sea in different parts of the fishing-waters, because a person not acquainted with all these conditions cannot know

with absolute certainty in which places the fish may be found at different seasons of the year.

A farmer or mechanic who only occasionally engages in fishing, therefore, runs the same risk as a bird which, born in a cage, suddenly gains its liberty. It starves to death on account of its lack of the faculty of observing and its ignorance of those places where food may be found. To this must be added the circumstance that a good farmer, accustomed to handle the plow and spade, does but rarely possess the necessary skill in using lines and hooks or nets, and will, consequently, not be a very successful fisherman. Fishing should, therefore, only be carried on by persons who have been able to gain some practice in it, and who can devote their whole attention to it; and those who have such small fishing-waters that it would not pay to keep a special person to take care of them would, therefore, do best to club together with some of their neighbors and let out their fishing-waters to skilled fishermen.

After having thus given the most important rules which should be observed with regard to the mode of life of fish, and after having likewise pointed out the way in which our fisheries could best be furthered and protected, we will briefly mention the way in which a fisherman should go to work, the methods of fishing, and the fishing-implements which can and should be used at different seasons of the year.

Various ways in which the fisheries may be improved.—Rarely, or perhaps never, do we find a sheet of water which is so favorable to the propagation of the different kinds of fish living in it that its condition could not in any way be improved, that is, made more convenient and suitable for the spawning of the fish. Just as the farmer must be very careful to water, to plow, dig, and fertilize his ground, because, being left to itself, it will be overrun with weeds and will not yield the produce which, with some care, might be expected from it, thus the proprietor of fishing-waters must take care of these waters and aid nature by artificial propagation, and make the water a suitable dwelling-place for the young fish, and protect these as much as possible against their enemies. The propagation of fish fortunately goes on under such conditions as to enable man to extend considerable aid to nature; and to give this aid should be the first duty of every proprietor of fishing-waters who has his true interest at heart.

Of our common fish, the perch, the pike, bream, roach, and other carp-like fish spawn in spring or early summer, whilst the salmon, gwiniad, char, and burbot spawn in autumn and winter. Most of the fish which spawn in spring lay their roe on pieces of wood, aquatic plants, algæ, grass, reeds, &c., to which the roe remains sticking until the young have slipped out. This is the case with the perch, for example, which lays its eggs in bag-like heaps on pieces of wood or on reeds, as also with the roach, whose roe is in separate grains, fastened to pieces of wood, stones, or aquatic plants found near the shores of lakes. The pike, the bream, and the tench and other carp-like fish lay their eggs on grassy bottoms or

among aquatic plants. These fish love to lay their eggs in places where there is a current, as in small streams, the mouths of brooks, &c. The fish of the salmon kind, on the other hand, lay their eggs free, not fastening them to any object, and select for this purpose gravelly and stony places in brooks and rivers, on whose free bottom they lay their eggs. In order to protect the eggs which have been thus laid the fish of the salmon kind beat the bottom with their tails, in order thus to cover the roe with gravel and sand.

Every one who intends to further the propagation of fish and thus to improve the fisheries must, in the first place, ascertain how those fish of which an increase is desired spawn in nature, and then to arrange his course of action in accordance with the knowledge gained. As regards the fish of the salmon kind, whose roe generally takes a longer time for developing, experience has shown that their number can best be increased by protecting the fish during the period it stays in the streams and is occupied in spawning, and also by introducing artificial propagation, that is, impregnating the roe in an artificial manner and keeping it in special establishments until the young fish are large enough to take care of themselves. As there can be no question of establishing hatching-places for fish of the salmon kind on the Baltic, as these would have to be made in brooks and streams, this is not the place for describing the arrangement of such establishments; but we shall here mention the various means by which fish-waters may be improved.

If it is the intention to increase the number of those fish which spawn in spring and whose roe is fastened to branches and other objects in the water, the owner of the water must, first and foremost, see to it that such objects are found in the water. This is all the more important as through the destruction of the forests, the draining of the marshes, and the gradual rising of the Scandinavian peninsula, the natural spawning-places, at least in certain localities, are diminished or deteriorated. By placing in the spawning-places, a short time before the spawning-season commences, fir branches two to three yards long, or fagots, or by laying pieces of sod on the bottom of smaller sheets of water, or by planting aquatic plants which it is known that the bream and other kinds of fish prefer to lay their roe upon, natural spawning-places may be much improved. If such care is to be further extended to the young fish special ponds may be dug and their sides clothed with fagots or suitable aquatic plants. A number of fish which are about to spawn are then placed in these ponds, where they lay their eggs on the fagots or plants. The branches, full of roe, are taken out every day and placed in a smaller pond 2 feet deep under the water, which by a hedge of fagots is separated from the outer sea, so that large fish and crabs may be prevented from entering the pond and destroying the roe.

The bream, pike, and ide, which last-mentioned kind loves to lay its eggs in flowing water on a grassy bottom, may be inclosed in separate smaller basins at the mouth of brooks and streams where the above-

mentioned natural conditions are found or can be artificially procured. After the fish have laid their eggs they are caught and taken out, whilst the roe is, of course, left on the grassy bottom until it is hatched. The young fish are then allowed to go free if such is their desire. By these and other similar means the number of fish in a bay may be considerably increased. It is evident, however, that these means will help but little unless measures are taken to prevent the young fish from being caught in nets with small meshes or with other fishing-implements. Care must also be taken that the schools of fish in one and the same sheet of water are not, by excessive fishing, diminished to such a degree as no longer to be able to propagate their species at the rate necessary for keeping up their numbers. He who cuts down the tender blade will never reap any grain, and he who only sows one-tenth of the seed which his field ought annually to yield, will never have a full harvest. It is evident, therefore, that the owner of fishing-waters must not only employ the above-mentioned means for increasing his number of fish, but must also see to it that the spawning process is not disturbed and that the tender young fish are properly protected. With the view of obtaining this end and in view of the fact that fish will wander from one sheet of water to the other—thus making it possible that one owner of fishing-waters may disturb the fisheries of another—the common interests of the proprietors of fishing-waters imperatively demand that all carry on their fisheries in a manner suited to the nature of the fish and the peculiar condition of the water. He who desires to reap a full harvest from his fishing-waters must, therefore, not only himself carefully observe all the rules necessary for preserving and protecting his fisheries, but he must likewise see to it that his neighbors do the same. Wherever such rules have not yet been adopted it will be in the interest of the owners of fishing-waters to introduce them as soon as possible, as only after this has been done will there be any reasonable hope that the measures for improving the fisheries will be successful.

With regard to the nature of the fauna of our Swedish coast, there are chiefly two rules which ought to be observed in fishing, and these are, not to fish with nets during the spawning-season, and not to use nets whose meshes are shorter than one decimal inch, except in cases where bait is to be caught. Just as important as it is in spring to prepare suitable spawning-places for the fish, it will be to see to it that the above-mentioned rules are not transgressed during the year. Where all the possible means have been employed for aiding the propagation of fish, and where only suitable fishing-implements are used, the owner of fishing-waters, like the farmer, must not miss the harvest-time. Human ingenuity has, fortunately, in course of time invented so many methods of catching fish, that he who is well versed in these methods may derive a benefit from his fishing-waters nearly all the year round without using methods of fishing by which the young fish are destroyed, or by which the future of the fisheries is undermined.

Seasons and implements for the Baltic coast fisheries.—As the pike begins to spawn earliest in spring, and as it is a voracious fish-of-prey which should not be spared too much, it should form the first object of fishing. For this purpose it is necessary, before the ice is completely gone, to close the entrances to the larger inlets by brushwood. As the pike in most parts of the country begins to spawn much earlier than other fish spawning in spring, nets may be used, at any rate in the beginning of this fishery. Towards the end of April or the beginning of May, when the perch, the roach, the flounder, the bream, and other fish commence to spawn, net-fishing must, of course, be stopped, and stationary nets should be used, placed at right angles with the shore, and so as not to close the entrance to the smaller inlets where these fish usually spawn. Whilst the ice lasts, traps should be set for catching bream. Bundles of brushwood are also laid in May with traps for catching roach. Those roach which are caught during the spawning-season should be kept in marshy waters in a convenient place, so that during summer they may be used for bait. In the same manner smelt and bleak are also caught with large nets, and are used for food or for bait. It must be mentioned that fish caught during the spawning-season will live much longer in marshy waters than those caught when the spawning-season is over. A wise fisherman, therefore, will supply himself with as much bait as possible during the spawning-season. Besides nets and traps, wicker-baskets are used during the spring spawning-season for catching perch, bream, pike, &c., and are placed as deep as possible, as also the so-called Hertzman's nets, which are used at some fishing-stations, and with which generally a good many fish are caught.

After the spawning-season has closed, fish may be caught during June and July, either with fishing-lines in deep water or with nets in the fishing-waters and other places suitable for this implement. Different kinds of fish, of course, require different kinds of bait, live fish, fry, or worms, according to the kind of fish you wish to catch, whether pike, perch, bream, or other fish. At midsummer-time, fishing with hooks and lines properly commences. In July, immediately after the bream has done spawning, this fish is caught with smaller nets, which have a purse with large meshes. These nets, which are chiefly used in the province of Skåne (Southern Sweden), are let down from two boats in deep water, and in favorable weather a good many fish are caught in them. These nets only cost from $4 to $5.50 (American money) apiece. In July and August fishing is carried on with seines, common nets, and hooked poles. Casting-nets are also during summer thrown out among the reeds, and are used for catching all kinds of fish, with or without poles. During the autumn months seines and nets should chiefly be used, especially in those places where the bleak and smelt spawn. But even during this season a good many fish may be caught in deep water with deep-water nets. During winter, traps are set in streams and the mouths of brooks and in the spawning-places of the burbot, for catching this kind

of fish. In deep bays nets are set during winter, towards which the fish are driven by poles. Under the ice roach are caught in traps and are then used as bait for pike, which kind of fish is even caught under the ice with hooked poles or hooks and lines. By using the methods of fishing mentioned above, at the different seasons, a thrifty and energetic fisherman may derive a good income from his fishing-water all the year round.

II.

THE FISHERIES IN THE OPEN BALTIC.

a. THE HERRING-FISHERY.

The different kinds of herring which are found in the trade and on the coast of Sweden.—It is well known that in the sea which surrounds the Scandinavian peninsula there are found different kinds of herring, varying in size and fatness, which on certain portions of the coast are caught, and prepared in different ways reach the great markets under different names. Nearly all over Sweden the following kinds are found in the trade: Norwegian herring, gråben herring, lodd herring, fat herring, Gottenburg or Bohuslän herring, Kulla herring, Bleking herring, small herring, anchovies, skarp herring, spiced herring, &c. All these different kinds are prepared from only two kinds of herrings, viz, the herring proper (*Clupea harengus, L.*)—in the Baltic called "strömming"—and the sprat (*Clupea sprattus, L.*), of which the former both in nature and in trade occurs in far greater numbers than the latter, which is only caught and prepared to a comparatively small extent, mostly as anchovies. As the "strömming" is nothing else but a variety of the herring proper, as I intend to show later, the term "herring" used in this treatise is understood to mean both the herring of our western coast and the "strömming." The sprat can easily be distinguished from the herring proper by its smaller head and by the circumstance that its ventral fins are nearer the head than with the herring proper. The sprat, moreover, on its lower side ends in a sharp edge somewhat resembling a saw, which is not the case with the herring.

The herring, which on certain coasts forms a rich source of income, has its proper home in the North Sea and the Atlantic Ocean, but is also found in the seas connected with the above, the Kattegat and the Balfic. Like other fish the herring has also in course of time undergone certain changes regarding size, fatness, &c., according to the different seas or fiords where nature has placed it. These changes have chiefly been caused by a difference of food not only in the Atlantic Ocean, the Kattegat, and the Baltic, but even in different portions of the Western Sea and the Baltic. We therefore find that every portion of the sea and even certain bays have, so to say, their own race of herrings, which certainly are not a different species from those found on other neighboring coasts, but which, nevertheless, can easily be distinguished as a different

variety owing to the surrounding nature. Thus, for example, a larger kind of herrings is at certain seasons of the year found in some bays of the Baltic and can easily be distinguished from those herrings which live and spawn on the outer coast; and the herring found on the coast of Bohuslän and in the Christiania fiord differ in size, &c., from the herring found on the western coast of Norway. These differences have not only given rise to different ways of preparing the herring and to different names under which the herring comes in the market, but from them certain conclusions may be drawn regarding the mode of life of the herring, from which, again, important lessons may be derived regarding the protection and the improvement of the herring-fisheries. Even at this day there are many fishermen who entertain the opinion, which before science had spread more light was quite common, that the herring only accidentally came from remote portions of the ocean to those coasts where it is caught, and therefore these fishermen thought to do right by using these accidents and catching as many herrings as possible; in other words, to fish with the most destructive implements, even those by which a whole race of fish would be destroyed. But since experience has shown that Norwegian herring are never caught on the coast of Bohuslän, nor Kulla herring on the coast of Bleking, nor Gottland herring on the eastern coast, &c., and since the time and place have been discovered where the herring spawns; as well as the mode of life of the tender fry, its place of sojourn, &c., it has been ascertained that the herring—like the salmon and other fish—has certain limits to its migrations, certain places where it spawns, &c. If good herring-fisheries are to continue on certain coasts they must be carried on in such a manner as not to catch all the fish which come to a certain place either to spawn or to live. Care should also be taken to spare the young fry, because if this is not done the race of fish on the coast in question may be destroyed, since no new race can be expected to come here, and thus a large source of income will be lost, whilst if the young fish are spared good fishing may be expected every year.

In several places on the Baltic and the Western Sea carelessness with regard to the preservation of the race of herrings and the protection of the young fish has been severely punished. The investigations which have been made for several years, have shown conclusively that careless and destructive fishing has contributed not a little to the cessation of the great Bohuslän herring-fisheries, which unfortunately have not yet recovered, chiefly because as soon as a school of young herrings shows itself on that coast it is immediately caught with nets that have small meshes. Near Bresund, in Norway, the herrings used to come to the coast for many years, but ceased to come when people began to use nets with small meshes. To give instances from nearer home we will mention that not so long ago herrings came to the coast near Bråviken and to the mouth of the Motala River, as well as near Lósingsskär and Botilshäst, where large quantities were often caught. But people com-

menced to use nets during the spawning-season, by which this entire race of herrings was caught; and since that time fishing has entirely ceased in those places. Similar instances might be given from many other places on the Baltic. With these experiences fresh in our remembrance it will be evident to every one how important it is to carry on the fisheries in accordance with certain well-defined rules based on a thorough knowledge of the nature and mode of life of the fish, if the future of the fisheries is not to be seriously endangered.

To enable the fisherman to judge for himself what is best for the improvement of the herring-fisheries in every case, besides those rules which may possibly have been laid down by a law of the state, it will be necessary to give some further information regarding the nature and mode of life of the herring.

Natural history of the herring.—The herring is a gregarious fish and is generally found in large schools, especially at the time when it approaches the coast, which it does regularly at certain seasons of the year, partly to spawn and partly to seek food in calmer waters both before and after the spawning-season.

During winter the herring lives in the deep water outside those coasts on which it has its spawning-places; but even during this time it visits the deep fiords, and therefore moves about in the same way as during summer, which is shown by the fact that in the Baltic herrings may be caught during the winter with nets placed under the ice at different depths (from 5 to 24 fathoms), and even with drag-nets in bays and inlets. During its migrations to and from the coast as well as during its stay in the deep waters of the open sea, the herring is sometimes near the surface and at other times near the bottom; and these changes of place are thought to depend partly on the temperature of the water and partly on the currents and other natural causes, concerning which, however, experience has not yet taught us such certain lessons as to draw from them reliable conclusions regarding the depth at which the herring is found at different seasons of the year. Fishermen had, therefore, best make experiments by setting nets at different depths.

The spawning-season varies among the herrings found in one and the same sea, and even the different schools or tribes have different spawning-seasons, and even in one and the same school all fish do not spawn at the same time, probably owing to difference of age or to slower or more rapid growth, &c.

In the Baltic the herring spawns either in spring or in summer, and is accordingly called either spring herring or summer herring. In the Southern Baltic the herrings continue to spawn till the middle of October, whilst in the northern portions of this sea the spawning-season closes in August. The fish spawn either outside the coast on raised bottoms at a depth of 13 to 15 fathoms, or in the bays running inland, mostly in places where the bottom is overgrown with algæ. The spawning is done very quickly, as soon as the school has gathered in its spawning-

place, the whole process probably occupying not more than five or six hours. The roe is laid on aquatic plants, stones, pebbles, &c. The development of the roe occupies a shorter or a longer time, according to the different temperature of the water.

In May, when the water is colder, it takes 14 to 18 days to hatch the roe, but in August and July, when the water in the spawning-places generally has a temperature of 14 to 15 degrees (C.) (57.2°–59° F.), it only requires six to eight days. The newly-hatched young fish, which are smaller and more transparent than most other young fish, and are, therefore, hard to distinguish, are a little over ¼ inch long, and have, for eight days after the hatching, a bag attached to their body, which hinders the young herring from being very brisk in its movements during the earliest part of its life. Only after the young fish has lost this so-called umbilical bag it begins to swim about, gather in schools, and seek food. It is difficult to ascertain with absolute certainty the growth and size of the young herring at certain periods of its life, especially as not all the young fish have the same ability to gather food, on which circumstance their growth of course depends.

Attempts have been made to raise young fish by placing them in small basins and feeding them regularly, but so far these attempts have proved unsuccessful, as the young fish did not live longer than five weeks, at which time they have reached a length of about ½ inch. During the whole first year of their life the young fish may be found in the spawning-places, both on the outer coast and in the inner bays. Young fish, measuring 1 inch in length, may be supposed to be about two months old; at the age of three months they measure about 1½ inch in length, all the fins are completely developed, and the color of the body resembles that of the grown herring, so that they may be easily recognized as the young of this fish, which formerly could not have been done. After examining young fish found in the spawning-places one has felt justified in concluding that the young herrings measuring about 3 inches in length, which in spring are found in the spawning-places, are those fish which have been hatched earliest during the preceding year, and are, therefore, about a year old. The young fish measuring 5 to 6 inches in length, which are often caught in nets, are therefore supposed to be only two years old. When a fish has reached this size the roe and milt begin to develop rapidly, and when it has reached a length of 8 inches it is capable of propagating, and may then be supposed to be about three years old.

The food of the young herring, as well as of the full-grown herring, consists chiefly of small crustaceans scarcely discernible with the naked eye, which are found in large quantities in the water both in shallow and deep places. By towing in the sea-water with a net made of fine gauze large numbers of these little animals may be caught. They are more or less plentiful at different times and under different conditions of weather, and at different depths. This may possibly explain to some extent the

fact that the herrings are not always found at one and the same depth. In summer these small crustaceans are found nearer the surface, and the herrings at this time likewise go nearer the surface. Like other fish, the herring abstains from food for some time before and after spawning, and its stomach is then generally empty, but after spawning it begins to take food again, and gradually recovers the strength and fatness which it had lost during the spawning process. This explains why the herring is fat at one time of the year and lean at another.

About two months before spawning commences the herring may, as a general rule, be said to be fattest and best. This fatness it retains almost to the end of the spawning-season, when it begins to get lean, and when it is not fit to be caught. The herring, after having done spawning, usually goes into deeper water in order to seek food, and does not return until it has entirely recovered its strength. That the herring, like other fish, returns to the place where it was born as soon as it has become capable of propagating is proved by the fact mentioned above that certain schools or tribes of herring spawn at the same place every year. That the number of fish is one year larger in one place than in another is doubtless caused by changes in the weather, currents, &c. Similar causes may even produce an almost total failure of the herring-fisheries in some locality. Cold and unfavorable weather during the spawning-season doubtless often kills large numbers of the young fish of some school, which of course will affect the herring-fisheries for several years to come. These and other circumstances on which the herring-fisheries depend have so far been so little explained that not much can be said regarding them; but it is fully known and understood that man may destroy the herring-fisheries in some portion of the sea not only by using nets which will catch both old and young fish, but also by disturbing the spawning-places.

It has been mentioned before that certain tribes of herring, especially the larger ones, spawn near the coast on bottoms overgrown with algæ. If this bottom is made unfit for spawning by pulling out or otherwise destroying the algæ by dragging nets along the bottom or in any other way, the herrings are forced to seek other and more suitable places for spawning, and they consequently leave these waters which they used to visit regularly. Experience gathered in Bohuslän and other places has shown that the herring is very sensitive in this respect, and leaves its old spawning-place entirely if its nature is changed or disturbed. Every one, therefore, who wishes to protect his fisheries should be very careful not to change the nature of the spawning-places, either by disturbing the growth of the algæ or other aquatic plants or by throwing refuse or impure matters in the water.

Different methods of catching herrings.—From what has been said regarding the nature and mode of life of the herring, it will be seen that in order not to destroy the whole tribe by catching the young fish or by disturbing the spawning-places, it will be best not to use nets during the

spawning-season of the herring, but only use them in autumn and winter, when the herring visits the deep waters of the inner bays. Fishing with nets having large meshes may, however, be carried on at every season of the year.

On the coasts of Skåne, Bleking, and Gottland the herrings are not caught with stationary nets, but with so-called floating nets, which method of fishing is in many respects very advantageous, for which reason I shall briefly describe it.

After the usual number of nets, 27 to 30, have been well arranged and placed in a boat furnished with all the necessary apparatus and provisions, three men enter the boat and go out to sea. The time for leaving the shore depends on the wind and on the distance from land at which the herring is just then supposed to be, because the nets should be cast during dusk. When the casting is to begin the sail is lowered, one man places himself at the prow, another in the middle, and the third at the stern of the boat. The one at the prow takes hold of the oars and rows with the wind, the one in the middle loosens the floats and the weights, and the one at the stern casts the net. In this manner the whole net gets in the water with the exception of one end, which is hanging over the edge of the boat. To the last loop of the net a weight is attached by a rope of a certain measured length, with its float, which is thrown out, and then the whole net is carefully laid while the boat is rowed forward. When the first net has been set, the second one is taken, the loops are joined by a strong knot, to which again a weight and float are fastened, and this is continued until all the nets have been set, in such a manner that the largest floats are in the center of the whole stretch of nets, because otherwise the net would sink in the middle if a very large number of fish should happen to be caught. Finally, when all the nets have been set, there is attached to the last hoop, besides the weight and the float, the so-called floating line, a rope 30 fathoms long, to which at about a fathom's distance from the net a stone of the size of a fist is attached, so the nearest net might not be raised too high, especially if the weight has gone down deep. If the depth is only one or two fathoms no stone is used. The floating line is then cast out and finally fastened to the fore part of the boat. Boat and nets are then allowed to drive with the wind and current, and once every hour the nearest net is examined, to see whether the herring "takes," as the Gottland fishermen say. If you happen to fall in with a large school and the current is not too strong the net must generally be hauled in after two to three hours, so as not to catch more fish than the boat can carry. The Gottland boats carry about 300 "hvlar," besides the net and other apparatus. But in order to derive the full benefit from the herring-fisheries, it is not only necessary to take the proper care of them, so there is always a sufficient quantity of fish, but a thorough knowledge of the different ways of preparing fish for the trade is likewise required.

As fishermen very often are not able to sell the fish they catch for a

reasonable price whilst in a fresh condition, it is very important for them to know the best methods of preparing them, especially in these times, when the improved means of communication enable people to get even necessary articles of food from a distance. Every one should therefore endeavor to obtain and retain a good market for his fish by preparing them well and by constantly improving his goods.

The improved means of communication and intercourse between different parts of the world make it possible that the Baltic herrings may now be advantageously sold both at home and abroad, whilst formerly scarcely any were exported. The methods of preparing the herring have to be varied according to the different markets for which it is destined, as different countries have different tastes.

The preparation of the herring for the trade.—The methods of preparing the herring for the trade, at present in vogue, are the following:

1. Salting the herring (common Baltic salt herring) for home consumption or the German ports on the Baltic.

2. Preparing the herring after the Norwegian or Dutch method (so-called "*delikatess-sill*," *i. e.*, delicious or delicacy herring) for home consumption.

3. Spicing the herring (spiced-herring) for home consumption and for the foreign market.

The choice between these three methods will chiefly be determined by the fatness and general condition of the fish; but also by the greater or less ease with which markets for the differently-prepared fish are reached, and other similar circumstances, which may best be considered by the fisherman himself. The fat herrings which are sometimes caught during autumn and mid-summer on certain portions of the coast, are of course best suited for a finer article of goods—"delicacy-herring," or spiced-herring—whilst the common herring is best salted, taking care, however, that by salting a superior article of goods is obtained.

General rules for preparing fish.—The first and foremost rule is to bring the fish as soon as possible after it is caught in contact with the preserving element, viz, salt. Great care should be taken that the fish before being salted is not exposed too much to the sun, because it will in that case easily spoil or rot. During summer every boat should therefore be provided with a sufficient quantity of tarpaulin, so the fish may be kept well covered during the homeward voyage. It will also be found very useful to have on the boat a box with broken ice, in which the fish are laid as soon as caught, and are thus kept fresh until salt can be applied. Fish which have been brought to market fresh, and have for a time been exposed to the warmth, should never be salted, because such fish are frequently a little spoiled. Another very important rule which should invariably be observed is, that everything should be done in as neat and cleanly a manner as possible. Fish-refuse, or any other refuse, should therefore never be tolerated in the salting-houses, or in the vessels used for salting. Nor should old brine ever be used, as it contains slime,

blood, &c., and does not salt the fish thoroughly, but is apt to give it an impure and disagreeable flavor. The quality of the salt is also of great importance. It is not only necessary to use loose, strong, and hard salt, which is the best for salting fish, but also to obtain the best quality of the kind of salt needed. Salt which has been damaged by sea-water, or which contains impurities, should of course never be used.

If one has fresh and good herrings just taken from the water, good salt, and clean and ample vessels, all the necessary conditions are fulfilled for preparing a first-class article, following one of the methods given below.

1. *Method of preparing common Baltic herrings for home consumption and for the German ports on the Baltic.*

Two mistakes are often made in salting herring as this process is at the present time carried on by the fishermen on most of our coasts, viz, salting it too much and pressing it too hard. It is highly important to prepare the fish in such a manner that it may for a long time be preserved in good condition. It is of course also important, both for the buyer and seller, that the barrels should be well packed. Both these objects may be obtained without having the fish salted too strongly, and without pressing it almost flat, so it loses all its natural fatness and tastes of nothing but salt. In many places the fish are pressed so hard that they form a lump, from which the brine flows off without penetrating, which makes the fish dry and rancid and by no means agreeable as an article of food. Even if such fish were to find a market in some places, this method of preparing it must be condemned. Although it is of course impossible to lay down rules for preparing fish which would hold good in every case, or satisfy every taste—especially as one buyer cares little for the flavor or fatness of the herring, but only for its weight, whilst another cares nothing at all for the latter—most buyers nowadays endeavor to obtain an article having a good pure flavor, and being at the same time carefully packed. To prepare such an article the following directions are given, which may of course be modified to suit the different tastes, &c. These directions have for several years been followed in the best salting-houses in Gottland and on the southern Baltic coast, and fish prepared in this way will never lack buyers.

In preparing the common herring St. Ybes, Lisbon, or other strong kinds of salt should be used; but Cagliari salt, as well as some looser kinds of English and French salt, may likewise be used, especially if the fish are intended for speedy consumption. The salt should be crushed so that the larger crystals also melt in the brine, and the salt comes in the greatest possible contact with the flesh of the fish.

As salt herring are generally shipped to distant places, and are thus during the voyage exposed to the pressure of other goods, or whilst being transported by railroad or wagons run the risk of being handled carelessly, they should always be packed in carefully made tight barrels,

with good strong hoops, so they can stand a long journey without the brine running out. It should be remembered that herrings from a leaky barrel are not worth one-fourth as much as those in a good barrel. As soon as the herring has been taken from the net they should immediately be thrown in small vessels filled with pure and clear brine. There should never be so many herrings laid in a vessel that the lower ones are pressed too hard by the upper ones, but if the number of fish is very large a greater number of vessels should be used. After the herring have thus been immediately brought in contact with salt, they are taken out by degrees to be cleaned and gutted, care being taken that all the entrails are taken out, but not the roe and milt. The practical way of doing this is well known to every fisherman. As soon as the herring have been cleaned they are laid in another vessel also filled with pure brine. When the whole lot has been cleaned, or even while the cleaning is going on, the cleaned herrings are taken out of the brine and rinsed in fresh and clean sea-water, whereupon they are for awhile placed in small baskets or kegs with a perforated bottom, so the water may flow off. When this has been done the fish are placed in tight barrels, which are kept in readiness for the purpose, and sprinkled with dry salt. The sprinkling is done in the following manner: The fish are laid loose in a barrel with crushed salt, 3 kappar to the barrel; whenever a layer has been finished the fish and salt are stirred so they may mingle thoroughly. After 24 hours the fish are taken out and again placed in baskets or kegs with perforated bottoms, so the brine may flow off. After this has been done, which generally takes an hour, the fish are regularly packed and salted in tubs. The fish are placed in layers with their backs downward. Between every layer of fish there is a layer of crushed salt, at the rate of 5 kappar to every barrel. After the tub has been thus filled, a light weight is placed on the top, merely to keep the fish under the brine, and not press it too hard, which makes the fat and the juice of the fish run out into the brine, thus destroying the delicate flavor of the fish. After the tubs have been thus filled they are allowed to stand open for several days, and as the mass of fish gradually settles down, new layers are added to every tub. When after some days the fish do not settle any more, the tubs are closed. They ought then to be rolled gently and turned upside down every two weeks, so the brine may thoroughly penetrate all the fish. Whenever the herrings are to be shipped, the tubs are looked after once more; if they have settled any, they are filled up for the last time, and are then considered ready for the market. The brine which flows over from the tubs and that which is obtained after every salting, may be put in those vessels in which the fish are kept immediately after being caught and whilst they are being cleaned. It is important, however, to see to it that this brine is changed as soon as it has been used more than once or twice and becomes mixed with impurities. To use 9 kappar salt to the barrel, as is done on the coast of Oestergötland, is not advisable, because the fish is pressed too hard and

gets too salty. After the fish has been dry salted, no more than 5 kappar salt to the barrel is needed, whereupon the fish should immediately be placed in tubs and not be pressed more than is necessary for filling the tubs properly. In Norrland they let the herring lie uncleaned in brine for 24 hours, and moreover in brine which has been used many a time before for the same purpose. It will easily be seen from what has been mentioned above that this custom should be abolished and that the herring should be cleaned as quick as possible.

On the coast of Karlskrona they dry-salt the fish with only 1 kappar salt to the barrel, and then salt it with 7 kappar to the barrel. This method cannot be recommended whenever the fresh fish should have a chance to soak in a sufficiently strong brine, whilst, if this is done, it does by no means require as large a quantity of salt.

Baltic herring prepared in the above-mentioned way finds a ready market not only at home but also in foreign ports on the Baltic. The price of herring varies very much in different years, and is dependent partly on the result of the fisheries in each year, but also on the price of Norwegian and other foreign herring. In some years when the herring-fisheries have been successful, both in Norway and Sweden, the Swedish fishermen can scarcely obtain a price which fully pays them for their trouble. It may, therefore, be advantageous to seek foreign markets, and prepare the fish for these. Salt herrings may, at certain times, find a ready market in the ports of Northern Germany, Stettin, Stralsund, and other places. The best time for this trade is from mid-summer till the beginning of September. Herrings which are intended for the German market ought to be prepared in the above-mentioned manner, but should be very carefully packed in strong tubs, not holding as much as the Swedish barrel (about 220 pints), but in tubs of the same size as those used in Bornholm and on the German coast, which only hold about 193 pints each. Such tubs, if they are well packed and the fish are in good condition, fetch from $3.50 to $5.50 each in the Stettin market, a price which many a year may prove very acceptable to the fishermen of Southern Sweden, especially if one takes into consideration the fact that these tubs are much smaller than the Swedish and therefore contain fewer fish.

2. *Method of preparing the so-called "delicacy-herring" for home consumption.*

It is well known that every year considerable quantities of Dutch herrings and Norwegian fat herrings are imported into Sweden, partly in large tubs, but mostly in small barrels or kegs, and that these fish are mostly consumed by the better classes. Experiments have shown that the large and fat Baltic herring, which is caught in several places, can easily be prepared in the same manner, and make a better and particularly fine domestic article, which comes very near to the foreign "delicacy-herring," and therefore finds a very ready market at good prices.

all over Sweden; all the more as the Swedish "delicacy-herring" can be furnished for a much lower price than the foreign.

The very name "delicacy-herring" shows that it is not intended for every-day use. It is therefore generally kept in smaller kegs than the common herring. It is evident that the "delicacy-herring" should not be salted as much as the common herring, as it thereby loses its delicious flavor. As it therefore must be salted with finer and looser salt, it follows that it cannot be kept as long as the common salt herring. In preparing "delicacy-herring," finer and looser kinds of salt should be employed, *e. g.*, Liverpool salt, Lüneburg salt, Cagliari salt, &c. The Lüneberg salt is said to be the best for this purpose.

Norwegian method of preparing delicacy-herring.—As soon as the herrings are caught they are put in pure brine, whilst the cleaning process is going on. Some only take out the stomach, but it will be best, as is done in preparing the common herring, to take out both the stomach and the entrails. As soon as the herrings have been cleaned they are immediately laid in small tubs or kegs, in regular layers with the back downward; salt is placed between every layer at the rate of 6 kappar to the barrel, and salt is also placed on the top. As the herrings during the first days settle in the tub, new layers are added. After about six days an opening is made with a stick between the herrings and the side of the tub, which is filled up with salt, whereupon the tub is closed. Before being shipped every tub is examined and if necessary filled up, as was done with the common herring. If sufficient brine should not form in the tub, a little hole is made in its side with a gimlet, and pure brine is poured in, whereupon the hole is closed. It is very advisable to turn and roll the full kegs as often as possible. Herring prepared in this manner has kept entirely good and fresh for six months.

Dutch method of preparing Baltic herring.—Fresh and fat Baltic herrings are, as soon as they come out of the water, placed in small kegs, and are for at least an hour stirred with fine Lüneburg salt. Then the fish may be cleaned in the usual manner, or also, without being cleaned, be placed in kegs with fine Lüneburg salt between every layer. After the kegs have been filled they are closed and examined and filled again in the manner described above. The herring which has not been cleaned does not keep quite as long as that which has been cleaned. Fish prepared in this manner at Herba, in Gottland, has kept fresh and good for more than a year.

Swedish herrings, prepared in the Norwegian or Dutch manner, have fetched a good price both in Stockholm and other cities of Sweden.

3. *Method of preparing spiced herring.*

So-called spiced herring is an article of trade which, like anchovies, is kept in glass jars or very small kegs. It may be prepared from any kind of herring, and is esteemed as highly with us as in some cities of Northern Germany. But its preparation can so far not be said to form

a special trade, but must rather be considered as experiments made by housewives in order to give some little variety to their meals, but especially to the lunch-table. But as these herrings might be in demand in some places, and might possibly fetch a good price in the foreign market, I shall here give the receipt for preparing them.

Freshly caught herrings are immediately laid in vinegar, adding one-fourth part water and some salt. After twenty-four hours the herrings are taken out and the vinegar is allowed to flow off. The fish are then placed in a tub or keg, with the following spices in the following quantities to every hval of herrings: 1 pound dry fine salt, 1 pound powdered sugar, 1 ounce pepper, 1 ounce laurel leaves, 1 ounce saltpetre, ½ ounce sandal, ¼ ounce ginger, ¼ ounce Spanish hops, ¼ ounce cloves. Others use the following spices: 1 pound salt, ½ pound sugar, 2 ounces pepper, 2 ounces allspice, 1 ounce cloves, 1 ounce Spanish hops. The herring should remain in this mixture for two months before being used. Some lay the herrings immediately in vinegar which has not been weakened with water or salt, and after twelve hours they are taken out and treated in the above-mentioned manner. If the spiced herring should after a while be without brine, good brine of Lüneburg salt should be poured in, and then they will keep for years.

b. THE COD-FISHERY.

Of the many fish belonging to the cod family, *e. g.*, the codfish proper (*Gadus morrhua*), the pollock (*Gadus virens*), the haddock (*Gadus aeglefinus*), the ling (*Molva vulgaris*), the hvitling (*Gadus merlangus*), &c., which live in salt water, and which, in the Kattegat and the North Sea, form the object of those extensive fisheries by which many inhabitants of the Norwegian and Bohuslän coasts make their living, there is found in the Baltic only the common codfish (*Gadus morrhua*, L.), at least in such quantities as to repay the trouble of catching it. In the Sound and the portions of the Baltic adjoining it haddock (*Gadus aeglefinus*), glyskoljan (*Gadus minutus*), hvitling (*Gadus merlangus*), pollock (*Gadus virens*), and blanksej (*Gadus pollachius*), are frequently caught, but nowhere in the Baltic proper are they found in such numbers as to form the object of special fisheries. From these its relatives, the codfish proper is distinguished by its upper jaw projecting over the lower jaw, by having a beard on the lower jaw, by having its side bent near the center of the middle dorsal fin, and by having such small eyes that their diameter is much less than the distance from the corner of the eye to the tip end of the nose. The haddock, the glyskoljan, and the hvitling have, it is true, a projecting upper jaw also, but can easily be recognized: the haddock by having almost straight sides and a black spot on each side about under the middle of the first dorsal fin, the glyskoljan (*Gadus minutus*) by the circumstance that the diameter of its eyes is larger than the distance from the corner of the eye to the tip end of the nose, and the hvitling (*Gadus merlangus*) by its not having the beard which is found

on the lower jaw of the codfish, the haddock, and the glyskoljan. The pollock and the blanksej (*Gadus pollachius*) both have the lower jaw projecting farther than the upper jaw, and are thereby distinguished from the above-mentioned fish found in the Sound and the Baltic, which likewise belong to the cod family. The pollock is again distinguished from the blanksej (*Gadus pollachius*): the former has a cloven caudal fin, its sides are almost straight, and its color gradually changes from a dark sea-green on the back to silver-gray on the belly and sides; the latter has a caudal fin, which is but little indented, its sides are sharply bent, and the brownish-black color of the back is clearly defined from the silver-gray of the sides.

The codfish proper never reaches the same size in the Baltic as on our western coast or the coast of Norway. Whilst in the North Sea and the Western Ocean it grows very large, and often reaches a weight of 40 pounds, the Baltic cod seldom weighs more than 15 pounds. Like the herring, it gets smaller and smaller the farther north in the Baltic it is found. The average weight of the codfish found in the Southern Baltic and the Sound varies from 3 to 6 pounds, whilst near Gottland it is only 2 to 3 pounds, and on the coast near Stockholm only 1 to 2 pounds.

The color of the codfish varies considerably, owing chiefly to the difference of food and the different bottoms on which it lives. Generally the upper parts of its body have an ashy-gray or olive color, thickly dotted with round spots of a yellow or brownish hue, decreasing in number towards the sides; the lower part of the body is whitish, without any spots. The varieties which are found most frequently are the so-called "Berg"-cod, in Bohulsän, which has a reddish color, thickly covered with spots, and having reddish or grayish-brown fins and back; the "Pall"-cod, near Gottland and the "Berg"-cod of the Southern Baltic, whose whole body is of a dark color with but few spots. The full-grown codfish prefers deep water, either on the outer coast or in large bays and inlets, and only during the spawning-season it temporarily goes into shallow water. It spawns at different times on the different coasts: in the Sound in March, on the coasts of Skåne and Bleking from the middle of March till the end of April, near Gottland and on the coast of Stockholm during April and May. When the spawning-season approaches, the codfish ascends from the deep to shallow waters, either on the outer coast or in bays and inlets. There is this peculiarity about the roe of the codfish, that it does not adhere to aquatic plants and stones like that of other Baltic fish, but, according to observations made by the Norwegian naturalist G. O. Sars, floats about freely near the surface of the water. Even with a low temperature of the water the eggs are hatched after 18 days, and with a higher temperature, even in a shorter time. After being hatched, the young fish continue to float about near the surface of the water at least as long as they still have the umbilical bag which most young fish carry for some time after being hatched. This bag serves as the food of the young fish; and as soon

as it is consumed the fish requires other food, and seeks places where suitable food can be obtained, and where it can find protection against the attacks of the numerous fish-of-prey which eagerly devour the young fish. Such places are the algæ-covered bottoms near the shore, where small crustaceans, scarcely discernible to the naked eye, are found in profusion and form the first food of the young fish. As the young codfish grows, becomes stronger and larger, and is able to defend itself against its enemies, viz, fish-of-prey of every kind, not the least dangerous among them being the old codfish themselves, it goes into deeper waters, where it finds larger crustaceans, worms, and snails, which at a more mature age form its favorite food. When fully grown the codfish is a voracious fish-of-prey, devouring almost everything coming in its way, young fish and fish of every kind. It therefore prefers the deep waters, where it feeds on the large schools of herrings, and often visits the banks where the herring spawns, and devours its spawn and young. Since the roe of the codfish does not adhere to plants or stones, but floats about freely near the surface of the water, it depends on current, weather, and wind to what coast it will float, and a large portion of it is consequently very often cast ashore and lost. And as it is well known that the codfish, like other fish, when fully grown, revisits the coast where it was born, it is impossible to calculate on seeing again, as full-grown fish, the young codfish which were born on a certain coast. For the roe laid near some coast may, by current and wind, be carried to distant parts, and the home of the young fish will be the coast to which the roe has been carried accidentally; and this coast will be revisited by them when they are fully grown, when, after having closed their annual regular visits to the deeper waters, the time comes for them to seek shallow waters.

Nature has thus arranged it so that even with the greatest care and protection it is impossible to calculate with absolute certainty on a successful cod fishery on any given coast. Experience has shown that on certain coasts no codfish have come to spawn for several years, although fishing had by no means been carried on in a destructive manner, and although the natural conditions continued as favorable as during the time when the codfish annually visited those coasts in large numbers. It is supposed, and probably correctly, that the cause why enormous cod-fisheries have for many years been carried on uninterruptedly in some localities, *e. g.*, the Loffoden, the Norwegian coast, the Shetland Islands, Iceland, &c., must be found in the fact that these coasts or groups of islands are so favorably situated near or in deep waters, that even when current and wind are comparatively speaking less favorable, a sufficient quantity of roe and young fish is carried into the bays and sounds to insure good fisheries. It must also be remembered that the cod-fisheries carried on in the Loffoden and other large fishing places on the Atlantic Ocean, although carried on near the coast, have

altogether the character of ocean fisheries, fishing going on mostly in the open sea and at a considerable depth, 50 to 100 feet and more.

It is evident from all that has been said that the cod is a kind of fish which prefers the deep waters or banks in the open sea, and that one cannot calculate on its coming to a certain coast every year, and on catching it with the apparatus usually employed in coast-fishing. It has been shown by actual observations that the Baltic also contains a considerable number of codfish on those bottoms and banks which extend almost along our entire coast. Fishermen who expect annual productive codfisheries must therefore possess the necessary apparatus for deep-water fishing. We shall now give a few brief directions how to carry on these fisheries.

As the banks on which the codfish stay the greater part of the year are situated at a considerable distance from the shore, it is evident that the fisherman should have a good vessel, strong and large enough to reach the shore when a storm should spring up. For this purpose the boats used for salmon-fishing on the coast of Bleking, known by the name of "Blekings-ekor," are well suited. These boats are large enough to offer ample protection for the fish which have been caught, so the fisherman runs no risk of having his fish spoiled before he comes home.

Cod-fishing on banks may be carried on with so-called "hand-lines" or "codfish-lines," with "angling-lines," and with nets. As the "hand-line" is so well known, it will not be necessary to describe it.

The "angling-line" (long line or trawl-line), with which fishing in the open sea can and should be carried on, resembles a common long fishing-line, only with this difference, that it is furnished with floats which keep the bait from the bottom, as otherwise it would be eaten by different marine animals. The line should be made of such strong material that it will not tear when being hauled in; when laid, it should of course be steadied by weights sufficiently heavy to prevent its being driven away in stormy weather. To mark the place where the line is laid, a buoy is used, with a flagstaff and flag large enough to be easily seen when the fisherman comes to haul in his line. As bait may be used, pieces of herring or other fresh fish, worms, snails, and muscles. The line may be laid either in the morning or in the evening, and in favorable weather the fisherman should so arrange it that he can stay at the fishing-place until it is time to haul in the line. During this time of waiting, the crew may employ themselves by fishing with "hand-lines."

Net-fishing in deep water or in the open sea should be carried on with common codfish-nets, which, however, should be a little deeper than those used in coast-fishing. Each set generally has 24 nets. When the nets are to be set, they are fastened to two ropes of about the same length as the depth of water where the nets are to be set. To the ends of these ropes an anchor is attached; to this is fastened another rope reaching to the surface, and having at its end a buoy to indicate the place where the fisherman has to look for his nets. These, which have

been laid in the boats in good order, are then set in the manner shown in Figure 1, Plate I. When several fishermen set nets close to each other, it becomes necessary to attach an anchor also to the end of the row of nets, with a rope reaching up to the surface and having a buoy attached to it, to show in what direction the nets have been set, so that other fishermen may not set their nets across the former, and thus produce confusion and make the hauling-in difficult. If the net has been set so far from the coast that the fisherman can no longer see it, he must either cast anchor and remain in the fishing-place till the net is taken up, or he must when leaving the coast mark some object on it, and then by the aid of his compass row or sail for some time in a certain direction, so that he can easily find the place where his nets are set, even if stormy weather should oblige him to seek the coast before his nets are taken up. In cod-fishing one should have two sets of nets, so the one may dry whilst the other is in the water.

Methods of preparing the codfish.—To prepare a good article of codfish, it should never lie in the boat without being cleaned for any length of time, as it may easily spoil. A careful fisherman carrying on cod-fishing on a large scale should therefore always have in his boat small boxes or kegs in which the fish may be laid in salt. The crew should also be large enough, that two or more persons may immediately commence to kill the fish, so the blood may flow off, and, if possible, clean and salt them. It is likewise important that the fish should not be bruised or trodden on, as thereby their flesh becomes loose, full of holes, and its appearance is not very inviting. The Baltic codfish may be prepared either as so-called "brine-cod" (*Kabeljo*) or so-called "dry-cod" (*Klippfisk*). The Baltic codfish may of course also be prepared as "common dried cod" or so-called *lutfisk*, although by its small size it is not very well suited for this method of preparing it. Whether the fish is to be prepared as "brine-cod" or "dry-cod," it must first be cleaned thoroughly, so that no blood is found near the backbone; the entire skin is carefully removed from the whole lower part of the fish. In large codfish the backbone is taken out, whilst in smaller ones it is allowed to remain; the head is cut off, and the fish is then ripped open, so that it presents the appearance shown in Figures 1 and 2, Plate II. After the fish has been ripped open, cleaned and washed, the water is allowed to flow off, whereupon it is laid in layers in barrels and salted, the outer side downward, and with sufficient salt between each layer to keep the fish from spoiling. After the fish has remained in brine for about eight days, and its flesh has become firm, it should be taken out. If it is to be used for "brine-cod," it is again placed in barrels with enough fine white salt between the layers to keep the fish from spoiling; whilst if it is to be used for "dry-cod" (*Klippfisk*), it is treated in the following manner: The fish are taken from the brine, and laid in rows on slanting boards, so the brine may flow off. Whilst being taken up they are washed in the brine and brushed carefully, so as to remove all impuri-

ties. After the fish have laid on these boards for a night, they are spread out to dry either on flat rocks or on a sort of lattice-work placed in a drying booth. It is best to lay the fish on a lattice-work to dry, as the rocks often get very hot and therefore cause the fish to shrivel. When the fish are laid out to dry, the air should not be damp, nor should the fish be exposed too long to a hot sun. In the evening, as soon as the air gets damp, the fish should be piled up in heaps and be again spread out in the morning. This is continued till the fish gets half dry, when the pressing commences, which is done in the following manner: The fish are piled in large heaps, covered with boards, and on these stones of a suitable weight are placed (Figure 4, Plate III). Whilst being pressed the fish should again be spread out for drying, if the weather is favorable, but should likewise, when night comes or when damp weather sets in, be piled up and pressed, and the sides of the pile covered with matting or tarpaulin so as to keep the moisture out. This is continued till the fish gets so dry that when pressed with the thumb no impression is made, showing that the flesh has become quite hard. The fish are then packed in wooden boxes and are ready for the market. Fish prepared in this manner find a ready sale not only at home but also abroad, in England and Germany, where "dry-cod" fetches a higher price than "brine-cod."

c. SALMON-FISHING WITH LINES.

The salmon is a kind of fish which lives half the time in fresh water and half the time in salt water. Its nature compels it during summer to seek swiftly-flowing streams, where during autumn it deposits its roe among pebbles and rocks. Observations have shown that its roe loses its vital power as soon as it comes into contact with salt water. The young salmon hatched in the streams stay there about two or three years, and generally during the rising of the streams in spring return to the sea or to large lakes, where the easier access to food makes them grow rapidly. The young salmon, when they have reached the sea, as well as the full-grown salmon, live on small fish, *e. g.*, herring, launce, smelt, &c. When the salmon has become capable of propagating, after a stay of one or two years in the sea or some lake, it returns to the stream where it was born, deposits its roe, and goes back to the sea; and thus its life continues to be a regular change of its place of sojourn until it is either caught or meets with its death in some other way. Fishermen living near the coast can, therefore, not expect good salmon-fisheries unless the salmon are protected in the streams during the spawning-season; nor can the fishermen living along the streams hope to see the salmon again unless the coast-fishermen carry on fishing in such a manner as not to prevent the salmon from going up the streams. Both classes of fishermen have, therefore, an equal interest in having the salmon-fisheries regulated in such a manner as to suit the nature and mode of life of the salmon; for if this is not done, both the coast waters and the streams will soon lose their wealth of salmon. The laws for protecting the salmon-fisheries therefore prescribe that no salmon are to be caught

in the streams during their spawning-season in autumn, and that no nets shall be set at or near the mouth of streams in such a manner as to hinder the salmon from reaching their spawning-places in large numbers. Experience has shown that wherever these regulations have been carefully observed, the salmon-fisheries have very soon improved considerably. Every fisherman, therefore, who has the true interest of the salmon-fisheries at heart, should, above everything else, see to it that the fishery-laws are carefully observed in his neighborhood.

Salmon-fishing in the Baltic is chiefly carried on with nets. As this method of catching salmon is well known, it needs no further description. But salmon may also be caught with lines in the open sea near the outer coast. This is done on the southern coast of Sweden, and we shall therefore briefly describe this method of fishing.

It is well known that the salmon stays in the sea during the latter part of autumn, winter, and spring. Whilst the young salmon which spend their first year in the sea prefer to stay near the mouths of rivers, or, at any rate, not far from the coast, the older ones generally spend the cold season of the year in deep water, following the schools of herrings which are found there. The fishermen on the coasts of Skåne and Bleking make use of this circumstance, and during winter and spring, whenever the sea is free from ice, and stormy weather does not interfere with fishing, catch many salmon, which at this time are sojourning in deep water.

As was mentioned above, hooks and lines are used in this fishery. The hooks are laid in the open sea, and the lines are kept in position by anchors or heavy weights in the same way as is done in the cod-fishery in the open sea. The line is not, as is generally done in other fisheries, sunk to the bottom, but is kept floating near the surface by means of large cork-floats (Figure 5, Plate I). The line must of course be strong and the weight heavy, so the fish, which are generally large and powerful, may not carry everything away with them. As a very long line would doubtless get entangled during the winter-storms, only short lines are used, measuring about 20 fathoms in length, with no more than three to four hooks on each line. To make up for this deficiency a large number of lines is set, each with its separate weight. Cheap and very suitable weights may easily be obtained by inclosing large pieces of rock in a triangular lattice-work of wood, with sharp sticks of wood projecting on all sides.

For bait, herrings are generally used, which are attached to the hooks in the manner shown in Figure 5, Plate I. The hook should be of strong galvanized-steel wire, of the size and shape shown in Figure 6, Plate III.

Fishermen who use hooks and lines for salmon-fishing should of course be provided with a sufficient number of lines, so they may set new lines when going out to sea for the purpose of examining those which have been set for some time. As soon as the warm weather sets in, salmon-fishing with hooks and lines ceases, partly because the salmon then go up the rivers, and partly because the warm temperature of the water makes the bait spoil too quickly, so that it becomes entirely useless.

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