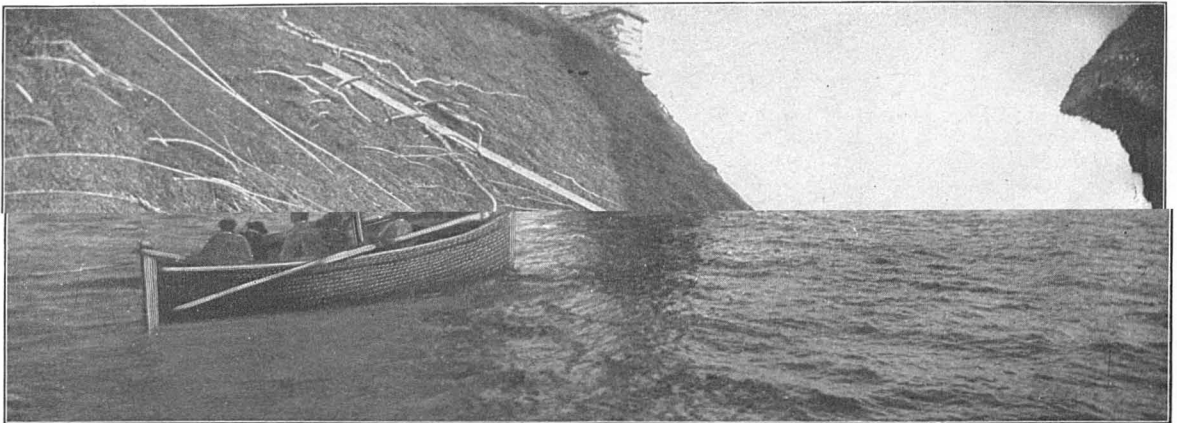
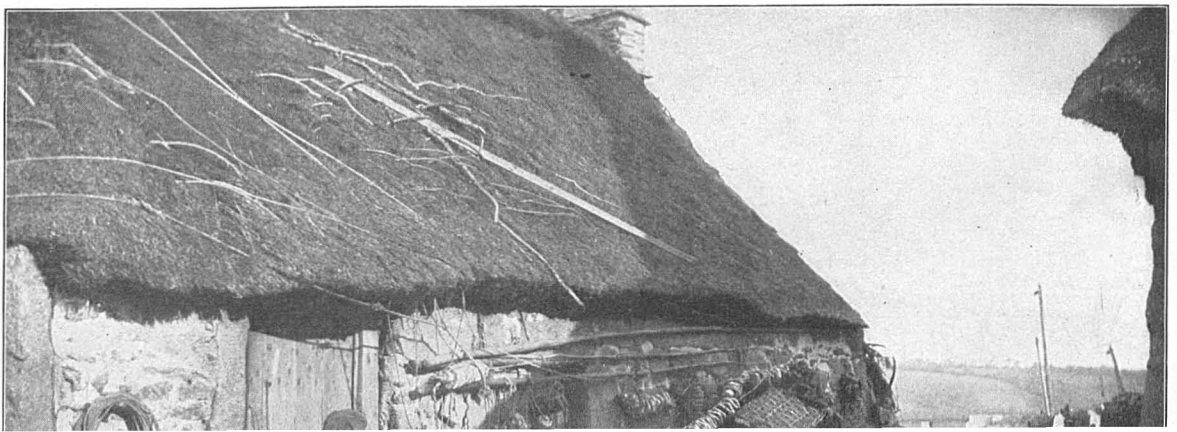


SARDINE BOATS SAILING TO THE FISHING-GROUNDS.



SARDINE BOATS SAILING TO THE FISHING-GROUNDS.



# THE FRENCH SARDINE INDUSTRY.

BY HUGH M. SMITH.

## GENERAL IMPORTANCE OF THE INDUSTRY.

Few if any foreign fishery industries are of greater interest or importance to Americans than the sardine industry of France. The wholesome, palatable, and convenient canned sardine is consumed in nearly every community, and the annual importations of French sardines into the United States are worth about \$1,000,000, a sum exceeded by the value of but few imported fishery food products. This is perhaps sufficient reason for the presentation of this report; but another consideration is the advantages that may accrue to the fishermen and fish-canners in the United States from a knowledge of the methods pursued in the sardine fishery and canning industry of France.

The sardine is the leading fishery product taken in the waters of France. From official statistics<sup>1</sup> it appears that in 1898 the sardine fishery gave employment to 31,871 fishermen; the number of boats used was 8,164, with a tonnage of 32 863 and valued at 5,934,633 francs; the apparatus employed was worth 7,030,945 francs; the quantity of sardines taken was 53,924,275 kilograms (or 118,633,400 pounds); and the selling price of the fish was 9,204,988 francs (or about \$1,840,997).

The information on which this paper is based was obtained by the writer during a visit to Brittany in September and October, 1900, and represents the conditions especially prevailing at and in the vicinity of Concarneau, where most of the time was spent. The fishing and canning methods of the various centers are so much alike in all essential respects that the descriptions here given are applicable in a general way to the entire coast.

## THE SARDINE.

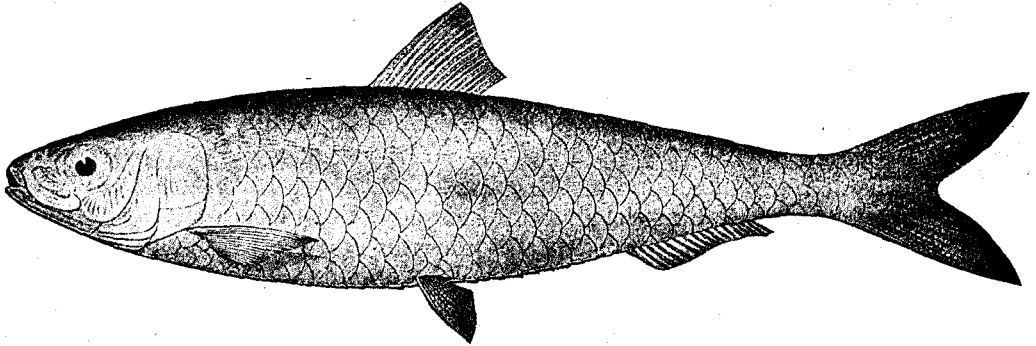
There has been and still is considerable uncertainty among the fishing interests in America and Europe regarding the specific relations of the sardine of the Bay of Biscay and the Mediterranean Sea. Some persons have believed that the sardine canned in France is a distinct species, while others have held that the French sardine, like the sardine of New England, is simply the young of some herring-like fish. The term *sardine* is a general one, applied to various clupeoid fishes, mostly of small size, in different parts of the world, and can not be restricted to any particular fish. Thus, there are the Spanish sardine of the West Indies and Florida; the California sardine, found along the entire west coast of the United States; the Chile sardine; the oil sardine of India; and the sardines of Japan and New Zealand. But the sardine *par excellence* is the French sardine, called also *céleren*, *célan*, *royan*, *galice*, and *cradeau*

<sup>1</sup>Statistiques des Pêches Maritimes, Année 1898. Paris. Imprimerie Nationale, 1900.

on various parts of the French coast. The name sardine has reference to the island of Sardinia, in the Mediterranean, about whose shores the fish is abundant.

As early as 1553, Pierre B  lon, a French naturalist, asserted that the sardine is the young of the pilchard; and at present this is the view of nearly all authorities. The pilchard, as is well known, is one of the most important fishes of the southern coast of England, being especially abundant in Cornwall. Young pilchards or "sardines" are found on the Cornish coast, but are apparently not so numerous as in France and are in little demand, as canning is very limited in extent; on the other hand large sardines or pilchards are caught on the French coast, but are much less abundant and less important than the small fish.

In allusion to the small sardine being caught almost wholly by means of bait consisting of fish roe (*rogue*), the French call it *sardine de rogue*, in contradistinction to the large fish which is taken without bait by means of drift nets, and hence called *sardine de d  rive*. Modern French writers on the sardine fishery seem averse to acknowledging the specific identity of the sardine and the pilchard; some even fail to explain or suggest the relation between the large and small fishes of the west coast



The Sardine or Pilchard (*Clupea pilchardus*).

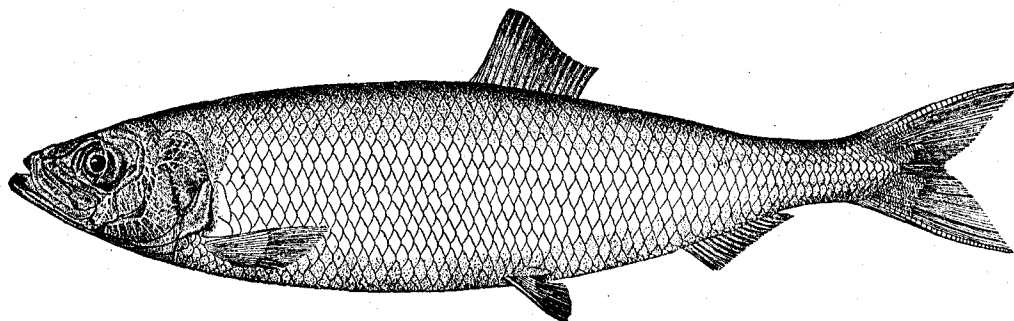
of France, but Messrs. Fabre-Domergue and Bietrix, of the French department of fisheries, in a paper<sup>1</sup> on the reproduction of the oceanic sardine, state that they consider the *sardine de d  rive* as the adult individual of the species, which toward spring lays pelagic eggs in local waters; the *sardine de rogue*, on the contrary, is the young form, whose age, according to their reasonably exact computations, does not exceed two years.

This fish has been referred to by most American and European systematic writers under the name *Clupea pilchardus* Linn  us. Cuvier, in 1829, described the small fish under the name *Clupea sardina*, which designation is still retained by some writers. In 1803 Lac  p  de separated the pilchard with several other species from the genus *Clupea*, because of supposed peculiarities of dentition, and referred it to a new genus, *Clupanodon*, which has been revived in a recent American work<sup>2</sup> and made to include the West India sardine, *C. pseudohispanicus* (Poey), and the California sardine, *C. c  ruleus* (Girard). Modern European writers on the pilchard (Cunningham, McIntosh, and others) apparently have seen no necessity for taking it out of the genus *Clupea*.

<sup>1</sup> Proceedings of the International Congress of Maritime Fisheries, Nantes, 1896.

<sup>2</sup> The Fishes of North and Middle America, by Jordan & Evermann. Part 1, 1896.

The pilchard is a well-marked species, easily distinguished by prominent radiating lines on the operculum and by large scales, as well as by other features. In general shape it resembles the sea herring (*Clupea harengus* Linnæus), but is less elongated and compressed. The greatest depth of the body is about one-fourth the length, and the length of the head is somewhat greater than the depth of the body. The lower jaw projects slightly; the upper jaw extends to a point opposite the front third of the eye. No teeth are found on the vomer, palate, or tongue, and on the jaws the teeth are either small or absent. The dorsal fin contains 17 or 18 rays, and begins nearer to the end of snout than to the base of tail. The anal fin has 19 to 21 rays. The ventral fins begin under the middle of the dorsal base. There are about 30 scales in a longitudinal series between the gill-opening and the end of the body. The back of the fish is a deep olive green, the sides are silvery, and the belly is white. In the full-grown fish there is a small dark spot in the scapular region. The normal length attained by the pilchard is 8 or 9 inches; the length of the largest recorded specimen was 14 inches (taken in Cornwall).



The Sea Herring (*Clupea harengus*).

The sardine of the French coast is a handsome little fish, whose beauty is not entirely lost in canning. In the water the back is of a greenish color, but out of the water the upper parts are rich dark-bluish, contrasting strongly with the silvery and white colors of the sides and abdomen. The scales are very easily detached, but their loss does not detract seriously from the appearance of the fish, either when fresh or canned, as the skin is rather thick and has a brilliant uniform silvery color. There are no evident spots on the sides in life, but after the scales are detached a few dark lateral spots may be seen. The back and belly are well rounded, being less compressed than in the young sea herring.

Several American fishes resemble the pilchard, among them the sea herring and the California sardine. The former, which is extensively canned on the coast of Maine, may be distinguished from the pilchard by its more elongate form, by the more posterior origin of the dorsal fin, by the smaller and more numerous scales, by the presence of teeth on the vomer, by the much projecting lower jaw, by the smooth operculum, and by the much compressed abdomen. The California sardine is distinguished from the pilchard in having a more elongate form, fewer dorsal rays, a somewhat longer maxillary, and a series of dark spots along the side.

The flesh is dark-colored, rich, and oily. The fresh sardine, when broiled or grilled, has a delicate flavor and is very palatable. It is improved by the slight salting that it usually receives when intended for immediate consumption. The California sardine resembles the French fish in character of flesh and is a more perfect substitute for it than any other American species.

The range of the sardine or pilchard extends from Sweden to the Madeira Islands. The southern coast of England, the Atlantic coast of France, and the Mediterranean Sea are the chief centers of abundance.

On the coast of Brittany the *sardine de roque* is found for about nine months of the year, being absent from the inshore waters most of the winter. When the fishing season opens, the fish are reported first about February at Arcachon and other southern points on the west coast, and gradually reach the districts toward the north. During the winter, however, the large fish—some a foot in length—are observed at various places on the coast.

The immature sardines frequent the coast waters throughout the summer and remain in Brittany until late fall. Some years, if the season is mild, they are caught until the first or second week in December; but a storm coming any time in November is likely to drive the fish away and terminate fishing for the season. In 1900 sardine fishing at Concarneau was ended November 5—the same date as in 1899—by a southwest storm, which swept away all the sardines in the bay.

The spawning time on the coasts of England and France is from June to October. Spawning takes place at a considerable distance from the land, and ripe or spawning fish are seldom caught, as fishing is done mostly in the inshore waters. The small fish used for canning purposes on the French coast are never found with ripe eggs or milt, and are now known to be immature fish hatched in the summer and fall of the previous year. The eggs are buoyant, and the average number extruded is reported as 60,000. In the Mediterranean the sardine apparently belongs to a different race, which is smaller than the oceanic form and reaches maturity when under 7 inches in length.

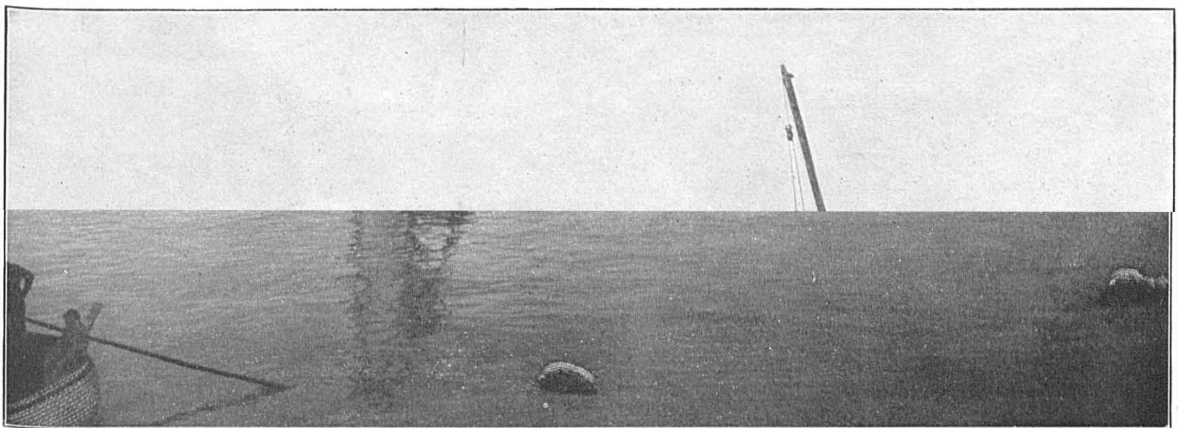
When sardines first arrive they are poor and unsuitable for canning; but as the season advances they improve in quality, and are fatter in September than in June and in December than in September. Their food consists mainly of copepods and other small crustacea. Small fish eggs are also a favorite food. The fondness of the sardine for such eggs plays an important part in the fishery.

The sardines go in schools and swim at or near the surface. As many as 100,000 fish have been taken in one net from one school, but the usual size of the schools is small. They are preyed on by cetaceans and by many fish—on the French coast the mackerel, the haddock, and the dolphin being especially destructive.

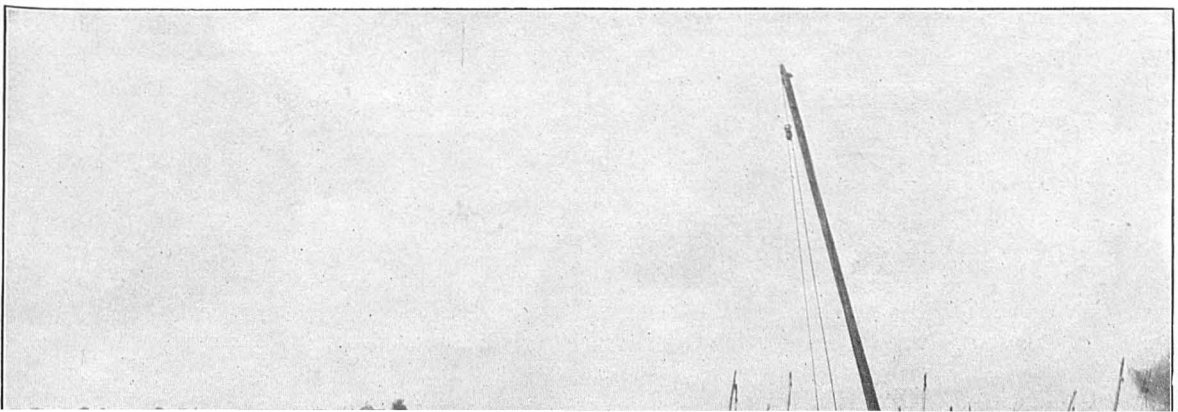
Like other free-swimming oceanic fish, the sardine varies in abundance from year to year; but there is no evidence that the extensive fishing is effecting any permanent reduction of the supply. During the years 1887 to 1890 there was an alarming scarcity of sardines on the French coast, and the outlook for the industry was serious, but after four years the fish returned in their former numbers. The history of the sardine fishery shows what extensive operations may be supported annually when the natural conditions permit the fish to spawn unmolested, the spawning-grounds in this case being many miles offshore.



FLEET OF SARDINE BOATS FISHING OFF CONCARNEAU.



FLEET OF SARDINE BOATS FISHING OFF CONCARNEAU.



## THE SARDINE FISHERY.

The sardine fishery of France dates back many years, and even in the early part of the eighteenth century it was an important industry, but it has become much more extensive since the introduction of canning. The building of railroads has also benefited the fishery by providing means of shipping to inland points that part of the catch which can not be disposed of locally. In all of the centers of the west coast essentially the same methods of fishing are followed, with slight local variations. The methods have an important bearing on the quality of the canned sardines, and will therefore be noticed with some detail.

The province of Brittany supports by far the most extensive fisheries and is the center of the canning industry. Here in 1898 were 21,684 sardine fishermen, with 4,611 boats, valued at 3,759,403 francs, and apparatus worth 3,307,643 francs; and here were caught 49,478,365 kilograms of sardines, selling at 7,572,347 francs. The leading center in 1898 was Douarnenez, which was credited with 4,200 fishermen, 710 boats, and over 18,000,000 kilograms of sardines, valued at 2,442,000 francs. Next in importance was Concarneau, with 2,695 fishermen, 490 boats, and 9,163,000 kilograms of sardines, worth 1,719,890 francs. Other important places in Brittany are Audierne, Quimper, Port Louis, Etel, Quiberon, La Turballe, and Le Croisic. Outside of Brittany the fishery is most extensive at Sables-d'Olonne, St. Gilles-sur-Vie, and Arcachon.

On the Mediterranean coast of France sardines are caught at numerous places and by many fishermen, but only in relatively small quantities. The fisheries here in 1898 gave employment to 7,794 men, using 2,861 boats, valued at 1,607,930 francs, and nets valued at 3,386,742 francs; the catch was 2,129,519 kilograms of sardines, valued at 987,738 francs.

## BOATS.

All of the boats engaged in the sardine fishery are registered, and have their numbers in large white figures on both sides of the bow, preceded by a letter or letters indicating the town to which they belong (thus, CC for Concarneau). Each boat is taxed about 4 francs yearly by the department of marine and 2 francs by the department of customs. Formerly the boats were smaller, flatter, slower, and less seaworthy. The larger boats, such as are used at Sables-d'Olonne, require rowboats for operating the nets.

Boats are built locally, and cost 1,200 francs when of oak and 1,000 francs when of Norway pine. They do not vary much in size in the different sections. In Concarneau and other parts of Finistère the average dimensions are as follows: Length of keel, 25 feet; length over all, 35 feet; beam, 9 or 10 feet; depth amidships, 6 feet; depth aft, 10 feet; length of foremast, 33 feet; length of mainmast, 36 or 37 feet.

The stern is pointed, the prow is sharp and straight, and the sides flare considerably, so that there is great carrying capacity. There is a broad floor about 2 feet below the rail, and on this platform most of the work is done and most of the fish carried; but when there is a large catch, some of the fish are put below to avoid crushing.

There are two long masts, the foremast raking aft, while the mainmast is nearly vertical. The masts may be lowered if desired. The raising and lowering of the foremast are facilitated by a rope running from its base through a pulley at the head of the mainmast. Each mast carries a large, square, lugger sail, and sometimes a

topsail and a jibsail are employed. The sails are either linen or cotton, the latter being used in summer fishing. Linen sails are tanned brown with catechu and cotton sails are colored with ocher.

The oars are large and heavy, 33 feet long, with a very small, narrow blade, and a square butt about 4 inches in diameter. Owing to the great length of the oar, the butt is large and heavy in order to balance the oar when in use, and stones are sometimes piled on it in rowing. There are four oars to a boat, each used by one man.

#### NETS.

In parts of Brittany nets were formerly used to surround the schools, and then stones were thrown in to frighten the fish into the meshes. In this way large catches were often made and the market was glutted; but the method came into disrepute and is no longer followed. Fishing is now carried on exclusively with gill nets made of very fine cotton twine. Some of the nets come from Germany, and some are made locally, at Nantes and Douarnenez. Those from Germany are cheaper. The nets are uniformly 45 yards long and 500 meshes deep. A change in depth has taken place within a comparatively few years; formerly they were only 200 to 300 meshes deep. The mesh is necessarily very small, as it is intended to gill the tiny sardines. Its size is determined or designated by stretching the meshes and measuring the distance apart of the first and last knots of a series of five—equivalent to two meshes.

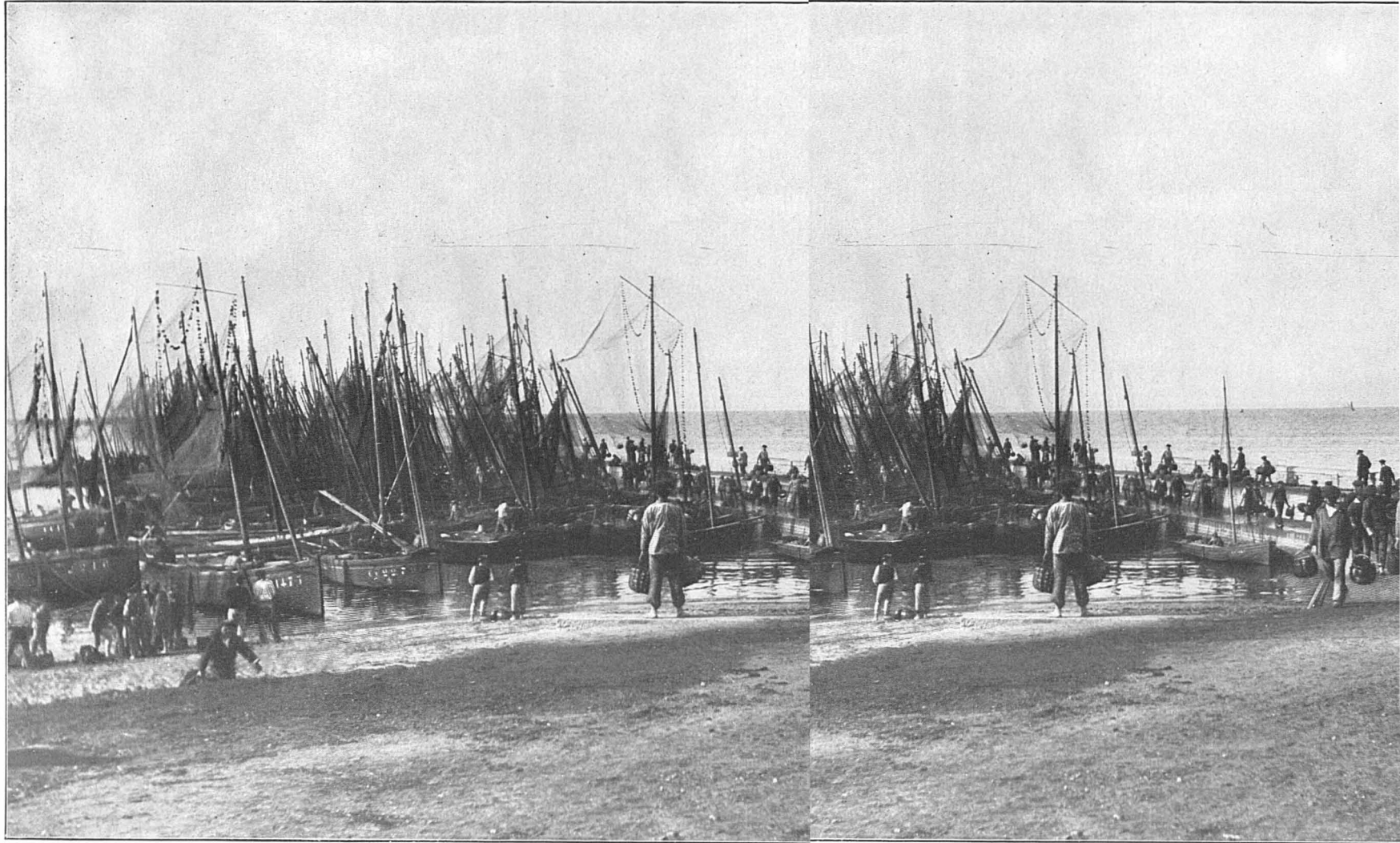
The nets vary in fineness to suit the different runs of sardines, and are of about three standard sizes. The largest mesh, designated 66 mm. (as measured according to foregoing rule), is equal, in America, to 0.66 inch, bar measure, while the smallest size, 40 mm., equals 0.40 inch, bar measure. The intermediate size is 52 mm.

The complement of each boat is 10 nets, representing three sizes of mesh, adapted for small, medium, and large fish. When actively used the nets last only three or four months, but with proper care they often last six months, or even an entire season. When rigged for use they are worth about 100 francs apiece.

The nets are dyed a bright greenish blue, and when suspended from the masts to dry add to the picturesqueness of the fishing boats and the wharf scenes. The dyeing is for the twofold purpose of preserving the nets and rendering them less conspicuous when in the water. The practice of dyeing the nets blue has been in vogue only a short time and appears to have begun shortly after the introduction of cotton nets. Formerly, when linen twine was employed, the nets were stained brown by tannin. The dye substance is an aniline, in the form of a powder, and 50 grams are used on one net. This quantity, with a little alum, is dissolved in enough hot water to thoroughly wet a net. The nets are soaked in the solution and spread out to dry before use. Fishermen are often seen with their hands and wrists stained a uniform blue from handling wet nets. The blue dye is reported to be better than tannin for cotton nets and to render nets less conspicuous. The dyeing is repeated from time to time as the color becomes soaked out.

The nets are kept in position in the water by numerous cork floats and a few sinkers. The corks are 4 inches in diameter and half an inch thick, and about 400 are used with each net. For about 1½ feet below the cork line the net consists of coarser twine of large mesh, to give strength, as, owing to the method of fishing, this part of the net is subjected to great strain. The lower edge of the net for a depth of 3 or 4 inches is also of coarse twine, to support the stone sinkers, two or three sinkers about the size of a man's fist being attached to each net.





SARDINE BOATS AT THE WHARF DISCHARGING THEIR CATCH. CADINE BOATS AT THE WHARF DISCHARGING THEIR CATCH.

## BAIT.

In the fishery for sardines for canning, bait is almost as important as the boats and nets. In no other net fishery in the world is bait so extensively employed and so essential to the success of the industry. The scarcity of bait is always a serious matter in fishing districts, curtailing the catch, reducing the income of the fishermen, and often producing distress among the fisherfolk. It is therefore remarkable that for this indispensable article the French should be absolutely dependent on other countries and that the success of the fishery for sardines should be intimately related to the fisheries for other species in distant lands.

In the early days of the sardine fishery, especially prior to the establishment of canning, small shrimp-like animals, about half an inch in length, were much used as bait. These are one of the natural foods of the sardine and are considered the best bait, but can not be procured in sufficient quantities to meet the demand and are now rarely used. The gathering of this kind of bait was an occupation of the women, who sought the schools in the bays and coves, catching them in large canvas bag-nets. They frequently made their best catches in water up to their necks, when the weather was bad and the water along the shores was thick. The crustacea were heavily salted in barrels and retained until required. The taking of these little creatures appears to have been prohibited many years ago, because of the supposed destruction of fish eggs at the time of catching the shrimps. Although the interdiction is now removed, little effort is made to secure this form of bait.

The bait now in general use is the salted eggs of the cod (*Gadus callarias*), though the eggs of hake, haddock, pollock, cusk, herring, mackerel, and many other fishes are also employed. Cod eggs are not known to possess any properties which make them superior to the eggs of several other species, but owe their prominence to the abundance of cod in regions on which the sardine fishermen depend for their bait supply.

Well-prepared roe has a not unpleasant fishy odor; but the odor is not a matter of any special importance, and the production of any peculiar odor is neither sought nor realized. When the roe becomes old it acquires a rank smell. The sardines are attracted by the sight of the bait rather than by the smell, although it is possible that the strong odor of the old roe used in the early fishing, when the fish are more scattered, may serve to attract the fish. The color of salted roe is a delicate salmon. The ovarian membrane is normally transparent or light; when brown or dark, it is an indication of age or of fresh water (usually rain) having fallen in the barrel.

The annual consumption of roe in France at present is 40,000 to 45,000 barrels, for which the fishermen pay about \$300,000. It is reported that in favorable seasons as many as 25,000 barrels of roe have been expended in Concarneau alone.

For at least two centuries cod roe has been imported from Norway, which country has always furnished the greater part of the sardine bait. Other countries which have contributed supplies are Holland, Newfoundland, and the United States. From time to time the French Government has encouraged its own cod fishermen (at St. Pierre and Miquelon; on the Grand Banks; in the waters of Iceland, and in the North Sea) to preserve the roes of cod and other fish, and in 1816 offered a bounty of \$4 a barrel for roe made from fish caught by them; but this and other inducements have had little effect on the supply from native sources.

The price of roe has varied greatly from year to year. In the early part of the eighteenth century, bait was bought for 50 cents to \$1 a barrel, and throughout that century prices were comparatively low. In the second decade of the last century prices reached their highest point; they were apparently never less than \$32, and ranged from that to \$60 per barrel. By 1822 the price had fallen as low as \$5 or \$6, and since then has seldom been as high as \$25 or \$26, averaging \$12 or \$15.

The average price for Norwegian roe recently has been about 35 francs (\$7) per barrel. In 1900, owing to the failure of the Norwegian cod fishery and the resulting scarcity of roe, the price for Norwegian bait rose to 120 francs (\$24) per barrel, or about 7½ cents per pound. The price of American and Newfoundland roe is but little more than half that of the Norwegian. In 1900 the best American roe was selling at \$8.60 a barrel and in the previous year at only \$4.60.

Mackerel roe, which ranks next to cod in quantity used, brings uniformly 10 to 50 per cent more than the latter.

The sardine fishermen also use peanut meal or flour to mix with the roe, it being much cheaper. It comes in bags holding 75 kilograms, and costs 15 francs a bag. Floating lightly and being quite conspicuous, it attracts the attention of the sardines, which readily devour it. When they gorge themselves, however, the mass swells so as to burst their intestines. The relative quantities of meal and roe used depend on the scarcity of roe and the personal preference of the fishermen. The two articles are often mixed in about equal proportions, but rather more roe than meal is usually employed. In the case of a certain sardine boat in Concarneau, whose operations are elsewhere referred to, the bait consumption one season was 7,500 kilograms of roe and 6,000 kilograms of meal.

The following description<sup>1</sup> of the methods of preparing roe for sardine bait was issued by the French Government in 1817 for the information of the native fishermen, and applies well to the present time:

The ovary of the cod or of the other fishes of the same family that are fished for on the same bottoms incloses the eggs in a double sac, which is ordinarily thrown into the sea with the refuse. To convert these eggs into rogue, several methods can be pointed out.

The first consists in separating the ovary from the body without tearing the covering, and placing it, with the inclosed eggs, on a plank pierced with holes or in an inclined position, or on a small-meshed net, in order that the drying may ensue equally at all points. When this covering is dry, several ovaries are brought together and placed in a barrel, the bottom of which is spread with salt; and, without pressing them too much, the ovaries are piled one above the other, separated by light layers of salt, until the barrel is entirely full. Then it is closed sufficiently tight to prevent the air from penetrating into it; otherwise there will ensue a fermentation injurious to the quality of the rogue.

Another manner of preparation is to put the eggs into barrels without drying them. The layers of salt and of rogue are put in alternately, as in the preceding case; but as the barrel becomes full the quantity of salt should be increased. Four days suffice for the rogue to sink; the barrel is filled to the top again, and this is continued until the vessel is ready to be closed. To provide for the escape of the brine the precaution is taken to pierce several holes in the lower end of the barrel; by this means the brine escapes and the rogue forms a mass, which keeps in good condition up to the month of June, when the fishermen carry it to Bergen. There the salting is finished by adding a quantity of salt equal to the first; the rogue is put into new barrels, which are also pierced, and these can immediately be delivered to the merchants, who ship them to France. It is said that formerly the Hollanders

<sup>1</sup> Instruction sur la Manière de préparer les Rogues de Morue et de Maquereau employées comme Amorce dans la Pêche de la Sardine.

bought in Norway a certain number of barrels of this rogue, to which they gave this last treatment, and that they sold it afterwards to advantage in barrels of oak wood under the name of rogue of Holland fish. In Norway use is not made of Portuguese or Spanish salt, but of French salt; that of Croisic or of Ile de Ré seems to possess the desirable qualities.

The preparation of the rogue, according to the two processes which have just been mentioned, is susceptible of improvement. It has been improved in Norway, especially since the very much higher price obtained in the markets of France has stimulated the activity of fishermen; for it must not be supposed, because the importation of rogue into Brittany has diminished, that less rogue is manufactured at Loffoden. It has simply found another market in Biscaye and in Galicia; but its importation into Brittany would very soon be resumed if French trade were not promptly supplying our wants in this direction.

The proportion of salt to rogue is as one to four, 25 kilograms of salt sufficing for 100 kilograms of rogue.

The method of improving this substance consists particularly in ridding it of all fatty and mucilaginous parts and in rejecting the envelope of the eggs, over the length of which are spread a number of blood vessels, which render it all the more susceptible of fermentation, since salt has little effect on them. It is important to preserve the eggs from contact with the air, which gives them a yellowish-red tint, especially if the temperature is high. Fine salt is more suitable than coarse salt, and marine salt should be preferred to mineral salt. Cod eggs derived from summer fishing require more salt than those from the winter fishing, decomposition being less active in winter than in summer. It is necessary to exclude from salting all rogue of fish too ripe; the rogue has not the necessary consistency when the eggs are about to be extruded. It is what the Norwegians call *bløde roem*, soft rogue.

The barrel should be hermetically closed except a hole in each end, one to give passage to the brine, the other to let the gas freely escape. There should be no space between the upper end of the barrel and the rogue, which can easily occur if the barrel is closed only several days after it is filled. As much as the arrangement of the building permits, the barrels should be sheltered from dampness.

By taking these precautions one is sure to prepare rogue superior to that which the Norwegians put on the market, especially if the quantity of salt employed has been calculated, according to its more or less penetrating qualities, as new salt or old salt.

In the respective interests of the cod and sardine fishermen, it would perhaps be well to make use only of barrels of a uniform gage; but this is a matter which could be settled later.

Finally, the French fishermen ought to prepare the rogue with all possible care. It is the best means of assuring sale, of obtaining preference in the markets of Brittany, and of having no longer to fear there foreign competition.

In the ports in which mackerel fishing is conducted the rogue of this fish can be prepared in the same manner as that of the cod, and is in fact so prepared in some of them. In applying to the preparation of the eggs of the mackerel the simple and easy methods indicated for the eggs of the cod, both will be improved in the same degree; they can very soon supply the place of each other and maintain the equilibrium between the needs and resources of each year. The union of their respective products will then free the sardine fishery from the tribute which it has paid to foreigners, a tribute which they themselves are no doubt astonished at receiving for so long a time.

In an article on "The Sardine Industry in Vendée"<sup>1</sup> Dr. Marcel Baudouin has the following references to bait:

The rogue or *résure* is that which serves as bait for taking the sardine on the coast of the ocean, while in the Mediterranean no use is made of it. The rogues are called natural or artificial. The natural rogue, the most prized, is of a very high price.

Since it is necessary to employ large quantities, it can easily be conceived that an attempt would be made to substitute other substances; whence the invention of artificial rogues, which are manufactured especially in Brittany. In Vendée these artificial rogues are little employed. Some fishermen sometimes prefer to them bait yet more simple and common, bran incompletely sifted, the product of the flour mill, of which the cost price is almost nothing (it has been employed at Saint-Gilles recently),

<sup>1</sup> Revue des Sciences Naturelles de l'Ouest, 1898.

or else a sort of special bait called *guedre*, a mixture of the fry of fish and little crustaceans, especially prawn and shrimps, broken and pounded. Forbidden in 1726 by a declaration of the king, the use of *guedre* was allowed in 1853, then forbidden a second time. Now it is employed again, not only at Croisic and at Turballe, but in Vendée—at Noirmoutiers, for example—where it has procured good fishing. There, as well as elsewhere, it is said to spoil the fish by facilitating decomposition. The manufacturers reluctantly buy sardines caught with this bait.

A number of artificial rogues have been tried in Vendée. We will point out from memory the principal ones which, successively, have been used in commerce: (1) The artificial rogue called "*de Douarnenez*," prepared by Messrs. Morvan and Delasalle. (2) The same rogue, modified by Mr. Morvan in 1876, which contains pickled meal and a small quantity of natural Norwegian rogue; this is the "*farinaceous mixture of Morvan*"; it is no longer manufactured; in 1877 a barrel of 130 kilograms of this rogue was worth 25 francs, while a barrel of good natural rogue was worth 40 francs at least. (3) The "*heterogeneous rogue*" of Mr. Ispa (of Douarnenez) is composed of cakes formed of oleaginous grains (sesame, arachide) diluted with water and a quarter of Norwegian rogue. (4) Caillo, senior, about 1818, made a trial of artificial rogue, composed of boned sardines, pounded and reduced to a paste; he used the flesh of all fish except of those called fat fish. (5) Caillo, junior, reports that a long time ago a pharmacist of Leon d'Angers prepared and sold as rogue grains of linseed or rape seed.

While these artificial rogues may still be occasionally used in Vendée, recourse is usually had to the two natural and well-known rogues. At the Sables, on the Isle of Yeu, among others, the rogue of Norway or of Bergen is employed (rogue made with the eggs of salted cod, stockfish) to cause the fish to come to the surface of the sea at the beginning of the fishing. The rogue made with the eggs of the mackerel serves to keep the fish on the water. This last costs 70 francs a barrel of 130 kilograms; the Bergen rogue, very much in use on the Vendéen coast, is not worth more than 55 to 60 francs.

#### FISHING SEASON, GROUNDS, AND METHODS.

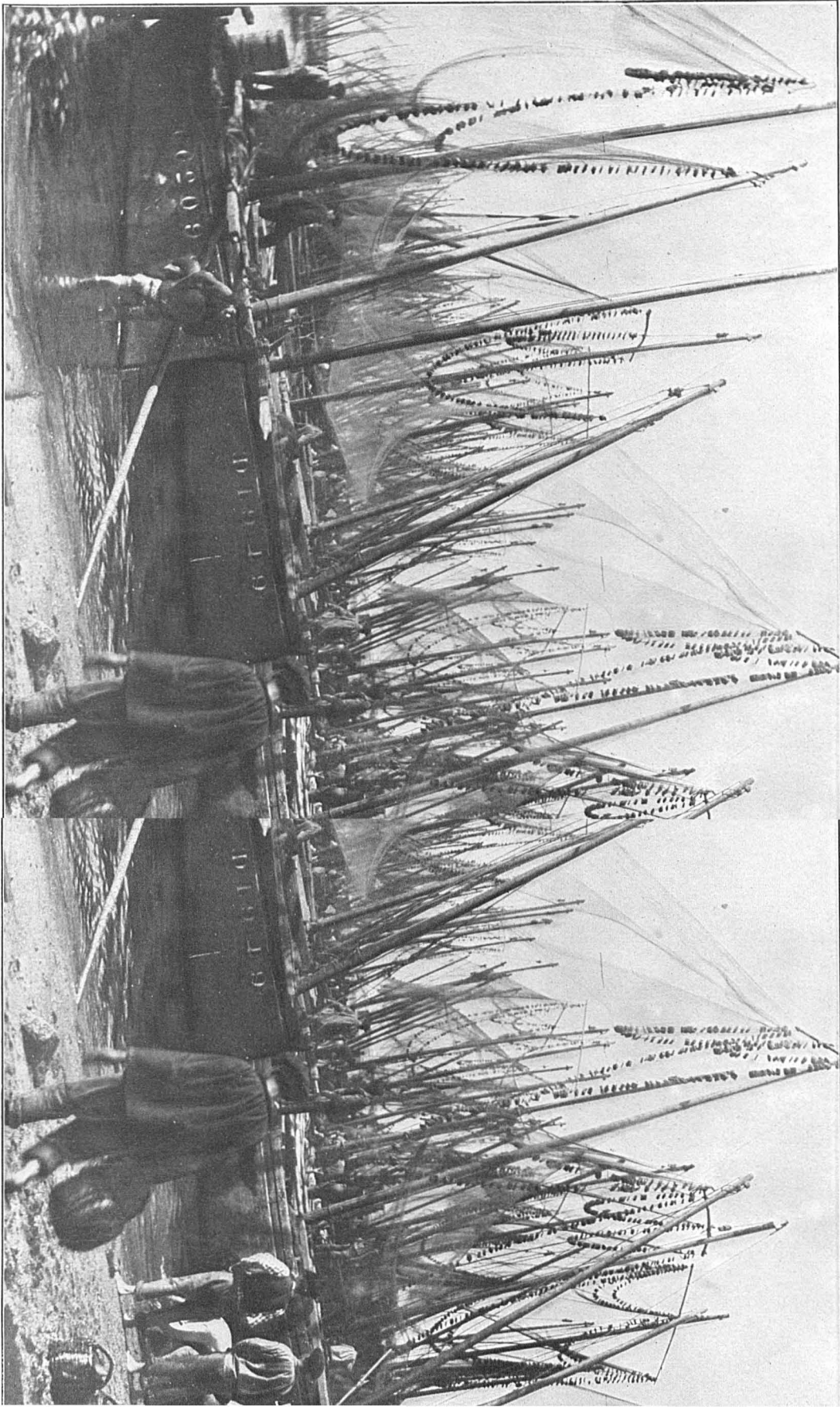
Sardines are caught in greater or less numbers throughout the year. On the west coast, however, the fishing season opens in February and continues to November, rarely extending into December. In Brittany the fishing begins rather later and continues longer than at points farther south on the Bay of Biscay. Fishing in the canning district is continued as late as practicable, usually as long as the fish remain in abundance, as their condition at that time is good. In the Mediterranean sardines are caught during every month of the year.

The sardine fishery is emphatically a shore fishery, and most of it is done within a very short distance of the home ports. This permits the use of smaller and less expensive boats than would otherwise be required, and insures the landing of the fish a short time after capture.

The early fishing for the sardine *de dérive* is mostly within 1 or 2 miles of the shore and rarely beyond 5 or 6 miles. In the summer and fall fishing with bait, the boats may go 10 miles to sea, but the largest part of the catch is taken within 3 or 4 miles of shore, and a very considerable proportion close inshore in the bays.

The fishing in the early part of the season—that is, in March, April, and May—is done mostly with old nets and is conducted only at night. About 20 nets are used by each boat. These are tied together and submerged about 1 yard, the corks being attached in bunches of four or five at intervals of 2 yards. While the boats are lying near by under a small aft sail and the men sleeping, the nets are allowed to drift. No bait is used. The fish thus caught are not fat and not used for canning, but are salted or sold for immediate consumption.

The regular fishing is carried on only by day. The boats start for the fishing-grounds early in the morning (2 to 4 o'clock), so as to be there when day breaks;



A PART OF THE SARDINE FLEET AT THE DOCK IN CONCARNEAU OF THE SARDINE FLEET AT THE DOCK IN CONCARNEAU.

they may also have to leave earlier if the tide would otherwise beach them. The best fishing is in the early morning, and the boats are often back to port by 9 or 10 o'clock with full fares.

When waiting on the fishing-grounds (at night, early in the morning, or at any other time) the fishermen place one of the long oars obliquely upward and backward from the bottom of the boat to the rear mast (where it is fastened), and over this they spread a sail. Under this shelter they sleep or rest.

When a boat arrives on the fishing-grounds the rear mast is taken down and the boat is headed toward the wind. If fish are present a net is shot and slowly towed by means of a short line attached to the cork line and fastened in the stern of the boat. When there is no wind, or when the wind is from an unfavorable quarter with reference to the water currents, the sails are lowered and the crew row the boat. In the sardine fishery at Sables d'Olonne, where large boats are used, the nets are not towed therefrom, but are pulled by means of rowboats.

Bait is always used in the day fishing, being necessary in order to attract the fish to the vicinity of the boats and into the nets. The casting of the bait, on the proper use of which a great deal of the success of fishing depends, is always done by the master or "patron," who stands in the stern of the boat on a little platform and uses the flour and roe as required. When the fish have come toward the surface and are on one side or the other of the net his object is to cast the bait in such a way that they will rush against the net and become gilled.

Considerable skill and experience are of course necessary in managing the net and in having it hang properly in the water and not become folded or wavy owing to currents or tide. Unless the net is straight or gently curved, the fish will see and avoid it. When a net contains fish and is ready for hauling, it is taken in the boat and the fish are removed from the meshes by gently shaking the net or by hand. The fish are put in a compartment in the bottom of the boat. When large catches are made other receptacles are provided.

In summer fishing, when sardines are abundant, the fishermen often let one net go adrift when it is full of fish, trusting to pick it up later, and put out another net. Indeed, a boat may have fish in three nets at one time, though this is rarely the case.

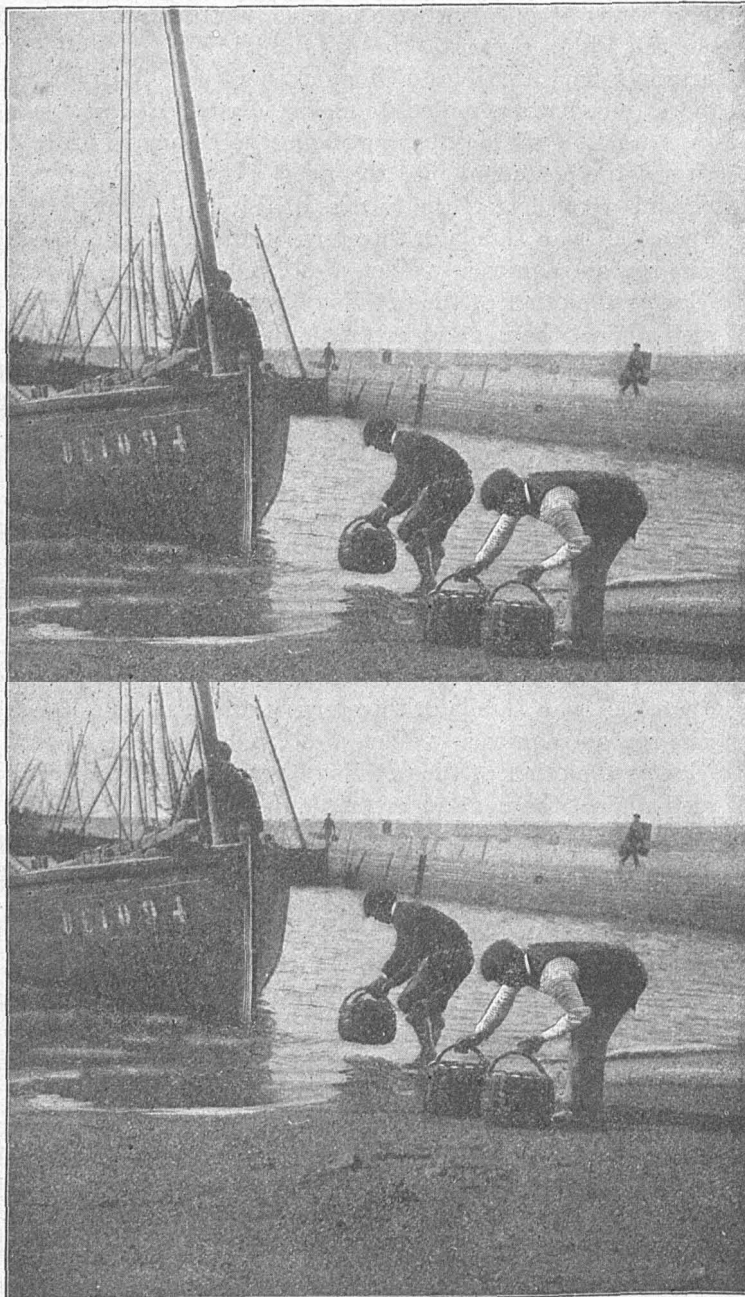
The sardines are often found in a more or less compact body, and the boats will be concentrated in a comparatively small area, at times so close together that the operation of the nets would seem almost impossible and the chance of catching fish very improbable. The entire fleet of a given port—consisting of several hundred boats—may be at work on one school and fishing literally en masse instead of individually. This is shown in a measure in the upper figure of plate 2.

No ice or other preservative is used on the fish, which are landed a short time after gilling. The fish reach port in good condition, and are often at the canneries within one or two hours after capture. Should the failure or unfavorable direction of the wind threaten to delay the arrival of the boats, and hence impair the quality of the fish, the crews row leisurely back to port.

Soon after reaching port the nets are spread for drying, being hauled to the top of the masts and suspended between them for this purpose. When all the fleet has arrived and the nets are spread, the view of the maze of blue nets, sails, and masts is most interesting and unique.

## WHARF SCENES.

When the fishing boats begin to arrive, the wharves, which have practically been deserted, assume a very busy and animated appearance, and as the arrivals increase in number the bustle among the different classes of people becomes intense, although good nature and good order prevail. The foreign visitor here witnesses some exceedingly interesting and picturesque fishing scenes—thousands of fishermen in their coarse blouses and flat cloth caps, with trousers rolled up and their feet bare or in the huge wooden shoes of the country, unloading their fish and carrying them



Washing Sardines on the Beach.

to the canneries; hundreds of women and girls in short dark skirts, white caps and collars, and wooden shoes, negotiating for sardines, receiving the fish from the fish-



small one-room wooden houses which serve as their headquarters for the purchase of fish. To some of these cabins a telephone wire runs from the factory, so that instructions as to prices and information regarding the quantity of fish landed may be mutually communicated.

The cannery managers, having determined on the approximate prices they will pay for the different sizes of fish, send their purchasing women to the wharf as the boats come in and the bargains are then made. Sometimes the fishermen hold out for better prices and animated discussions ensue.

On arriving at the wharves the fishermen at once begin to discharge their catch. The fish are counted by hand into wicker baskets with round bottoms and sides, each



A Sardine Fisherman bringing Fish ashore in Baskets.

basket having 200 fish (plus 5 per cent for possible imperfect fish). When the tide

of fish and move them rapidly up and down in the water in order to remove the dirt and loose scales from the fish and make them look bright. Many scales come off, and the shores of the harbor are lined with them after a day's fishing. The water about the shores is usually quite foul, and the rinsing of the fish therein seems very objectionable.

The fish are then taken by the fisherman to the agent of the cannery to which the cargo has previously been sold, and the contents of each basket are poured into a flat box or basket. If a cannery is conveniently located the fishermen may carry the fish directly thereto; but as a rule the fish are taken to the factory in wagons, the trays being carefully packed so that no pressure comes on the fish. From the time the sardines are first caught everything that will bruise, mash, or otherwise impair the soundness of the fish is carefully avoided. The method of discharging the catch in small lots insures the arrival of the fish at the cannery in similar quantities and obviates the formation of large piles in the cutting room, as the cutters are in ample numbers promptly to dispose of the fish as brought in.

#### PRICES RECEIVED FOR SARDINES, ETC.

The prices received by the fishermen are regulated by the factory operators, and depend on the supply, the size and quality of the fish, the weather, and other considerations. The fish of each boat are virtually sold at auction, only there is as a rule no counter bidding, the prices offered by one or two factories being adopted by the others and accepted by the fishermen. If a fisherman is not satisfied with the price offered by one factory, he is at liberty to seek a higher price elsewhere. Some boats always sell their catch to the same factory, and all of them, to a greater or less extent, deal with particular factories.

The maximum price which factory operators can profitably pay for sardines is 25 francs (\$5) per 1,000 fish. The dealers in fresh sardines can pay as much as 35 francs per 1,000. At times the demand for sardines to be sold fresh (*au vert*) tends to keep up the prices; but this use is limited and does not interfere greatly with the cannery demands.

The following are the average prices for sardines at Concarneau in 1900, and about the same prices prevailed in other parts of the coast:

Size of nets in which caught.	Price per 1,000 fish.
	Francs.
60 millimeters .....	17 to 18
52 millimeters .....	7 to 9
40 millimeters .....	2½ to 5

Women represent the factories as purchasing agents. They are given considerable discretion by their employers and are very sharp in making bargains. The price agreed on is for the entire cargo. Payments are not made in money, but in tokens or tickets which are redeemed weekly. As the fishermen deliver their fish, two baskets full at a time, to the agents of the canneries, they receive a metal tag or token with the name of the buyer on it. When all the fish are landed the metal

pieces are counted and surrendered and a claim check is issued in their place. At the end of each week the master or the owner of the boat (often the same person) goes to the factory, receives the money due, and apportions the earnings of the crew.

The boat, nets, equipment, and bait usually belong to a non-fisherman (who may own a number of boats). The men of the crew furnish their own food, fuel, and clothing. The owner is entitled to half of the sales of fish, and the remainder goes to the crew in the following proportions: There being 6 men in the crew, 4 of them get equal parts, the captain or patron receives the share of one man plus 10 per cent, and the cook half a share. Dividing the proceeds into 22 parts, the owner is entitled to 11 parts, 4 members of the crew to 8 parts, the master to 2 parts, and the cook to 1 part; the share of the master being increased by 10 per cent of 2 parts and that of each member of the crew diminished by  $2\frac{1}{2}$  per cent.

At the end of the season the boat owners usually give to each master a quarter of a share ("quart de lot") as a bonus, if the crew have been selected and engaged for the next year's fishing. In this way it is possible for the owners and the masters to select the best men. During the winter, say in January, the crew will report, and each man will receive, as a kind of bonus, about 5 francs and perhaps a loan of money. Advances are repaid in fish or cash after the season opens.

From the time the men begin to fish until the close of the season, they pay to the government 1.10 francs per month, in consideration of which they are pensioned on attaining the age of 50, provided they have served 300 months on sea duty (either in fishing or in any other maritime occupation). They also pay 1.50 francs per month as premium on an insurance fund which the government allows for injury due to the vicissitudes of sea life. In case of death, the family of the fisherman receives an annual pension depending on the size of family and on the age and length of sea service of the deceased, the minimum sum being 300 francs; naval service increases the pension.

#### DETAILED FISHING RECORDS.

The average stock per boat in a given season varies greatly on different parts of the French coast, depending on various local causes besides the abundance of fish, such as weather, bait supply, local demand, shipping facilities, energy with which fishing is prosecuted, and other evident factors. The boats fishing out of Brittany ports have a larger average yield than those of other ports of the west coast; and those in the Mediterranean have by far the smallest stocks. Thus, in 1898, the average catch per boat was about 10,700 kilograms of sardines in Brittany, 3,300 kilograms in the southern part of the Bay of Biscay, and only 745 kilograms in the Mediterranean.

Considering the record for 1899 of a certain boat in Concarneau which fished regularly, it appears that the aggregate stock was 4,400 francs, of which the crew of 5 men and a boy received 2,200 francs in the proportions elsewhere mentioned. The owner of the boat had the following expenses to meet out of his half of the proceeds: Twenty-five barrels of bait, at 35 francs; 2 new nets, at 100 francs; 40 bags of peanut flour, at 15 francs; and miscellaneous items, bringing the total to 1,725 francs, leaving a net profit of 475 francs.

Some idea of the energy with which the sardine fishery is pursued at times may be gained from the following outline of one day's fishing operations at 15 centers on the coast of Brittany. The data are compiled from a local newspaper (La Depeche

de Lorient), and relate to September 17, 1900, for some of the places and September 18 for others. The number of boats fishing was about 1,500, the approximate total catch was at least 17,000,000 sardines, having a value of 200,000 francs, or \$40,000.

- Audierne, September 18:* Number of boats going out, 200; average number of fish per boat, 6,000 to 8,000; average price per thousand, 13 francs; size of sardines, 12 to 14 to the quarter can (*quart*).
- Concarneau, September 17:* Number of boats going out, 500; average number of fish per boat, 2,000; sold fresh (*au vert*), 30,000; sold for frying (*friture*), 970,000; average price per thousand, 18 francs; highest price, 24 francs; lowest price, 2.50 francs.
- Croisic, September 18:* Number of boats going out, 2, which have caught 6,000 to 7,000 sardines; highest price per thousand, 28 francs; lowest price, 26 francs.
- Douarnenez, September 18:* Number of boats going out, some hundreds; average number of fish per boat, 45,000; average price, 14 francs; size of sardines, 8 to 17 to the "quart."
- Etel, September 17:* Boats not going out because of bad weather. *Sept. 18:* No fishing. The boats going out late have been unable to fish on account of a calm and have not returned at evening.
- Gavres, September 17:* Number of boats going out, 86; average number of fish per boat, 9,000; number of fish to the "quart," 10 to 12; average price per thousand, 4.50 francs; highest price, 7 francs; lowest price, 3 francs. Some boats have an average of 18,000 to 20,000 fish.
- Guilvinec, September 17:* Number of boats going out, 20; average catch per boat, 15,000 to 20,000; number of fish to the "quart," 14 to 16; average price per thousand, 4 francs; highest price, 5 francs; lowest price, 3 francs. Some boats have an average of 25,000 fish.
- Ile Tudy, September 17:* Number of boats going out, 35; average number of fish per boat, 15,000; number of fish for frying, 535,000; highest price per thousand, 7 francs; lowest price, 2 francs. Some boats have an average of 20,000 fish.
- Lannion, September 18:* Number of boats going out, 67; average number of fish per boat, 1,100; average price per thousand, 9 francs; highest price, 10 francs; lowest price, 8 francs. Some boats have an average of 5,000 fish.
- Loctudy, September 18:* Number of boats going out, 35; average number of fish per boat, 15,000; average price, 6 francs.
- Palais, September 17:* Number of boats going out, 75; average catch per boat, 3,000; sold fresh, 50,000; sold for frying, 165,000; average price per thousand, 15 francs; highest price, 16 francs. Some boats have an average of 6,000 fish.
- Penmarch, September 18:* Number of boats going out, 45; average catch per boat, 10,000; average price, 4.50 francs; size of sardines, 12 to 18 to the "quart."
- Port Louis, September 18:* Number of boats going out, 55; average number of fish per boat, 6,000 small; 10 boats with 4,000 large; average price, small, 5 francs; large, 18 to 22 francs; sizes of fish, 7 to 8 and 16 to 20 to the "quart."
- Saint Guenolé, September 17:* Number of boats going out, 100; average catch per boat, 15,000; number of fish sold for frying, 15,000; average price at midday, 4 francs; highest price, 6 francs; lowest price, 2.50 francs. Some boats have an average of 20,000 to 25,000 fish.
- Sauzon, September 17:* Number of boats going out, 84; average catch per boat, 10,000; number of fish to the "quart," 7 or 8; average price per thousand, 15 francs; highest, 16 francs; lowest, 14 francs. Some boats have an average of 13,000.

The following similar record is for several of the foregoing places and some additional ones on September 22 and 23, 1900:

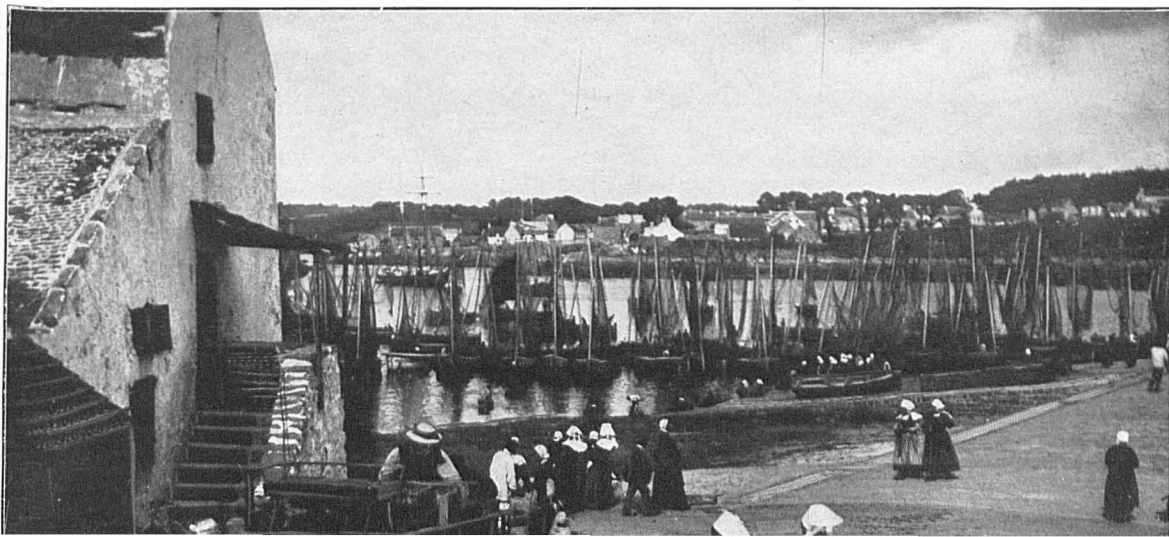
- Croisic, September 23:* Number of boats going out, 30; average catch per boat, 2,000; average price per thousand, 24 francs; highest price, 28 francs; lowest price, 20 francs. Some boats have an average of 5,000 fish.
- L'Herbaudière, September 22:* Number of boats going out, 25; average catch per boat, some hundreds; number of fish sold fresh, 30,000; uniform price per thousand, 12 francs. Some boats have an average of 6,000 to 7,000 fish.
- Lannion, September 22:* Number of boats going out, 65; average number of fish per boat, 1,300; average price per thousand, 9 francs; highest price, 10 francs; lowest price, 8 francs. Some boats have an average of 6,500 fish.
- La Turballe, September 22:* Number of boats going out, 60; average catch per boat, 3,000; number of fish to the "quart," 9 to 10; sold fresh, 120,000; sold for frying, 80,000; average price per thousand, 18 francs; highest price, 23 francs; lowest price, 15 francs. Some boats have an average of 4,000 and 5,000.
- Les Sables, September 22:* Number of boats going out, 150; average catch per boat, 6,000; number of fish to the "quart," 14 to 16; average price per thousand, 4 francs; highest price, 6 francs; lowest price, 2.50 francs. Some boats have an average of 17,000 fish.
- Lomener, September 22:* Number of boats going out, 40; average catch per boat, 7,000; number of fish to the "quart," 15 to 20; uniform price per thousand, 4 francs. Some boats have an average of 10,000 sardines.
- Port Louis, September 23:* Number of boats going out, 86; average catch per boat, 8,000; number of fish to the "quart," 10 to 12; average price per thousand, 3 francs.



SARDINE BOATS ON THE SHORE, CONCARNEAU.



SARDINE BOATS ON THE SHORE, CONCARNEAU.



## THE CANNING INDUSTRY.

## THE FACTORIES.

The construction of the first sardine-canning establishments dates from about 1845, since which time the growth of the business has been almost uninterrupted. The factories gave to the sardine fishery a great impetus, and to-day are the chief supporters of the very extensive fishing operations in the Bay of Biscay.

The factories are generally large stone structures surrounded by a stone wall and inclosing a courtyard. They cost from 30,000 to 75,000 francs or more to build and equip. Their capacity varies greatly. Some are able to utilize upward of a quarter of a million fish daily. The yearly output of individual establishments is from 300,000 to 4,000,000 or 5,000,000 boxes. They pay no special license tax, but have the same taxes as other manufacturing establishments, based on number of employees and size of plant. The output is not taxed.

In no line of the business is there any standard to be followed, except what the trade demands and the interests of the canners dictate. There is no government or other official inspection of the canned products.

The sardine canners, not unnaturally, are averse to having strangers enter their works and are circumspect in granting permission to do so. Almost every canner has some slight peculiarity in method of preparation which he thinks advantageous and worth being kept to himself. As the factories are surrounded usually by high stone walls, and entrance is only through a guarded gate, a stranger might remain in some of the fishing villages for a long time without being able, from personal inspection, to learn anything about the canning methods.

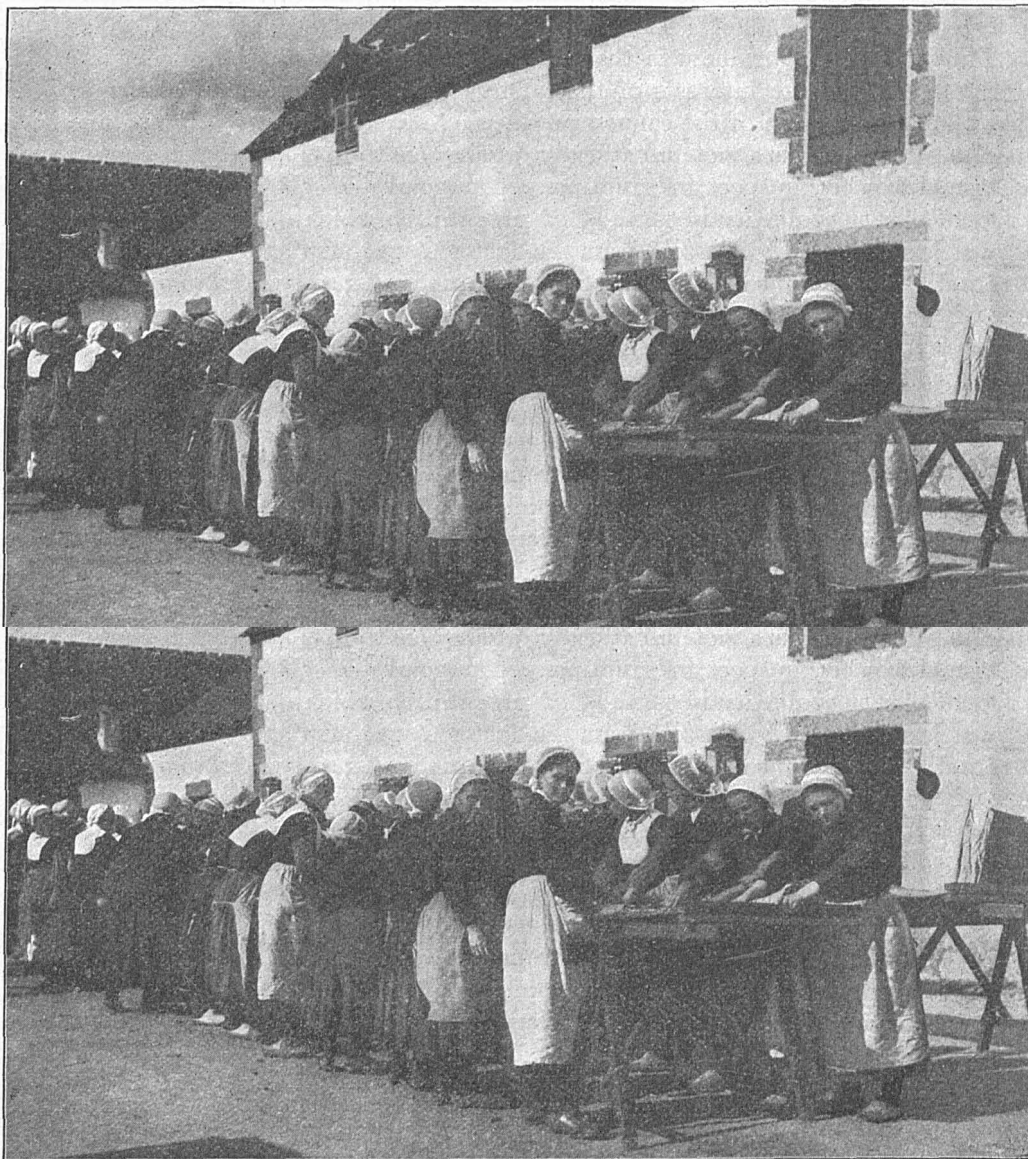
No complete statistics for the canning industry are available, but it may be stated that over 100 factories are operated, and not less than 15,000 persons, mostly women and girls, are employed therein. Concarneau and Douarnenez have more factories than any other localities, the number operated in 1900 being 29 and 25, respectively. A large number of the canning establishments are owned or leased by companies having headquarters at Bordeaux and Nantes.

## CANNING PROCESSES AND MATERIALS.

When the fish are taken to the factory they are spread on large tables and sprinkled with a little salt. The women who remove the heads and viscera either stand or sit, and perform their work with great rapidity. They hold the fish in the left hand and with the right hand press the knife into the back and side of the head of the fish, using the right thumb for a counter pressure. The head is pulled or torn off, rather than cut, and the esophagus, stomach, and most of the intestines go with it. The body drops into one basket, the refuse parts into another. The refuse is disposed of to farmers for fertilizing their fields.

Immediately after evisceration the fish are sorted by size into large tubs (half oil barrels holding 250 liters) containing a brine strong enough to float a potato. Here they are left for half an hour to an hour, depending on their size, quality, and the condition of the weather. They are then placed in small wicker baskets and taken to the yard, where they are washed in either fresh or salt water (salt preferred) while in the baskets, each basket being put through two waters. This washing, which takes but a few seconds, removes from the fish any undissolved salt, loose scales, and dirt.

Drying, which is the next step, is preferably done in the open air, and a large part of the product is so treated. For open-air drying the fish are arranged by hand, one by one, in wire baskets or trays holding about 150 fish of medium size, placed on wooden frames or flakes. The baskets are 16 or 18 inches long, 9 inches wide, and  $3\frac{1}{2}$  inches deep; are made of coarse wire with a polygonal mesh two-thirds or three-fourths inch in diameter, and have a long bridle-like wire handle on each side by which they are suspended on the flakes, each bridle having at its middle a loop or ring which interlocks with its fellow. The distinctive feature of this wire tray is its division into about 7 crosswise compartments, V-shaped in section, the spaces being pointed at the bottom and open above. The divisions are of coarse wire, and one side of the V forms a wider angle with the basket bottom than the



Beheading and Eviscerating Sardines.

other. Against the more oblique sides the sardines are placed in regular rows, with their tails upward, so as to promote the escape of water from the abdominal cavity. By means of the loop in the handle some of the baskets are hung on the frames, somewhat above the head; others are rested on lower frames. Wooden baskets or trays are used in some places.

older canneries the wire baskets are suspended from a wire lattice under which are small charcoal furnaces.

From the drying flakes the fish are taken in the same wire baskets to the cooking room and immersed in boiling oil, in open vats of various sizes and construction. As the fish are quite dry, much of the oil is taken up in cooking and has to be replaced from time to time by fresh oil. The immersion in oil usually lasts about two minutes, but depends on the size of the fish and is best gaged by experience. When the caudal fin will break easily, the fish are said to be cooked enough. The baskets are then removed to a table or platform with an inclined metal top, where the surplus oil is allowed to drain from the fish. After a few minutes the baskets are taken to the packing room, where they are hung on wooden frames over metal-top tables for further draining and cooling. The oil which drips off here is in some places used in soap-making.

The sardine manufacturers employ two kinds of oil in their canning operations—olive oil and arachide or peanut oil; and small quantities of sesame oil have at times been used. While it is reported that the manufacturers knowingly handle only the oils named, it is understood that cottonseed oil, being tasteless and cheap, is used by the French oil-dealers for adulterating both olive and peanut oil. Information on this subject is naturally difficult to obtain; but the testimony of several oil-manufacturers and dealers clearly indicates the existence of the practice. It is interesting to note, in this connection, that during the fiscal year 1899 the United States exported to France nearly 17,000,000 gallons of cotton-seed oil, having a value of \$4,000,000.

French olive oil is used with the best quality of canned sardines. Fish packed in it will remain in good condition ten years or longer, and are reported to be better the second year after packing than earlier. The cost of olive oil to the canners is from 175 to 300 francs (\$35 to \$60) per 100 kilograms.

Arachide oil is extensively employed. It is made in Bordeaux, Fécamp, and Marseilles from peanuts imported from India, Senegal and other parts of Africa, and other countries. It comes in three grades and costs 65 to 95 francs per 100 kilograms, the best quality being worth less than one-third that of the best olive oil. The mass remaining after the expression of the oil from the peanuts is made into cakes and used as food for cattle. The cakes are ground into flour and employed as bait in the sardine fishery.

Peanut oil is largely used to meet the American demand for a low-priced sardine. Most of the cheaper French sardines exported to America are packed in peanut oil, which is practically tasteless.

A canner may fry his sardines in peanut oil and fill the cans with olive oil, or vice versa; or one oil, with or without the admixture of cotton-seed oil, may be used throughout the process.

The following account of the utilization of peanuts in France is quoted from the Philadelphia Manufacturer:

Americans have come to look upon the peanut chiefly as an article of food, associating it with circuses and country fairs. Its employment for food purposes is, however, one of the least important of its uses. Although Europeans seldom eat the nuts, Marseilles is the peanut center of the world. In 1899 that city imported 61,241 tons of unshelled and 9,579 tons of shelled peanuts, and that was not an unusual year. Bordeaux also uses large quantities every year, but the first-named city stands in Europe at the head of the production of vegetable oils from oleaginous seeds. The chief sources of



the city's peanut supply are Bombay, Mozambique, and Senegal, although large quantities are received from other places.

In the Marseilles crushing mills for handling the peanuts, the shells are broken by means of toothed rollers and the kernels separated by a system of winnowing machines, such as are used in flour mills. The inside red skin is then removed by revolving sieves and air blasts, and the kernels are ground, after which they are ready to be pressed. The pressing takes place in the same manner in which other oleaginous seeds are pressed, the meal being enveloped in strong fibrous mats and subjected to hydraulic pressure. The resulting cake is then reground, the oil remaining in the meal secured as in the first instance. The oil is graded according to first, second, or third extraction. This oil, after being clarified by filtration and the admixture of fuller's earth, is put on the market and used as an illuminant, and more extensively as an adulterant in olive oil, in which latter field its chief competitor is cottonseed oil.

The cake left is sometimes chemically treated to secure the oil that may have escaped the presses, but whether thus treated or not, it is valuable as a food for cattle. The husks are sometimes used for fuel, and they have some value as fodder, although goats are about the only animals that will eat them when not mixed with the peanut cake.

Sesame oil comes from Egypt, and costs about 80 francs per 100 kilograms.

There are various other ingredients with which or in which the sardines are packed to give them flavor or piquancy. Some of the very best goods are prepared with melted butter of good quality instead of oil; these are mostly for special French trade. Tomato sauce, pickles, and truffles are also used. With all of these the sardines are packed precisely as when oil is employed and in cans of the same sizes. Only relatively small quantities of such goods are prepared.

When the fish reach the packing room, the women who had been cutting will probably have finished that task and are seated at a table ready to take up the packing of the sardines in tin boxes; they carefully place the fish in the cans, and then pass them along to another set of women who fill the boxes with oil from a faucet or with other materials used with the sardines—tomato sauce, mustard, truffles, etc.

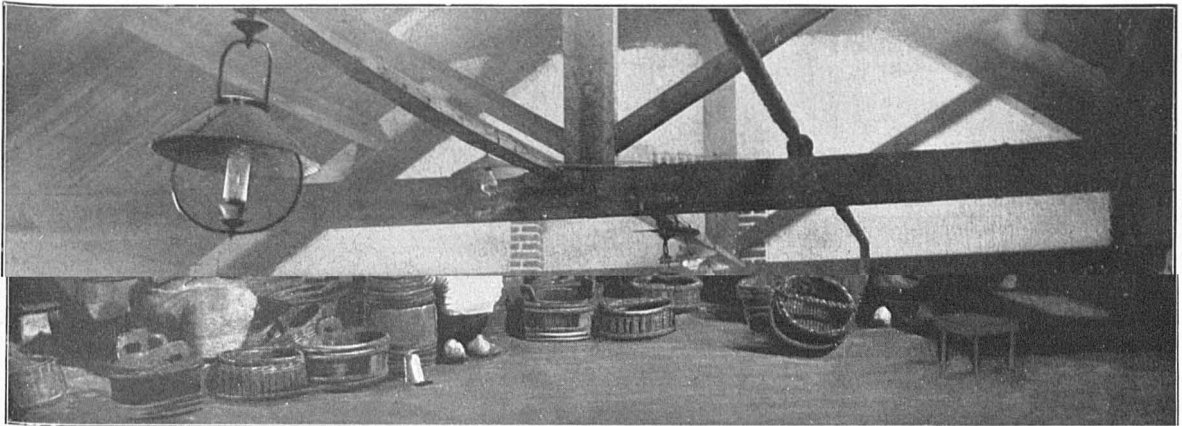
In some countries (United States) the trade demands that the blue back of the sardines be uppermost when the box is opened; while for other countries (France, Belgium) the white belly should be uppermost. The position of the fish when the top of the can is removed by the consumer is reversed in packing, as what is the bottom of the can from the packers' standpoint is in reality the top.

With most of the oil sardines a small quantity of spices is used in order to impart a flavor. The usual ingredients for each can are 1 or 2 cloves, quarter or half of a laurel leaf, and a small piece of thyme; these are put in the can before the fish, so that they will be on top when the can is opened. The fresh leaves of tarragon (*estragon*) are sometimes used.

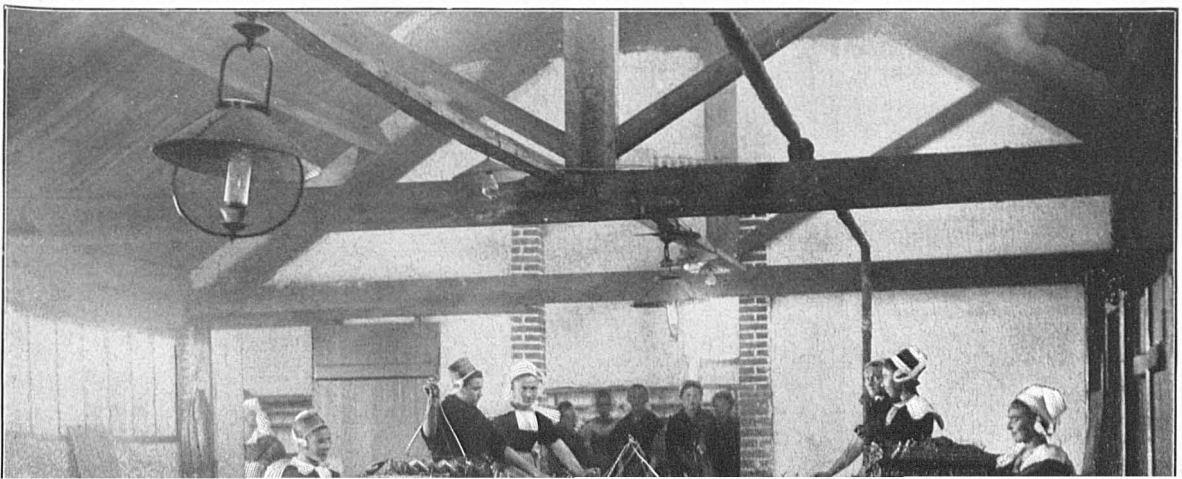
Sardines are packed in tin boxes of a large variety of sizes and shapes, some of which are well known to the American public, while others do not enter into the general trade here. Among the kinds which have received special designations are the "quart bas," "quart haut," "demi," "huitième," and "triple." The "quart" can is the standard. It ordinarily contains 12 to 14 fish, but sometimes as many as 20 and sometimes only 6 or 8. The "demi" is twice as large as the "quart," and the "huitième" is only half as large; while the "triple" contains 12 times as much as the "quart." Lozenge-shaped and boat-shaped cans (which are protected by patent) are also employed by a few companies; and some factories put up fish in glass vessels. The standard wooden cases in which the cans are packed and sent to market contain 100 "quarts," 200 "huitièmes," 50 "demis," etc.



YARD OF A CANNERY. WOMEN CUTTERS AWAITING THE ARRIVAL OF SARDINES.



YARD OF A CANNERY. WOMEN CUTTERS AWAITING THE ARRIVAL OF SARDINES.



At one factory the writer observed that the fish in course of canning were for the most part mutilated, soft, and uneven, and were being put up in peanut oil, and learned that these sardines were destined for the American market.

Sealing the bottoms on the cans—the next step in the preserving process—is one of the few things done by men. Soldering appliances of various types are used in the different factories. The most convenient, time-saving, and modern soldering iron would appear to be that which is kept constantly heated by gas. The handle of the iron is pierced by two pipes, one conveying gas and the other air for admixture with the gas; and the gas is ignited in the head of the iron in such a way as to keep the soldering edge continually at a white heat. The free movement of the iron is effected by rubber tubes connecting it with the main supply pipes extending lengthwise under the table at which the solderer works. While being closed the can is held in a frame on a small turn-table moved by the foot of the solderer. The cover is applied so as to force out the air, and at the same time a good deal of oil escapes. The soldering begins in this oil, at the middle of one end of the can, and is continued around by the revolution of the turn-table rather than by the movement of the iron.

From the soldering table the cans are taken to another room in which they are placed in large square iron vessels, open at the top and holding several thousand "quart" cans. The vessels are then immersed in boiling water for two hours. This accomplishes a fourfold purpose: (1) The cooking of the fish is completed; (2) the bones are softened; (3) the bacteria in the oil and fish are killed, which would otherwise produce putrefaction; (4) the presence of leaks in the cans is disclosed.

After cooling, the cans are placed in dry sawdust and stirred from time to time; this absorbs the oil and moisture on the surface and renders the cans clean and ready for packing.

There is a comparatively small proportion of the fish prepared as "boneless sardines," which are rendered "boneless" by bending the caudal peduncle until the backbone breaks, and then drawing out the vertebral column with special tweezers or pincers. Fish intended for this purpose require more prolonged drying (2 to 3 hours), so that the muscular tissue may separate more completely from the vertebrae. Only fish 60 mm. long or over are made "boneless," and of even the larger fish only a small quantity is so treated. The best sardines are not so prepared, as they are fresher when they reach the cooking room, having required only one-half or one-third the time for preparation up to that stage. The "boneless" fish, while undergoing the additional drying, are deteriorating. The removal of the backbone adds about 6 per cent to the value of the fish, although the women who prepare them receive no additional wages.

Tin plate for sardine cans is manufactured at Nantes and other places in France. In Concarneau, Nantes, Hennebont, and elsewhere cans are made for the canneries at special establishments and are sent to the factories in the same boxes in which they are subsequently shipped when filled. At Hennebont there is a plant for the decoration of tin plate.

Most of the canning factories receive their cans ready-made, but some simply have the separate parts cut, and during winter give employment to the can-makers. Nearly all of the sardine cans are now provided with keys, which are placed on the cans as the sardines are boxed for market. The sardines of the best quality

have keys for use on the side or edge of the can, rather than on the top, which remove a thin strip of tin.

Labeling of French sardines is an important branch of the canning business, and although the use of labels is not required by French law, labeling is almost invariably practiced. The most popular and generally employed label is that which is stamped on the tin. Very few paper labels are used, and these are chiefly for special French trade. Some of the best grades of sardines are labeled with brass labels of oval or oblong shape, attached to the side of the cans by solder.

#### CANNERY EMPLOYEES AND THEIR WAGES.

The canning of sardines gives employment to many thousand persons, at what are considered good wages, and in some of the fishing towns gives work to practically all able-bodied persons who are not engaged in fishing. In Concarneau, a town of 10,000 people, fully 3,000 men, women, and children are directly connected with the sardine-canning business, besides the fishermen. The average number of employees at the factories in Brittany is over 100, and at the largest cannery in Concarneau about 335 persons are employed. Living in the fishing towns is very cheap. The principal diet is fish and bread, and meat is eaten usually but once a week.

Most of the work in connection with the canning of sardines is done by women and girls, a few men being employed for special duties for which women are not adapted (can-making, soldering, boxing, etc.), together with a small number of boys who are apprentices.

Among women and girls in the Brittany factories uniform wages prevail. The rate in 1900 was 1½ francs for each 1,000 fish, the aggregate being divided equally among employees. A good week's income for cutters and packers is 30 francs (\$6).

The solderers, who seal on the tops of the cans, receive 1.50 francs for 100 cans. In winter many men devote their time to can-making and are paid 3 francs per 100 cans. Other employees about the factories are paid by the month and receive an average of 70 francs. A good solderer can seal 1,100 to 1,300 cans daily, and some men do considerably more. Boxes that are badly soldered are returned, and, with their contents, charged to the solderer, who is not allowed to sell them. M. Deyrolle-Guillou, of Concarneau, communicates the following interesting note on the work of apprentice solderers:

I have heard of a solderer who could seal up 1,800 "quart" cans of sardines in a day, but an ordinarily good worker does about 1,300. It is very easy work to learn. I have recently spoken with a cannery director, who told me that he had six young apprentices of last year, one of whom can now (1900) solder 1,200 boxes in a day, two can do 1,100, two can do 1,000, and one can do 900. These are only 15 to 17 years old, and must be apprentices three years and get only half pay during that time, that is to say about 75 centimes for 100 "quarts" soldered up.

#### PRICES OF SARDINES.

In 1900 the sardine packers received an average of 50 francs per 100 "quart" cans for fish of good quality in "olive" oil; in 1899 the average price for the same goods was 43 francs per case. Some "quarts" in oil, however, bring as much as 100 francs per 100 cans, and retail in Paris at 2 francs per can. These are the fish with which special care is taken; they are brought to the factories early in the morning and are canned with the minimal amount of softening and deterioration. Fish intended for the average American trade are quoted at about 35 francs per case of 100 cans.



THE DRYING YARD OF A CANNERY. WOMEN WITH SARDINES ON GRILLS. WOMEN WITH SARDINES ON GRILLS.

During the first week of July, 1900, the wholesale prices of French sardines in New York were \$10.50 to \$14 per case for choice "quarter" oils, \$6.75 to \$11 for ordinary "quarter" oils, and \$16 to \$23 for boneless "halves." During the last week in December, 1900, the quotations were \$8.50 to \$12 for choice "quarter" oils, \$7.25 to \$11 for ordinary "quarter" oils, \$14 to \$17 for choice "halves," and \$16 to \$23 for boneless "halves."

#### COMPARISON OF FRENCH AND AMERICAN SARDINES.

Observation has shown that French sardines, when of the best quality, have a flavor and richness which make them preferable to any sardine prepared on the Atlantic coast of the United States from the young of the sea herring; French sardines of average grade, even when canned in peanut and cotton-seed oil, are much superior in palatability to the great bulk of the American output; while the cheaper grades of French sardines—which unfortunately find a ready market in the United States—are certainly not preferable to much of the native pack.

The conditions which underlie the general superiority of the French canned sardines, and the steps which may be adopted in America for narrowing the gap which now separates the product of the two countries, appear to the writer to be chiefly as follows:

(1) The methods adopted in the French sardine fishery result in the landing of the fish in excellent condition. This is the main object and is never lost sight of. The fish are caught singly in a delicate mesh, removed by hand, carefully kept on board the boats so as to avoid crowding and mashing, counted by hand into small baskets, taken to the factories within a few hours after being caught, and promptly put through the preserving processes, so that ordinarily the deterioration which ensues is not worthy of mention. The sardine fishery on the coast of Maine is a weir fishery and the unit of measure is not the individual fish, as in France, but the hogshead. A large number of fish—sometimes a vast school—may be in a weir at one time, and are often held in the weir for many hours, sometimes for several days, during which they are without food, are incessantly harassed by their fellows and by other fish, and necessarily undergo deterioration; they are then taken from the trap with large dip nets and transferred to the collecting boat, where they are piled deep in bins or in the hold, and are often many hours in reaching the cannery. There the unloading results in further mashing, crushing, and bruising, so that by the time the sardines reach the cooking room they have lost so much of their flavor and firmness that no amount of subsequent care and no kind of oil or spice can replace or restore their quality. Although fish are liable to more rapid decomposition after capture than any other class of food animals, there are no products with which greater liberties are taken, and none in which the lack of care results so disastrously; this is especially true of the American sardine, and, in the writer's opinion, is largely responsible for the unsatisfactory quality of the canned fish.

(2) In France the sardines caught in the early part of the season are not canned, because they are not in the best condition. It is only after the fish have become fat that they are considered suitable for canning. The fattening depends on an abundance of proper food, and along with it is an improvement in the flavor and general quality of the flesh. In the case of our sardines, fishing for the canneries is carried on from April to December, without reference to the fatness of the fish.

While the young sea herring is an excellent fish, it may be admitted that even when at its best its meat is inferior to that of the fat young pilchard in richness. The latter has a peculiar flavor which, to a considerable degree, is preserved in canning, and which probably can not be successfully imitated in the sea herring. However, the difference in flavor between the French and the American sardines, on which many persons lay much stress, appears to the writer to be of only secondary importance. The taste for French sardines has been acquired and perpetuated in the United States because of the long-continued unsatisfactory quality of American sardines. The herring is naturally no less wholesome than the pilchard; if it is caught for canning only when in prime condition, and if, in the form of canned sardines, it is placed on the markets with the minimum amount of deterioration and with such adjuvants in the way of oil, spices, etc., as may be suitable, it should and will receive ample recognition at home, and meet with a constantly increasing demand, at prices that now are hardly dreamed of.

The history of a few canneries on our east coast during recent years has shown that a very marked improvement in the quality of American sardines is entirely practicable and, furthermore, is highly appreciated by consumers, as evidenced by the much higher prices they are willing to pay and the steady demand beyond the capacity of the factories. With regard to the sardines of the Pacific coast of the United States, there is no reason why they should not, when properly canned, prove equal to the French fish in every respect. The high reputation which has been acquired by the comparatively small quantities packed in California during the past five or six years, and the excellent prices which they have commanded, argue well for the success of an extensive business.

#### AMERICAN BAIT FOR THE FRENCH SARDINE FISHERIES.

The matter of supplying bait for the extensive sardine fisheries of the French coast has received some little attention in a few New England towns during the last few years, resulting in a small increase in the trade; but the consumption of bait is so large, the demand is so great, and the prices are so remunerative, that the American trade should be very much extended, especially as the bait material is now a waste product and may readily be prepared at a trifling cost.

Upward of ten years ago the United States Commission of Fish and Fisheries brought this subject to the attention of the New England fishermen, but with no noteworthy results. Now, owing to a shortage of the cod catch in the country which furnishes the principal part of the bait supply, the opportunity is unusually favorable for our fishermen to enter the market and establish a permanent trade. Having recently visited the sardine district of France for the purpose of investigating the industry and having given special attention to the requirements of the sardine fishermen in the matter of bait, the writer here presents the results of his inquiries and observations with a view to show the benefits that will arise from the utilization of an article that is now generally thrown away.

The preparation of sardine bait from cod eggs is entirely feasible in all the coast States from New Jersey northward, and if proper precautions are observed the business should result in a very substantial increase in the incomes of many of our cod fishermen. There would seem to be a similar opportunity for fishermen in other fisheries and in other parts of the country. The eggs of the cod are an artificial food of the

sardine, and are not known to possess any properties, especially when salted, which make them an indispensable bait. So far as known, all fish eggs not over one-sixteenth of an inch in diameter are suitable for bait. Among the gadoid fishes, the haddock, the hake, the pollock, and the cusk should yield eggs not inferior to those of the cod. Reference has already been made to the value of mackerel eggs as bait. Many other common species inhabiting our salt or fresh waters might be mentioned.

Norwegian roe has for many years practically monopolized the trade, and is still the leading bait as regards quality, quantity used, and price. American roe, as such, is just as good and just as satisfactory to the sardine fishermen as the Norwegian, but, owing to certain differences—amounting to positive defects—in the methods of packing, it is far less acceptable than the Norwegian, and will inevitably bring much less money per barrel until other methods are observed. The roe brought in by the French fishermen of Newfoundland is inferior to the American.

A description of the manner of preparing cod roe, as practiced in Norway years ago, and of the improvements therein suggested by the French Government, has already been given. The features which give to the Norwegian roe the superiority which it has continued to maintain, and the points to which Americans must give careful consideration if they would hope to receive a fair share of the trade, appear to the writer to be as follows, after a critical comparison of the product of the two countries as seen in France:

(1) The Norwegian roe is closely packed in the barrels, and when the barrels are opened the sardine fishermen find them practically full. The roe is evidently salted on shore and then repacked and pressed in the barrels with some force; and after standing and settling the barrels are apparently filled again before being finally closed. Barrels of American roe, on the other hand, although the same size as the others, invariably contain less bait, owing to shrinkage incident to salting, to failure of the packers to properly fill them in the first place, or to both these causes combined. The roe is taken from the barrels and carried to the fishing-grounds in buckets. A barrel of Norwegian roe will fill eight buckets, while often a barrel of American roe will fill only five or six buckets. Barrels of Newfoundland roe, while larger than the Norwegian, often contain 20 to 25 pounds less of roe.

(2) Norwegian roe is packed dry, and remains dry unless it becomes very old. The barrels contain no undissolved salt and no free brine. The brine which may form after the closing of the barrels escapes through holes, about one-fourth inch in diameter, bored in the sides of the barrel. Barrels of American roe are either dry or may contain more or less brine; they are also liable to have considerable undissolved salt in the bottom or mixed with the roe. The barrels should contain nothing but dry roe, as the French fishermen are too economical and too keen to knowingly expend their hard-earned money for salt and water as bait for sardines. Small shipments of roe from America ten or more years ago were very unsatisfactory and gave rise to a well-founded prejudice which still prevails to a considerable extent. Barrels were occasionally found that contained very little roe and were filled chiefly with salt. "Salt is not good for sardine bait," was the remark of a dealer at Concarneau. The quality of American roe in the foregoing respect is now better, although, in the opinion of the fishermen, there is still much room for improvement.

(3) The Norwegians observe several grades of roe, depending on the ripeness of the eggs, and pack them in separate barrels, which bring different prices. The ripeness of the roe determines its quality as bait, because of the plus or minus of ovarian capsule or membrane, which is thinner and relatively less in quantity when the eggs are riper. With the American roe no distinction of this kind is made, but eggs of all degrees of ripeness are mixed. Large pieces of thick ovarian membrane are often found in the roe from the United States.

(4) The ovaries are salted more or less entire in Norway, and when a barrel is opened the individual organs may be removed one by one. As the roe needed for fishing is transferred from the barrels to the buckets by hand, the existence of the whole roe facilitates the work and is appreciated by the men. American roe is largely a concrete mass of wet eggs with strings of membranes running through it.



The foregoing considerations lead to the presentation of the following suggestions and information for persons who may be in position to undertake the preparation of bait for use in the sardine fishery:

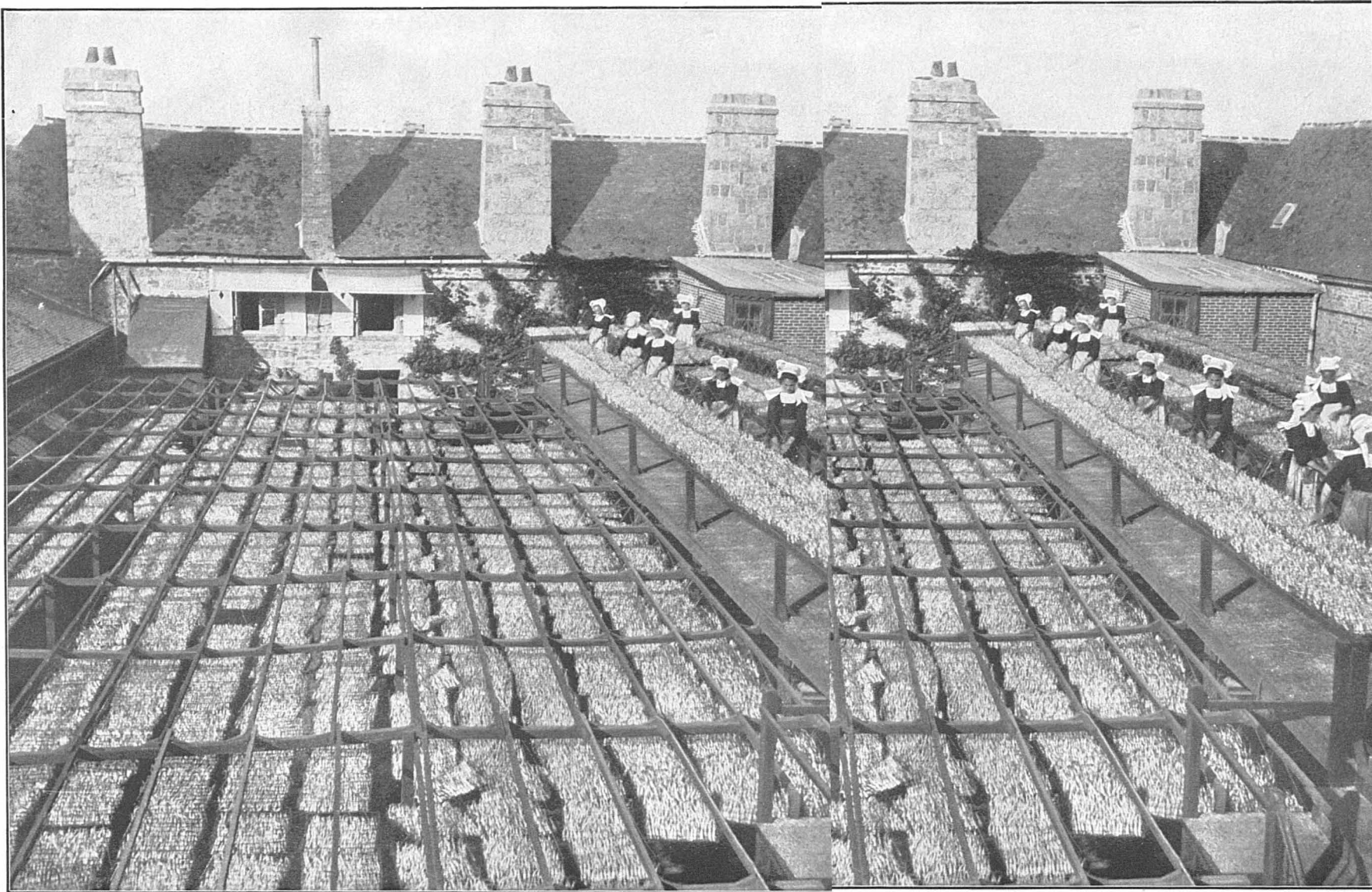
(a) Ovaries in which the eggs are sufficiently developed to be separable are suitable for bait. They should be removed and salted as soon as possible after the fish are caught. In the offshore vessel fisheries the roes may be salted loosely in barrels or vats, and repacked in suitable barrels after the vessels return to port. In the shore fisheries the salting may be deferred until the boats land their catch. When practicable, the ovaries should be removed entire and salted between layers of dry, rather fine, salt. The salting should be thorough, so that no salt need be put in the barrels in which the roe is shipped.

(b) The repacking of the roe is to be commended and will amply repay the extra labor involved. The barrels should be of uniform size, neat, and well made. While the size of the barrels is not a matter of much importance, the sardine fishermen have become accustomed to a barrel holding about 140 to 144 kilograms (308 to 316 pounds) of roe, and their preference should be borne in mind. Barrels should have not less than 300 pounds of roe, net, and should have no unoccupied space. The pressing of the roe, in order to completely fill the barrel, is desirable. Escape should be provided for the brine that may run from the eggs, by boring several small holes near the ends of the barrel.

(c) The grading of the eggs is recommended. Eggs of different degrees of ripeness and from different species should not be mixed in the same barrel. The amount of ovarian membrane should be reduced to a minimum; after salting, this can be stripped off more easily than when the eggs were fresh. Loose eggs, resulting from ovaries ruptured while fresh or in process of salting, should be packed in separate barrels.

(d) The barrels should be marked with the name of the packer, together with the kind and grade of the roe. The eggs of all the members of the cod family may properly be labeled "cod." The net weight of the roe (in kilograms) might also be put on each barrel. Packers desirous of establishing and increasing their trade will of course see that no discrepancy exists between the contents of the barrels and the marks on the outside.

(e) American bait now goes by steamer to Havre and thence by rail to the fishing towns. The freight on a barrel of roe from Havre to Concarneau is 6 francs. Roe might be sent directly to the fishing towns, or to some center on the west coast, from which it might be distributed at less cost than from Havre. The present duty on roe is about 1 franc per barrel of 144 kilograms. Bait-dealers or agents may be found in all the leading fishing towns. It is reported that they make a net profit of 20 per cent on the roe handled.



YARD OF A LARGE CANNERY, SHOWING SARDINES DRYING ON GRILLS. A LARGE CANNERY, SHOWING SARDINES DRYING ON GRILLS.