CHAPTER 12

The Regional Development of Fisheries and Fish Processing

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I. General Survey

Chapter 7 of Volume II by the senior author described the role of fish in world nutrition in general and in specific areas. Chapter 18 of that volume outlined the major discernible trends in the utilization of fish on both global and regional bases. This chapter aims at surveying the actual happenings in technical and industrial respects with reference to commercial developments in individual countries.

The world's fish industry is experiencing an expansion without precedent in human history. Endeavors were conspicuously successful in the creation of the large Peruvian fish meal industry, based on organizing a fish catch now exceeding that of the Soviet Union. Another noteworthy happening is the growth of tuna processing from a prewar catch of 200,000 metric tons to a figure now exceeding 0.5 million tons. Third, freezing and filleting have made extensive inroads into a great number of countries.

Owing to the immense discrepancies between the technically advanced countries and those less advanced in this respect, it seems most conducive to a lucid understanding of present developments in the fish-processing industry to analyze each region separately.

To facilitate discussion of these regions, the countries involved are listed at the beginning of the section. However, since some countries border more than one area and since the statistics may not be given by regions, the country will be discussed in the section where the major portion of the catch is landed, with a few exceptions.

II. Northeast Atlantic—Europe

Norway

The fisheries off the coast of Norway may be some of the oldest in the western world. The hardy Norsemen probably were primarily fishermen and explorers later. Cod and herring form the bulk of the catch. The Lofoten fishery off the coast of northern Norway is one of the richest cod fisheries in the world. During the peak winter season as many as 20–30,000 fishermen with 4,000 boats have fished there. Other fishing
grounds are the Icelandic Banks, Faeroe Banks, banks in the Barents Sea and off Bear Island and Spitsbergen. Norwegian fishermen regularly fish in the Davis Strait and the Grand Banks. In addition, Norway does considerable whaling in the Antarctic, but this fleet is being reduced.

### Table I

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* All Germany.

Cod is caught all along the Norwegian coast. One of the oldest fish products is stockfish, which is dried unsalted fish, mainly cod. In 1961 Norway produced 35,200 metric tons of this item, over 70% of the world total. Stockfish is even better than salted cod in the humid tropics since it has no salt to absorb moisture from the air. In the same year almost as much (34,900 metric tons) salted cod was produced. Norwegians usually process most of their salted cod by a special dry-salting method to produce klipfish. Norway is also one of the main producers of cod-liver oil.

The herring fishery is, however, more important than that of the cod. The herring group accounts for one third of the total catch, and cod fishes another third. In 1956 the percentages were 62.7 and 27.4, respectively. These changes are due to the fluctuations of the herring catches. One would expect considerable waste unless adequate provisions were made to process excess fish. Consequently a fish meal industry has been developed. In 1960 almost half (48.9%) the herring catch was processed in reduction plants.

Of the herring used for food 38% is salted, 24% frozen, 7% spiced and marinated, 3% smoked, and the rest canned. The so-called canned herring consists of a number of smoked products, such as kippered herring, small herring, and sprats. Sprats have been canned at Stavanger, the center of the fish-canning industry, ever since 1878. Herring products make up the bulk of the fish pack.
Like most leading fishing countries, Norway has shown a notable increase in the production of frozen products. From 1950 to 1958 frozen fillets increased 2.5 times; in the same period frozen herring increased over 4 times.

In recent years, salted lingcod has been giving salted cod stiff competition on the Cuban market. Brazil is Norway's largest customer for salted cod. In 1961 Norway earned more money from the export of fish and fish products than any other country except Japan. Norway has a growing industry in supplying salted herring roe to Japan, where it is made into "kazanoko" which is consumed in quantity during the Japanese New Year celebrations.

**DENMARK**

The Danes have long depended on fish as a staple item of the diet. The Danes have further developed fisheries in the waters around the Faeroe Islands and near Greenland.

One third of the catch is herring and related fish; another third belongs to the cod group. Mullet comprises one tenth of the catch and flounder slightly less.

Over half (56%) of the nation's food fish (22.7% of the total catch) is consumed unprocessed. Half the total catch is used for reduction. Besides the offal, part of the herring and certain species formerly discarded or not captured earlier, as the sand launce, are processed into meals. Miscellaneous uses, such as fish silage, account for 9.4%.

Between 1948 and 1961 the volume of fish frozen almost quadrupled, while the percentage of food fish frozen doubled. This expansion has affected fresh-market sales and the amount of fish cured and canned, all showing declines. Frozen white fish fillets have become an important item of export. Freezing facilities in Greenland have been expanding in the last few years.

The main product of both Greenland and the Faeroe Islands is still, however, cured fish. In Greenland, more than four fifths of the catch is cod. Approximately three fourths of the cod is salted and most of the rest goes for stockfish production. About 3.5% is filleted and exported, but nearly 7 times more catfish is filleted. Shrimp, most of which is frozen and exported, forms the major portion of the remaining catch.

In the Faeroe Islands, about the same proportion of the total catch is cod. About 84% of fish is cured, mainly by salting. Haddock is about the only species canned; in 1962 this amounted to only 44 metric tons fresh weight. Besides the offal, less than 1000 tons are ground into fish meal.

Young herring is usually processed in oil or tomatoes and labeled
sardines. The canning industry has developed several specialties, such as "caviar" from lumpfish roe, smoked cod livers, and cod roe.

A thriving industry has developed in Denmark: the raising of rainbow trout for export, mainly to England and the U.S. Cultivation is centered around Jutland.

**UNITED KINGDOM**

The fisheries in the North Sea and around the Shetland and Hebrides Islands have been known since prehistoric times. The British have visited Icelandic waters since at least the tenth century. Just when they discovered the Newfoundland Banks may never be known.

Two thirds of the catch is cod and related fish and one tenth herring. Four fifths of the catch is consumed unprocessed; one tenth is frozen; minor quantities go for reduction, curing, canning, and miscellaneous purposes.

Cod is largely distributed unprocessed or frozen. Unlike most continental European countries, salt cod was never very popular. Conversely, almost nine tenths of the herring catch is processed in some way; over one eighth quick-frozen, one twelfth canned, one fifth for meal and oil, one seventh for pet food, and the rest cured. Some special products are well known: kippers make up 11.5% of the total, of which 3.5% is processed into red herring, 1.5% marinated, and 1% klondyked.

**Smoking**

Smoking is the most popular processing method in the U.K. today. Kippered herring and finnan haddie are almost as synonymous with the English way of life as tea and crumpets. There has been a 60-70% decline in the postwar period in the consumption of both these items, possibly due to poor quality control in manufacture. An effort is being made to increase their popularity by using good quality raw material.

Both haddock and cod fillets are smoked. Bloaters and bucklings are produced for home consumption, but most of the red herring is exported to the Mediterranean region. Aside from "smokies" made from undersize haddock, almost all other fish are cold smoked. Mildly smoked salmon is a delicatessen item. Cod roe is smoked after being fairly heavily salted.

**Other Methods**

Salting has also declined in volume in recent years. Canning has never been of great importance in the U.K. fish industry. Cod roe and fish pastes make up a minor portion of the pack. The chief pack is herring or pilchards in tomato sauce, most of which is exported to Australia. Kippers are also canned. By far the largest pack is pet food, mostly canned, but some is dehydrated.
The offal and excess fish are processed into meal, oil, and solubles. A comparatively new industry, the collecting and processing of seaweeds for alginate, shows considerable promise in the Hebrides.

**IRELAND (EIRE)**

The Irish have been basically an agricultural people. Nonetheless fisheries have also emerged. The deep-rooted Catholicism of the nation has been an important factor in the regular inclusion of fish in the diet. The great number of fishing ports along the coast has not been conducive to rapid development of a large-scale fish-processing industry. Plans have been developed for the construction of eight major harbors geared for the export trade.

Most fisheries are restricted to coastal shore waters, particularly in the numerous bays; some fishermen go out into the Irish Sea. A little less than half the total catch is herring; molluscs comprise one tenth.

It is not surprising that over four fifths of the catch is eaten fresh. Curing accounts for one eighth. The remaining fish is frozen or processed into meal or oil in about equal proportions.

The government has recently been trying to stimulate interest in the expansion of the fishing industry. Danish capital has been backing a trout-rearing venture in western Ireland. The trout are frozen for export. The cold storage facilities also handle salt-water fish. Both the U.S. and Japan are now investing in large Atlantic fisheries enterprises, to be based on processing facilities in Ireland.

**THE NETHERLANDS**

The Dutch have always depended on fish in the diet, as is evidenced by a steady increase in their catch. Aside from whaling, Dutch fishermen have usually confined their efforts to the North and Irish Seas.

The Dutch pioneered the cultivation of oysters. A few of the river estuaries have been adapted for controlled oyster farms, making Netherlands the second ranking oyster producer of Europe.

Herring and related species make up about two fifths of the total catch, this proportion having dropped during the fifties. Molluscs, mainly common mussels, come second as one fourth of the catch; flounder and related species make up almost one tenth and cods a slightly smaller portion.

Close to half is consumed unprocessed, slightly less than a third (29.0%) cured, 9.5% canned, and only 3.7% frozen. The remainder goes for reduction and miscellaneous purposes. As facilities expand, freezing is expected to grow.
Herring makes up the bulk of the catch, being salted on board, slightly over half of which is salted whole. Much salted herring is subsequently smoked by a special process to render golden smoked herring. Some fresh herring is hot smoked to make bloaters. Late in the season, much herring is pickled in vinegar and spices (marinades).

Smoking is also used for processing of mackerel, whiting, and sprats as well as fresh-water eels. Pickling is employed for mussels.

Only about 20,000 metric tons annually are packed in cans, four fifths being ocean fish and the rest mussels. A major portion of the catch is marketed unprocessed.

**Belgium**

Most fish are caught in nearby coastal waters. The catch is modest in size. Occasionally fishing boats venture into the Irish Sea, more frequently into the North Sea or English Channel. One half the landings is cod and related fishes, almost one fifth flounder, halibut, sole, etc., and one tenth shark and other elasmobranchs.

Three fourths of the catch is marketed unprocessed. Of the remainder, one tenth is frozen, 6.0% cured, 3% canned, and 3% goes for reduction. The domestic frozen fish industry has a production capacity of 200 metric tons per 24 hours and a cold storage capacity of about 1200 cu. m. Belgium has a unique practice of delivering raw unprocessed fish by parcel post.

Belgium is one of the few countries where stockfish is prepared, the fish being dried without salt. Drying with salt is nevertheless more common. The two best-known products are “zoute haring” and “labberdaan” or hard dried salted cod.

Smoking is far more popular than salting and/or drying. Belgium imports about 2000 metric tons of smoked fish every year. In addition to the smoked products some 12,000 tons of salted herring are imported, most of which is smoked. Depending on both the degree of salt cure and the method of smoking, no less than seven types of salted and smoked herring are prepared. Some of the smoked products are marinated, but unlike many countries most of the fish is cold pickled. Many additional fish species are smoked and/or salted, each to give its own special products. Lack of adequate refrigeration facilities hampers the sale of frozen fish.

Canning is very limited, with little prospect for future development. The reduction plants process several kinds of products: white-fish meal, herring meal, whole meal, condensed fish solubles, and oils of herring and cod liver.
FRANCE

Like most maritime nations of Europe, France has fished the rich fisheries in the Northwest Atlantic for centuries. In the Treaty of Paris in 1763, which ceded Canada to the British, St. Pierre and Miquelon were retained by the French to be used as bases for fishing. The French also retained the right to dry fish on the Newfoundland shore.

In addition, the waters of the Bay of Biscay are very rich in fish, and are the source of most of the sardines processed in France. While the Mediterranean fisheries are not nearly as productive as the Atlantic they materially add to the over-all picture. Fish cultivation is increasing along the south coast. Oysters and mussels are cultivated in Brittany.

Over 60% of the fish catch is consumed fresh. Since these figures include both fresh or chilled and frozen fish, it is impossible to tell the proportion actually frozen. This percentage has undoubtedly been increasing rapidly during the last few years. Like many countries, France has been changing to freezer trawlers.

Tuna fishing has greatly expanded all over the world since the last war. As elsewhere, most of the tuna is canned. Canned tuna in France is surpassed only by canned sardines. Tuna is preserved in three styles: chunks, flakes, or fillets, in oil, tomato sauce, or natural. Sardines are packed in oil, à la ravigote, in spices and garlic sauce, or in tomato sauce. Both herring and mackerel may be marinated in white wine. Over 16% of the (1961) catch was canned.

The rest of the food fish is cured. Of the 124,000 metric tons cured in 1961, 45% was salted cod and 10% salted herring. On the Mediterranean most of the anchovy is salted. A number of species are cold smoked.

Most of the drying in the north of the country is done with hot air, much of it in connection with cod. The salting is usually done on board ship before reaching port.

France is one of the few western countries where fish sauces like nuoc-mam and nam-pla are known. After the independence of Indo-China, many of the French residents returned to Europe and created a demand for these exotic sauces.

Since France still has colonies or former colonies all over the world, she is admirably suited for building fishing bases at strategic places. The French have enlarged the facilities at St. Pierre and Miquelon, but that is about all. Japan has stepped into this void and built bases, with French financial assistance, at Tahiti, New Caledonia, Ivory Coast, Dakar, etc.
WEST GERMANY

The Germans have fished for centuries in the North and Baltic Seas. But with the boundary revision at the close of World War II many of the Baltic ports were lost. Kiel is about the only fishing port left to West Germany on that sea. West German fishermen have moved farther out into the Northwest Atlantic until at present around two thirds of the catch is from the North Sea and the waters near Iceland. The Federal Republic has acquired within the last decade a growing trawler fleet and are presently able to process a growing portion of their catch at sea. As early as 1955, West Germany started high sea fishing in the Davis Strait off western Greenland.

One third of the catch belongs to the cod group. Mullet and related species comprise one fourth with almost as many herring. More than one third of the catch is consumed unprocessed, one fourth canned, one seventh cured, and only one twentieth frozen. Most of the sea-frozen fish are reprocessed on land before marketing.

One fifth of the landings goes to reduction into oil and meal, the latter being a comparatively new trend that started around 1950. Besides offal and inedible fish, the fish meal factories receive food fish whenever the supply exceeds the demand. Fish meal factories have become in recent years an integral part of the trawler fleets, since processing can be done at sea. Some salted cod is processed and landed at foreign ports.

Salted herring, as in most countries, is one of the oldest products prepared at sea. Since shrimp is so perishable it is usually boiled on board. The smaller shrimps, exoskeletons, and offal go for fish meal. Fish-liver oil is extracted on board.

Both hot and cold smoking are used for curing. The hot smoked products are bloaters, sprats, mackerel, and eel; cold smoking produces kippered herring and smoked salmon.

West Germany produces a number of marinades made chiefly from herring. Three items are peculiar to them (see Chapter 5, this volume). Depending on the kind of process employed, the product may be pickled herring, grilled herring, rollmops, Bismarck herring, etc.

A comparatively new way of curing is seen in oil preserves, consisting of salted or filleted fish in oil. The best-known products are saithe slices and small fillets and matjes herring; these products do not keep indefinitely.

Heat processing of fish has been steadily increasing since the end of World War II. Some of the products include cured items subsequently canned to prolong their keeping time.
Iceland

Iceland was colonized by the Vikings about the ninth century A.D. Until about the middle of the last century, agriculture was the chief industry and fishing was of secondary importance. After that time, the climate became unsuitable for wheat growing and fishing gained in relative strength. Now fish products account for over 90% of the total value of exports. The waters around Iceland are extremely rich in marine life, and have been fished by many nations throughout the centuries.

Over 90% of the catch is about equally divided between cod and herring. The ground fish have in later years shown a declining trend. The disposition of the catch is presently as follows: two fifths frozen, one third cured, one fifth goes to reduction plants, and less than one tenth is marketed unprocessed. Before development of the freezing industry, most of the catch was cured; this percentage is likely to decline.

Almost three fourths of the herring catch is reduced to meal and oil. Salted herring is one fifth; the frozen proportion is approaching one tenth. The disposition of the cod landings is radically different. Close to two thirds is frozen, as fillets or in the round. One fifth is salted, one tenth dried unsalted to make stockfish, and only a few percent goes into fish meal. Minor quantities of cod and herring are landed at foreign ports.

The production of stockfish had fluctuated appreciably. In the eighteenth and first half of the nineteenth centuries stockfish was exported. Then, until a few years before World War II, the trade practically ceased. During the war it declined, but was subsequently resumed. Much of this production goes to tropical West Africa.

Like most fisheries, the most rapid increase has been in fish freezing. The first freezing plant was built in 1930, but the fish industry did not realize its potential for about five years. In 1945 no less than 68 plants produced about 600 tons of fillets per day. Fourteen years later the number of plants had grown to 80 with a capacity of 1400 tons. New freezing plants are starting.

Iceland in 1959 had about 40 fish meal factories and some newly built trawlers that process on board. Both cod-liver and herring oils are significant products, although synthetic vitamin A is reducing the volume of the cod-liver industry.

Faeroe Islands

After World War II, especially after extension of the Icelandic fishing limits, the Faeroe deep sea fisheries more or less concentrated on west Greenland waters. Old trawlers were bought in Iceland and the U.K., new ones were built, and at times nearly 200 fishing vessels, trawlers,
schooners, cutters, sloops, and dories were engaged in this ambitious fishing enterprise. One of the trawlers, the 955-ton "Saklaberg," is equipped with a number of processing lines. Several plants have been built ashore, and the Faeroese now process, salt, fillet, or freeze the principal part of the total catch of cod, the most important species caught.

Half the export consists of klipfish and salted fish, supplying Brazil and the Mediterranean. The U.K. buys most of the reported fresh-market fish. Frozen cod fillets are sold to the U.K. and U.S.

GREENLAND

Although Greenland is discussed under Denmark, it is felt that the future importance of the island may warrant additional comments. New fisheries have been developed in recent years in the Davis Strait and off the west coast of Greenland. A number of fish bases have been built along the west coast, Faeringhavn being the chief one. At this base nearly 100 boats a day may visit during the fishing season and 200 may be stationed there. Freezing-salting and filleting plants, power stations, wharves, and a salt silo have been built. In all, 62 salting plants, two filleting and freezing plants, and two shrimp factories are in operation along the coast. They also process fish oil.

The cod may be salted, dried unsalted, or filleted; the shrimp is canned or frozen. The shrimp and cod fillets are exported to the U.S.; the other two items go to southern Europe.

III. Baltic

FINLAND

It is natural to expect Finland with its long coastline and many lakes to have a fishing industry. Half the catch is herring, more than one fourth fresh-water fish, and the remainder unsorted. The last item emphasizes that much of the fishing is done by local small boats that do not sort the fish; most of their catches are sold directly to fish retailers that supply the consumer.

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<td><strong>Total Catch of Baltic Countries</strong></td>
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<td>(1000 metric tons)</td>
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\(^a\) 1947.
Two thirds of the catch is marketed unprocessed, one sixth frozen, one tenth cured. Only a little above 1% is canned and the rest, almost one fifth, goes for reduction. No major changes are expected in the immediate future, although the proportion of the catch frozen will most likely expand.

**Poland**

At the end of World War I Poland once again became an independent nation. With the acquisition of a seacoast a marine fishery began to develop. The first major fishing port was Gdynia. Additional ports were built at Jastarnia and Wladystawowo. Before the last war Gdynia had a freezing plant and an ice and fish meal factory.

After World War II Poland recovered broader access to the sea. She now has three big ports, Gdynia, Gdansk, and Szczecin. A new site was chosen at Świnoujście (earlier Swinemünde) in the Odra Firth to function as the chief base for the North Sea fisheries. A fleet of new modern factory ships has been acquired for the northern Atlantic. The port of Wladystawowo serves the Baltic fishing. At present there are in the fishing ports seven refrigerated storehouses, seven ice factories, nine fish unloading centers, two fish meal factories, one cod-liver oil plant, and six cutter hoists.

The chief Polish fishing waters are, besides the numerous inland rivers and lakes, the Baltic with the important Gulf of Danzig and the major coastal lagoons, Frisches Haff and Stettin (Szczecin) Lagoon, and estuaries of the Vistula (Wista) and the Oder (Odd).

In 1961 over half the catch was of the herring type. Cod, hake, haddock, etc. account for over one fifth, mackerel almost one twelfth. One tenth of the catch was from fresh water, most of which was consumed fresh.

Before World War II most of the Baltic Sea catches were smoked. The two main species were sprats and flatfish. Even today the U.S.S.R., U.S., U.K., South Africa, West Germany, and the Philippines are the only countries that smoke more marine products than Poland. However, none of these countries even approaches Poland in the high percentage of the total catch that is smoked.

Two methods of preserving the fish until reaching port are used. Baltic fishermen usually pack the catch in ice, while the boats fishing in the North Sea salt the catch. Most of the herring caught in the North Sea is salted; the Baltic herring is processed into smoked, canned, or pickled products. The latter procedure accounts for only one fourth of the total herring catch.

Only about 40% of the cod is processed. Of this amount 15% of the
total catch is smoked, 10% filleted, 10% salted as "Laberdan" (hard dry cure), and 5% canned in oil and tomatoes. Approximately 70% of the sprats is canned or smoked and the rest is made into fish meal. Mackerel is usually salted but at certain seasons, when it is plentiful, is brought to port fresh and used for canning or smoking.

Most of the other fish is consumed fresh or frozen for use by the canneries in their slack season. An increasing amount of the catch is undoubtedly being frozen and stored until needed by the consumer. This is especially true with the acquisition of high-sea freezer trawlers and the construction of refrigerated storages at the ports.

Poland is following the Soviet lead and building modern freezer trawlers with an operating range of 12,500 miles, thus enabling them to join the international fleets at the fishing banks of Newfoundland, Labrador, and Greenland, and off the African coast. The first trawler was delivered in 1959, to be followed by 54 additional ones in the next 15 years. The number includes all types. Land facilities are also being improved. Technical aid is rendered to African lands and others.

**EAST GERMANY**

Fishing in East Germany is still largely a private enterprise. Several cooperative institutions are coordinating their efforts. The state, however, is entering into both catching and processing. Rostock is converted into a sizable combine on the Soviet pattern with large refrigerated warehouses.

The freezing capacity of the country is being expanded, particularly at sea. High sea fishing is being provided, with freezing trawlers with a daily capacity of 200 metric tons—resembling the Soviet vessels. The first two such vessels are in service and nine more are on order. The production of frozen fish fillets will thereby increase from 3,000 metric tons in 1958 to 32,000 tons in 1965. These ships are built in East German shipyards, as are the herring trawlers also equipped for freezing, through which it is hoped to quadruple the present herring catch and make East Germany self-sufficient in this respect. Transport ships (two or more) were built in 1962 to service the fishing fleets in distant waters.

East German trawlers have joined the Soviet fleets fishing in the Davis Strait, off Newfoundland (Flemish Cap) and off Labrador. These East German fishing boats have experienced what Soviet units noted at an early stage: that the waters in Barents Sea, around Bear Island and off Spitsbergen, have shown a persistent decline in catches in latter years.

Carp is the major (60%) fresh-water fish, the remainder being eel and pike. As in most countries, the greater part of these fresh-water species is undoubtedly eaten fresh.
A marine-fish research institute for East Germany is operating in Rostock-Marienehe, devoted primarily to sea fisheries and fish utilization. It is also in charge of education as well as developing standards for various sectors of the fish industry. A special branch is located in Sassnitz and serves Baltic fisheries. Inland fisheries have their scientific center in Berlin-Friedrichshagen. A special carp institute is operating in Königs­wartha. The branch for catching techniques is in Gross-Glienicha, near Potsdam on the Sacrower Sea.

**SWEDEN**

Although close to some very good fishing waters, Sweden imports one third of its intake, largely in processed form; the exports are raw unprocessed fish sold to continental Europe, the U.K., and Denmark.

While most of the fish are caught in nearby waters, Swedish fishermen fish also in Icelandic waters. Close to two thirds of the total catch is herring and one fifth cod. Some of the whitefish is filleted and frozen. Most of the herring is salted. A considerable proportion of the latter goes into semipreserves: packs of old tradition, such as Scandinavian anchovies, herring tidbits, etc. (see further Chapter 6 of this volume). Half the catch is registered as used for miscellaneous purposes, being largely this very industry. One fourth is consumed unprocessed, one tenth goes for reduction, and another tenth in equal amounts to freezing and canning. Almost the same amount is cured.

Another specialty of Sweden as well as Norway is fishballs. They presumably constitute the first ready-made food ever to be canned, even prior to the soups of the U.S.

**IV. Soviet Fisheries**

**Soviet Union**

Among the major transitions taking place in the Soviet Union during the last decade, those concerning fish have an important place. Russia in earlier years depended for fish primarily on regional resources: internal seas, rivers, lakes, and other waters. In 1900 only one sixth of her fish consumption came from the oceans and it was eaten mainly in coastal areas. It is a major accomplishment to have doubled the total fish catch in less than fifteen years and this expansion has taken place at an accelerated rate since the middle 1950's.

An increase of more than 10% in the fish catch has been registered almost every year since 1953. This was accomplished by greater exploitation of the bordering oceans from which two thirds of the fish supply now comes. Ocean fishing has been given priority, and it is anticipated that
more than 80% of the constantly growing catch will come from the sea by the end of 1965.

The achievements of the Soviet fishing industry are due primarily to the acquisition of a considerable number of large fishing vessels equipped with modern radio navigation and search equipment (in many cases special searching vessels) as well as with new mechanized equipment and more productive fishing gear. In 1951–1960 alone, the number of vessels increased 2.8 times, and their motor power 3.7 times. At present, vessels of at least 300 h.p. provide about four fifths of the entire fish catch.

Present Catch

The Soviet catch has increased by more than 2 million metric tons since 1938, when it amounted to something over 1.5 million tons. In 1962 it was more than 4.1 million tons, 400,000 tons above the figure for the previous year. Included in this amount is a catch of whales and other marine mammals, estimated at about 500,000 tons.

Soviet Aquatic Catch (exclusive of whales and other mammals)

<table>
<thead>
<tr>
<th>Year</th>
<th>1913</th>
<th>1930</th>
<th>1940</th>
<th>1945</th>
<th>1950</th>
</tr>
</thead>
<tbody>
<tr>
<td>1913:</td>
<td>1.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1930:</td>
<td>1.28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1940:</td>
<td>1.40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1945:</td>
<td>1.13</td>
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<td></td>
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<tr>
<td>1950:</td>
<td>1.76</td>
<td></td>
<td></td>
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<tr>
<td>1955:</td>
<td>2.50</td>
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<tr>
<td>1956:</td>
<td>2.85</td>
<td></td>
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<tr>
<td>1957:</td>
<td>2.53</td>
<td></td>
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<tr>
<td>1958:</td>
<td>2.62</td>
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<tr>
<td>1959:</td>
<td>2.75</td>
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<td>1960:</td>
<td>3.05</td>
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<td>1961:</td>
<td>3.25</td>
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<td></td>
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<tr>
<td>1962:</td>
<td>3.62</td>
<td></td>
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</tr>
<tr>
<td>1963:</td>
<td>4.12</td>
<td></td>
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</tr>
</tbody>
</table>

In the first phase of the postwar maritime drive, major emphasis was placed on the Atlantic flank. In the present second phase, the Pacific flank is given priority.

Plans providing for a Soviet fishery catch of 4.6 million metric tons by 1965 were changed in July 1962 by a ministerial decree, raising this goal to 5 million metric tons with the high sea catch given as 3.6 million metric tons. The anticipated catch for 1964 is 4.50 million metric tons.

Stagnant Inland Catch

The U.S.S.R. shares with Western Europe, the U.S., and now also Japan the detrimental effects of industrialization on the productivity of inland waters. Extensive and damaging pollution is accompanied by the diversion of large amounts of water for irrigation and hydroelectric dams. The most spectacular of these consequences is the dwindling of the mighty Caspian, the northern part of which is seriously affected and will entirely disappear in a few decades.

Concentrated efforts have been made to compensate these losses through artificial local fish production from ponds, wherever climate permits. The many dams, covering 5 million hectares, are being exploited.
Background

An annual increment to the U.S.S.R. population of more than 3 million people, the vagaries of the climate making agricultural production less dependable, and dwindling catches from inland waters (p. 315) are the three driving forces in the Soviet upsurge in marine fisheries. To this can be added the desire to improve the nutritional standard.

The U.S.S.R. recognizes that the fishing industry is a vital part of the Soviet economy, and that fishery products provide the people with more than one third of their total consumption of animal protein. In recent years, even greater emphasis has been placed on increasing the fishery intake because livestock production has failed to reach predetermined goals.

Despite gains in catch volume there are certain signs of dissatisfaction, as part of the homeland catch includes growing amounts of less desirable and small-sized species, such as sprats, sardelles, khamsa (Caspian anchovy), etc., which have only a limited demand. The catch of esteemed fresh-water species, which have a basic demand (i.e., Pike, sazan, carp, bream, sheatfish, etc.), has declined. This deficiency will presumably be met by the new marine tuna fisheries (see below).

Catch Pattern (Species)

The sources of the Soviet fish catch are presented in Table III. Herring is the principal catch in the eastern regions of the Soviet Union; 90% of all flatfish are caught in the Pacific region. The Atlantic-Arctic catch breaks down in the following way: 60% in the Barents Sea and 35% in the Baltic. The remainder, from inland waters, comes largely from the Black Sea and the Sea of Azov.

Cod dominates the Arctic catch (85%). Next comes the rapidly growing landing of ocean perch. Soviet planners anticipate a drop in the current availability of cod and an appreciable expansion in ocean perch.

<table>
<thead>
<tr>
<th>Species</th>
<th>Atlantic-Arctic</th>
<th>Black and Caspian Seas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flatfish</td>
<td>9.5 6 3.5</td>
<td>90 0.5</td>
</tr>
<tr>
<td>Cod and related gadoids</td>
<td>90 75 15</td>
<td>10 --</td>
</tr>
<tr>
<td>Herring, sardines, etc.</td>
<td>46 2 7</td>
<td>30 24</td>
</tr>
</tbody>
</table>

\[ a \] \( I = \text{total.} \)
\[ b \] \( II = \text{Barents Sea and White Sea.} \)
\[ c \] \( III = \text{the Baltic.} \)
Filleting machines and other equipment are adjusted to meet this switch. Sprat, together with the Baltic herring, cod, and flounder, account for a third of the Baltic catch.

**Distant Fishing**

The modernized fishing fleet has enabled the fishing industry to go into new distant fishing grounds in both the Atlantic and Pacific Oceans. Soviet fleets are catching fish along the shores of Alaska (Bristol Bay), Kodiak Island, off Yakutat, at British Columbia (Vancouver Island), and northern California. They operate further in the waters west of Greenland (Davis Strait) at the Grand Banks of Newfoundland (Flemish Cap, Sverdlovsk Bank) down to George’s Bank and off Long Island. Smaller fishing fleets have been spotted off the coasts of North Carolina and Florida. Exploratory fishing has started in the South China Sea, in the Indian Ocean (around the Chagas Islands), and in the Red Sea.

Efforts are presently concentrated on raising the catch in equatorial waters of both major oceans. Special measures are being taken to boost the catch of bass, mackerel, pike, saury or saira, and bring in tuna from the southern Pacific, together with horse mackerel and mackerel from the Sea of Japan. The haul of shrimps, oysters, squids, sea kale, and other marine products is also expected to mount. The Pacific saury fishery is a new undertaking for which the immense Japanese expansion paved the way.

Since 1956 the experimental ship “Nora” has been exploring the tuna potentialities of the Pacific. A number of tuna vessels of new design are presently being built by the U.S.S.R. in its own shipyards as well as in Japan, Scandinavia, etc. The U.S.S.R. will join the big scramble for the migrating tuna shoals of the oceans and on a large scale.

The incorporation of large-tonnage power vessels into the fishing fleet has improved the economics of the industry by increasing the fish catch per fisherman. Some 78% of the catch originates with 7% of the vessels.

**African Sardines**

Russian freezer ships have fished sardines (*Sardinella aurita*) all along the west coast of tropical Africa, and *Sardinops* spp. further south in the waters of South Africa. These frozen sardines have been brought back to the homeland, to Archangelsk, to Cherzon on the Black Sea, or to Kaliningrad on the Baltic.

A growing number of vessels have taken part in this fishing ever since 1957. A specialized air-conditioned freezing trawler of the so-called “Tropik” class has been designed and put in operation to meet the particular needs of this fishery.
Due to the high temperature and humidity, efficient freezing facilities are essential prerequisites. The abundance of this sardine and the large catches secured in each trawl further require that the freezing capacity be large.

Several freezing trawlers have in seven trips per year each brought back 4,000 tons of sardines from this South Atlantic area.

Catching is done largely through light attraction combined with hose suction. Chilling is accomplished immediately by pumping the small fish into ice-cold ocean water tanks on board through a hose some 100 feet long. Slime formation detrimental to quality is suppressed in this way.

**Processing at Sea**

Most significant, however, is the build-up of the processing potential at sea. Some vessels combine catching and processing functions. Medium fishing trawlers operate at sea at sufficient capacity to serve effectively this new fishing fleet. Large trawlers with the necessary equipment for suitable processing are of increasing importance. On such vessels, fish is frozen (whole, cleaned, headed, or filleted), canned, or salted. Fish meal and oil are manufactured on board. All scrap is utilized. Fleets are serviced by special transport vessels with refrigerated holds which receive the finished products.

Major attention is devoted to the large-scale expansion of the Soviet processing potential at sea in Chapter 11 of Volume IV. (Various phases with respect to the utilization of these catches were analyzed in Chapters 7 and 19 of Volume II.)

A few pertinent facts will be briefly reviewed here. The Soviet development differs basically from that of Japan by placing almost complete emphasis on processing capacities of the floating fleet. This has the advantage of a minimum of political entanglements. Only one distant base appears to have been created, namely, that on Cuba (see below). Some transshipment takes place at Port-of-Spain, Trinidad.

Otherwise, the entire fleet is serviced from the homeland. Water and food may occasionally be picked up in English ports, at Vera Cruz in Mexico, or at Walvis Bay in Southwest Africa.

**Freezing Trawlers**

There are three types of so-called large freezing trawlers (BMRT), listed below in chronological order, almost identical in size, tonnage, and velocity but with improvements in disposition of space and in equipment (length 84.5–85.2 meters; velocity 12.5 knots):

1. “Pushkin” type (Hochwaldtswerke, Kiel)—2,470 gross tons.
12. REGIONAL DEVELOPMENT OF FISHING INDUSTRY

(2) "Mayakovsky" type (Nosenko shipyard, Leningrad)—3,170 gross tons.
(3) "Leskov" type (developed jointly with Poland)—2,890 gross tons. See further Volume IV, Chapter 11.

Motherships

A very advanced factory ship, the "Andrei Shakharov" (14,000 gross tons), was delivered in 1961 from East German shipyards at Rostock. The processing is highly automatized, in fact almost completely. A special device allows separation of large and small fish and mechanized chilling operations. The vessel is equipped with sardine dryers, automatic oil extractors, an ice-making plant with a capacity of 25 metric tons per day, and a carton-folding machine. This ship is presently operating in the Red Sea and the Indian Ocean.

The large Soviet factory ship "Vladivostok" (14 knots, 17,000 gross tons, 408-man crew), built to order in West Germany, is part of the Soviet Antarctic whaling fleet. It also serves as a mothership for fishing operations in the North Pacific and is basically a freezing plant. The holds for frozen fish have a capacity of 3,200 cu. m., those for finished fish meal of 4,400 cu. m., with additional tanks for oil of 1,100 cu. m.

A new crab-canning factory ship, the "Aleksander Obukhov" built in Leningrad, joined the North Pacific fleet in 1963. The canning line has a daily capacity of 200,000 cans. This is a greatly improved version of earlier such canning units. A new series of giant processing ships (43,000 tons), starting in 1964, is being launched from the Admiralty shipyard, Leningrad.

West European and Japanese shipyards are reported to have orders for 25 motherships and 2 whaling ships (13 are 8,000 gross tons each, the remainder 20,000 gross tons each) for delivery to the Soviet Union by 1965. No less than 66 factory ships are being built in Stralsund, East Germany, intended for fishing tuna, herring, horse mackerel, and sardine in tropical waters. Some of these are delivered and in operation in the tropical Atlantic. Each has a frozen fish capacity of 500 tons and is equipped to manufacture 60 metric tons of fish meal. Some 20 major freezing trawlers, factory ships, transport vessels, and tuna ships are being built in Japanese shipyards for delivery in 1964–65.

Transport Ships

The growing distance between fishing grounds and home bases is causing concern and initiating new developments. Even the modern freezing trawlers are harassed commercially by their lengthy unproductive travels to and from the fishing locations.
The modern transport vessels for frozen fish are classified as belonging to the "Aktubinsk" class. They maintain a temperature of —18° to —20°C. (0°F.) in the holds. These vessels are of 10,000-ton displacement and have ten cargo spaces (both holds and twin deck spaces) with an aggregate volume of 8,628 cu. m. Cooling is done by means of plain-surface single- and twin-row coils mounted on the walls and ceiling.

**Average Catch**

The average annual catch per large freezing trawler with stern holds (BMRT) was reported for 1962 as 5,500 metric tons each. The highest annual catch recorded in 1962 for a BMRT vessel was 8,000 metric tons. Soviet fishery experts hope to increase the regular take of BMRT types of craft to an average of 7,000–8,000 tons yearly by resorting to transfer and transport vessels, thus prolonging the fishing time of the BMRT. Special devices have been installed for such load transfer.

The average catch per medium fishing trawler (SRT) was about 1,400 metric tons in 1962. The highest recorded catch for this type of vessel was 3,200 tons in 1961 (*Pravda*, January 28, 1963).

**Bases**

The U.S.S.R. is belatedly following the Japanese patterns and creating transoceanic bases for its operational fleets. The largest is being built at Ateras Cove close to Havana. A 10-year agreement regulates the operation of the base, which is to be run by Cubans and also used by their growing oceanic trawler fleet. This is planned as an unloading port for 110 Soviet trawlers taking part in the Middle Atlantic fishing. A second refueling and transshipment base is Port of Spain, Trinidad, mainly for the fleet fishing in the Caribbean and off the coast of Mexico. Food and water are regularly picked up at Vera Cruz, Mexico.

A second major base for Soviet fishing is to be built at Alexandria in Egypt, supplemented by a smaller base in the Red Sea at Ras Banas.

**Curing**

Salted dried fish is produced in relatively small quantities, and usually very small fish such as the smelt are used. They are prepared by preliminary salting or a combination of salting and drying. In the first method, the fish is salted to a 3–4% salt content and dried at 120–150°C. down to a moisture content of 28–30%. In the second method, it is sprinkled with salt and put into a very hot oven (250–300°C.); the resulting salted, cooked, and dried product has a specific taste and aroma and a crumbly consistency.
Drying

Dried unsalted fish is much in demand. It is prepared from species such as sea and Caspian roach, bream, pike-perch, chehon (*Pelecus cultratus*, related to carp), halibut, turbot, shemaya (*Chalcalburnus chalcoides*, related to freshwater bream), and vimba. The fish is first salted slightly to a 3–6% concentration, then rinsed, and slowly dehydrated in a hanging position in air for a minimum period of 15 days (in spring or autumn). More recently special dryers have been used in which dehydration is carried out in air at 30°C and 70% relative humidity, but a tastier product is obtained with the first method.

Dried fish has an old tradition in Russia. Dorsal flesh parts of the sturgeon ("balyk"), carp, and roach are commonly available dried. Pike, smelt, pike-perch, and others appear as salt-dried products. Such dried fish is used for making fish soups or is consumed directly as a snack. In some cases dried vegetables are pressed with fish into briquets.

Vacuum drying has been applied rather commonly in newer plants. A special plant for freeze-drying was opened in 1954 at Rostov-on-Don. Fish fillets (cod and others) and fish stuffing used for fish sausages are important items. Such freeze-dried material is used in the manufacture of ready-made dishes.

Salting

Salting occupies second place in Soviet fish utilization. Bulk freezing is often preferred for space reasons even when the fish later is submitted to salting in the final processing on land. Nevertheless there are several floating salting factories in full operation. A high degree of mechanization has been accomplished. One essential feature is the introduction of vibrators for dense packing of the barrels. Such measures reduced crews in floating salting factories to half.

Low-temperature salting is generally practiced to reduce losses of fat and protein as well as to control microbial activities. In most cases temperatures of 0°C (32°F.) or below are maintained. Even in the southern regions, as the Caspian and the Black Seas, these rules are followed by ample use of ice.

Salting is accelerated by mechanical circulation of frequently renewed brine. In ocean fisheries salting in barrels is becoming increasingly important. Two new methods are being used experimentally to accelerate maturing. A special enzyme preparation is added to the brine. Salted fish are tightly packed in crates or airtight boxes without brine. Enzymes within the fish are adequate to ensure the maturing of such salted fish. In packing salted fish without brine in these sealed containers, loss of nitrogenous substances through microbial activity is averted.
Factory ships with refrigerated holds have been salting Atlantic and Arctic herring with the addition of sugar, which supports a lactic acid fermentation. This is done immediately after catching, and the fish after preparing are cut into pieces, placed in tin cans holding 3–5 g. fish, sealed, and stored in holds at about 0°C.

A new type of herring-processing vessel, the “Lamut” built in Japan, has been in service in the Atlantic since 1959. This 4,982-ton vessel is equipped for automatic processing (salting and freezing) up to 120 tons of herring a day. Top speed is 14.5 knots. A second type called “Nikolai Isaienko” (4,500 tons) has been delivered by a Tokyo shipyard. An improved SRT-trawler of the “Atlantik” class has been specially designed for the North Atlantic. Its capacity is 200 metric tons, speed 12 knots, with a 600-h.p. motor. The salting facilities are mechanized and automatic and the holds maintain —15°C.

Highly mechanized salting factories are serving as motherships in the North Atlantic.

Smoking

Smoked fish enjoys immense popularity and is made from frozen, salted, or fresh stock. Cold and hot smoking are practiced, and production is said to approach 100,000 metric tons. Smoked fish is commonly available in the food stores. Smoking of fish (e.g., cod, gray mullet, salmon, and sprat) for packing in oil depends entirely on the cool climate and would be hazardous under warm conditions. The continuous smoking line at the Moscow combine has a 24-hour capacity of 40 tons. Regional methods with varying types of smoking kiln still prevail, as in the Far East, the Caspian, and the Baltic. But efforts to mechanize, automatize, and control the smoking process in detail are numerous. There are new-type smoking kilns.

Certain smoke-dried products constitute a special group called baljak —almost a condiment. This is prepared from the dorsal flesh of highly rated species such as sturgeon, sevruga, beluga, King salmon, sockeye salmon, Siberian salmon, char, nelma, and muksun.

Along with conventional methods of producing smoked fish, electrical smoking using steam or smoking fluid is employed. All stages (drying, baking, and smoking) are carried out with electrical energy, steam and smoking fluid being the smoking agents. Even small fish are processed by this method. For hot-smoke products, most species of fresh-water fish and certain ocean fish are used, e.g., Baltic herring (salake), Caspian sprat, cod, sea perch, catfish, ruff, plaice, mackerel, pelamids, gray mullet, and saury (saira).

Attempts to supplant traditional smoking methods with dips have
been numerous, particularly since the Soviet public health authorities confirmed the presence of certain cancerogenic substances in the smoke. These have to be removed to below a certain minimum benzpyrene value.

**Canning**

The canning industry produces some 240 types of canned fish pack in some 200 plants. Several of these have been erected since 1953. They are located chiefly in the large landing ports, but also close to flourishing inland fisheries.

Frozen fish frequently constitutes the basis for continuous, seasonally undisturbed operations of the canning plants. This is true of the herring from the Baltic and the Atlantic, sardines from Equatorial Africa, and several others. Special studies have been devoted to sardine canning, utilizing five classes of raw material (Baltic herring, Caspian sprat, sprat, Caspian anchovy, and small North Sea herring), and to manufacturing six types of product (sardines in oil, in tomato sauce, with tomato, au naturel, with vegetables, and in small pieces).

The U.S.S.R. enjoys a great variety of canned fish products: au naturel, with tomato sauce, and in oil—previously fried or not. Stews are made and packed from several species of salmon (ragout). Besides the traditional packs of herring, sprat, sardines, salmon, tuna, mackerel, etc., other canned species of fish include cod, bream, grayling, plaice, sole, pike, sturgeon, several whitefish, smoked lamprey, etc. The canning of saury is a new endeavor in which the Japanese have led the way (see p. 360). Large new factories for this pack have been built on the former Japanese Kuril island of Shikotan.

Specific Russian fish varieties used for canning are the “muskun” (*Coregonus muskun*), “som” (sheatfish), “syrok” (*Coregonus peled*), “nelma” (*Stenodus leucichthys*). Several are packed in jelly, such as nelma, Baltic herring, muskun, eel, lamprey, perch, and whitefish. Liver of cod and salmon is canned both au naturel and in tomato sauce, and is increasing in importance as a basic food, since cheaper synthetic methods have been adopted for the manufacture of vitamin A. Roe of cod and plaice is also canned; products include fish soups of the puree type. Fried fish (cod, plaice, Baltic herring) is frequently canned in tomato sauce.

Canned fish with various vegetable garnishes is being distributed on an increasing scale. It is manufactured mostly in the southern regions such as the Volga-Caspian and Azov-Black Sea basins where there are vegetable surpluses. Preparations from fish and molluscs with the inclusion of seaweed (sea kale, etc.) are being produced on the Pacific coast.
Miscellaneous

Sturgeon milt is canned with vegetables or in tomato sauce. Baltic herring (50-55%) is marinated with vegetables (onions, carrots, etc.), and a number of jellied canned fish are packed (e.g., sprat, perch, etc.). Several combined fish (30-35%) and vegetable (70-75%) products (as sturgeon with beans) are available.

Barges

Processing barges towed up and down rivers and along the coast were introduced by the Russians on the Volga at the beginning of the nineteenth century. Later canning barges for salmon and crab were towed along the rivers of the Sea of Okhotsk, Kamchatka, Sakhalin, and Eastern Siberia.

The crab-cannery barges of the Far East are being augmented by large crab factory ships, capable of also processing fish.

Fish Combines

The word “combine” is employed to signify processing plants uniting into a single entity almost every phase of utilization through processing. At least two large-scale fish combines were built in the late twenties and early thirties, in Murmansk and in Astrakhan. They have been constantly modernized, rebuilt and expanded. Several postwar combines have been constructed, some huge with thousands of workers.

The fish combines in large cities have in addition lines operating on a 24-hour basis for making ready-made dishes, such as fried fish and cooked fish in different sauces (parsley, dill, etc.), most of which is packed in plastic bags. Dry ice is used for distribution in trucks, canteens, and retail stores.

Murmansk Center

The Murmansk Fish Combine has grown from a small operation in the 1930’s to handle about 700,000 metric tons, or one fifth of the 1960 Soviet marine catch. From this the Combine produced 300,000 tons of frozen, salted, and smoked fish, plus 15 million units of canned fish. The canning operation is substantially mechanized; filleting, weighing, and other work are still done by hand. Further mechanization is planned.

The Murmansk unit comprises a refrigeration warehouse with an ice-making unit, several canning plants with a can-making factory, two salting units, a smoking plant (present capacity 23 tons per 24 hours), a fish meal factory, and a plant for medicinal oils. One canning plant produced 25 tons of finished products per 24 hours. The whole array of processed fish products is manufactured here with the exception of
12. REGIONAL DEVELOPMENT OF FISHING INDUSTRY

ready-made fish (fried or broiled). For such items there are several processing lines in the Fish Combine of Moscow together with a defrosting establishment.

The Murmansk combine covers an area of 100 acres and employs 4,000 of which 1,500 are designated as laborers. Some 300–400 trawlers operate in season out of Murmansk. Approximately one fifth of the whale brought in is processed on board. In this respect the combine also is a kind of central kitchen.

The 1965 goal is 340,000–350,000 tons of fishery products (excluding canned fish). The trend is toward relying more on factory trawlers for supplies of fresh and frozen fish. The Combine sells its products to a state marketing organization (RYSBYT) for distribution locally and to various parts of the U.S.S.R.

ASTRAKHAN

One of the biggest industries in Astrakhan is an enormous fish-processing plant—so-called combine—employing upwards of 5,500 people. Here every kind of fish processing is carried on, including canning, can making and tin recovery, freezing, smoking, salting, reduction of waste products, and preparation of the Volga brand of caviar. It operates several refrigerated barges for collecting caviar and live fish.

The Astrakhan combine, named for Mikoyan, has for a long time been the pride and the pioneer of Soviet fish processing. It is claimed to have started large-scale freezing of fillets in 1935 in a highly modern plant with a capacity of 50 tons per 24 hours, applying methods and equipment developed by the Refrigeration Research Institute (VNIKhI) in the period 1931–34.

The combine is located in the delta of the Volga, a few miles from Astrakhan, and serves the entire Volga-Caspian area. It handles annually 75,000 tons of fish, 80% of all fish from the Volga-Caspian area. It manufactures 12% of all canned fish in the Soviet Union, 80% of sturgeon caviar, and 70% of all cured sturgeon fillets (balyk).

ODESSA

Odessa on the Black Sea obtained a new canning and freezing plant in connection with the construction of a new port complex. The port can now accommodate ocean-going trawlers and even the large Soviet whaling vessels.

RIGA

A new fishing port primarily designed to handle Soviet catches of Atlantic herring is under construction at Riga in the Latvian Soviet Republic. It is situated at the mouth of the Daugava River.
The basin has been deepened to receive motherships such as "Riga," "Konda," and "Kaliningrad" and large refrigeration fishing ships with a displacement up to 4,000 tons.

Well underway toward completion is a 10,000-ton capacity cold storage plant with rooms for temperatures of 0° to −2°C. and enough space for 4,000 tons of frozen fish at −18°C. The second most important feature is a herring-processing plant with canning, salting, and smoking facilities. In many trawlers, herring is subjected only to primary salting in barrels. Twelve conveyor lines will transport the herring barrels to the plant. Here the herring will be washed, checked for quality, put into barrels again, salted, sealed, and stored. Hand labor is used only for filling barrels; electric vibrators will be employed for a denser fill of the barrels. The capacity of the processing plant is about 100,000 tons of herring a year. A freezing store with two chambers is provided against the contingency of factory overload. The chambers will hold 4,700 tons of herring. Conveyor belts will connect them with the processing plant.

The port includes two miles of dock frontage, warehouses, processing facilities, and housing for 15,000 people.

**PETROPAVLovSK**

A large cold store equipped for freezing of fish takes care of most fish brought by trawlers to Petropavlovsk on the east coast of Kamchatka, and for transient storage of fish frozen at sea or elsewhere. The actual capacity of this cold store is reported as follows: storage capacity for frozen fish, 8,000 tons; freezing capacity, 250 tons fish/day; manufacturing capacity for block ice, 120 tons/day. The storage space holds a temperature of −20°C. The ports of Nakhodka and Vladivostok on the coast of the Sea of Okhotsk have been modernized and expanded to meet the needs of the anticipated growth of Pacific fisheries.

**MISCELLANEOUS**

Several combines are operating in the peninsula of Kamchatka, and on the island of Sakhalin. Large modern units have been constructed in Kaliningrad (earlier Königsberg) in the Baltic, and in Archangelsk, facing the White Sea.

**Whaling**

Soviet participation in Antarctic whaling expanded greatly in the fifties—from 112,000 tons in 1950 to 214,000 tons in 1957. The whaling fleet was recently enlarged with two large modern units, "Sovyetskaya Ukraina" from the Nikolayevsk shipyards and "Sovyetskaya Rossiya" (slightly larger, 45,000 tons), described as the most modern whaling
factories in the Antarctic fleet today. The refrigerator holds have a capacity of 2,000 tons, and the tanks are capable of holding 18,000 tons of blubber. These ships can freeze some 100 tons of whale meat and liver daily, and store 1,800 tons of frozen products. They have a displacement of 44,000 tons, and are reported to be the largest vessels in the Soviet merchant fleet. They are equipped with modernized processing lines and scientific laboratories.

Their cruising range is given as 9,000 miles and their speed 16 knots. Accommodation on board is for 500 men with mess rooms, library, cinema, and recreation rooms. A helicopter is carried for spotting whales.

The build-up in whaling seems to be enormous. In 1960 a third large new whaling factory appeared in the news. This unit is reportedly built in an East German shipyard and named the "Yuri Dolgoruky." It is to lead the Soviet whaling flotilla in the Antarctic. This fleet's home station is Kaliningrad.

Two smaller whale-oil refineries, about 18,000 gross tons, have been built at Kiel (Western Germany) for work in Pacific waters. The cargo oil tanks have a capacity of about 13,700 cu. ft., refrigerated cargo holds about 4,000 cu. ft., and fish meal holds about 5,600 cu. ft. These floating plants will produce all the traditional items: whale oil, whale meal, refrigerated whale meat, vitamin oil, and whale-liver pulp. A unique feature is that outside the whaling season they are designed to be used as fish factory ships for producing frozen fish fillets, fish meal, fish-liver and vitamin oils. The processing plant is located on the flensing deck.

A Soviet whaling fleet, besides these modern factory ships, includes about 30 whale-catching boats, a scientific research vessel, and support ships.

V. Mediterranean

The Mediterranean is becoming a fished-out sea. At the same time the pressure on its limited resources has been intensified by the evolution of new nations around the shores, such as Libya, Tunisia, and lately Algeria, who are catching their own fish, with newly established fleets. This leaves Italian fishermen—and others in the same area—with the choice between a dwindling livelihood and going farther afield.

EGYPT (UNITED ARAB REPUBLIC)

Fish has always played a key role in the Egyptian diet. It is probable that fish as food was more or less seasonal before the building of the regulating dams.

According to 1961 figures, three fifths of the fish landed was from fresh water. The balance was listed as unsorted, indicating that the land-
ings were sold by local fishermen to fish mongers or direct to the consumer. In the absence of utilization figures we may assume that most of the catch is consumed unprocessed.

Modern Egypt is suffering from overpopulation. The government is turning to the sea as a possible source of food. It is conducting surveys of all territorial waters to ascertain their productivity. Even the new high Aswan Dam will not alleviate the situation appreciably.

### TABLE IV
**CATCH OF MEDITERRANEAN COUNTRIES**

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\(^a\) 1958.

Japan has been exporting canned saury and other canned goods to Egypt. But in order to bolster their own trade balance the Egyptians are building a tuna- and sardine-canning plant and three shrimp-freezing plants to process these items for export. A cannery at Damietta will process sardines, "musa," anchovies, crabs, and shrimp.

**LIBYA**

Most Libyans are Arabs and traditionally no fishermen; most of this country's fish are therefore caught by Italian, Greek, and Maltese nationals. The fish found in the coastal waters may be larger than is common elsewhere in the Mediterranean, chiefly due to the fact that these grounds are not overfished. The city of Tripoli has six canneries for sardines and tuna, caught mainly along this section of the coast.

**TUNISIA**

Just how long the fisheries off modern Tunisia have been exploited will probably never be known. Ancient Carthage was situated here. Undoubtedly, the Carthaginians used fish since the time of their ancestors; the Phoenicians were seafarers.

The present Tunisian landings consist of almost one half (44.7%)
unsorted fish, almost as many (44.1%) sardines, one twelfth tuna, and 1.3% each of crustaceans and sponges.

Practically all of the unsorted fish are consumed unprocessed. The sardine industry is concentrated to the ports of Mahdia, Monastir, and Sousse, the locations for major canneries.

In their migrations the tuna follow close to the Tunisian coast when passing through the Sicilian Strait from May 15 to July 1. This is an important fishery since ancient times (see further Chapter 4, Volume IV).

**ALGERIA**

Before independence in 1962, Algeria's catch was included in the figures for France. After seven years of civil war it would be unjust to try to analyze Algeria's fishery trends at this early date.

**MOROCCO**

The fisheries off the northwest coast of Africa have been known for centuries. Portugal and Spain were probably among the first regular visitors to these waters. The fishing was largely coastal while Morocco was still a colony of France and of Spain. After independence, fishing was given greater emphasis.

Sardines are the mainstay of the business. Three fourths of the catch is sardines, tuna one tenth. The utilization pattern is radically different from most African countries in that less than one tenth is consumed unprocessed. The major portion (2/3) goes for reduction, one fifth is canned, one tenth is frozen, and insignificant quantities are cured.

The most conspicuous factor in recent developments is the rapid expansion of fish meal manufacture from sardines. Fish flour of high quality, standing storage in cardboard containers for 2 years, is also manufactured. It has been used experimentally in biscuits, soups, stews, etc. A plant with 700-ton capacity has been built for making this product.

The manufacture of Moroccan canned sardines is limited by the high price of cans; this is said to be probably the chief cause for the 60% drop in sardine production from 1957 to 1960. Agadir, Safi, Tangier, and Casablanca are the centers of the sardine-processing industry.

Tuna and mackerel are next to sardine in volume, and are packed in olive oil for export. The can price is less critical for these kinds of fish.

A thriving shrimp industry has recently been growing up around Tangier. While some shrimp is used locally most is frozen for export. The frozen fish are used locally mainly for home consumption or canning. Bulk-frozen sardines are sold regularly to the French sardine-canning industry.
ITALY

One would expect Italy, with its long coastline, to look to the sea for one of its major food supplies. Fish has been a dietary staple since the days of ancient Rome. Italian fishermen have stayed near their coast and not ventured far from the Mediterranean. Consequently most of their fish is consumed unprocessed. In 1961 over 85.7% of the catch was marketed this way. Of the remainder, 7.2% was cured, 3.8% canned, and 3.2% frozen. The consumption of anchovies and sardines in brine has been steadily declining in the last decade.

The canning industry, on the other hand, has been expanding. Tuna is the largest single item canned. The canneries in recent years have been importing frozen tuna from other countries. Japan is the chief supplier. In fact within the last few years Japanese-Italian companies have been formed to build modern processing plants and refrigerated facilities on Italian soil. Japanese deep sea fishing fleets will supply most of the raw material.

Tuna is the chief product and is canned in oil, au naturel, or as tonetti (small tuna in oil). The latter is an Italian tuna specialty famous throughout the world.

Sardines and anchovies are canned as well and are still preserved in brine. Sardines and other non-tuna fish in oil are decreasing. Another world-famous Italian product is canned eel. Eels are raised in lagoons on the Adriatic coast of north Italy.

Some 125–150,000 tons of fish are acquired abroad each year, almost 40% of the total intake. The Blue Plan (Piano Azurro), for considerable expansion of fishing, aims at self-sufficiency and is given high priority. Italy is being driven to take such measures by hard necessity.

YUGOSLAVIA

Yugoslavia has conducted coastal fishing for centuries. Until recently, when the Japanese built a 500-ton tuna vessel on Yugoslav order, practically all aquatic foods were caught in lakes or nearby waters. This new tuna ship is based at Casablanca and fishes in the North Atlantic.

In 1961, more than two fifths of the catch was sardines or other members of the herring group, one third fresh-water species, and less than one tenth mullets and related species. Most of the sardines is canned for export. Like other nations without highly industrialized fisheries, most fish, aside from sardines, is consumed unprocessed.

GREECE

The coastline of Greece and her many islands indicate that the Greeks must have depended on fish in the diet for centuries. Fish was probably a vital food in the Golden Age of Pericles.
Of the 1959 catch one third was classified as unsorted, indicating that much of the fishing is done by small local boats selling their catch direct to fish dealers. Sardines and their relatives comprised a fourth, mullets and the like about one sixth, and fresh-water species one eighth. Trout cultivation has been successfully introduced.

The statistics for 1958 show that 62.8% of the catch was consumed unprocessed, 13% cured, 5% frozen, and 1.2% canned. The percentage of fish frozen has undoubtedly increased since then.

Salting of sardines is probably the most common curing practice in Greece, a holdover from an age-old practice of the rural people.

The fishing firms in late years have been acquiring more freezing trawlers and are working in the Atlantic off Northwest Africa. Most of this catch is tuna. Planning is underway for construction of a Greek fish meal factory.

Japanese fishing interests have been collaborating with the Greeks in the expansion of their fisheries.

**Turkey**

Turkey is believed to have considerable fishery resources in the Mediterranean Sea, the Black Sea, and the Sea of Marmara. The potentialities of these waters have not been assessed. Turkey has, however, very recently extended its territorial fishing limits from 3 to 12 miles. In addition to the marine fisheries, composed mainly of tuna, bonito, mackerel, and dolphin, there are the carp, eel, and yellow-pike fisheries of the inland waters.

Shrimp is a small portion of the total catch. Iskenderun near the Syrian border is the center of the shrimp industry for southern Turkey. The main shrimping grounds are in the Gulf of Iskenderun and off the coast of Mersin-Karatas-Yumurtaluk. Estimated total annual shrimp landings for Iskenderun are 40–60 metric tons.

Over 70% of the total catch is marketed unprocessed, the rest is cured (24%) or otherwise processed. Tuna and bonito are exported to the canneries in Italy and Yugoslavia. Mackerel and dolphin are reduced in a state-owned factory in Trabzon. Shrimp is sold fresh or exported to Syria and the Lebanon. Some is frozen (the facilities are not mentioned).

The Turkish Meat and Fish Office, a government agency, is reportedly planning the development of marine fisheries in cooperation with a private fishery firm on the Island of Marmara in the Sea of Marmara. Special advice has been sought in Japan and a special study delegation from that country visited Turkey for first-hand observations and formulation of a long-range program.
ISRAEL

Israel entered the field of distant-water fishing with a Norway-built trawler in 1961. Her success resulted in the building of a second freezer trawler. Following a cruise to the Grand Banks off Newfoundland early in 1963, she began fishing off the northwest coast of Africa.

Israel also conducts deep sea fishing in the Canary Islands fishing grounds in the Atlantic, in the Indian Ocean off the Malagasy Republic and the coast of Africa and the Red Sea. Eilat, Haifa, Caesaria, Tel-Aviv, Acre are the important fishing ports and markets provided with cold storage facilities. The majority of the high sea catch is tuna and sardine. These endeavors are pursued jointly with Japanese and Norwegian interests through special companies. The Sea of Galilee still is a source of fish.

Coastal fisheries in the Mediterranean yield few edible fish. A substantial part of the domestic fish supply consists of carp and tilapia produced in fresh-water ponds.

Israel at present produces about 60% of its fish supply. With a per capita consumption of over 28 pounds of fish per year, fish is generally marketed unprocessed. In 1962, 15 million cans of fish, mostly sardines, were packed. The imports consist of frozen cod and haddock, salted herring from Scandinavia, and sea bass from South Africa. Some canned sardines are exported to Rumania and South Africa.

VI. Black Sea and Caspian Fisheries

IRAN

Iran's catch comes from three sources: the rivers, the Caspian Sea, and the Persian Gulf-Indian Ocean coasts. The most important fish caught in the Caspian Sea is the sturgeon; others are white salmon, whitefish, bream, pike, catfish, and herring. Species caught in the Persian Gulf include sardine, tuna, bream, snapper, mackerel, and shrimp. The industry is centered around Hormuz Island. The Elburz Mountain rivers and streams flowing north and south supply small river trout and other edible fish.

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<td>42</td>
<td>46.5</td>
<td>51*</td>
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</table>

* 1958.  

b Soviet Statistics.
The king of the Caspian Sea is the sturgeon, 25–2,500 lb. in weight. Although its flesh is somewhat oily, it is a tasteful and delicate fish and one of the most expensive on the local market. The sturgeon fisheries lie between Astara in the northwest and Bandar Shah to the east, a distance of 600 miles. Sturgeon, like salmon, run up rivers to spawn and enter the warm creeks around Bandar Pahlavi and Bandar Shah. They are netted in their migrations by 45 fishing stations in four administrative sectors for the extraction of caviar.

After the caviar is extracted, the fish are shipped to Hassan Kiadeh for cold storage. Over 2,000 tons of sturgeon are caught annually and 98% of it is exported. FAO has recently proposed to the Iranian Government to set up plants to can surplus sturgeon.

**Caviar**

Iran is a major source of the world caviar supply. Four species of sturgeon abound in the waters of the Caspian Sea and provide the roe for 96% of the yearly world production of over 2,000 tons. Russia produces 90% of this caviar and Iran 5–6%. Iran's caviar production during the fiscal year 1957–58 was 163 metric tons as compared with 127 tons the previous year. It exports caviar mostly to the U.S.S.R. and also to France, the U.S., and West Germany.

The roe of sturgeon is collected in a basin, gently rubbed through a coarse sieve, washed, and mixed with salt. Each kilogram of roe is mixed with 44 g. salt. The salted roe is packed in cans, kept in ice and sawdust, and shipped at temperatures just below freezing.

The most commonly used preservative for caviar is boric acid, which is acceptable in all countries except France and the U.S. Salting is employed for caviar exported to these countries. It cannot be frozen nor can it be sterilized by heat.

First-grade caviar is golden in color with grains large and firm. The second grade is dark gray to black with grains small and loose. The product is known under the name of the variety of sturgeon from which it originates, such as beluga, sestruga, and assetrine.

Fish from the Persian Gulf is frozen, smoked, salted, or canned, and shrimp frozen or dried, but these products are small in quantity.

The most important fisheries enterprise in Iran is the Iranian Fisheries Company, a government agency. The exploitation of fishery resources in the Gulf began in 1955 with the organization of a joint venture between Iran and Japan. This arrangement was subsequently terminated. The shrimp fishery in the Gulf was substantially developed by a joint Iranian-U.S. Company, starting operation in 1958.
Bulgaria

Lack of adequate refrigeration and transportation has always been a factor in the scarcity of fish and other seafoods in Bulgaria. The government has recently initiated a number of fishermen cooperatives designed to tap the vast resources of the Black Sea. The chief port is Sozopol near the important port city and provincial capital of Burgas.

One of the chief species caught is the dolphin, a marine mammal averaging 50 lb. in weight. One ship during the season can catch up to 2,000 on a voyage of 3 or 4 days. The dolphins are skinned, deboned, and salted aboard ship. Due to lack of storage facilities the freshest steaks are stacked on deck. They are kept up to 2 days without salting. On docking about one half is distributed to the markets fresh or salted. It is probable that some of this is dried for the use of local cooperative farms. The other half of the catch is taken to the Sozopol cannery where it is processed. Canned dolphin resembles canned tuna.

Other species of commercial importance are tuna, bonito, mackerel, gray mullet, and turbot.

Bulgaria is now, with Soviet help, developing a high sea fleet for fishing around Iceland, Newfoundland, and off the coast of tropical West Africa. Present plans are eyeing fishing also in the Indian Ocean.

Romania

Information about Romanian fisheries is practically unavailable to western scientists. A Japanese shipbuilding company has, however, delivered two multipurpose stern-fishing vessels (3,603 tons) for initiating fishing in the waters of the northwest Atlantic. Until now fish cultivation and fresh-water fish, mainly from the Danube, have provided most fish on the market. In 1960, 78% of the catch originated in this river.

VII. Northwest Atlantic

United States

The United States ranks fifth at present in the amount of fish landed each year, but as late as 1956 it was second in rank. There are many major fishing grounds close to the coast. The continental shelves are

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comparatively wide along the East, Gulf, and Alaskan coasts, which is usually conducive to high fishery production.

In 1961, two fifths of the catch was of the herring group (mainly menhaden), one fifth molluscs, one twelfth of the mullet group (ocean perch, jack mackerel, sheephead, etc.), and 6.9% crustaceans. A meager 2% of the total catch was from fresh water, yet this amounted to 56,200 metric tons, which puts the U.S. seventh in the production of fresh-water species. Much of the catch is consumed unprocessed, but some of the whitefish, pike, and perch is filleted and frozen. An interesting sidelight is the utilization of carp. In some of the mountain states the reservoirs and lakes are seined for this species, which is frozen whole and ground up for trout and other game fish as feed.

Utilization is as follows: a little more than one third of the total catch goes for reduction, a little below one third is marketed fresh, one fifth canned, and one tenth frozen. Only 1% of the catch is cured.

Almost the entire menhaden catch from the East and Gulf coasts is processed into oil and meal. In fact, four fifths of the U.S. production of fish meal is from this species. Practically all of this meal is used for broiler growing. There was a 20% increase in fish meal production in the fifties.

Canning in the U.S. started in 1819 when Underwood heat-processed lobsters and salmon in Maine. Since that time the canning industry has become big business. The largest cannery in the world was recently built in Puerto Rico. Most of its output is canned tuna. Much of the raw material is caught by foreign fishermen and transshipped to Puerto Rico. About half the raw tuna has been imported in the last few years. In 1950 almost all tuna was canned in oil, but a decade later a complete switch took place with nearly the entire pack in brine.

The production of canned sardines declined considerably in the fifties. The Maine sardine pack remained fairly constant, but the Pacific pack was in 1960 only 12% of that for 1950, due to the disappearance of the Pacific sardine. The salmon pack has also declined but not so drastically. The total pack during the fifties declined about one third, caused chiefly by smaller catches. Other species processed by heat include mackerel (both Pacific and jack), alewives, and crab. In addition a considerable number of fish preparations, such as oyster stews and clam-and fish-chowder, are heat-processed.

Frozen fish products have shown a marked increase, fillets and fish sticks being the leading items manufactured. Approximately half the raw material is imported. Shrimp freezing has shown a similar growth but here also imports account for more than half the pack.
Many of the most productive fisheries in the world are near Canada—the Grand Banks, George's Bank, and the Davis Strait, west of Greenland. On the west coast the offshore waters near the “inside passage” are the source of many fish, but the tuna boats hunt in the East Central Pacific off Baja California. In addition many fish are caught in the Great Lakes, Lake Winnipeg, Great Slave Lake, and the myriad of other lakes found in eastern and northern Canada.

Almost two fifths of the catch belongs to the cod group (mainly Atlantic cod) and three tenths is herring. The salmon group accounts for about 8% and the flounder and related fish for 7.5%. One fourth of the catch is frozen, one fourth cured, one fifth marketed fresh, and close to one fifth taken to reduction plants.

By far the largest proportion of the frozen fish consists of fillets for domestic and U.S. consumption. Cod, haddock, halibut, hake, and freshwater fish make up the vast bulk of production. Some of the fillets are reprocessed into fish sticks. Others are breaded and precooked. In the 6 years prior to 1959 the production of fillets on the Atlantic Coast almost doubled.

Many of the fish are cured along the Atlantic in almost the same way as when Canada was first settled. Most of the cod is dry-salted, sun-dried, or pickled. Artificial dryers are now in use in many areas. Along the Gaspé peninsula a special cure is produced, the Gaspé cure, known throughout the world. Some areas still smoke herring to produce “bloaters” or related items.

Canadian sardines are mainly small herring caught in weirs along the Bay of Fundy. That area has the largest sardine cannery in the British Commonwealth. Canned salmon is the chief product of the west coast canneries. All five species of Pacific salmon are utilized. Tuna is also canned. As the Canadian boats cannot supply the demand, additional material is imported.

Experimental work has been done on using filleting trimmings for the production of fish flour. A new process which dehydrates a fish and potato mixture, forming readily reconstituted flakes, shows considerable promise. Other new products are “fishfurters,” fish loaves, fish croquettes, and whitefish sausages.

VIII. Caribbean and Gulf of Mexico

MEXICO

The largest portion of the landings is crustaceans. These account for almost one third of the total, practically all shrimp. Molluscs comprise
one seventh, sardines one ninth, and fresh-water fish one tenth. Aside from shrimp and other invertebrates, the majority of which are exported, most of the fish is probably used for local consumption.

TABLE VII

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<td>1.4</td>
<td>1.6</td>
<td>1.5</td>
<td>1.6</td>
</tr>
<tr>
<td>Jamaica</td>
<td>4.5</td>
<td>—</td>
<td>—</td>
<td>8.5</td>
<td>11.5</td>
<td>—</td>
</tr>
<tr>
<td>Guadeloupe</td>
<td>0.4</td>
<td>0.9</td>
<td>1.8</td>
<td>3.2</td>
<td>3.3</td>
<td>1.6</td>
</tr>
<tr>
<td>Martinique</td>
<td>2.5</td>
<td>2.5</td>
<td>2.8</td>
<td>3.3</td>
<td>3.1</td>
<td>—</td>
</tr>
<tr>
<td>Netherlands Antilles</td>
<td>0.1</td>
<td>0.1</td>
<td>0.6</td>
<td>0.6a</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Venezuela</td>
<td>21.7</td>
<td>92.3</td>
<td>61.6</td>
<td>84.7</td>
<td>83.0</td>
<td>—</td>
</tr>
</tbody>
</table>

Mexico has made great strides in recent years in the canning and freezing industries, due largely to the great volume represented by the shrimp-freezing segment of the industry. There are 49 freezing plants in operation with a total capacity of 500 tons, which freeze principally shrimp. Canneries in operation in the country total 35. There are eight major reduction plants for production of fish meal.

The Banco Nacional de Fomento Cooperativo financed a new fishery harbor, the first to be specifically constructed with facilities to integrate all fishery processing operations. Work began in November 1962 by opening and deepening through dredging the channel and bays at the port of Alvarado, Veracruz. The main objective of the project is to increase production of market fish for the country’s needs, and it will receive the catch of several hundred canoes and boats that operate in the area. Handling facilities will be for 80 tons daily, and a boat yard will handle boats up to 200 tons.

The center will also put into operation five 110-gross ton fishing vessels, geared for trawling, seining, and long-line fishing. The first of these have been delivered. They are being built in the Netherlands and are intended for instructing fishermen of the Alvarado Region. They can be used for shrimp fishing as well as for purse seining and beam trawling. They are Diesel-driven. The refrigerated holds have a capacity of 100 metric tons at 1°C. (33.8°F.).

A large new commercial fishing industry centered particularly on
fillets, lobster tails, turtle meat, and other products, is coming into being along the Gulf and Caribbean coasts of Mexico in an area stretching to British Honduras. These new industries are doing much to stimulate economic activity in areas among the least developed in Mexico.

A recent improvement program increased freezing capacity at the shrimp-freezing plant from 6,000 to 12,000 lb. daily and procured new equipment. Deveiners are commonly used throughout in this important process.

Freezer boats carry the finished product to Miami, Tampa, and Port Isabel, Texas. A fleet of 25 boats serves the Mariscos del Golfo plant—the Bay of Campeche is noted for its high quality production, and shrimp and fish come from this area.

Shrimp is put up block-frozen in 5-lb. boxes, and individually quick-frozen in polyethylene bags weighing 3, 2.5, 1.5, 1 lb., and 12 oz.

Another shrimp-freezing plant is located at Merida, Yucatan, with a capacity of 9,000 lb. daily.

**West Indies**

The West Indies constitute some of the most densely populated areas in the New World. The Bahamas with 9 people per square kilometer and the British Virgin Islands with 14 are at one end of the scale, while Barbados with 538 is at the other. Only three other areas, Cuba with 61, the Dominican Republic with 64, and Dominica with 77, have less than 100 people per square kilometer.

All but five of the areas are governed by other countries. The Dutch-ruled islands have a common government, but many of the other islands publish their own statistics. The landings and their composition are given in Table VIII. Most of the unsorted fish is consumed unprocessed. Most areas do not supply their own needs.

Puerto Rico has one of the largest tuna-processing plants in the world at Mayagüez. There are two other canneries in that city and one at Ponce. The four plants can process 445–485 tons per day and store 8,600 tons of frozen fish. Much of the raw material is caught by foreign fishermen who deliver the frozen tuna to transshipment ports. Many of these have been built and enlarged with Japanese help. The bases at Willemstad, Curaçao; Port of Spain, Trinidad; and Philipsburg, Sint Maarten (St. Martin) are mainly for supplying the Puerto Rican canneries.

In the Dominican Republic cold storage facilities are fairly common throughout the country, facilitating the use of unprocessed and frozen foods. In Cuba an ambitious undertaking is being pushed to build refrigeration plants throughout the island. This is part of an over-all program to enlarge the Cuban fishing fleet with more boats and port
facilities. Some of the vessels will be freezing trawlers for high sea fishing. The U.S.S.R. is giving technical assistance and building five of these trawlers; Japan has started delivering the large trawlers ordered from them. A new large fishing base at Ateras Cove is, through a 10-year agreement, to serve the Middle Atlantic fishing fleet of the U.S.S.R. (110 trawlers). (See p. 320, this volume.)

**TABLE VIII**

**WEST INDIES FISH CATCH**

(1000 metric tons)

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Total Catch</th>
<th>Country</th>
<th>Year</th>
<th>Total Catch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antigua</td>
<td>1962</td>
<td>0.8</td>
<td>Montserrat</td>
<td>1961</td>
<td>0.1</td>
</tr>
<tr>
<td>Bahamas</td>
<td>1962</td>
<td>1.6</td>
<td>Netherlands</td>
<td>1957</td>
<td>0.6</td>
</tr>
<tr>
<td>Barbados</td>
<td>1962</td>
<td>4.7</td>
<td>Antilles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cuba</td>
<td>1962</td>
<td>35.9</td>
<td>Puerto Rico</td>
<td>1962</td>
<td>3.5</td>
</tr>
<tr>
<td>Dominica</td>
<td>1959</td>
<td>0.5</td>
<td>St. Kitts</td>
<td>1960</td>
<td>0.8</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>1961</td>
<td>1.6</td>
<td>St. Lucia</td>
<td>1960</td>
<td>0.4</td>
</tr>
<tr>
<td>Granada</td>
<td>1962</td>
<td>0.9</td>
<td>St. Vincent</td>
<td>1962</td>
<td>0.4</td>
</tr>
<tr>
<td>Guadeloupe</td>
<td>1961</td>
<td>3.3</td>
<td>Trinidad and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tobago</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haiti</td>
<td>1949</td>
<td>2.1</td>
<td>Virgin Islands</td>
<td>1956</td>
<td>0.2</td>
</tr>
<tr>
<td>Jamaica</td>
<td>1961</td>
<td>11.5</td>
<td>(U.S.)</td>
<td>1961</td>
<td>0.8</td>
</tr>
<tr>
<td>Martinique</td>
<td></td>
<td>3.1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A U.S. firm recently agreed to develop a fish industry and frog breeding facilities in Haiti.

**VENEZUELA**

The catch is composed of over one third sardines, almost as many of the ocean perch group, one tenth fresh-water fish with slightly less tuna and half as many molluscs.

Almost all the fish is used for food; only 2.5% goes to reduction plants. A little over one third of the total is marketed fresh, slightly more canned, and one fifth cured.

Next to the U.S. canneries at Puerto Rico, it seems probable that Venezuela has the only sizable fish-processing industry of the Caribbean, comprising a canning center at Cumana and curing and freezing industries around Isla de Margarita and the Gulf of Cariaco.

Sardine canning is the major fish-processing industry (in 1962, 800,000 cases with 100 cans per case of 3 3/4 oz. per can). Since the industry was operating at only half capacity, the production could readily be increased to 1.5–2 million cases per year.

The Japanese tuna fleet fishing in the Atlantic Ocean has been encouraged to use Venezuela as a base and sell part of their catch to the
canneries at Cumana, since they are not operating at full capacity and the sardine catch is not sufficient.

IX. Middle Atlantic

Spain

There are rich coastal fishing grounds around Spain. Sardines are found along all coasts, but are most abundant along the northwest shoreline and fairly plentiful in the Strait of Gibraltar. The related sprat is found here, and crustaceans, mackerel, horse mackerel, anchovies, and

<table>
<thead>
<tr>
<th>Table IX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOTAL CATCH OF MIDDLE ATLANTIC COUNTRIES</strong></td>
</tr>
<tr>
<td>(1000 metric tons)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>423.5</td>
<td>547.2</td>
<td>690.3</td>
<td>898.0</td>
<td>1,014.5</td>
<td>1,006.0</td>
</tr>
<tr>
<td>Portugal</td>
<td>247.2</td>
<td>292.1</td>
<td>429.5</td>
<td>475.1</td>
<td>500.7</td>
<td>518.2</td>
</tr>
<tr>
<td>Morocco</td>
<td>43.7</td>
<td>68.6</td>
<td>112.2</td>
<td>154.1</td>
<td>164.9</td>
<td>162.9</td>
</tr>
<tr>
<td>Mauritania</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.6</td>
<td>0.7</td>
<td>0.6</td>
</tr>
<tr>
<td>Senegal</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>122.1</td>
<td>126.9</td>
<td>133.4</td>
</tr>
<tr>
<td>Guinea</td>
<td>—</td>
<td>—</td>
<td>16.0</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>—</td>
<td>3.0</td>
<td>0.5</td>
<td>17.4</td>
<td>18.8</td>
<td>21.0</td>
</tr>
<tr>
<td>Liberia</td>
<td>—</td>
<td>—</td>
<td>0.5</td>
<td>2.2</td>
<td>1.2</td>
<td>—</td>
</tr>
</tbody>
</table>

*m 1956.

molluscs abound in these waters. Aside from the pouting, the water around the Iberian Peninsula is too warm for the gadoid fishes, yet bacalao (salted cod) is one of the staples of the Spanish diet. For centuries the Spaniards have been catching cod in the fisheries off Newfoundland and Greenland. It is green salted on the ships and finished in land-based plants along the Basque coast. Haddock, hake, and pollock are all caught in the North Atlantic and tuna and related fish farther south. Almost one third of the catch is cod, over a fourth the herring group, one sixth ocean perch and related fish, and over one eighth sold unsorted.

As one might expect, much of the food fish (two thirds) caught by Spain is consumed unprocessed. The remainder is processed, one fifth cured, and some 13% canned. Only a few percent of the catch goes to the reduction plants.

Nine tenths of the cod is salted and dried, accounting for almost one third of all cured fish. Anchovies in brine make up one fourth; conger eel, sea bass, and perch comprise the bulk of the remaining cured products, and are mainly dried and salted.

The main canned products are about equally divided between sardine
and tuna, both in oil. In the last few years over 500 fish-processing plants have been operating in Spain; over 60% are for processing in oil, the rest for pickling.

Until the second decade of the latter half of this century practically none of Spain's fish was frozen. In 1962 a start was made toward construction of refrigeration facilities at both Cadiz and Santander, and a modest effort was made toward developing a trade in frozen fish. This interest has been stimulated by the recent construction of freezing trawlers operating off the African coast almost down to South Africa. Modern floating salting factories have been built, expanding Spanish participation in the Grand Banks cod fisheries. New modernly equipped salting and drying plants have been erected in the homeland.

Portugal

Who discovered the Grand Banks fishing grounds off Newfoundland may never be known. However, it is fairly well established that the Portuguese fishermen knew about them a long time before the discovery of America by Columbus. Undoubtedly the explorations by Henry the Navigator's group discovered other fishing grounds.

Since the Portuguese fisheries are so old and many of the areas so far from home, it follows that a way to prevent the fish from spoiling on the way home had to be found. Consequently, curing by salting was used. Salt fish has become so integral a part of the Portuguese diet that even today 56.8% of their food fish is cured. Only 5.7% is consumed raw (fresh or frozen). The rest is canned. The actual percentage of salted fish is much higher in the native diet because most of the canned fish is exported. Most of the cod is green salted.

In 1962, 75,219 metric tons (4.1 million cases) of canned fish were exported. Of this amount over 78% was sardines in oil or sauce, more than one fourth going to West Germany, a little less than one fifth to Great Britain and Italy each, and slightly less to the U.S.

Besides having sizable fleets still operating on an annual basis on the Grand Banks of Newfoundland, Portugal started some years ago to send trawling fleets to northwest African waters. Due to increased competition and alleged depletion of resources, these trawlers have been compelled to move to more distant fishing grounds, off Southwest Africa and South Africa. The catches here are frozen on shore and picked up by refrigerated transport vessels.

Negotiations are in progress with the Japanese for building a fish base in Portugal and developing the Azores into a major Atlantic base.

For fish processing in the Portuguese province of Angola, see below (pp. 347-348).
Mauritania

The waters off Mauritania have been fished for centuries by many nations. It has been estimated that 80,000–100,000 metric tons of fish have been taken from them each year. Since there is no accurate estimation of the catch which was classified as unsorted, it is doubtful that these statistics include the fish taken from the Senegal River on the south boundary. Most of the fresh-water fish are caught by natives living along the rivers and consumed unprocessed.

The commercial fisheries are concentrated around the northern seaport of Port Etienne. There are three drying plants, processing 5,500–6,000 tons of dried fish every year, and two canning factories, one processing only lobsters which are locally abundant and the other canning tuna, sardines, shad, and herring.

The government plans to increase the processing potential to 40,000 metric tons. Spain is giving technical assistance.

Senegal

The Senegalese have been fishermen for centuries, but their boats are mainly log canoes (pirogues), which prevents them from going far from shore. They have not sorted the catch, indicating that most of it is consumed unprocessed.

Fish canneries at Dakar have an annual capacity of 30,000 metric tons of product weight, but these plants operate at only about one third capacity. Their chief supplier is the French and the Spanish also sell to them. Since they pack the natural or “salmon-style” tuna, not very popular in the U.S., some nations (e.g., Japan) use Dakar as a transshipment base for supplying the U.S., mainly Puerto Rican, canneries. The government is attempting to get these local canneries to process sardines in order to increase their output. It is also trying to build up a national tuna fleet. Frozen tuna is sent to the former mother country, France.

A pilot plant for the production of fish flour from sardines and tuna for supplementing baby food is operating at Dakar. The Norwegians are negotiating to build a sardine fish-meal factory at Dakar.

Guinea

Statistics for this former French West African colony are unavailable. However, the fish production has been estimated at 6,000 metric tons, one third of which is landed by a joint Guinean-Polish trawling enterprise.

Most of the fish is marketed fresh. Negotiations have been held with Japan for the development of Guinea fisheries, to include more fishing
vessels, a fish meal factory, and other base facilities. Yugoslavia is presently surveying Guinean waters.

**Sierra Leone**

Almost half of Sierra Leone's catch consists of sardines. Close to one fourth is listed as unsorted, one seventh is identified as ocean perch, and one eleventh as hake or related fish. Most of the fish is consumed unprocessed. A new cold storage facility has been built at Freetown where tuna and other fish are frozen and stored for transshipment to Puerto Rico and Europe for processing.

**Liberia**

Liberia is the oldest republic in Africa, but is still rather underdeveloped as far as fisheries are concerned. Most of the fish and shellfish are from the sea. They are usually consumed unprocessed in and around Monrovia, the capital and chief port. The main species are soles, crawfish, crabs, lobsters, and shrimps. There are freezing facilities at Monrovia and the Japanese have constructed a storage warehouse for 2,000 tons of frozen fish, largely for the transshipment of tuna.

**X. Internal Africa**

The landlocked central portion of Africa procures a great deal of fish from lakes and rivers. It is not possible to analyze each country separately. A few pertinent notes:

Lake Chad covering about 10,000 square miles provides a great deal of fish but primarily to the bordering countries. The Chad Republic catches more than 100,000 metric tons. There are several other lakes in this general region.

Some of the fish are consumed unprocessed. Most of them are dried (unsalted), but some salted or smoked fish are exported to adjacent regions.

Important river fisheries are those of the Niger and Senegal rivers. In flood periods fish migrate widely to return fattened when waters recede.

Further south, Ruanda Urundi has previously been the center of extensive efforts to expand fish cultivation on the basis of *Tilapia*.

**XI. Southeast Atlantic**

**Ivory Coast**

This former French colony has access to the rich Gulf of Guinea fisheries. Most of the fishing is done by coastal vessels.

A private U.S. firm concluded an agreement with French investors
to construct a tuna-freezing and storage plant at Abidjan. The plant can freeze 130 tons per day, store 1,300 tons, and make 60–80 tons of ice per day.

Table X

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ivory Coast</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>44.0</td>
<td>41.5</td>
<td>43.0</td>
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<td>Ghana</td>
<td>—</td>
<td>20.0</td>
<td>20.0</td>
<td>31.8</td>
<td>34.5</td>
<td>42.4</td>
</tr>
<tr>
<td>Togo</td>
<td>3.0</td>
<td>3.1</td>
<td>3.3</td>
<td>—</td>
<td>—</td>
<td>4.3</td>
</tr>
<tr>
<td>Dahomey</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>28.0</td>
<td>28.0</td>
<td>30.0</td>
</tr>
<tr>
<td>Nigeria</td>
<td>—</td>
<td>—</td>
<td>42.0</td>
<td>58.5</td>
<td>48.5</td>
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<tr>
<td>Congo (Leopoldville)a</td>
<td>0.9</td>
<td>17.5</td>
<td>78.4</td>
<td>153.4b</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Angola</td>
<td>26.2</td>
<td>113.2</td>
<td>254.0</td>
<td>252.0</td>
<td>241.5</td>
<td>260.3</td>
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<td>4.0</td>
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<td>256.5</td>
<td>289.6</td>
<td>353.0</td>
<td>407.0</td>
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<tr>
<td>South Africa</td>
<td>62.7</td>
<td>176.1</td>
<td>366.5</td>
<td>578.0</td>
<td>657.3</td>
<td>655.0</td>
</tr>
</tbody>
</table>

a No figures are available for Congo (Brazzaville).
b 1959.

An Italian-Japanese firm is constructing a tuna base. France buys substantial quantities of the tuna; the tuna fishermen are largely Basques who moved down here long ago and have developed a French market.

Most of the domestic consumption is unprocessed fish.

Ghana

Since independence, the government has been trying to improve the nutritional status of the average Ghanaian. As in many underdeveloped countries, the protein-deficiency disease kwashiorkor is a major problem. The officials plan to combat it by building up their fishing fleet. They have stern trawlers, side trawlers, freezing trawlers, and carrier ships either built or on order with a capacity of 150,000 metric tons or close to a trebling of present catches. In addition, irrigation dams are being built on the lower Volta River system, 213 altogether. These are being stocked with fish. The recent effective control of the tse-tse fly permits the exploitation of these resources.

With such an ambitious program naturally provisions would have to be made to care for fish in times of oversupply as well as for transporting fish into the interior. The latter problem is being solved by a fleet of refrigerated and open trucks.

A U.S. firm has refrigeration and processing facilities for tuna at Tema, near Accra. Their products are exported.

The government is building a cannery for sardines, salmon, and other fish as well as refrigerated storages, also at Tema. A smoking plant was built to aid in prolonging the shelf-life of fish for domestic consumption.
Japan, Norway, the U.K., U.S., and U.S.S.R. are all giving technical assistance to Ghana. China is largely active in the field of the freshwater resources.

In December 1963 an agreement was signed with U.S.S.R. for the long-range buildup of the marine fisheries of Ghana. A permanent joint commission was created for research and development.

**Togo**

Slightly over one third of Togo's landings are from the rivers of Oti, Mono, and Kara; several hundred basins as well as the brackish Lake Togo are stocked by the government. Most of the catches are consumed locally, unprocessed. Smoking, salting, and drying are commonly practiced but with primitive methods.

**Dahomey**

Only one fifth of Dahomey's fish landings are from the sea; the remainder come from fresh water. Although the Niger forms only part of the northern boundary it is the source of most of the fish, since this river is abundant in fish. The coastal lagoon, Lake Aheme, also furnishes part of the catch.

**Nigeria**

Like many of the new nations, the Nigerians have tried to improve the nutritional status of their people. One of their chief problems is the protein-deficiency disease, kwashiorkor. Therefore special attention is being given to the development of their fisheries.

Slightly over half the catch is from fresh water, one half of this from Lake Chad. Of the marine landings, over 87% is caught by canoe fishermen along the coast. Most of the marine fish is eaten fresh as is most of the non-Lake Chad fish. Most of the Lake Chad catch is smoked and dried, but is usually infested with insects, mainly dermestid beetles. These infestations can cut the protein content as much as 40%. Salting has been introduced in recent years in order to control the beetles. The dried smoked fish is usually sold in the southern cities. The bongal (Ethmalosa spp.) which is abundant in the Niger delta region is also smoked in quantities.

The Gulf of Guinea is being fished for tuna by at least four nations. The Japanese have been negotiating for a base at Lagos. The Nigerian government has plans for a terminal island complex of facilities for unloading, freezing, storage, reduction, and canning, which could also be used as a transshipment base. Poland is rendering technical advice in the development of their fisheries. A joint Nigerian-Polish company is
operating out from Lagos with modern Polish stern trawlers of the "Dalmor" class.

CAMEROUN

This former French colony has only a limited coastline (186 miles). However, it is cut by numerous salt water lagoons which experts believe will become excellent fisheries.

It is too early to ascertain the potential of these sea fisheries. In 1960 only 6.1% of the total catch of 49,000 metric tons was from the sea. The bulk of the landings came from fresh water. Like most underdeveloped areas, the vast majority of the catch is consumed fresh. It is probable that until the catch exceeds the demand for fresh fish there will be little need for processing. However, if the sea fishing expands as expected, facilities for processing will undoubtedly be erected.

CONGO (BRAZZAVILLE)

The government of this former French colony has not released figures for their fisheries. This may be due to the fact that the majority of the catch is caught by natives in small boats who land their fish at many places along the coast and rivers.

A pilchard and tuna cannery has been operating in Pointe-Noire for some time. In 1961, it processed 450,000–500,000 cans per month. By autumn of that year the output had nearly doubled the 1960 monthly average of 375,000 cans. Most of the products are marketed within the Equatorial Customs Union.

A U.S. firm has been negotiating with the Congolese government for the erection of an additional fish-processing plant and refrigeration facilities at Pointe-Noire.

CONGO (LEOPOLDVILLE)

Lake Tanganyika, like Lake Baikal, is geologically very old. Almost 75% of the fish species found in Lake Tanganyika and its tributaries are endemic. The lakes of Central Africa and the Congo River system are the source of almost all fish landed. Pond cultivation of tilapia has been encouraged on a large scale.

Before the recent independence the Belgian officials, appalled by the high incidence of kwashiorkor among the natives, had built wharves, a 20 tons per day ice plant and cold stores, workshops, and offices capable of handling 550 tons per month a few miles south of Matadi on the Congo estuary. Not much is known of what has become of these facilities in the last few years.

Probably the country's largest fishery is in Lake Tanganyika, which
stretches for about 400 miles along the eastern frontier. About two thirds of this catch consists of two species of clupeids, similar to sardines and treated in the same way.

Disposition figures for the fish caught are not available.

**ANGOLA**

The Benguela Current coming from the Antarctic contains a rich marine fauna. The natives have fished these waters for centuries, and European participation dates from 1571. Fish processing in this area dates from the middle of the last century. Since much of the adjacent land is arid, the climate is ideal for drying of fish, still an important source of animal protein for natives in the interior. Until the development of the fish meal industry much fish was wasted. Before the introduction of the modern industrial method, sun-dried fish were ground into meal of low protein content. The meal is sold largely in Italy and Eastern Europe and directly to the Far East, chiefly Hong Kong and Singapore.

Horse mackerel and related fish constitute three fifths and pilchards and other oily fish one fourth of the catch.

For the last few seasons a Japanese fish meal factory ship, that spends the regular season in the eastern Bering Sea, has been anchoring off the Angolan coast and buying fish from the natives. This has created international friction since the Angolan factories need the fish. There are some 9 large and 36 small fish meal factories operating along the coast. There are two major plants in Luanda and a third under construction at Porto Alexander (Porto Alexandre) in the south. Fish oil is burned in some places to heat the fish meal dryers. Total oil production is 2000 metric tons.

The Japanese are also buying frozen dressed redfish for their own markets. The viscera, head, and fillet trimmings go to Angolan reduction plants.

The fish-canning industry is centered at Moçâmbedes (Mossâmbedes) at Baía Farta, and is confined to tuna and mackerel. Around 1,500 tons of canned tuna are produced annually, but the demand cannot be supplied.

The pilchard catch from Tiger Bay (Baía des Tigres) bordering Southwest Africa goes for the manufacture of fish meal.

The fishing grounds off Angola were surveyed in some detail during 1963 with the cooperation of Japanese experts. On the outcome of these investigations hinges the prospect of future continued Japanese engagement in Angolan fisheries.

The coastal area has an abundance of lobsters, crabs, and shrimps, particularly off Luanda.
In Baía Farta there is a coastal fisheries records station. A central fish institute was started by the government in 1960. This agency controls all fisheries activities and has subdivided the country into three major regions (North, Central, and South).

**SOUTHWEST AFRICA**

The Benguela Current which flows north just west of southern Africa makes the Southwest African fisheries very productive. Walvis Bay is the major center for these fisheries. It is one of the most important fish bases of the world and was founded as a base for U.K. whaling ships. With the decline of whaling, its importance was reduced.

Around 1948 the main activity here was seasonal snoek fishing and catching of rock lobster which were taken to the Lüderitz cannery and freezer. Since 1949 the Walvis Bay pilchard landings have increased over 43 times. There are now six canneries there with a total quota of 600,000 tons of fresh fish to be processed. The maximum quota for the next 25 years has been set at 720,000 tons. Two new canneries will be built by 1965. About one third of the present population of 15,000 depends on the fish industry, either directly or indirectly. It takes 55,000 tons of fresh tomatoes to supply the puree for those canned in tomato sauce.

Since this former German colony was mandated to South Africa after World War I, its economy is often incorporated both statistically and administratively.

**SOUTH AFRICA**

South Africa is one of the major fishing nations of the world. About three fifths of the landings is pilchards or South African sardines. Cape hake and other cod-like fish make up one seventh, tuna one tenth, and maasbanker (horse mackerel) and related species one twelfth. Crustaceans, mainly rock lobsters, account for only 1.3%.

Almost half the catch is reduced to meal or oil, one fifth eaten fresh, one sixth cured, one ninth canned, 6.1% frozen, and 0.2% for miscellaneous purposes.

Perhaps the most widely known South African marine product is rock lobster tails. Most are frozen and shipped to the U.S. The offal of the lobster is processed into meal. Live lobsters have recently been shipped to France by air.

The best of the surplus Cape hake is filleted and smoked to produce Cape cod fillets for the export trade. Some is quick-frozen and sawed into fish sticks which are marketed unbreaded, unbattered, and uncooked. A comparatively recent development is the salting and drying of this species. One dehydrating plant has a capacity of 70 tons per day. About
half the produce is unsalted. The hake livers are used to process liver oil. The offal and excess quantities (unsalable) go to the fish meal factories.

The pilchard catch is the backbone of the industry, and forms the foundation of the fish meal industry. A new plant at Gansbaai on the south coast is capable of handling 20 tons of fish per hour. It has two reduction lines, one of 15 tons and one of 5 tons. This plant is building its own fishing fleet.

Canning is an important way of preserving South African catches. In fact, South and Southwest Africa together are surpassed only by Japan and Portugal in volume of canned fish products exported. The pilchard catch is the basis of much of the canning industry. From 1944 to 1962 the output of canned pilchards increased over 74 times. One plant at Hout Bay produces 54 different fish products. Maasbanker and mackerel are also canned, totaling about one fifth of the pilchard pack. Snoek (the South African tuna) is not canned to a great extent; most are used fresh, but those landed north of Saldanha Bay are usually salted.

The fisheries of South Africa produce considerable amounts of oils, such as the hake-liver oil mentioned, and many body oils as well. Pilchard oil is one of the leaders. One ton of raw meal produces 10–16 gallons of oil. Most of the maasbanker oil is hydrogenated or otherwise processed for human use; pilchard oil is usually used for industrial purposes.

Unlike the U.S. and Peru that use mainly fatty fish for meal, South Africa uses nonfatty fish. A great potential for food to the undernourished colored population would therefore be the conversion of such meal into fish flour (fish protein concentrate) for human use.

XII. Southwest Atlantic

The Guianas

The Guianas (British, French, and Dutch Guiana or Surinam) on the northeast coast of South America are the only colonial holdings on the continent. Most of the catches are unsorted fish, around three quarters of the total; the remainder are chiefly shrimp. Surinam takes one tenth

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</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>55.3</td>
<td>71.2</td>
<td>78.1</td>
<td>100.9</td>
<td>93.7</td>
<td>94.4</td>
</tr>
<tr>
<td>Brazil</td>
<td>103.3</td>
<td>144.8</td>
<td>174.3</td>
<td>257.1</td>
<td>281.7</td>
<td>—</td>
</tr>
<tr>
<td>Uruguay</td>
<td>3.6</td>
<td>3.5</td>
<td>4.1</td>
<td>8.0</td>
<td>8.8</td>
<td>5.9</td>
</tr>
</tbody>
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of its catch from freshwater resources. Most of the fish is consumed fresh; the shrimp from all three countries is quick-frozen and largely exported. Shrimp is caught the year around off the coast of Surinam.

Japan is helping British Guiana to develop her fisheries. U.S. firms have built shrimp packing plants at Cayenne and St. Laurent, French Guiana.

BRAZIL

Croakers, mullets, and the like make up one third of the total catch, fresh-water fish one fifth, sardines, anchovies, and menhaden one sixth, shrimps and other crustaceans one ninth, and one tenth is sold unsorted.

The Amazon River system probably has the greatest unexploited fishery of any fresh-water source in the world. Unfortunately, the underdevelopment of the region is not conducive to a rapid expansion of this resource. Manaus is 1,000 miles from Belem. The pirarucu (*Arapaima gigas*) found only in the Amazon is the largest fresh-water fish in the world, frequently weighing 200 lb. or more. It is filleted on the river bank, lightly salted (about 10% salt), and dried for the use of rubber workers and other inhabitants of the region. The fierce piranha makes a tasty meal. Over 1,800 species of fish have been collected in this area. Other sources of nonmarine fish are the Sao Francisco and Parana Rivers and Lake Mirrim. Two land-based whaling stations are operating in southern Brazil.

Most of the sea fisheries are located on the continental shelf which extends along Brazil's long coastline. The most extensive shrimp fisheries are along the Santa Catarina and Rio Grande do Sul coasts, especially in Lagoa dos Patos. The industry is centered around Isla de Santa Catarina. Shrimp is frozen for export at Belem and Sao Luiz in the north. Blast freezers have been installed at Recife for the processing of lobster tails.

The canning industry is concentrated on the southern coast from Rio de Janeiro to the Uruguayan border. Sardines form the bulk of the pack.

Besides the pirarucu, sea fish also are salted. In Rio Grande do Sul the chief species are croakers, drums, weak-fish, and catfish. Farther north flying fish are salted and sold in the interior. Sand smelt (manjuba) has been canned experimentally in the state of Sao Paulo.

The fish meal industry is comparatively minor. In 1960 there were only 16 small plants operating mainly around Rio de Janeiro (at Niteroi) and in Rio Grande do Sul. Most of the raw material used for fish meal is offal and other scraps from processing plants. Occasionally whole fish may be used to raise the protein content of the final product.

The Japanese have been helping the Brazilians to develop their
fisheries. The introduction of modern methods caused some resentment among the native fishermen with their jangadas. The differences were finally settled when the Japanese agreed to train Brazilian fishermen and transferred some of their ships to Brazilian registry.

**Uruguay**

Of the total catch two thirds is hake, pollock, and forkbeard, one sixth of the mullet group, one seventh unsorted, and 2.1% elasmobranchs. More were undoubtedly caught since no fresh-water fish are listed and Argentina catches over 14,000 tons largely from the River Plata, the boundary river between these two countries.

In the absence of statistics it is assumed that most of the fish is consumed unprocessed.

**Argentina**

Argentina's fish and shellfish landings have shown a steady increase over the last two or three decades. The total catch is composed of two fifths hake and related fish, over one seventh sabalo (*Prochilodus platensis*) and other fresh-water fish, one eighth tuna, one ninth anchovies, one tenth of the ocean perch group, and 7.2% molluscs. In 1960, over half the catch was consumed fresh, almost two fifths canned, 5.0% went for reduction, 4.8% frozen, and 0.8% cured.

The fish are caught mostly on the continental shelf which extends out about 200 miles along the Argentina coast. The Rio de Plata, actually an estuary extending up the Uruguay and Parana Rivers, varies from fresh to salt water. The majority of the fresh-water species come from this region. The cold Falkland Current brings nutrients from the Antarctic which favor the hakes and anchovies and other species not important as food fish, but nevertheless forming significant links in the food chain.

Fish such as skate, tuna, and horse mackerel are considered trash fish in Argentina.

The canning industry was originally based on sardines and anchovies but now bonito and mackerel are also processed. The center of this industry is Mar del Plata which has about 80 canneries. This city is also the center of the comparatively new frozen fish industry; the frozen fish are shipped via refrigerated trucks to Buenos Aires. Mar del Plata also has a fish meal and oil-processing plant. A new reduction plant is being built at Puerto Deseado in the south. In 1960 there were 16 reduction plants in the country. Ten of these processed freshwater fish.

The large red-shrimp industry is centered at Rawson. This species forms the bulk of the export trade. However, the bulk of the catch is the common shrimp. This fishery is also centered at Mar del Plata where
there are four shrimp-processing plants. The largest one can freeze over 450 metric tons of shrimp per month. This species is also canned. At this port there is also a fish concentrate plant, employing enzymatic proteolysis for the manufacture of a mixed fish and meat paste.

Japan has recently been aiding Argentina in the development of her fisheries. Through Japanese influence the industry has initiated skipjack (bonito) canning.

Lack of adequate refrigeration facilities, both at the ports and, more so, in the interior, has retarded the expansion of the frozen fish trade. Also in this field Japanese influence is felt.

Salted lingcod has been substituted in some places for the popular bacalao (salted cod). There is probably a chance for expansion along this line.

**BOLIVIA**

Landlocked Bolivia landed 500 metric tons of fresh-water fish in 1961. Lake Titicaca probably supplied the bulk, although Lake Poopo and the numerous lakes on the headwaters of the Madeira River and its tributaries are local sources. Since the quantity is not great, most is probably consumed unprocessed with some dried locally for winter use.

**XIII. Southeast Pacific**

**CHILE**

Chile's fish industry was not greatly developed until very recently. The Chilean government has undertaken a strong promotion campaign to increase fish consumption, seeking both an expansion and stabilization of the fishery industry and to improve the diet and nutrition of the Chilean people.

**Table XII**

**Southeast Pacific Fish Catch**

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<tr>
<td>Chile</td>
<td>32.2</td>
<td>64.6</td>
<td>155.0</td>
<td>339.7</td>
<td>429.8</td>
<td>638.6</td>
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<td>Peru</td>
<td>—</td>
<td>47.7</td>
<td>179.1</td>
<td>3,531.4</td>
<td>5,243.1</td>
<td>6,830.0</td>
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<td>Ecuador</td>
<td>1.8</td>
<td>3.4</td>
<td>12.2</td>
<td>43.2</td>
<td>60.2</td>
<td>52.4</td>
</tr>
<tr>
<td>Colombia</td>
<td>10.0</td>
<td>15.0</td>
<td>17.0</td>
<td>29.7</td>
<td>47.5</td>
<td>51.7</td>
</tr>
</tbody>
</table>

In the edible-fish industry, 41,000 tons of shellfish and 52,000 tons of other fish were used in 1961, compared with 20,000 and 46,000 tons, respectively, in 1951. Of this three fifths was sold unprocessed for local consumption, one fourth canned, one tenth frozen, and 0.7% dried.

The most significant increases in the past decade have been in the production of frozen and canned fish as well as in the export of frozen
and canned crustacean shellfish, mainly centolla crab from the Humboldt Current.

CORFO (Government Development Corporation) is erecting a canning unit to produce annually 360,000 cases containing 48 lb. of sardines and a second line 400,000 cases of tuna and bonito. The freezing plant will have a capacity of 100 tons of whole fish per day and storage space for 1,000 metric tons of frozen fish. Finally, a reduction plant is being installed, designed to handle 30 tons of fish meal per hour, largely anchovies. This fish-processing complex will be manufacturing approximately one third each of (1) canned fish, (2) frozen fish, and (3) fish oil and meal. CORFO is also supporting the installation of additional large meal plants. South African, U.S., and Norwegian companies are partners in modern units being built at Iquique in northern Chile.

Several new fish meal plants have been built in the same region and several older ones have been re-equipped and expanded. The chief catch for these reduction plants is the “anchoveta,” identical with the species caught off the coast of Peru.

Peru

Peru has become the third largest fishing nation of the world. The growth began about 1956 with the initiation of anchovy (anchoveta) fishing on a large scale for industrial purposes. About 5 million tons, 96.1%, of the 1961 Peruvian catch was anchoveta, the abundant raw material from which the major product of the industry, fish meal, is made. Other fish industries in Peru are fish oil, frozen fish, canned fish, and protein concentrates.

In 1961 there were 101 fish meal plants. In northern Peru, some 48 fish meal plants are reportedly in operation or under construction in Chimbote alone. In the course of the last two years, Peru has become the leading world supplier of fish meal. Exports of fish meal constitute the bulk of Peru's fisheries industry shipments, exceeding four fifths of the total (see tabulation).

<table>
<thead>
<tr>
<th>Fish Meal Production and Export (1000 metric tons)</th>
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<tbody>
<tr>
<td>Production</td>
</tr>
<tr>
<td>1938: —</td>
</tr>
<tr>
<td>1950: 1.1</td>
</tr>
<tr>
<td>1955: 20.1</td>
</tr>
<tr>
<td>1956: 31.0</td>
</tr>
<tr>
<td>1957: 64.5</td>
</tr>
<tr>
<td>1958: 126.9</td>
</tr>
<tr>
<td>1959: 332.4</td>
</tr>
<tr>
<td>1960: 558.3</td>
</tr>
<tr>
<td>1961: 839.8</td>
</tr>
<tr>
<td>1962: 1,121.0</td>
</tr>
<tr>
<td>1963: 1,380.0</td>
</tr>
<tr>
<td>Export</td>
</tr>
<tr>
<td>1956: 27.8</td>
</tr>
<tr>
<td>1957: 61.7</td>
</tr>
<tr>
<td>1958: 105.8</td>
</tr>
<tr>
<td>1959: 277.6</td>
</tr>
<tr>
<td>1960: 507.0</td>
</tr>
<tr>
<td>1961: 708.4</td>
</tr>
<tr>
<td>1962: 940.5</td>
</tr>
<tr>
<td>1963: 1,160.0</td>
</tr>
</tbody>
</table>

* Compiled by the National Fisheries Society, Peru.
Many existing plants are doubling their facilities rapidly and numerous new plants will be coming into production within the next few months. With the increased capacity, another million tons could be added annually to Peru’s fish meal production by 1964. The availability of fishing vessels is considered to be a limiting factor for such increases. Progressively larger vessels with increased range and speed are being built to help cut costs, but there are several signs of limitations in fish supplies reflected in smaller catches per comparable fishing effort. There are further annual fluctuations in stocks which some years are pushed out to sea due to deviations of the current along the coast.

Fish oil is a by-product of the fish meal production process, and has recently become important as producers seek ways to improve efficiency of operations and to reduce costs. In 1961 89 plants were producing crude oil with a production of 118,900 tons, an increase of 147% over the 1960 production of 48,200 tons. Peru has become the leading world supplier of fish oil also.

Except for the preparation of oil from turtles at Pisco and the capture of whales at Tumbes, there is no fishery for oils in Peru.

**Freezing and Canning**

There has been little change in the freezing and canning of fish which continue to be a small but important part of the over-all fisheries industry.

Seven plants produced 22,300 tons of frozen fish in 1961, an increase of 23% over 1960 production. About 90% of the frozen fish is exported, normally most to canneries in the United States, especially to Puerto Rico, which took 77% of the exports in 1961; the remainder went chiefly to Italy.

Bonito is the basis of Peru’s canning industry. Some 80% of the fish canned in 26 plants along the Peruvian coast in 1961 was bonito. Of 24,000 tons of canned fish produced in 1961, 80% was exported.

The tuna-canning plants are closing because of depressed prices, high costs, and the more advantageous use of equipment in supplying anchoveta to fish meal plants.

Two Peruvian fishing companies in spring 1963 purchased a U.S. vessel ("Neva") for a tuna-canning factory ship. They plan to produce about 100,000 cases of canned tuna per month. In addition, this vessel has quick-freezing machinery and a cold storage facility.

This product may become increasingly important, not only because it can be spray-dried to produce a cheap dehydrated protein (or amino acids) but also because it appears to have excellent nutritive value.

Fish flour from anchoveta and anchoveta that is sun-dried and salted
are both found to be excellent sources of protein in supplementary foodstuffs for the indigenous population, particularly in the Andes.

There are many other regional methods of preserving fish and fish products for local consumption, such as the dried eggs of the "voladov" or flying fish, called "cau-cau," which can be kept for about a year, or "charquecito," made from the congro (conger eel). Congrios are opened, cleaned, washed in salt water, and hung to dry for 6–8 days. There are many other examples of sun-drying and salting.

**Ecuador**

The 1961 catch was 7 times the amount taken in 1952, and over 33 times the 1938 figure. This phenomenal growth is linked primarily to the intensified tuna fisheries of this coast. Practically half the landings is from the tuna group, 6.6% crustaceans, and 2.0% mulluscs. The remainder is miscellaneous food fish for domestic consumption, largely unprocessed.

In 1962, freezing plants started operation in Manta and Puerto Lopez chiefly for preserving the catches of small fishermen. The Development Program for Ecuador is implementing freezing plants and starting chilling facilities in the fish markets of major cities.

In 1963 the government granted a permit to a U.S. freezer ship to purchase fish in Ecuadorean waters for one year. The agreement provided for the owners to submit a plan for the establishment of a land-based freezing plant and a 5-year operating plan.

Japanese catches of tuna and shrimp will be sent to a freezing plant at Quito. The shrimp is later exported to the U.S. A U.S. supermarket company has installed a freezing plant in Ecuador and plans to buy there about 50,000 lb. per week of lobster and shrimp. A Japanese firm is to participate in the establishment of a processing plant for packing tuna and manufacturing its by-products.

**Colombia**

The 1961 catch was almost 5 times the 1938 catch, and over 1.5 times the previous high, landed in 1957. Although Colombia has a longer Pacific coastline than Caribbean, only about 6% comes from the west coast. The numerous bays and inlets along the north coast make good fishing grounds. The Magdalena River is an important source of the fresh-water fish which comprises two fifths of the total. The ocean perch group makes up almost two fifths, sardines one tenth, and crustaceans 4.2%.

Most (over three fourths) of the fish is consumed unprocessed, one seventh cured, and 6.9% for miscellaneous purposes. There are fish canneries in each of the three major fish ports, Cartagena, Baranquilla, and
Santa Marta. However, the total pack is small. There is also a freezing plant with 30-ton daily capacity, but storage facilities are not adequate.

Much of the fresh-water fish is salted on the spot under rather unsanitary conditions. Over two thirds is characids (Characidae) and one fourth catfish. In the shrimp fisheries, most of which are in the estuary waters near Baranquilla, 600,000–1,000,000 lb. are harvested annually. Much of this is exported.

The sea fish are usually caught within 20 miles from the coast at less than 100 fathoms. Japan has recently been surveying the nearby waters for tuna.

XIV. Middle America

**British Honduras**

The fisheries of British Honduras could be developed much further. The low coast has numerous lagoons with numerous creeks and rivers flowing into them and a wide continental shelf, factors that point to good fishing. However, since the population of this British Crown Colony is low, there has been little demand for fishery development. Most of the catch has come from within 20 miles of the coast by native craft. The majority is consumed unprocessed.

Fish caught off the offshore bays is largely salted and dried for the Belize (the capital) market. Spiny lobster tails are frozen and shipped to the U.S.

**Guatemala**

Most landings are classified as unsorted fish and most is consumed unprocessed. A joint Japanese-Guatemalan shrimp-fishing company was established at Champerico toward the end of 1961. In its first year the company produced about 590 metric tons of shrimp (heads off), shipped mostly to Los Angeles and New York. Base facilities at Champerico include a 100-ton capacity refrigerated plant and a quick-freeze unit of 12.5-ton capacity.

Other shrimp-freezing plants are now operating at Guatemala City and San José. The estimated shrimp production for 1962 was 900 metric tons.
An inland fisheries research center has been created at Barcena not far from Guatemala City. Several types of fish are studied here and can be profitably cultivated. Many lakes have been stocked for subsistence purposes and several farms have initiated pond cultivation.

**Honduras**

Almost nine tenths of the landings is marketed as unsorted, 8% is crustaceans, and 4% molluscs. Like most Central American republics the shrimp, which forms the bulk of the crustaceans, is mostly exported. There are three shrimp-processing plants, at Caratasca, Guanaja, and Puerto Cortes. The first two can each freeze 6.3 metric tons of shrimp per 24 hours and have cooler space for 56.7 metric tons of processed shrimp. The last has a capacity of 158.8 metric tons, but much of its space is used for beef.

Aside from about 40 miles on the Gulf of Fonseca, all of the coastline is on the Caribbean side and is low with numerous shallow lagoons that make good fishing grounds. The small native boats can be used without venturing into the open sea. Specialists maintain that the lagoons could be developed into very productive fisheries.

Many species such as mullet, shoo, tarpon, snapper, grunt, etc. are found along the coast. During certain seasons anchovy, king mackerel, and Spanish mackerel appear in commercial quantities. Turtles are plentiful. Salting and drying are common methods of preserving fish. Farm cultivation of carp and guapote (*Cichlasoma managuense*) has been successfully introduced and is rendering good yields.

**El Salvador**

All fish was classified as unsorted and it is assumed that most was disposed of unprocessed. In addition, two thirds as many shrimp was caught. There are four shrimp-freezing plants, two at Puerto El Triunfo and one each at Puerto La Union and San Salvador. The larger one at El Triunfo can freeze 40,000 lb. of shrimp in 16 hours. Most of the frozen shrimp is exported.

The lakes are heavily fished and a number of farm fish ponds (more than 50) have started producing.

**Nicaragua**

Landing statistics are not available. Most of the fish is taken by small craft. Nicaragua has more than 190 miles of coast on the Pacific and about 280 miles on the Atlantic. In addition, Lake Nicaragua with an area of about 3,000 square miles is the largest lake between the U.S. and Peru. This lake is peculiar in containing the only known species of fresh-
water shark. Most of the fish is undoubtedly consumed unprocessed. A second big lake, Lake Managua, is rated as capable of rendering 5,000 tons of fish per year, 40% of which would be first class quality. On the whole, Nicaragua has more than one million hectares of waters with good fish-producing potentialities.

In the last few years the shrimp-fishing industry has mushroomed. Most shrimp is exported. In 1961, 432 metric tons of headless shrimp was exported, mostly fresh and frozen, and 688 tons in the first 7 months of 1962. Freezing plants have been built at Corinto, El Bluff, and Puerto Somoza. There is a processing plant for spiny lobsters on Corn Island.

**COSTA RICA**

One third of the catch is listed as unsorted. Crustaceans, mainly shrimp, account for another third, tuna represents over one fourth. An interesting feature is the fact that one tenth of the harvest is turtles. Aside from the tuna and shrimp, most products are consumed unprocessed. The turtles, hawkbills, and other species are kept alive in "kraals" or pens at Port Limon until sold. Some are shipped by air to the U.S.

The shrimp industry is based at Puntarenas on the Gulf of Nicoya on the west coast. This port is also the chief fishing port. Before World War II it was an important tuna base with one of the largest freezing plants in Central America and a cannery. In 1947-48 the "red tide" killed all the sardines along the coast so that bait for tuna was no longer available. Consequently its importance declined and the freezing plant was converted to shrimp processing. Sardines were re-introduced from Panama and the tuna industry is being revitalized. Most of the locally processed tuna is sold on domestic markets.

Shark meat is dried and salted along the northeast coast and shipped to the interior where it is sold as "dried fish, codfish-style."

**PANAMA**

A little above half (54.9%) the sea catch is marketed unsorted, probably caught by small fishing craft and sold locally. The rest of the catch is crustaceans, mainly shrimp.

The Caribbean coast is about 480 miles long, the Pacific about 770 miles. The major portion of the commercial catch is corbina (*Pseudocaena deliciosa*), red snapper, Spanish mackerel, grouper, pack, mullet, snook, and threadfin (*Polynemidae*).

Most of the shrimp is found on the Pacific coast, centered in the Bay of Panama. The main base is on Taboga Island. Most of the frozen shrimp is flown to the U.S.
XV. Northeast Pacific

The sea catch of the United States and Alaska and also of Canada is discussed in Section VII.

XVI. Northwest Pacific

JAPAN

Fishing has an ancient tradition in Japan and was a characteristic feature of the first inhabitants of these islands, the Ainus, who subsisted largely on shellfish in earlier periods and later developed extensive fishing.

TABLE XIV

NORTHWEST PACIFIC FISH CATCH

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<tbody>
<tr>
<td>Japan</td>
<td>3,562.0</td>
<td>2,431.4</td>
<td>4,659.7</td>
<td>6,192.5</td>
<td>6,710.5</td>
<td>6,863.7</td>
</tr>
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<td>North Korea</td>
<td>925.2</td>
<td>275.0a</td>
<td>223.0</td>
<td>604.6c</td>
<td>730c</td>
<td>840c</td>
</tr>
<tr>
<td>South Korea</td>
<td>838.3</td>
<td>285.2</td>
<td>259.4</td>
<td>357.2</td>
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<td>China</td>
<td>1,500.0</td>
<td>490.0a</td>
<td>2,234.0</td>
<td>5,020.0b</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>—</td>
<td>34.3</td>
<td>44.1</td>
<td>62.3</td>
<td>63.1</td>
<td>71.0</td>
</tr>
<tr>
<td>Taiwan</td>
<td>89.5</td>
<td>83.5</td>
<td>154.3</td>
<td>259.1</td>
<td>312.0</td>
<td>327.0</td>
</tr>
</tbody>
</table>


of herring, salmon, etc. The Japanese islands are surrounded by an intricate series of currents, warm and cold, creating massive upswelling whereby active mixing of waters takes place. This favors conditions for good plankton production and indirectly for rich fisheries. The Japanese coastline is mostly irregular, indented by innumerable large and small bays. Several afford large areas of shallow water protected from the violence of the sea.

As a result of damage to the nation’s fishing fleets during the war, the catch was reduced to a low of 1.8 million tons in 1945. The industry managed, however, to make a remarkable postwar recovery. In 1952

JAPAN’S AQUATIC HARVEST

<table>
<thead>
<tr>
<th>Year</th>
<th>Catch (MILLION METRIC TONS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1925</td>
<td>2.77</td>
</tr>
<tr>
<td>1930</td>
<td>3.34</td>
</tr>
<tr>
<td>1935</td>
<td>4.15</td>
</tr>
<tr>
<td>1938</td>
<td>3.56</td>
</tr>
<tr>
<td>1940</td>
<td>4.47</td>
</tr>
</tbody>
</table>

a Including seaweed, but not whales. The catches in the 1930’s do not include the catches of the colonial empire.
the aggregate catch was 4.5 million tons, or more than the prewar record, and the catch has been steadily increasing ever since with a lull in 1963.

The fishing industry of the homeland is centered in some 3,200 villages distributed along the entire coastline of these islands. The large-scale fishing operations, which account for about a third of the total landings each year, are centered in the large ports.

The significance of coastal fisheries is consequently diminishing while long-distance fishing and pelagic fishing are increasing. This has affected the composition of the aquatic harvests. There is a notable decline in sardine and herring, while the catches of saury, mackerel, tuna, cod, and cuttlefish have greatly increased.

Offshore trawling was earlier concentrated in the East China Sea, Yellow Sea, and South China Sea but has in latter years extended to the entire Pacific and finally to all oceans of the globe. Japan is to an increasing degree depending on deep sea fishing operations. Fleets of large tuna ships, usually 200–400 tons, and trawlers constantly increasing in size (2,000–3,200 tons) are now operating in the Indian Ocean as well as the Atlantic.

Several catches have reached or exceeded the half million ton mark: squid, flatfish, horse mackerel, tuna (including skipjack), and saury. The sizable tuna catches are related largely to the general expansion of high sea fishing. This tuna is generally frozen for canning, while that caught in adjacent waters is taken for direct canning to inshore installations.

Total Catch of Tuna (1000 metric tons)

<table>
<thead>
<tr>
<th>Year</th>
<th>TunaCatch</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>181</td>
</tr>
<tr>
<td>1956</td>
<td>232</td>
</tr>
<tr>
<td>1957</td>
<td>279</td>
</tr>
<tr>
<td>1958</td>
<td>280</td>
</tr>
<tr>
<td>1959</td>
<td>331</td>
</tr>
<tr>
<td>1960</td>
<td>389</td>
</tr>
<tr>
<td>1961</td>
<td>493</td>
</tr>
<tr>
<td>1962</td>
<td>525</td>
</tr>
</tbody>
</table>

Japan's trawler fisheries in the early 1950's began an elaborate campaign to find new fishing grounds and this search has been pursued persistently. As a result several new grounds have been opened up for exploitation in the South Pacific, Indian Ocean, and Middle Atlantic.

A new fishery, that of saury, is actively carried on north of Hokkaido and Honshu and now holds first rank among fisheries in terms of economic returns. There are indications that overfishing is taking place, as 1963 was a poor year.

Most of the saury catch is canned and some is exported, but most is consumed in the homeland. Skipjack is eaten raw, boiled, or roasted; it is most valuable when processed into katsuwo-bushi (see below).
Fresh-Water Production

The extensive industrialization has caused the use of hydroelectric resources to the utmost and induced widespread pollution of both coastal and fresh waters. This partly explains the drop in the coastal catch and the drastic decline in fresh-water fishing. It is also felt in the rice fields where intensive use of artificial fertilizers and chemical sprays has affected production.

Floating Factories and Motherships

CANNING

Floating canneries preceded the present freezing trawlers. They were used early by the United States in Alaska. These vessels were equipped for canning and also for waste processing. They were, however, land-based. Japan started to move out to high sea fishing as early as the 1920's, and later entered into competition with the Soviet Union by catching and processing salmon off the Soviet Pacific Coast.

The tuna-canning factories also serve the King crab fishing and salmon fishing of the North Pacific. They are 5–8,000 tons and carry complete canning lines. They are in turn served by fishing vessels generally based in Hokkaido.

Due to Soviet objections, only a few Japanese factory ships are allowed in the Sea of Okhotsk for the catch of salmon and crab. This has forced Japan to long-distance fishing in the Bering Sea and for other than salmon in the Gulf of Alaska. Several Japanese trawlers have been catching crab in the Bering Sea. Motherships of 5,630 gross tons have come with catcher vessels, each of 400 metric tons. A second mothership operates with four such catchers and four portable so-called “kawasaki” vessels of 350 metric tons.

SALMON

The number of salmon-fishing mothership fleets in the North Pacific has been declining. In 1958 there were 16 such fleets; in 1963 only 11 Japanese fleets were seen in the North Pacific. Red salmon makes up 60% of the total catch.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total catch (1000 number)</th>
<th>Canned (1000 cases)</th>
<th>Salted (metric tons)</th>
<th>Frozen (metric tons)</th>
<th>Roe (metric tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1957</td>
<td>60,358</td>
<td>1,742</td>
<td>9,213</td>
<td>22,710</td>
<td>626</td>
</tr>
<tr>
<td>1958</td>
<td>49,798</td>
<td>1,567</td>
<td>5,429</td>
<td>23,032</td>
<td>822</td>
</tr>
<tr>
<td>1959</td>
<td>42,331</td>
<td>1,496</td>
<td>3,849</td>
<td>14,155</td>
<td>723</td>
</tr>
<tr>
<td>1960</td>
<td>26,424</td>
<td>1,221</td>
<td>2,099</td>
<td>12,117</td>
<td>501</td>
</tr>
</tbody>
</table>
CRAB

About 6 Japanese mothership fleets with 79 catcher boats have been fishing for crabs in the North Pacific, apart from salmon and bottom fish. Five floating canneries served the Japanese catchers in the Sea of Okhotsk. Since 1960, both canneries and freezing vessels have fished the eastern Bering Sea and the waters off Alaska.

King crab is both canned and frozen, generally at different seasons.

FREEZING

The extraordinary size and capability of the stern freezing trawlers employed in distant waters throughout the world by the great Japanese operating companies are highlighted by a new 2,500 ton class with freezing capacity of 214.5 tons of frozen fish. Several recent ships even exceed 3,000 tons (see further Volume IV, Chapter 11).

The fish factory ship "Shikishima Maru" (gross tonnage 10,150) has five refrigerated holds, a fish-meal manufacturing unit, and a salting room. About 230 tons per day of whale meat or fish can be frozen to —4°F. (—20°C.); 215 tons per day are placed in lots into 44 cabinets through which brine is circulated, and another 15 tons per day are frozen in a small plant provided with brine piping and an air blast system. The frozen products are stored in the holds maintained at —4°F. (—20°C.) by brine grid coils.

Most tuna ships are equipped with freezing facilities.

MULTIPURPOSE UNITS

Processing motherships follow the fishing vessels into the Bering Sea and the tuna fishing in the central Pacific. These factory ships are quite sizable, 5,000–20,000 tons. Besides extensive freezing installations, they may be equipped with processing lines for canning, fish meal production, and oil extraction. Leading this group of floating factories are those serving whaling fisheries.

A modern salmon fleet consists of (a) mothership of 7,000–10,000 gross tons, with a canning line of daily capacity up to 9,000 cases of salmon, a reduction plant for offal, and often a quick-freezing plant; and (b) 30–36 catcher boats of 75–85 gross tons, 280–400 h.p.

Among recent additions to the Japanese fishing fleet is a factory ship for freezing, canning, and processing of salmon and trout in the North Pacific. This also serves as a whale factory. It carries a fleet of 4–6 20-ton fishing craft transported on the foredeck or slung alongside on davits. Its maximum speed is 17 knots with a service speed of 14 knots.

Danish vacuum freezing units are reported to be installed on Japanese
factory ships, operating from Angola, for processing shrimp and crab meat. These freeze-dried products will be marketed by a U.S. firm.

**Transport Vessels**

Transport ships, generally refrigerated, serve the fleets, pick up their catches, and carry food and other essentials to the widely spread units. One type holds 1,250 tons of fish, another is 6 times larger. Merchant ships of several nations carry fish from the bases to Japan.

**Fish Meal Factory Ships**

Several large newly built fish-meal factories of more than 14,000 gross tons joined the Japanese fishing fleet in the 1960's. They have an average velocity of 17 knots. This is the prototype of future fish-meal factories. These fish meal factories have been operating in the eastern part of the Bering Sea in summer; in winter they have been dispatched to the waters of Southwest Africa, off Angola, or recently to Chilean waters. Fish meal operations have also started off the coast of northern Japan, comprising saury, herring, etc.

**Bases**

Japanese high sea fishing, in contrast to that of the U.S.S.R., is serviced by a world-wide net of bases and ports of transshipment. Besides storage facilities, these bases may have installations for freezing, canning, and waste utilization. This has held the Japanese fleet of factory trawlers and motherships on a more modest scale than that of the U.S.S.R. Approximately one fifth of their high sea catches is processed by motherships. The remainder passes through this global network of bases. The creation of these bases seems to be only at its beginning.

The globe is presently girdled by a large number of such operations at bases and transshipment ports, in almost every major region. In some 35 countries joint Japanese companies are registered for fishing and processing.

**Utilization**

Japan’s fish catches total some 6 million tons a year, of which about 76% is made into canned, caked (“kamaboko” and others), soy-preserved (“tsukudani”), salted, salted and dried, and other processed products. It is therefore of importance in the manufacturing of marine products to maintain freshness of fish before landing and during processing.

The traditional methods of drying and salting remain the main methods of utilization of Japanese catches. In terms of original fresh weight the aquatic foods are taken care of in the following major channels and relative amounts:
Curing: 2/5  
Fresh market: 1/5  
Freezing: 1/7  
Canning: less than 1/10  
Reduction: 1/7

The skipjack landings exceed 600,000 metric tons, the largest catch of this fish in the world. A large part is dried and salted, some fermented, and some canned, constituting an important export article to the Philippines and Singapore.

Japan has also the world's largest squid catch, around 650,000 metric tons. This is salted, dried, and to some degree made into various fermented products. A minor portion is frozen for use as bait.

Fisheries companies are currently diversifying production and broadening activities by canning meat, poultry, dairy products, and fruit juices, and by manufacturing sausages, mayonnaise, etc.

Ice and Chilling

Natural ice has been used through the centuries for chilling purposes. Now a large number of ice-making plants serve the fishing industry, some with a capacity of more than 100 tons a day. There are 5 factories producing more than 200 tons a day, and 25 factories producing 100–190 tons a day.

Freezing

Fish has been frozen for several decades, and frozen fish was actually available as relief food after the great earthquake of 1923 in the Kanto region. It has been increasing ever since, most rapidly in latter years, from an annual capacity of 300,000 tons in 1955 to over 600,000 tons in 1963. Japan is the second largest freezer of fish as human food next to the U.S.S.R. A number of trawlers are equipped with chilling and freezing installations. All ships for long-distance fishing have freezers or are served by motherships with freezing facilities. Frozen are (1) tuna for export (mostly for subsequent canning), and (2) cheaper fish for domestic use. Fish is also frozen for holding, thereby alleviating gluts on the fresh market. Frozen fish products are extensively used in the canning and manufacturing of fish sausages, fish paste, salted and dried products, etc.

Curing

Drying and salting have since time immemorial dominated the Japanese fish-processing industry and are still the leading methods for preserving catches of cod, herring, salmon, and mackerel. The drying plants are located largely in Hokkaido, where the catch is big in relation to the population. There are some 22,000 dehydration plants and 6,000
salting plants on this island, and 10,000 drying plants and 3,000 salting plants in the north of Honshu.

**Drying**

For a great sector of Japanese society, dried fish and shrimp are regular ingredients of the daily soup. For the rural population and several low purchasing power groups they represent the main sources of high quality protein.

Drying is frequently combined in conventional ways with salting, but more uniquely with fermentation, the chief product of which is katsuwo-boshi (see below). A special Japanese feature is the additional preservation attained through boiling the fish prior to drying. Boiled fish preserved in soy sauce—"tsukudani"—is also an important item. This is done with "iwashi" (sardines). Some 80–90,000 tons are manufactured each year of this type of dried food—the Japanese sardine and the sand lance ("tobis"). Shrimp is dried both commercially and in the home.

The breakdown of the approximate annual production volume is as follows (1,000 metric tons):

<table>
<thead>
<tr>
<th>Process</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dried</td>
<td>50,000–60,000</td>
</tr>
<tr>
<td>Salted and dried</td>
<td>105,000–110,000</td>
</tr>
<tr>
<td>Boiled and dried</td>
<td>120,000–130,000</td>
</tr>
</tbody>
</table>

**Salting**

Salting was quite common in the early days of the Japanese salmon activities in the Russian Far East. Both pink and humpback salmons were dry-salted in immense numbers. In 1915 no less than 50,000 barrels of pickled salmon were prepared in the Amur region, while the Japanese dry-salted about 6 million chum salmon including a few reds, and 80 million humpbacks or "salmon trout" as they are called in Japan.

Salt is now in short supply in Japan. Shoyu (soy sauce) with its high salt content serves this purpose. Several fishes (eel, salmon, etc.) are therefore preserved by adding soy sauce.

**Katsuwo-bushi**

Katsuwo-bushi is made by a combined smoking, drying, and mold-fermentation of skipjack flesh. Both in appearance and texture it resembles in its final form a stick of hardwood, hence the name "dried skipjack stick."

In addition to flavoring and dehydrating the fish, the mold aids in removing fat and in breaking down complex amino acids. The growth and scraping off of the mold, followed by sun-drying, are repeated.
several times. Mold growth ceases entirely when the flesh is thoroughly dehydrated.

Katsuwo-bushi is one of the most appreciated condiments in the Japanese diet. Shavings of the sticks are used to flavor soups called suimono and other dishes.

Canning

Canning industries started with the packing of fish (salmon, sardines) in the 1870's. The Sino-Japanese War (1894–95) and Russian-Japanese War (1904–05) gave canning an impetus at the end of the nineteenth century and beginning of this century. Many small canning plants were also built by the Japanese on the Kuril Islands, Sakhalin, and Kamchatka.

Canned tuna dominates the pack, followed by the new saury products. Among new tuna products on the market are (1) large tuna flakes in jelly, (2) tuna with vegetables, (3) tuna steaks, and (4) tuna in curry.

The present industry consists of 450 canners, half of whom specialize in marine products. The pack of around 25 million cases (48 cans) breaks down approximately in the following way:

<table>
<thead>
<tr>
<th></th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuna, bonito</td>
<td>6.0</td>
</tr>
<tr>
<td>Salmon, trout</td>
<td>4.5</td>
</tr>
<tr>
<td>Sardine</td>
<td>3.0</td>
</tr>
<tr>
<td>Saury</td>
<td>2.0</td>
</tr>
<tr>
<td>Mackerel</td>
<td>1.5</td>
</tr>
<tr>
<td>Shellfish</td>
<td>2.0</td>
</tr>
<tr>
<td>Others</td>
<td>6.0</td>
</tr>
</tbody>
</table>

Saury is the large new pack which was a newcomer on the scene in the latter part of the 1950's. Crab and shrimp canning is conducted in the Bering Sea on factory ships. Large can-making factories are operating in the islands.

Two thirds of the canned food output is consumed domestically; the rest goes overseas. The trend has been to retain a growing percentage of the pack for domestic consumption, leaving less for export, although the total pack has been increasing. Fish and shellfish continue to constitute the bulk of canned food exports, mainly salmon and King crab.

Fish Sausages

Due to the scare created against fish, particularly tuna, by the "Dragon" incident (see p. 629, Vol. II), new ways had to be found to save the unaffected fish for human food. This was the rebirth of the fish sausage industry. The product imitates meat sausages, using mainly (although not more than 50%) tuna and whale flesh together with other fish. Pork is frequently added as a fat, giving the product a little of the flavor of traditional sausages. Several different types are made. Presently there are some 70 enterprises registered as manufacturing this item. The production volume has grown from some 4,000 tons in 1952 to over
120,000 tons in 1963. A number of large-scale plants have been created with capacities of several 100,000 sausages per day, handling some 10–50 metric tons of fish per 8 hours.

This important industry has grown to its present impressive size largely since 1953–1955. Sausage factories have also become part of the Japanese development plans in other parts of the world. One plant is located at Willemstad, Curaçao. Others are being built in Guatemala, Ghana, etc.

Fish Jellies (Kamaboko)

Fish jelly is an original product of Japan, somewhat like meat loaf or sausage without casing with fish meat used instead of beef. Fish jelly, usually called “kamaboko,” has long been favored by the Japanese. The word appears in the literature of 400 years ago. It has sometimes been translated as fish paste.

Kamaboko started to be made in many varied forms only 100 years ago, although at that time it was solely on a home industry basis supplying the demand of the neighborhood. The fish used for making kamaboko were not limited to one or two kinds as now, but any fish available and suitable for kamaboko seems to have been used. Most kamaboko plants are small units; some 30,000 are registered.

The cohesiveness of the jelly (“ashi”) is due to retention of the water-binding capacity of the myosin. Fresh quality is a prerequisite for this. Less-fresh fish need a binder: starch, or the addition of polyphosphates to maintain the elasticity of the product; the quality of this product cannot match that of truly fresh fish meat.

Because of the rapid increase in the production of fish jelly, the raw material, especially the croakers, etc. caught in the sea west of 130° longitude, is getting scarce. New species such as rattail, conger eel, etc. have been tried.

As the demand for and production of fish jellies grew, the fish caught in nearby seas alone were not enough; raw material had to be sought afar.

Algae (Seaweeds)

Japan consumes 340,000 metric tons of marine algae per year, which amounts to about 5% of its total consumption of marine products, including fish, shellfish, whales, etc. The Japanese people eat about 10 g. (fresh weight) per capita daily. This amount may appear rather insignificant, but seaweed constitutes an important bulk material besides providing essential minerals and vitamins, including B₁₂ accumulated on the surface by microorganisms growing there. The two most significant items are “kombu” and “nori.” The former is dried tangle (Laminaria sp.) shaved
or scraped from the fronds or cut into pieces and dipped in shoyu (soy sauce) for processing purposes. Nori is the dried fronds of red algae of the genus *Porphyra* sun-dried on a smooth surface and stripped off in sheets. Nori is particularly high in vitamin B₆.

**Trade**

Japan is the first ranking fish trading nation of the world in terms of earnings accruing from her 415,700 tons of fishery exports, although the volume of fish is slightly less than that of Norway.

Japan has regained most of her prewar markets, aided through the liberalization of imports by the U.K. which is the second largest customer for Japanese marine products exceeded only by the U.S.

Japanese export of canned salmon has grown in particular during the sixties, chiefly through heavy shipments to the U.K. The export of canned crab meat reached a peak in 1959, and then began to decline as a result of (1) growing domestic demand for canned crab meat, (2) competition on the United States market from Alaskan products, and (3) the large influx of Soviet canned crab meat into the European market.

Of the total canned food output in 1962, two thirds was for domestic consumption, and one third (14.96 million cases in 1962) for overseas sales. The trend has been to retain a larger percentage of the canned food pack for domestic consumption, leaving less for export, even though the total pack has increased. In one decade the export sales have dropped from 40 to 30% of the total.

Frozen fish has attained a notable position in Japanese foreign trade, no less than 0.25 million metric tons in 1963.

Frozen octopus and oyster are exported to the U.S. and Canada and have been growing in volume. They are used as bait for halibut fishing in Canada and Alaska.

Most of the frozen tuna imported to California for subsequent canning comes from Japan. The U.S. receives more than 60% of all Japanese exports of tuna. Regular deliveries have been made also to Puerto Rican canneries. The U.S. has further been a good buyer of swordfish and halibut steaks, black cod, and rainbow trout. The quality of the packs has vastly improved in latter years.

**Imports.** A surprising feature of Japanese foreign trade in seafood products is the emergence of importation during the sixties. A growing amount of shrimp is being bought in Australia, U.S., India, Mexico, Taiwan, and other places. The domestic manufacture of fish meal is no longer adequate for the growing animal production. To supplement her own sizable fish meal production, fish meal is purchased from Southwest Africa, Chile, and Peru.
Whaling

There was formerly an abundance of whales in Japanese waters, and a sizable hunting is still carried on in various northern waters. A third of the Antarctic whale catch is now in Japanese hands, with seven whale-catching fleets. Japan has in latter years acquired one Norwegian, two British, and in 1964 one Dutch, whale-factory ship.

Besides the oil which is largely exported (75–80%), much of the flesh is used as human food. It goes into fish sausages or other special products. Both whale and dolphin meat have been consumed in Japan for centuries. It is also cut into thin strips and eaten raw with condiments, similarly to fish and chicken.

Another edible whale product is the blubber. It is served raw or salted, often with a spicy sauce.

As early as the 1930's Japan dispatched her first Antarctic whalers accompanied by refrigerator ships with holds at a temperature of —25°C., in which the meat was transported home to cold stores. Most of this meat continues to be bulk-frozen today.

Development Program

The Japanese Fisheries Agency is preparing a broad, long-range fisheries management program covering roughly a 5-year period beginning with 1967, the year when all fishing vessel licenses become renewable. The announced purpose is to develop from an over-all viewpoint a coordinated management program for the Japanese coastal, offshore, and distant-water fisheries, which are intimately related to each other.

North Korea

Little information is available on the fisheries of North Korea. Formerly, like its southern counterpart, the vast majority of the catch was from the rich continental shelf which is rather wide in that area.

Like most communist countries, there has been an organized expansion in the fisheries. The program is probably not as grandiose as that of South Korea. Trawlers of 400–1,000-ton displacement are, however, being built in North Korean shipyards. A 7,000-ton freezing trawler is on order from a Dutch firm. This will be capable of freezing 100 tons of fish per 24 hours, and a blast freezing tunnel can handle 20 tons per 24 hours. The delivery date is given as December 1964.

With these new ships, North Korea expects to move out into the northwestern and southwestern Pacific.

According to Soviet statistics the catch exceeds 750,000 metric tons and consequently surpasses that of South Korea.
The government signed an agreement with France and Italy on 21 January 1963 for 159 modern fishing boats. France will supply equipment including vessel hulls and equipment, and Italy marine motors and other machinery. By an earlier agreement the same French-Italian enterprise would extend to the Korean government a $120 million loan for constructing 950 new fishing vessels with a total tonnage of 118,000 tons. Most of these will be built in Europe. The involved company is to train Korean fishermen and technicians and assist in marketing Korean fishery products throughout the world. It is predicted that the project will boost the annual South Korean catch to over 1 million metric tons. Modern facilities are being created at six ports for the proper handling and storage of the increased catch. The government also plans to set up a fisheries and marine industry center at a shipbuilding yard by installing refrigeration, ice-making, and processing facilities for fish and other marine products.

The most important species of fish in the South Korean catch are saury pike, horse mackerel or bluefin tuna, Alaska pollock, anchovy, yellow croaker, hairtail, shrimp, crab, and squid. Of the 1962 landings about two thirds was fish, one eighth squid, one tenth seaweed, and 4.5% shrimp and almost as many oysters and clams. Anchovies made up one seventh of the fish catch, over one eighth was hairtails and almost as many saury pike.

The South Korean fishery industry supplies an estimated 85% of the animal protein to the Korean people, as well as 20% of the total value of the exports.

Over four fifths of the catch is marketed fresh. The rest is cured, canned, or otherwise used. Fish is dried with or without salt.

Fish is frozen at sea in modern freezer trawlers at an average rate of 20 metric tons per day at —35°C. The fish holds maintain —20°C. At the end of 1959, South Korea had 67 ice and cold storage factories with the following daily capacities: ice-making 1,557, freezing 275, cold storage 8,415, and ice storage 23,652 metric tons. Only 27 quick-freezing plants were in operation with a daily capacity of 275 tons.

In 1958, South Korea had 38 canneries in operation with a capacity of 35 million cases or about 52,000 metric tons. Most are equipped with modern facilities. The daily capacity of individual plants varies from a minimum of 300 cases to a maximum of 1,350 cases for an 8-hour day. Tuna and saury are the principal species canned. Other species canned include mackerel, scallop, ear shell, topshell, sea eel, white and red clams, crabs, oysters, shrimps, and anchovies. Under a recent contract, tuna is also supplied to a U.S. packer's canning plant in American Samoa. Korea sells canned saury to Burma.
South Korea's 42 fish-oil plants are all quite small, having a combined annual capacity of only 700 tons. Sharks are processed for oil, and mackerel oil is being considered as a possible product. These plants produced 353 tons of fish in 1958.

Shrimp, squid, and oyster are generally sun-dried. There are now eight shrimp-freezing plants in the country. The U.S. is South Korea's best market for frozen shrimp. In addition to exports, over 10 tons of frozen shrimp are sold annually to United Nations' forces in Korea. The principal market for dried shrimp is Hong Kong.

China

The history of Chinese fisheries is an old one. Fish culture, presumably a Chinese innovation, dates back to 2,000 B.C. China is perhaps the world's leading fishing nation. According to FAO statistics the registered catch of fish in 1961 was 6.5 million metric tons, 2.5 million of this from fresh-water sources. Much local fishing from ponds and rivers is of a subsistence nature and never enters commercial statistics.

In the northwestern province of Tsinghai are a series of lakes which provide fish for that interior area. Most of the province is on high plateau 9,000-10,000 feet in elevation. Tsing Hai or Koko Nor, 2,300 sq. mi., is China's largest salt-water lake and the chief source of the fish. A road has been built completely around the lake and wharves and storage facilities have been constructed. Fishing is done all months of the year. Fish-processing plants have been built throughout the province and the surplus fish is sent to neighboring areas.

China's coastal fishing grounds extend nearly 6,000 miles and cover 436,000 sq. mi. Numerous varieties of fish, from salmon in the northern streams to croaker and tuna in the southern seas, abound in these waters. Assuming an average yield of 25 metric tons per year per square mile of water, over the continental shelf the possible yield in marine products from China's marine waters could exceed 10 million metric tons.

There are two fishing areas: the coastal area and the deep sea fishing area. The near-sea fishing areas are the waters on the continental shelf of the Yellow Sea, East Sea, and South China Sea. This total area embraces 1,350,000 sq. km. (511,100 sq. mi.); chiefly sedentary fish are caught in these waters.

The northern fishing area includes the banks and coastal waters of Antung, Liaoning, Hopeh, and Shantung. Waters along the Shantung peninsula permit dragging operations all year. In other waters, the cold temperature of the water makes dragging difficult.

The central fishing area includes the waters along Kiangsu, Chekiang, and the southern part of the Yellow Sea. In this area, the northern part
has many shoals and the southern part is lined with many islets, such
places favoring the growth of plankton and forming a center for fish-
breeding and spawning. The waters around the Chu Shan Islands provide
good fishing for this reason. When the fishing season opens, thousands
of fishing boats work in this area.

The southern fishing area includes the waters along Fukien, Kwang-
tung, and the southern part of the East China Sea. Taiwan is located
within this fishing region (see further p. 374). During the winter, the
temperature of the water in the deep part of Po Hai and the Yellow Sea
near the coastline of China reaches the freezing point. Consequently
large schools of fish migrate south of latitude 30°N. and remain all
winter in the warm sea region in the eastern part of the East China Sea,
close to the warm current. Hence the best fishing in winter is in the East
China Sea.

The South China Sea, excluding the continental shelves, and the
Pacific Ocean off the east coast of Taiwan are good deep sea fishing
grounds because of the warm current. These are the areas of fish
migration. Tuna is abundant in the South China Sea and adjacent waters.

The fresh-water fishing consists of two types of activity: (1) pond
culture operations and (2) ordinary fish catching. Over 19 million acres
of rivers and lakes and 3.5 million acres of ponds and rice fields yield
fresh-water fish, the most important being carp. The provinces of
Kwangtung, Hunan, Kiangsu, Hupei, Chekiang, Kiangsi, and Anhwei are
notable for fresh-water fisheries.

Fish culture in ponds is a significant farm sideline. A 1937 survey
revealed that 410,500 acres of ponds were used for fish culture involving
the full or part-time employment of 13 million persons. In addition to
fish, fish fry is produced on a large scale for export or domestic sale.

Fish is consumed fresh or dried and salted, the fresh fish being
generally consumed within a few miles of the point of landing. Ice is
carried on the sea-going vessels and the landed fish are generally in fair
condition. It is estimated that about 10% of the total production is
processed. Development of a fish-canning industry is difficult because of
the lack of large fisheries comparable to that of the salmon and sardines
of the U.S. The yellow-croaker fisheries are the largest fisheries of China,
but the fish is not suitable for canning; it constitutes the basis of im-
portant salting and drying industries. Fish and shellfish are dried, salted,
and made into sauce in the provinces of Chekiang, Kwangtung, Fukien,
Hopei, Kiangsu, Shantung, and Manchuria. Fins of shark, beche-de-mer,
squid, jellyfish, scallop, awabe, etc. form specialties and important
articles of domestic commerce.

Fishing operations are being rapidly modernized. The future ex-
pansion of fisheries includes modernization of fishing boats, use of nylon nets, electrification of communication, continuity of operation throughout the year, and increase in variety of products. Exploration of new fishing grounds, conservation of resources, etc. are also stressed. A number of modern trawlers are at present being built in Shanghai. They are equipped with telecommunication facilities, machinery for hauling in the nets, and fish-shoal detectors. To handle the increasing number of motorized vessels, fishing wharves in Lushun-Talien, Chousan, Shanghai, Canton, and elsewhere have been extended. Several new fishing ports have been erected. A whaling fleet is presently being built.

**Hong Kong**

Hong Kong, a British colony founded in 1841, consists of the New Territories and a number of islands. The primary product of the colony is marine fish from a fishing fleet of over 8,500 junks and 20 Japanese-type trawlers. At the end of 1962 Hong Kong mechanized 5,199 fishing vessels with loans from the Government Fisheries Development Loan Fund; over 90% are owner-operated. Croakers, tuna, sea bass, and shrimp constitute the major portion of the marine catch. Almost half the catch belongs to the mullet-sea bass group. Carp, mullet, oyster, and shrimp are cultured.

Fish is generally marketed fresh; however, the sailing junks often salt their early catch at sea to preserve it. The Hong Kong Marketing Organization is establishing a wholesale fish market in the Castle Peak area of the Crown Colony. It will serve fishermen using Castle Peak Bay as an anchorage and fishermen normally landing their catches at Cheung Chau and Tai Po. A substantial portion of the catch is salted and dried for export to Indonesia, Malaysia, Canada, and the U.S. No major attempts on a commercial scale have been made to market such manufactured products of the industry as glue, fish meal, or pearl essence.

Freezing of shrimp is conducted for export to the U.S. There are no plants in the Colony devoted exclusively to processing of shrimp. There are at least five cold storage plants which have quick-freezing facilities.

Shrimp are peeled and deveined manually. The meat is placed in freezing trays of 0.5-lb., 1-lb., and 5-lb. capacity. Freezing is done at a rate of 1 inch per hour at 26°F. or a 5-lb. block in 4 hours. The frozen blocks of shrimp are packaged in polyethylene bags, labeled, and placed in cold storage pending shipment. There is a small export of frozen red snapper fillets to Australia.

There are local food-processing plants which sun-dry shrimp and make shrimp paste or a flour used for making noodles and chips. There are no known shrimp-canning plants in the colony. Oyster meats are dried or processed into oyster sauce.
TAIWAN

Taiwan is situated in the semitropical zone. Washed by the warm Kuro-Shio Current, its waters are rich in migratory fishes. The fishing grounds consist of (1) the trawling grounds in the southern part of the East China Sea, Strait of Taiwan, South China Sea, and Gulf of Tonkin, (2) tuna-fishing grounds in the South China Sea, Sulu Sea, Celebes Sea, and Indian Ocean, (3) the mackerel, sardine, and skipjack fishing grounds northeast and east of Taiwan, and (4) sardine-fishing grounds in the southern part of the Strait of Taiwan.

Taiwan's fisheries are classified into four main categories: (1) deep sea fisheries, (2) inshore fisheries, (3) coastal fisheries, and (4) fish culture. There were 35 tuna long lines in 1960 (four of 350 tons, 15 of 100-200 tons, and 16 of 50-90 tons). It also operates, since 1962, 550-ton Japan-made tuna vessels in the Indian Ocean and hopes to export part of these catches to the U.S. A supply base has been established at Singapore. Tuna, spearfish, and shark account for about 10% of the deep sea catch. Whaling began in 1957 as a joint Taiwan-Japanese enterprise, based in southern Taiwan. Taiwan's progress in deep sea fishing is remarkable. The Taiwanese tuna fishermen supply Malagasy canneries.

Inland fish cultivation is one of the greatest of the ancient Chinese arts and is being greatly expanded in Taiwan with much modernization and scientific study. Milkfish, tilapia, carp, and mullet are extensively raised in ponds and paddy fields.

Taiwan's fisheries have so far largely contributed to the sustenance of the island's population. Due to the lack of surplus fish, progress in developing the fish-processing industry has been slow. Most processed fishery products are for local consumption. Exports of frozen tuna, canned fish, fish-liver oil, etc. are in small quantities. Exports of frozen tuna amounted to 1,800 tons in 1962 and are expected to be 3,400 tons in 1963. Canned fish is also finding a market in South Asian countries.

About 25% of fisheries production in the island is processed, the most important product being dried-cooked fish. Other processed products, in order of importance, are fish balls, salted fish, canned fish, dried-salted fish, fish-liver oil, and shark fin.

Ice is used in quantity for fish preservation all over the island, excepting for a small part of inshore fisheries which use salt instead of ice. At the end of 1958, there were 158 refrigerating plants scattered over the island with an aggregate capacity of 1993 metric tons of ice-making per day, 60 metric tons of freezing per day, 15,000 metric tons of cold storage.

The major shrimp-fishing grounds of Taiwan are off its southeastern

coast; shrimp is caught year round, but the best season is March–May when 50% of the annual catch is landed.

All shrimp landed is consumed locally. Large and medium shrimps are shipped with ice from producing centers to consuming centers. They are used mostly by restaurants and hotels; the price is too high for the average family. Small shrimp is consumed fresh or dried. Dried shrimp is processed by boiling and sun-drying. About 7% of the annual landings is dried. Freezing and canning of shrimp are negligible. The extent of mechanization in shrimp processing will depend largely on the prospect of export.

In 1957, 41,694 metric tons of edible fishery products were produced. Almost half of this was boiled dried fish, over one fourth fish balls, and over one eighth canned.

XVII. Southeast Asia

PHILIPPINES

In 1961, more than 39% of the landings of commercial fishing vessels came from the Sulu Sea fishing grounds, and 25% from the Visayan Sea. Manila Bay yielded about 7% of the commercial landings. By the end of 1961, 125,810 hectares of fish ponds yielded 60,824 metric tons of fish.

Table XV

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\[a\] All Vietnam. \[b\] 1949. \[c\] 1956. \[d\] —, not available.

Despite increases in gross annual fish production, the Philippines imported 74,630 metric tons of fish products in 1961, 94% of which was canned.

The Fisheries Commission of the Philippines has plans to establish a central fish market as well as regional piers for the distribution and marketing of fish. It has started a project calling for the construction of 16 fishing ports, 13 refrigeration plants, 51 fresh-water fish farms, and
20 brackish-water fish nurseries. Development of oyster farms and training of fishermen are included in the project.

More than half the catch (60%) is marketed fresh and the rest is cured or otherwise utilized. Sun-drying with or without salting is the usual way of curing fish. Small fish like dilis (*Stolephorus* sp.) are not salted or eviscerated before drying. They are given a quick wash with sea water at the beach, laid out in a single layer on long bamboo mats or oblong bamboo trays, and sun-dried for 2–3 days. Medium and large fish, such as *Mugil* sp., *Caranx* sp., *Rastrelliger* sp., etc., are salted before drying in the sun. After splitting the gills, viscera and blood are removed by a hard brush and the fish cleaned in sea or fresh water. Very large fish are filleted. The fillets are soaked in a 10% brine for about an hour to leach out as much blood and slime as possible. Each piece of fish is rubbed thoroughly with salt and packed in vats, barrels, or earthenware pots with salt between the layers and around the pieces. The ratio of salt to fish is 1:4 by weight. Within 2–7 days the fish are removed from the salt and brine, cleaned, washed, and laid on split bamboo mats and trays or strung on hooks suspended from poles. Drying is completed within 7–10 days depending on weather.

Wet-salting and then sun-drying are also practiced. The following species are treated in this way: *Rastrelliger brachysomus*, *Caranx kalla*, *Sardinella* spp., and *Leognathus* sp.

The fish are cured in concentrated brine for 2–3 hours, washed with sea water, and dried in the sun for 2–3 hours.

Small fish such as anchovies (dilis) and small mouth (sap-sap) are difficult to salt without some fermentation and protein hydrolysis taking place. “Bagoong” (fish paste) is a good example of small salted fish. Usually the free liquid from bagoong is skimmed off and used as a sauce (“patis”), while the semiliquid residue is ground, if necessary, and sold as bagoong. Some manufacturers, after the patis is drawn off, add saturated brine to the bagoong residue, let it stand a few days, and make another extraction of patis.

Patis is strained or filtered until it is light in color. Good patis may contain 9–10% protein.

“Dinailan” is a shrimp paste. Very small shrimp are dried in the sun for a day and ground in a mortar. The mass is dried and ground again for 2 more days, formed into cubes, and sold in the market.

Smoked fish or “tinapa” is a delicacy. Fish and shellfish, like barracuda, tuna, sailfish, sardines, anchovies, gobies, shrimp, oysters, etc., are smoked with considerable success. They are washed in sea water, cooked in a medium brine, sun- or air-dried to remove surface moisture, and smoked in baskets placed over individual fire pots.
The Philippines obtained two floating fish canneries from Japan under the latter's World War II reparation program. One is a 2,000-ton factory ship turning out 840 cases of 0.5-lb. cans a day.

The government is constructing a fish cannery in San José, Mindoro, which will produce 1,250,000 cases of fish, mainly sardines, mackerel, and anchovies. It will also produce fish meal. The plant will increase the country's fish-canning capacity by about 150%.

**North Vietnam**

Like many communist countries, statistics on North Vietnamese fisheries are not available to western scientists. From the little information gleaned from the literature, it appears that the government is trying to increase fish production to alleviate the protein shortage. It is well known that both China and Taiwan fish the Gulf of Tonkin and the South China Sea.

In 1959 the catch for the first half of the year was 40,000 tons, an increase of 25% over the same period in 1958. The Soviet Encyclopedia reports 97,000 hectares fish cultivation, rendering around 75,000 metric tons in 1961.

A fish cannery has been built in Hanoi with Russian aid.

**South Vietnam**

The commercial fish catch has increased 69% in 4 years, an increase made possible by the continued mechanization of the fishing fleet and construction of ice factories in various fishing centers. Major achievements in the field of fisheries in 1961 were (1) the development of new export markets, (2) the discovery of large schools of threadfin (*Polynemus* sp.) further north than ever before, and (3) the undertaking of a survey of the nation's fishery resources.

Fish is generally marketed fresh. A substantial portion of the catch is sun-dried with or without salt. Very small fish are dried whole without salting. Comparatively large fish are eviscerated and incised. Salt is rubbed into the incisions, or salt and fish are placed in alternate layers. Since the salt used is crude and hygroscopic, redrying is required from time to time which, of course, reduces the nutritive value and flavor of the product. Brining is conducted in some areas. Roasted and ground rice are sometimes added to the fish before drying.

Nuoc-mam (fish sauce) is a staple item and important source of protein in the Vietnamese diet. It is more or less similar to the nam-pla of Thailand in regard to preserving and processing. It is a clear brown liquid rich in salt and soluble nitrogen. It is usually prepared from different kinds of small fish both marine and fresh-water. A method has
recently been developed by the Fisheries Directorate for reducing nuoc-
mam to solid form, which has important military uses.

Fish pastes are prepared by adding cooked glutenous rice, roasted
rice, rice bran, and other cereal products.

A factory in Phan Thiet, one of the principal fishing ports of the
country, processes canned sardines. Annual production is 5,000–10,000
cases, all of which are consumed locally. The company has plans to
produce 50,000 cases per year, 30,000 to be exported.

There is one modern shrimp-processing plant in the country. How­
ever, shrimp is consumed locally, fresh or dried, and a portion of dried
product is exported to Singapore and Hong Kong. The main center for
shrimp fishing is Rach-Gia on the Gulf of Siam.

CAMBODIA

One of the best known flood fisheries in the world is on the Mekong
River in Cambodia. During the rainy season a tributary of this river,
Tonle Sap, flows backward and fills up the Grand Lake. As the Mekong
waters recede, the Tonle Sap begins to drain the lake. Although fishing
goes on in all seasons, the greatest activity is in the period of receding
waters when the fish return to the rivers. The fish are dried, smoked, or
salted; but the majority are fermented to make “nuoc-mam,” a fish sauce,
or “pra-hoc,” a fish paste (see Chapter 8, this volume).

Four-fifths of the landings are from fresh water, while the rest are
from the Gulf of Siam. Most fisheries are of a subsistence nature.

THAILAND

Fisheries rank next to agriculture in extent and value among the
basic industries of the country. The marine fishing grounds of Thailand
comprise three fourths of the coastal waters of the Gulf of Thailand and
a long section of the eastern shore of the Indian Ocean between Burma
and Malaya, the total length of the coastline being over 1,500 miles. Fresh­
water fishing grounds comprise many large interior rivers, lakes, swamps,
streams, and ponds, many of which are used for fish culture operations.
Carp, tilapia, catfish, sea bass, and gouramies are among the cultured
fishes.

Thailand is one of the leading fishing nations in Southeast Asia. Rapid
increase in fish production in recent years became possible by mechaniz­
ing the fishing fleet, but most fishermen still work in the shallow warm
waters of the gulf, inshore if possible, to escape the worst of the
monsoon weather. They look mainly for the 6-inch chub mackerel or
“pla-thu” (Rastrelliger sp.), which comprised more than 20% of the
total catch in 1961. To encourage fishermen to venture into the richer
waters of the outer gulf and the Indian Ocean, the Fisheries Department is conducting an extensive survey of previously untouched grounds with the help of a 300-ton research ship. A new port is being developed at Ranong, on the west coast of the Thai portion of the Malaysian Peninsula. Some 100 boats, from 10-ton smacks to fast 100-tonners, are operating there, bringing in 200 tons of fish a day from the unexploited grounds in the East Indian Ocean. The Government is building a modern fishing station where ships can tie up, auction their fish, repair their nets, fill up with fuel and ice, and be out to sea again in a few hours.

Modernization and expansion have become a necessary corollary to the country's booming population. Fish provides more than 70% of the animal protein of the rice diet of the Thais.

Nearly 60% of the total catch of fish is consumed fresh and the rest processed in various ways. The common methods for processing fish are sun-drying, salted drying, smoking, cooking, production of paste (kapi), fish sauce (nam-pla), fish and starch products, e.g., fish cake and fish crackers ("look-shin" and "kaocrieb"), and fermented fish. In addition, there are some small canneries, 2 fish-liver oil plants, 3 meal plants, and many cottage plants. There are 5 freezing and cold storage plants of different sizes and 49 ice factories.

_Drying and salting_ are the two principal fish-processing industries of the country. Small fish are dried whole in the sun without salting. Large fish, pla-thu (*Rastrelliger* sp.), for example, are eviscerated, washed in sea water, salted or brined, and spread on bamboo mats in the curing yard to dry in the sun for 2–3 days.

_Dried shrimp_ processing is considered to be an important industry. They are washed in sea water, boiled in water with or without salt for half an hour, and dried in the sun. On rainy days they are dried on a fire. They are then put into heavy sacks and shelled with the help of a wooden mallet.

_Sea mussels_ are thoroughly washed and shucked by boiling. The meat is boiled again in weak brine for 5 minutes, and sun-dried.

_Shark fins_ are cut out and put in the sun after washing. They are boiled to remove the cartilaginous material before drying.

_Squids_ and _sea cucumbers_ are eviscerated, washed in sea water, boiled for a few minutes, and dried in the sun.

Only fresh-water fish are _smoked_. Cleaned and eviscerated fish are strung on bamboo sticks which, holding 10–20 fish each, are placed on platforms and a fire is lit. The distance of the fish from the fire is about 3 feet. The product is called "pla krob" or crisped fish.

_Cooking_ is employed mostly for fresh fish during the period of glut. This reduces transport costs and preserves a portion of the catch. They
are gutted, cleaned, and dipped in saturated brine for about 30 minutes. Four or five fish are placed in a small bamboo tray and cooked in boiling saturated brine for 10 minutes.

Shrimp paste is made from shrimp as well as from small fish. They are washed, salted, and placed overnight in a basket with a weight on top. This presses out and drains most of the water. Next morning the mixture is exposed to the sun for partial drying. Then it is ground and exposed to the sun again for some time. The product is lightly packed in wooden tubs for a period of several months for ripening (partial fermentation). To make the finished product more attractive, safranin or fuchsin is sometimes added.

Nam-pla (fish sauce) manufacturing is a household industry in many fishing villages. The principal fishes used for this purpose are Stolephorus sp., chub mackerel (Rastrelliger sp.), and carp (Cirrhina sp.). Sometimes entrails are also used (see further Chapter 8 of this volume).

There is no commercial fish canning in the country. Some home-canning plants exist, that turn out pla-thu in tomato sauce and oil at the rate of one ton per day.

In Chumphon and Ranong, there are three continuously operating plants, each producing about 5 tons of dried meal per day. Along the coast there are many small fish meal units on the cottage scale. The annual production is probably 1,000 metric tons.

One fish-liver oil plant with encapsulating unit has been set up in Nondaburi under the supervision of the Health Department. The plant has a capacity of 450 kg. of livers a week, extracting on an average 25% of oil.

Fish cake (look-shin) is a rather popular fishery product in the country. The number of plants in Bangkok is more than 100. The fish, Cybium sp. for example, are headed, scaled, eviscerated, and boned. The meat is ground several times in a grinder, mixed with salt, and boiled or fried in oil. There are many varieties of product of different shape and taste.

Fish crackers are improved fish cakes. Two parts of fish are mixed with 3 parts of tapioca flour, salt 2–3% of the weight of fish, pepper 1–1.5%, garlic 2.5%, and water 20–25% of the weight of fish and tapioca flour. The product fetches a higher price if shrimp is used instead of fish.

The processing method for fish crackers is very similar to that for the fish cake: the ingredients are thoroughly mixed together, steamed, cut into thin slices, and dried in the sun.

Indonesia

The catch is from marine sources as well as the fish (mostly carp) being bred in tamboks and rice fields.
Japan is establishing a tuna and bottom fishing base at Tandjung Periuk near Djakarta. Besides furnishing fishing vessels, Japan will construct freezing and other processing facilities at the base. Tuna would be exported to the U.S. by a Japanese marine products trading firm.

Fish, being the only significant source of animal protein, is generally marketed fresh; a lesser amount is cured. Drying and salting are the usual methods of fish processing.

**Salting**

*Pindung* is a wet-salted fish product. The fish are put in pots or cans and cooked with up to 50% salt by weight; spices and tapioca flours are sometimes added on cooking, and the product is put in earthenware pots or kerosene tins. Air is excluded as far as possible. It is transported to various inland markets. The product remains good for a few days to a few months depending on the amount of salt added.

Fish and shellfish are dried in the sun with or without pretreatment with salt. Small fish and shrimp are dried whole with salt. In Sumatra, shrimp is cooked for a short time in water with salt, sieved, and spread in the sun for 2 days. Shelling is done by thrashing.

Somewhat larger fish are headed, eviscerated, and salted. They are also brined in some areas. Salting is done in various ways, such as rubbing the fish with salt or putting fish and salt in alternate layers.

**Fish Sauce or Petis**

Petis is the cooked and concentrated liquor obtained from salting fish in various ways. The method of manufacture is similar to that for nam-pla of Thailand or nuoc-mam of South Vietnam.

**Fish Paste or Trassi**

It is manufactured from fish as well as shellfish. The fish are headed, eviscerated, and scaled. Water is removed from the fish by pressure. They are then salted, dried in the sun, and pounded in a wooden mortar to a paste. This is exposed to the sun in thin layers (for various trassi products see Chapter 8 of this volume).

**Fish Cakes or Krupuk**

Fresh cleaned fish (*Lates* and *Stolephorus* spp.) are mixed with an equal amount of tapioca flour, 20% salt, a few eggs, and sugar. The mixture is made into long rolls which are steamed, sliced, and dried into thin cakes. Sometimes shrimp is also used. The cakes are fried in oil before serving.
Malaysia

Considerable activities are evident for improving the deep sea and fresh-water fisheries in ponds and rice fields. The government has allocated over $2 million (U.S.) for development of the country's fishery and processing industry during its current second 5-year plan.

Fish is generally marketed fresh, but a substantial portion of the catch is salted and dried.

Small fish are cleaned of gills and entrails. Large fish are eviscerated and split into halves. All fish are rinsed in sea water before salting and placed in wooden tubs or concrete tanks containing brine. Salt is applied in 10:1 ratio. The salted fish are taken out in rattan baskets with numerous holes at bottom and sides facilitating drainage, rinsed with sea water, and drained.

Sun-drying of the salted fish is carried out on structures called planters. A planter is a platform of planks supported by poles planted in the sea or on the foreshore according to circumstances. Pieces of matting made of pandan (Pandanus sp.) leaves are spread over the planter and the fish laid out in a single layer. They are turned over several times in the course of the day. Sun-drying is completed within 2 days, depending upon the weather. Shark fins are treated similarly and dried in the sun.

Processing

A joint Japanese-Malayan firm is canning tuna at Penang, Malaya. The enterprise presently has a productive capacity of 500 cases of tuna a day, a quick-freezing capacity of 40 metric tons a day, and a cold-storage holding capacity of 600 metric tons of frozen tuna a month. It planned to expand the present cold-storage holding capacity to 1,200 metric tons a month by December 1963.

The tuna for canning are caught in the Indian Ocean by four Japanese fishing vessels, two of 100 tons and two of 150 tons. Approximately once a week one vessel returns to Penang with the catch. Three types of tuna are caught: albacore with white meat; yellow-fin and big-eye, both with light meat. Spearfish and marlin are also caught.

Aboard the fishing vessel, the fish are stored in refrigerated holds. On docking, the fish are transferred to the refrigerated warehouse of the canning firm with a capacity of 200 tons. These rooms are also used for the storage of sauries for bait.

The fish are taken out of the refrigerators and thawed. Chunks of meat are cut out and placed in wooden frames with wire bottoms. They are cooked in steam ovens. On cooling, the bones, dark meat, and skin are removed and the cleaned meat is put through a slicing machine. The
slices are weighed and put into 7-oz. cans. Salt is added and the can is filled with cottonseed oil, soybean oil, or tomato sauce.

The firm prepares in addition 70 lb. of tuna sausages a day for local consumption, and half a ton of fish meal a day for poultry food. Finally, the company produces a small amount of tuna-liver oil, which can be added to the fish meal for enrichment or used in the manufacture of margarine.

The company exports its canned tuna to West Europe and the U.S. There is still no market for canned tuna in Malaysia.

**Shrimping**

Shrimping is conducted on a cooperative basis by coastal village fishermen in small sail or motor boats. There are no shrimping vessels. Most shrimp is consumed fresh. During glut, it is salted and exported to Singapore or Hong Kong. In 1959, export from the Federation of Malaya of crustaceans salted, dried, or simply cooked amounted to 292 tons.

Shrimp paste and fish balls are manufactured, but on a very small scale.

**Borneo**

British Borneo is divided into three colonies: Brunei, North Borneo, and Sarawak. In August 1963 the latter two voted to join the New Federation of Malaysia, but Brunei abstained.

Most of the marine catch is landed by small native or Chinese fishing craft that sell their landings locally to be consumed unprocessed. Sarawak and North Borneo (Sabah) have no published statistics on their production, but Brunei landed 2,438 metric tons of fish and 255 metric tons of prawns in 1960. The small prawns and small fish are used for hog feed.

"Balachan" (shrimp paste) is made by mixing prawns and salt in a bag. The moisture is extracted by pounding and pressure, and the mixture is partially dried in the sun. It is then pounded with rice to a paste.

**XVIII. Oceania**

**Australia**

Despite a 12,000-mile ice-free coastline, the fishing industry in Australia is small and relatively unimportant, employing only 0.4% of the total working force with 9,000 fishing craft of all sorts. Grounds near large population centers are already overfished and fisheries suitable for trawler operations are limited. It is difficult to provide cheap fish profitably; returns in relation to costs do not always justify the effort.
Stocks of estuary, onshore, and bottom fish are limited. The exploitation of extensive stocks of pelagic fish (such as tuna), crustaceans, and molluscs was until recently insignificant. Various species of fresh-water and marine fish, including both tropical and temperate, are available. The principal fish varieties caught are mullet, Australian salmon, jack, sea bass, tuna, barracouta (not to be confused with barracuda), flathead, snapper, whiting, and shark. Crayfish, shrimp, oyster, and scallop are also commercially exploited. Oyster, as well as prawn, cultivation is practiced in New South Wales.

More than half (66%) the catch is marketed fresh, the balance is frozen (16%), canned (13%), or otherwise utilized.

Processing

Very little fish curing and smoking are done, probably due to the scarcity of regular supplies of suitable species. In the past barracouta (Thyrsites atun) was used but is now marketed fresh. However, tailor (Pomatomus pedica), mullet, and fish roe are smoked in small quantities. In Tasmania kippered jack mackerel and smoked tuna steaks are produced.

There are a large number of small freezing establishments close to the catching areas. Distribution of frozen products is done by refrigerated trucks. Small refrigerated boats are being added to the fleets.

The fish-canning industry in Australia started in 1936. Today there are over 20 canneries in New South Wales, Tasmania, and western Australia. The principal fish species canned are barracouta, Australian salmon, and southern bluefin tuna.

Fish pastes are quite popular in Australia as sandwich spreads and are usually sold in glass jars or cans (2-oz.). They are manufactured from imported salmon and red herring as well as some small Australian fish.

For tuna chicken, the meat after filleting goes through a special preliminary processing followed by steam cooking in a retort. After cooking, the "chicken" is deep-frozen.

To make tuna ham, the fillets are dressed, brined, and smoked at 150°F. or more. This produces a desirable light tan color and delicate

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<tbody>
<tr>
<td>Australia</td>
<td>33.5</td>
<td>38.9</td>
<td>52.7</td>
<td>61.0</td>
<td>61.1</td>
<td>66.0</td>
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<tr>
<td>New Zealand</td>
<td>27.0</td>
<td>35.7</td>
<td>37.6</td>
<td>44.3</td>
<td>43.1</td>
<td>41.3</td>
</tr>
</tbody>
</table>

a 1959.
smoked flavor. The product is packed in 28-lb. cartons with grease-proof paper.

Most of the crayfish tails are now exported as the frozen product (see later).

Whale meat is frozen in small quantities for export to the U.S. to be used as mink feed. Whale oil is exported, 1.9 million gallons in 1961 as compared with 3.1 million gallons in 1959 and 2.3 million gallons in 1960. Most of this went to West Germany, the U.K., and the Netherlands.

In the southern states of Australia, the flesh of certain small species of shark is marketed in large quantities as a white-fleshed fish. Some attempts have been made to can this product.

A plant in New South Wales produces fish meal at the rate of 5 tons a day. The shark-liver oil industry is based on the school shark (*Galeorhinus rhinophanes*), whose liver oil yields approximately 20,000 I.U. of vitamin A per gram.

**Trade**

Even with its small population and low per capita consumption of fish (10 lb.) which may be due to an abundance of other foods, particularly of meat, Australia must import nearly half its annual requirements. About 90% of the imports are fresh, frozen, or canned; of the canned fish salmon, sardine, pilchard, and herring are the most important.

Despite difficulties in the fishing industry, a small specialized export trade has developed. Frozen crayfish tails, headless shrimp, and certain shellfish products have all (99%) been exported to the U.S. This export increased by 64% in 1961 over 1960. Fishing for pearl shell, trochus shell, and bêche-de-mer along the 2,000-mile tropical coast is important, but the return from the crayfish tails which accounted for £6.3 million (Australian) or 97% of all exports made them by far the most important fisheries export in 1961.

**NEW ZEALAND**

The important fisheries in West Coast Sounds and Stewart Island seem to have been depleted since 1956. Snapper, tarakihi, gunard, trevally, and blue cod are the principal fish species caught. Of the shellfish, crawfish and oysters are commercially exploited. Auckland, Wellington, and Timaru are the important ports where a majority of the catch is landed.

Tuna fishing in New Zealand is of recent origin. One canning company has bought a tuna trawler to fish tuna off the coast of North Island. A joint Japanese-New Zealand tuna-fishing venture was worked out in 1962. A canning factory was to be built at Rarotonga, Cook Islands.
A Nelson development company is trying to interest investors in building a fish canny there to exploit some of the nearby fisheries.

Among the processed fishery products, frozen crayfish tails is the biggest dollar earner followed by frozen fish, canned fish and shellfish, and cured fish. Otago crayfish is exported to France, Germany, and Switzerland.

The crayfish tails are frozen raw as well as cooked. The cooking is done, in Dunedin, by lowering a steel basketful of crayfish into boiling water for about 10 minutes. They are then dipped into a tub of cold water for cooling, drained of surplus water, packaged in polyethylene bags, and quick-frozen. Three Dunedin companies are now in this business.

New Zealand must import fishery products. Though imports of frozen fish were banned in 1960, canned fish including herring, pilchard, sardine, and salmon, canned oysters, and salted and pickled fish are imported in large quantities.

**South Pacific**

Most of the thousands of islands in the South Pacific Ocean are inhabited but none is self-governing. The latest estimate for total production of marine products is around 23,000 metric tons. Of this quantity some 17,000 tons are tuna landed at New Hebrides, American Samoa, and Fiji. It is difficult to determine the exact amount caught; aside from tuna, most is caught by small native craft and disposed of locally. Whale meat is eaten on Tonga.

Perhaps the most important factor in the South Pacific area is the fishing bases for processing tuna. The American cannery on Samoa was the first to be built; now the Japanese have built or are building fishing bases at Espiritu Santo, New Hebrides; Noumea, New Caledonia; Papeete, French Tahiti; Si-Amilis, North Borneo; Rarotonga, Cook Islands; and Levuka, Fiji. Most of these have a cannery, refrigeration facilities, hospitals, and recreation areas, as well as living accommodations for the workers’ families.

**XIX. Indian Ocean**

**Burma**

The majority of Burma’s catch is from inland waters. Fishing is also carried on along the coastal regions of the Bay of Bengal and in the lower Irrawaddy Delta. Kyaukpyu Island, Ye Township, Mergui and Pyapon Districts are the large-scale fishing and processing centers. Coastal fishing is carried on mainly during the dry season (November to May) because of rough seas during the rains.

Fish is generally marketed fresh; a small amount is sun-dried and
12. REGIONAL DEVELOPMENT OF FISHING INDUSTRY

TABLE XVII
INDO-PACIFIC FISH CATCH
(1000 metric tons)

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<tbody>
<tr>
<td>Burma</td>
<td>—</td>
<td>—</td>
<td>100.0</td>
<td>360.0</td>
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<td>360.0</td>
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<tr>
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<td>—</td>
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<td>827.9</td>
<td>1,161.4</td>
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</tr>
<tr>
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<td>—</td>
<td>24.0</td>
<td>28.8</td>
<td>57.8</td>
<td>74.0</td>
<td>83.9</td>
</tr>
</tbody>
</table>

Notes: a 1950, b 1951.

of ngapi is “nganpya-ye” (fish sauce) and is the juice collected from the ngapi. Shrimp “brains” are preserved in sesame or peanut oil and marketed as shrimp oil. Shrimp and shrimp products are very popular.

Research is being conducted on methods of improving food preservation, canning, and processing with the help of FAO. The establishment of standards and specifications for the manufacture of ngapi is the first step taken in food standardization in Burma. A commercial type of standard fish-drying chamber has been designed and is being put into operation. Small-scale shrimp-canning plants with a daily output of 300-500 cans are reported to be profitable.

Burma and Japan signed an agreement in 1960 to establish a joint fishing company. The Japanese firm will furnish the fishing fleet with two 240-ton motherships and 24 carrier and fishing vessels. The motherships will cure fish and shellfish and manufacture fish paste on board and will discharge the products at ports at intervals.

INDIA

India has abundant marine and inland fish resources. It has a coastline of about 4,607 km. (2,863 mi.) and a continental shelf of 259,000 sq. km. (100,000 sq. mi.) or more in area, offering considerable scope for establishment of fisheries. The Bay of Bengal and Arabian Sea abound in fishing grounds; gulfs and bays all along the coast and a large number of islands with their mangrove swamps and coral reefs are rich sources of marine fish. Tidal estuary waters in the mouths of large and perennial rivers, large brackish water lakes, backwaters, lagoons, and swamps scattered along the entire coastline, afford lucrative estuarine fisheries.

Vast stretches of fresh water consisting of rivers, streams, lakes,
reservoirs, tanks, ponds, and paddy fields offer scope for inland fisheries. When added to other fresh-water resources, the total surface would run to several million acres of which not more than a million acres presently are under fish culture.

Fishing in Indian seas is generally confined to a narrow coastal belt 11–16 km. in width, and the richer offshore and deep sea waters are poorly exploited due to shortage of powered fishing vessels. A limiting factor is the coastal topography of the continent, with notably few natural harbors and few places suitable for construction of ports; this is frequently due to the shallow sand ridges along the coast.

Half the total fish landings is sun-dried, salted, or pickled for future consumption, but the curing processes are by and large unscientific and the product is inferior. However, cured fish makes up four fifths of fish exports. A major part of the landed fish spoil owing to inadequate transport and preservation facilities, and are used as manure or otherwise disposed of.

Two thirds of the catch is obtained from the sea. A 10-fold increase in fish production is considered necessary to meet adequately the demand for fish in the country. A beginning in this direction has been made with the employment of modern fishing techniques; trawlers and power vessels are replacing indigenous boats and smacks, and refrigeration units have been installed for preservation and storage of fish. Combined with this, the provision of quicker and better transport and marketing facilities is expected to result in increased fish production and improved trade.

A major commercial fisheries project has started at Okha Port on the Saurashtra coast of the State of Gujarat. This project envisages the employment of five medium mechanized vessels to exploit the shrimp resources of the Gulf of Kutch and two trawlers to carry on offshore fishing in the Arabian Sea. In addition, two transport launches are to pick up fish to be landed in adjoining fish harbors. The project will include the establishment of various processing lines for canning, freezing, cold storage, and manufacture of fish meal. Besides exploiting domestic markets in the principal cities such as Bombay and Delhi, efforts are directed toward the exporting of processed products to the U.S., West Germany, and other countries. The government has fisheries research stations at Port Blair in the Andaman Islands, Paradip, Mangalore, Bombay, Cochin, Tuticoreni, and Visakhapatnam.

In December 1962 the Indian government opened the largest and most modern frozen seafood processing plant on the Asia mainland at Cochin on the southwest coast. It can produce 6–10 million pounds of products per season.
Ceylon has more than 140,000 acres (2,187.5 sq. mi.) of fresh waters and 300,000 acres (4,687.5 sq. mi.) of estuary waters, most of which have a potential for fish production. These resources have not been fully utilized. Inland fisheries consist mainly of the catching of natural stock by traditional methods. Irrigation reservoirs and village tanks, some built centuries ago, are not fulfilling their likely fish-producing potential.

The significance of developing these fresh and brackish waters through management and cultivation is known and stressed in most development plans.

The catches have been increasing rapidly in recent years. This was made possible by the mechanization of nearly 2,000 boats. Ceylon has an ambitious plan to increase the number of mechanized boats to 8,000 by 1968. A Navy training vessel is being converted to a research ship for studying the hydrology and basic productivity of the waters around the island.

It has ambitious plans to expand lobster and shrimp fisheries, extract agar from local seaweeds, hygienically manufacture dried fish, convert fish waste to fish flour, and study fish spoilage. Two fish harbors at Burewela and Tangalla on the west coast and another in Galle in the southern province are nearing completion.

Fish is generally marketed fresh. The manufacture of dried fish with or without salting is of considerable importance. Sun-drying without salting is limited to very small fish and shellfish like shrimp. They are dried whole on the hot sandy beach. Salting and sun-drying are applied to all other species. The fish are gutted, split, incised, and salted. The moisture is drained off, and the product is washed in sea water and sun-dried for 3-5 days. In some areas, untreated fish from large catches are buried under one foot of sand on the beach for up to 3 days before processing.

Salting and wet-curing with ultimate sun-drying are also practiced. Whole small fish and scaled, eviscerated, and filleted large fish are placed in barrels of concentrated brine, to which dried pericarp of goraka (Garcinia gambogia) is added. This ingredient decreases the sharp taste of the salt in the cured product. Salt is added repeatedly. In dry weather, small fish are removed from the brine and sun-dried during the day and returned to the brine at night.

Maldive fish, specially tuna (Euthynnus pelamis), are gutted and cut into thick chunks. A broth is made either by boiling offal, blood, and bones in half sea and half fresh water by weight or by boiling with goraka in half-diluted sea water. The chunks of fish are placed in the
boiling broth for 10 minutes, removed, rolled in wood or coconut-leaf ash, smoked for a few days, and sun-dried.

There are cold storage facilities at Mutwal where two trawlers are based.

Ceylon and Japan entered into an agreement in 1955 which was renewed in 1961 for fishing tuna. The tuna is sold in Ceylon as fresh fish, but there are plans to freeze tuna, spiny lobster tails, and shrimp. The enterprise also plans to can 5 tons of tuna per day.

Under Colombo plan aid, the Canadian government has set up an ice plant and storage in Colombo. China and Poland are also offering aid in fisheries development in addition to the help already given by West Germany and the U.S.S.R.

**PAKISTAN**

Fishery is second only to agriculture in extent and importance among the basic industries of the country. The fish catch comes from two sources—marine and fresh water, the latter being two thirds (67%) of the total.

Fishing in Pakistan is a seasonal industry. During the monsoon months it is generally poor in East Pakistan due to squally weather conditions in the Bay of Bengal and the flooding of the rivers and inland reservoirs. Sea fishing is restricted to the coastal waters and the fishing boats go out only when calm weather prevails. It is conducted along the West Pakistan coast after cessation of the southwest monsoon, generally from the end of September through January. Among the important marine fish and shellfish are sardine, mackerel, sole, hilsa, pomfret, shark, and shrimp. Carp constitutes nearly half the total fresh-water fish marketed, being closely followed by catfish.

Although mechanization of fishing craft has been going on steadily, a major portion of the fish is still caught from country boats. The number of mechanized vessels was 344 in 1961, and has since increased to nearly 500. The government has built a modern fish harbor in Karachi, West Pakistan; three more are under construction, two in West Pakistan and one in East Pakistan.

Besides government efforts aimed at increasing the fish catch, improving the socio-economic conditions of the fishermen, and promoting exports, the FAO, the U.S. Agency for International Development, and Japan and Sweden are providing technical assistance in the development of Pakistan’s fisheries. Pakistan Industrial Development Corporation, a government agency, requested the Japanese Overseas Fisheries Cooperative Association (JOFCA) to send a fishery survey team to Pakistan in 1962. The team surveyed the shore facilities and conducted coastal and
offshore water surveys for about 40 days. If the survey proved promising, Pakistan would probably seek Japanese assistance in developing its fishing industry.

The provincial governments of East and West Pakistan have an elaborate fish culture program in inland waters. Fallow water areas are being reclaimed for fish culture. Exotic food fish like tilapia and common carp, which breed rapidly in confined waters, are being popularized.

Four fifths of the total catch is marketed unprocessed and the rest converted to processed fishery products. The means of fish transport are outmoded and are mostly head loads, shoulder slings, pack animals, bullock carts, country boats, pony carts, and camel-back. Private trucks, railroads, and steamers are also used in the transport of fish but none has chilling or freezing facilities.

**Processing**

Curing is the principal method of processing marine fish; most of the fresh-water fish is consumed fresh. Sun-drying without salting and dry- as well as wet-salting are the general methods of curing fish. Drying and salting are carried on as cottage industries, except at Chittagong and Karachi where they are “big business.” Shrimp is dried without salt or boiled in light brine before being put to the sun. Shelling is done manually. Hilsa, mackerel, etc. are wet-cured.

The freezing and canning industries are of recent origin, and are primarily restricted to shrimp. There are 14 freezing plants located at Karachi, West Pakistan, with a total capacity of 140 tons of frozen shrimp per day, and their combined cold-storage capacity is about 4,500 tons. There are only two freezing plants in East Pakistan, one at Chalna and the other at Chittagong. The first has a freezing capacity of 5 tons daily and cold storage for 200 tons, the second 2.5 tons and 50 tons, respectively. There is one canning plant at Karachi with a capacity of 5,000 3\frac{3}{4} oz. cans per day.

In freezing and canning shrimp, peeling and deveining are done manually. Grading, freezing, and actual canning are mechanized. Labor being cheap, it is not expected that peeling and deveining will be mechanized in the near future. However, in one freezer trawler automatic shrimp-processing machinery, such as shrimp peeler, shrimp cleaner, waste separator, deveining, and grader, has been installed. The vessel's two holds maintain a temperature of —20°C. (—4°F.).

**Fish Meal**

In 1962 13,300 metric tons of fish went to the reduction plants. Fish oil is produced on a very small scale by cottage industries. Fish like
sardines and mackerel are generally converted to meals during periods of glut. There were six fish meal plants in Karachi in 1961. Of these, two are modern reduction plants, and the others grind the sun-dried fish. Total estimated capacity is about 130 tons per day. The government plans to establish four more fish meal plants in the country—two in East Pakistan and two in West Pakistan. The fish-liver oil is extracted mostly from the hammerhead shark (*Sphyrna blochii*). This oil averages about 15,000 I.U. of vitamin A per gram, nearly 25 times as much as standard cod-liver oil.

Pakistan recently (1963) declared it would establish a whale-oil processing plant.

**Kuwait**

The fishery statistics of Kuwait are not available. Regarding fisheries trends, two companies have been organized to fish in the Persian Gulf area and possibly the offshore areas of the Sudan. One company plans to open in Kuwait a new privately owned fish market containing the most modern refrigeration facilities for the sale of both fresh and frozen fish. The company also hopes to supply large foreign oil companies in the area with edible fish. Regional distribution will begin with the Lebanon.

Shrimping is the only successful fishery in Kuwait. It has two active shrimp vessels which fish about 35–40 miles off the Kuwait coast. The only processing plants are those on board ship. The shrimp are beheaded, mechanically graded, and manually packed in 5-lb. cartons and blast-frozen aboard the vessels. The cartons are then packed in 50-lb. master cartons and stored on the vessels until transferred to ships in Kuwait harbor. Shrimping is conducted from August to May.

In 1960, shrimp processing for export was a monopoly of a single company. Another company, supported by a leading sheik with the help of a British firm, is currently engaged in shrimping in the entire Persian Gulf with the processing plant located south of Dubai.

Besides the successful shrimping, the company officials have based the founding of both companies on the expectation of large-scale fish processing including freezing, canning, and smoking of fish, production of fish meal, and extraction of fish oil. As conceived, the major part of the fish-processing aspects of the business would be based in Dubai.

**XX. Red Sea**

Some experts believe the waters of the Red Sea to have one of the richest fisheries in the world. They may also be the least exploited. The Ethiopians and the Yemeni are the two most important fishing nations in the area. Soviet and Japanese fleets have also entered these waters.
SUDAN

Although Sudan borders on the rich resources of the Red Sea, only 4% of the catch is from that region. Over nine tenths of the catch is from the Nile River system. The rest is composed of miscellaneous aquatic animals and residues. Most of the catch is consumed unprocessed but any dried and salted fish finds a ready market. Such processing is being encouraged by the government.

ETHIOPIA

For centuries the Ethiopians were isolated from the outside world by the Moslems. Although the Coptic Church with its 100 fasting days per year on which only fish could be eaten should have promoted the use of seafoods, the mountainous terrain and lack of transportation tended to negate the Coptic influence. Then too the Italian conquest of Eritrea in 1882 deprived Ethiopia of her seacoasts. Upon federation of Eritrea with its old mother country in 1952, the interest in fisheries was revived.

The fisheries that are being exploited are close to the coast with two main centers, Assab and Massawa. The fishing is done mainly by small boats. Most of the sardine and anchovy catch is sun-dried on the beach by the catcher, and sold to the fish meal factories that grind it into meal for export. For the Massawa fishery in 1961 the fish meal processing accounted for almost seven eighths of the catch. The fresh fish for local consumption was only 3.2% of the catch; about one tenth was refrigerated for export, mainly to Israel.

With so many small fishing enterprises it is impossible to keep track of all the landings. All but about 100 metric tons of the reported catch was classified as unsorted.

SOMALIA

Information is scanty about the fisheries of these former Italian and British colonies. The U.S.S.R. has started a tuna cannery in the Las
Khorek zone of northern Somalia. This plant can manufacture 21,000 metric tons of canned fish per season. The daily capacity of the reduction plant is 15 tons and that of the freezing unit is 20 tons. There are also cold storage facilities for 800 tons of frozen fish.

In Alula, in the northern part of the country, a U.S. processor and distributor is establishing a joint fish freezing, processing, and marketing operation. This plant will cost about one million dollars and will be operated on an equal share investment basis.

JORDAN

Most of Jordan’s 200 metric tons of fish are landed at Aqaba on the Red Sea. This port is equipped with a freezing plant and storage facilities for 700 tons of fish per year. Before the fish consumption can be increased in the interior, roads and a fleet of insulated trucks are needed. Most of the fish is consumed unprocessed.

YEMEN

Although Yemen has considerable potential for developing its Red Sea resources, fishing today is still conducted on a small scale with primitive craft and gear. Fish is an important constituent of the diet of the inhabitants of coastal towns and in areas around Hodeida, Mocha, and Salif.

The fishery statistics of Yemen are not available. However, the Yemeni fishermen catch kingfish, red snapper, pompano, and other varieties of edible fish. Shrimp, crab, and spiny lobster are found in the waters off the Yemeni coast. They catch and export a small fish ("wazeef") which seems to be a variety of sardine. Catching of wazeef is operated from Mocha and Khawkha.

Most of the catch is marketed unprocessed. Some is dried at Khawkha and sold throughout the southern Yemen. The fishermen generally take their catch to Amran or directly to Aden where the fish is dried and prepared for export. In 1959, the combined Yemen-Aden dried fish exports consisted of 2,575 metric tons, 83% of which went to Ceylon.

ADEN

Most of Aden’s fish catch comes from the Arabian Sea. Fishing is seasonal and is intensified during the fall after the southwest monsoon is over.

Fish is mostly marketed unprocessed but some is cured. The city of Mukalla, the second largest in the protectorate, is establishing fisheries and processing facilities for both tuna and spiny lobster. A U.S. importing firm was reported to have made preparations in June 1962 to bring a
12. REGIONAL DEVELOPMENT OF FISHING INDUSTRY

TABLE XIX
SOUTHEAST AFRICA FISH CATCH
(1000 metric tons)

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</thead>
<tbody>
<tr>
<td>Rhodesia and Nyasaland</td>
<td>—</td>
<td>2.0</td>
<td>6.8</td>
<td>13.6</td>
<td>8.3</td>
<td>25.5</td>
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<tr>
<td>Kenya</td>
<td>—</td>
<td>—</td>
<td>16.3</td>
<td>12.6</td>
<td>13.5</td>
<td>18.4</td>
</tr>
<tr>
<td>Tanganyika</td>
<td>16.0</td>
<td>22.0</td>
<td>51.0</td>
<td>60.0</td>
<td>60.7</td>
<td>60.2</td>
</tr>
<tr>
<td>Uganda</td>
<td>—</td>
<td>11.0</td>
<td>28.0</td>
<td>68.8</td>
<td>68.5</td>
<td>71.1</td>
</tr>
</tbody>
</table>

60-ft. refrigerated fishing vessel to Aden for commercially fishing spiny lobster. A New York City firm recently installed a small sharp freezer for spiny lobster, while the British Commonwealth Development Fund built a large freezer and cold storage plant for tuna.

XXI. Southeast Africa

EAST AFRICA

The former British East Africa is now divided into Kenya, Tanganyika, Uganda, and Zanzibar. The last consists of a two-island sultanate, off the coast of Tanganyika. It has recently established a Fisheries Development Company which is trying to broaden its economic base by expanding its tuna and salted and dried-salted fish products. Kenya is also developing her marine fisheries. Several hundred tons of dried shark and kingfish are imported annually from Arabia.

The other three are closely linked with the Great Lakes of Africa. All three border on Lake Victoria, the second largest fresh-water lake in the world. Other lakes include Tanganyika, Nyasa, Rudolf, Edward, Albert, Kyoga, and Eyasi. Lake Victoria furnishes the bulk of the fish for all three nations. As much of the fishing is done by small native boats that sell their catch locally, it is difficult to estimate the landings. It has been estimated that about 100,000 tons are caught annually from Lake Victoria. Tilapia comprises the major portion of the catch.

By far the vast majority is consumed unprocessed. However, freezing facilities are being developed at Lake Baringo in Kenya; in Uganda there are processing plants on Lake Edward and Lake George, and a small freezing plant at Katunguru. At Katwe on Lake Edward there are permanent salting vats and hot smoking pits. Fish cultivation is extensively developed in some sections of Uganda. South of Mombasa, sea fish are often lightly cooked before marketing. A recent survey showed that the canning of “dagaa” (*Linnothrissa miodon* and *Stolothrissa tanganicae*) from Lake Tanganyika was feasible.

In the northern Nyanza region of Kenya, fish ponds are common (there
are more than 7,000); production reportedly averages 60 lbs. per 100 sq. yd. The potential, sustainable yield of Lake Rudolf is estimated at 20,000 tons of tilapia and Nile perch together.

**Rhodesia and Nyasaland**

One would never expect a landlocked country to depend much on fisheries, yet this Federation landed 8,300 metric tons of fish in 1960, from the large lakes in this area. The four largest are Tanganyika, Nyasa, Bangweulu, and Mweru. In addition the dam on the Zambezi River in the Kariba Gorge created Lake Kariba, the largest man-made lake (2000 sq. mi.) in the world. Lakes Nyasa and Mweru are the most important fisheries. Conservation scientists, however, feel that Lake Kariba has a substantial potential for future fish raising.

The sardines of Lake Tanganyika find a ready market when dried. Unless the Nile perch are also caught and utilized, some experts feel that they (the perch) will deplete the sardine population through predation.

Most of the non-sardine fish is eaten fresh. Government officials are experimenting with a number of processed products, such as non-sturgeon caviar and smoked burbot.

The Tropical Products Institute (U.K.) in Nyasaland has tried the canning of fish from Lake Nyasa. None of the three dominant fish was regarded as suitable for canning. After processing, flesh texture was poor and the bones inadequately softened.

**Malagasy Republic**

The waters around the island of Madagascar have long been known for their abundant fauna. The Japanese and Taiwanese have been making regular trips to this area. However, the Malagasyans do not take advantage of these waters; the total catch in 1961 was only 4,000 metric tons. This is undoubtedly only the marine catch, since the production from fish cultivation is 22,000-25,000 tons per year.

Most of the catch is consumed unprocessed, a little is smoked or salted. Nonetheless, a French canning company has opened small canneries in Majunga, Diego Suarez, and Tamatave to ascertain if tuna can be processed profitably. This firm has contracted with Taiwanese fishermen for their supply of tuna.

A Japanese enterprise has freezing facilities at Majunga and Tamatave where shrimp is purchased from the local fishermen, frozen, and exported.

Sea cucumbers (holothurians) are abundant along the west coast and constitute the basis for a regular export to Hong Kong. Some are
extracted off one of the Comoro Islands at the north end of the Mozambique Channel.

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Ethiopia

Faeroe Islands

Fiji

Finland

France

W. Germany
Ghana

Greece

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Israel

Italy

Japan

Jordan

Kenya

Korea, South

Lebanon

Liberia

Libya

Malagasy Republic

Malaysia

Mauritania

Mexico
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Nicaragua

Nigeria

Norway

Nyasaland

Pakistan

Panama

Peru

Philippines

Poland

Polynesia

Portugal

Rhodesia and Nyasaland
Romania

St. Lucia

Saudi Arabia

Senegal

Somalia

South Africa

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