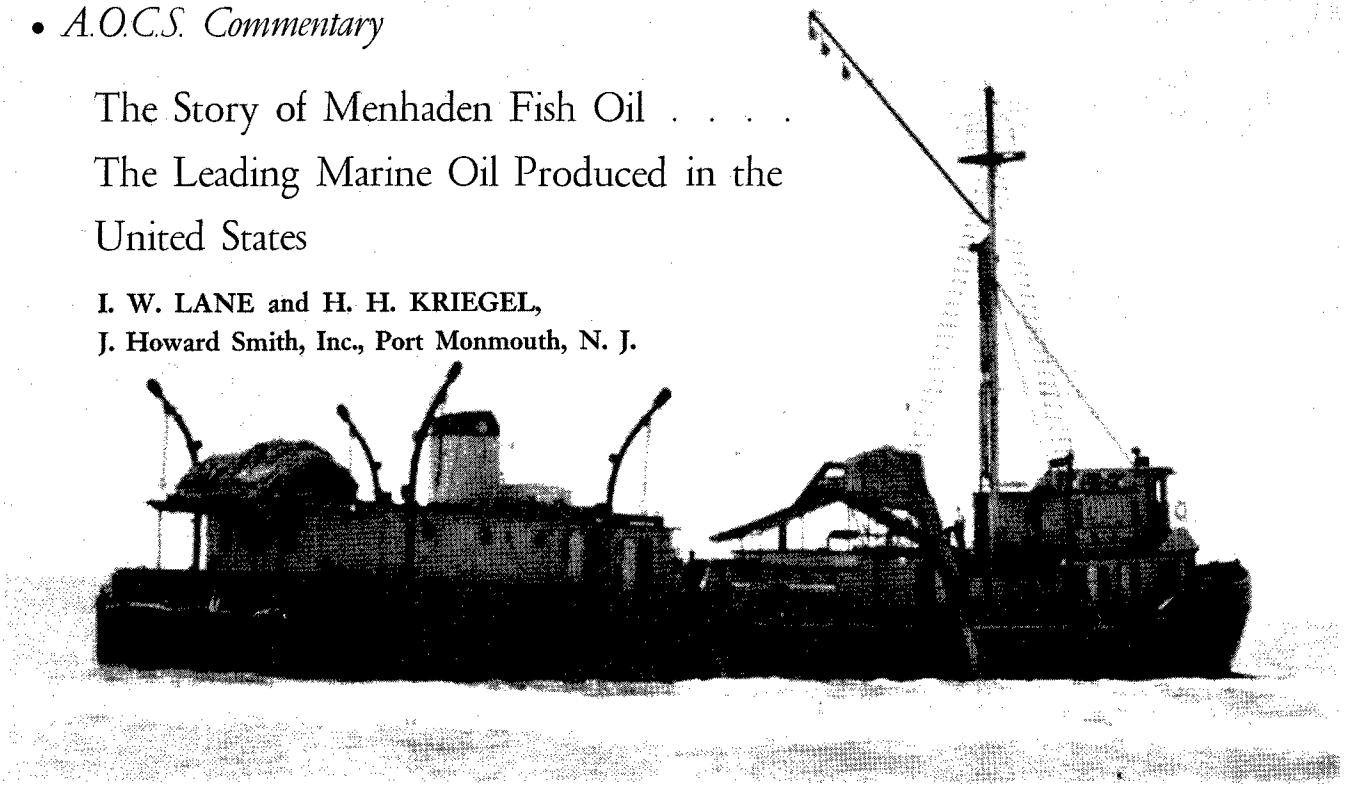
• *A.O.C.S. Commentary*

The Story of Menhaden Fish Oil . . . . The Leading Marine Oil Produced in the United States

I. W. LANE and H. H. KRIEGEL,
J. Howard Smith, Inc., Port Monmouth, N. J.



EACH YEAR from late spring through late fall schools of Menhaden fish swim along the Atlantic coast from southern New England to Florida and across parts of the Gulf of Mexico. These fish, closely related to the herring, have no teeth, and, like the shad and herring, they feed almost entirely on microscopic sea creatures called plankton, which occur in abundance in temperate waters. The Menhaden, commonly referred to as "moss bunkers," are a stranger to most people. Nevertheless, in aggregate, according to Government figures, the Menhaden catch accounts for approximately one half the tonnage of all fish landed in the United States each year by any and all means, including sport fishing.

The Menhaden, a silver-scaled fish, averages 12 inches in length and three-quarters of a pound in weight. Full-grown Menhaden will be as large as 18 inches and weigh almost five pounds. The name Menhaden is, interestingly enough, very much Americanized, being derived from the Indian word, "Munnawhatteaug," meaning "that which enriches the earth." Practically every schoolboy knows that when the colonists first came to America, they discovered the Indians planting corn in a peculiar way. It seems that the Indians placed a dead fish in each hill of corn to fertilize it. The fish used were Menhaden.

Menhaden are not commonly used for table purposes, solely because they are oily in taste and quite bony. Products made from this fish, however, have a tremendous impact upon the over-all economy of the United States and the World.

The protein resulting from the cooking and pressing of Menhaden is called fish meal, and today it is used almost exclusively for poultry and animal feeds. However, there are many indications that some of this protein in the future may be used for human use in the form of Fish Protein Concentrate. The oil released after the fish are cooked and pressed has many uses in our over-all oil economy.

Menhaden usually swim in schools fairly near the surface and primarily within three miles of the shoreline. The schools are usually located by airplanes working in close collaboration with large fishing ships, referred to by the fisherman as steamers. The fishing vessel, when approaching a Menhaden school, releases two 36-foot aluminum purse boats which carry the net, or purse seine. This seine, about 1,200 feet long and 50 feet deep, is used to encircle and capture the Menhaden school.

After being caught, the fish are pumped from the net into the large fishing vessel. Many of these vessels, especially in the Gulf of Mexico, have refrigerated holds to preserve the quality of the protein and the oil to be rendered from the fish. At the plant the fish are pumped from the boats to the plant. They are then continuously cooked by pressure steam and pressed. The resulting solids are dried under carefully controlled conditions to make fish meal. The liquids are separated by centrifuge into oil and water-soluble protein. The latter is concentrated to make a 50% solids protein additive for feed called fish solubles, while the fish oil is carefully cleaned and stored.

In the past, when a lay person thought of Marine Oil, his immediate connection was the spoon of Cod Liver Oil that was forced between his teeth as a youngster by a vitamin-conscious mother. Today, Marine Oils represent a distinct group of fats and oils in the over-all world supply. Their unique characteristics are challenging an increasing number of researchers to develop new products for the growing markets.

Menhaden Oil, as produced in the Atlantic, has an iodine number of 165 to 185. The Oil produced from the Gulf of Mexico fish has an Iodine Value 15 to 20 points lower.

H. M. Edwards of the University of Georgia shows in

TABLE I

Fatty Acid Composition of Menhaden Oil Unsaturated Fats

Fatty Acid	Carbons: Double bonds	Weight %
Caprylic	8:0	.....
Capric	10:0	.....
Lauric	12:0	Trace
Myristic	14:0	11.9
Myristoleic	14:1	0.4
Palmitic	16:0	22.9
Palmitoleic	16:1	17.1
Stearic	18:0	6.3
Oleic	18:1	14.7
Linoleic	18:2	3.8
Linolenic	18:3	1.4
Licanic	18:4	3.2
	20:3	Trace
	20:4	Trace
	20:5	13.0
	22:6	5.4

Table I, the fatty acid composition of Menhaden Oil. Note the uniqueness of the composition of Menhaden Oil, especially in the long-chained, highly unsaturated fatty acids.

Marine Oils find a ready market in the surface coating industry. This continued usage stems from a stable, moderate price and the quality of finishes realized with fish oils. As with every raw material, Marine Oils do have limitations, such as a tendency for alkyds made from fish oil to discolor on ultra-violet exposure. In spite of this, the oil is finding substantial use in alkyds, varnishes, and per se in paints.

House paints (exterior) use heat-bodied fish oils with raw linseed oil. They can also be used in aluminum paints for both interior and exterior applications. Fish oil can be blown with air and these oils are being used as nitrocellulose plasticizers, in barn and roof paints and as rust-proof coating. Fish oil can be polymerized with dicyclopentadiene and can be used in undercoat paints.

Although varnish manufacture is on the decline, there is still a substantial market for fish oil use. Bodied fish oil with chinawood oil is being used more today than it ever has been. With chinawood oil being so high priced, the varnish manufacturer takes advantage of the lower coat of fish oil to supplant some of the chinawood oil in varnish formulations.

Fish oil, with its high iodine value, is put to good use in making alkyds with both orthophthalic anhydride and isophthalic acid. These resins have better durability than the processed fish oils.

Research work is continuing at Government and private laboratories on increasing uses of Menhaden Oil and its derivatives. Many of these projects are concerned with the utilization of the long-chained, poly-unsaturated fatty acids in such fields as protective coatings, textile chemicals, lubricating oil additives, alkyd resins, plasticizers, emulsifiers, aldehydes, and fatty alcohols. Menhaden fatty acids can even be utilized for the preparation of polyamide coatings to restrict the burning of solid rocket propellants.

At this time, a large portion of Menhaden Oil is used abroad for margarine and other edible shortenings. For this purpose, the oil is refined, hydrogenated and blended with other fats. The hydrogenation eliminates the inherent characteristics of Marine Oils, such as odor and taste, heretofore associated with fish oils.

Nutritional data have indicated fish oils may be effective reducing serum cholesterol. Research is being directed toward the elimination of odor and taste so these beneficial characteristics can be more readily utilized in the edible field.

Animal and poultry research in previous years has often led in a nutritional advance which may later be applied in human nutrition. In this sense it is interesting to note that large quantities of Menhaden Oil are now finding their way into poultry feeds. These are being added at very low levels to supplement other fats used largely for energy purposes. The reason, in addition to the low cost, is the large quantities of unsaturated fatty acids which apparently are giving a growth response in broilers as well as increases in egg production.

While Menhaden Oil is produced only in the United

States—the Menhaden fish being indigenous to the Atlantic and Gulf coasts of this country—substantial quantities of various other Marine Oils are available in other parts of the globe. Along the west coast of South America vast quantities of Anchovies are caught—the fishing grounds extending from the northern ports of Peru down along the coast of Chile. The "Anchovetas" are brought into some 150 reduction plants primarily for conversion into Anchovy Meal, a high protein feed ingredient. Although the oil yield of the Anchovy is small, it is anticipated that this year's production of Anchovy Oil will amount to no less than 120,000 metric tons in Peru and about 20,000 metric tons in Chile.

Present along the coast of the southern tip of the African continent are Pilchards, which represent a large source of raw material for the commercial fishing industry. There is an annual production of 60,000 metric tons of Pilchard Oil in the Republic of South Africa and neighboring Southwest Africa. In the northern hemisphere, Iceland, in recent years has become a large supplier of Herring Oil, some 50,000 tons. Norway and Denmark also account for substantial quantities of this valuable oil. Our neighbors to the north have a large reservoir of Herring in British Columbia, and our own Alaska produces Herring Oil.

Every year during October/November, the whalers, the oldest industry to produce oil from the sea, send out their fleets into the Antarctic. British, Norwegian, Dutch, and Japanese factory ships, accompanied by fast chasers, go out for the whales. Oil and meat for human consumption are produced right at sea. Last season's catches accounted for about 300,000 metric tons of Whale Oil and about 90,000 tons of Sperm Oil.

In Europe, both on the Continent and in the British Isles, Marine Oils are being consumed in ever-increasing quantities for edible purposes, principally in the margarine industry, some going for shortening. This year's consumption is in excess of 600,000 metric tons.

Modern technique has made possible great progress in the production of margarine from Marine Oils and has extended the "shelf-life" of the finished product. In addition, the price structure of Marine Oils has been conducive to increased usage in the edible field. Fish oils, Herring and Whale Oil during the course of the year 1962, reached the lowest price level since the days of the depression. The reason for this decline was the sudden appearance of a

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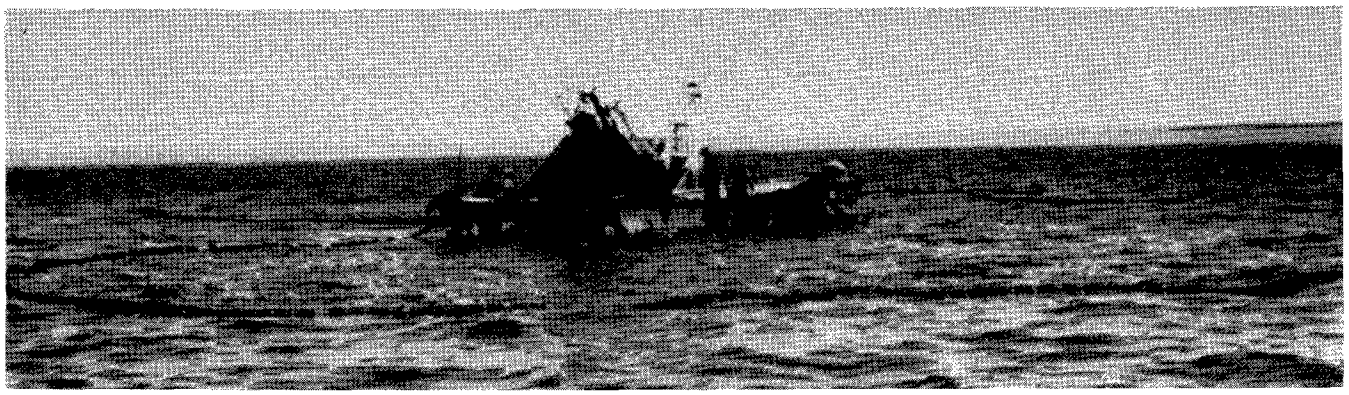

The purse seine net containing the trapped menhaden school being gathered in mechanically by the two purse boats.

• *Local Section News*

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On November 28th the North Central Section met at the Builders Club for their last meeting of the 1962 season. Dinner was preceded by a social hour.

Following the dinner, S. C. Miksta, substituting for President Angelo Graci, asked all members to give thought to the selection of suitable candidates for the annual Bailey Award.

Speaker of the evening, H. J. Harwood, Organic Chemistry Section, Durkee Famous Foods, was introduced by T. W. Findley. Dr. Harwood delivered a most interesting and informative talk entitled, "Some Reactions of the Fatty Acid Hydrocarbon Chain."

The next meeting of the North Central Section will be held January 23, 1963.

H. J. Harwood addresses attendants at the North Central Section Meeting, November 28. The title of his presentation was "Some Reactions of the Fatty Acid Hydrocarbon Chain." Section Program Chairman, T. W. Findley, sits at Dr. Harwood's right, and Section Secretary, Geraldine Boyle, at his left.

North Central Section Members and guests enjoy the last Section Meeting of 1962.

1963 Short Course on Soaps and Detergents Scheduled at Princeton Inn

Plans for the 1963 Short Course on "Advances in Soaps and Detergents" are progressing well, according to a report from the Program Chairman, Erie Jungermann, Armour & Co., and his Committee.

The meeting will be held June 23–26, 1963, at Princeton Inn, Princeton, New Jersey. Program details, plant trips, and rates will be announced shortly. Response has been excellent and a number of qualified speakers have volunteered to talk on timely subjects.

It is to be noted that, in addition to Committee Members listed in past issues, R. L. Liss, Monsanto Chemical Co., has joined the Program Planning Committee.

Menhaden Fish Oil. . .

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relatively large quantity of Anchovy Oil from Peru. Users in Europe were not geared to absorb the excess of some 100,000 tons and methods of increased consumption had to be found. Now the world market seems to have stabilized and prices are appreciating.

In the United States, crude Menhaden Oil is the least expensive highly unsaturated fat, presently ranging in price from 4 to 6 cents per pound in bulk FOB production plant. The price fluctuates according to location, quality, time of delivery, and end use. Total production of Menhaden Oil in the USA during 1962 might reach 130,000 short tons, of which more than half is expected to be exported to the Netherlands, Germany, England, Norway, Sweden, and Canada.

Marine Oils will continue to grow in supply as the world increases its harvesting of the seas. As volume grows, the uniqueness of Marine Oils will spur research and development to better use this highly unsaturated, high-quality fat.