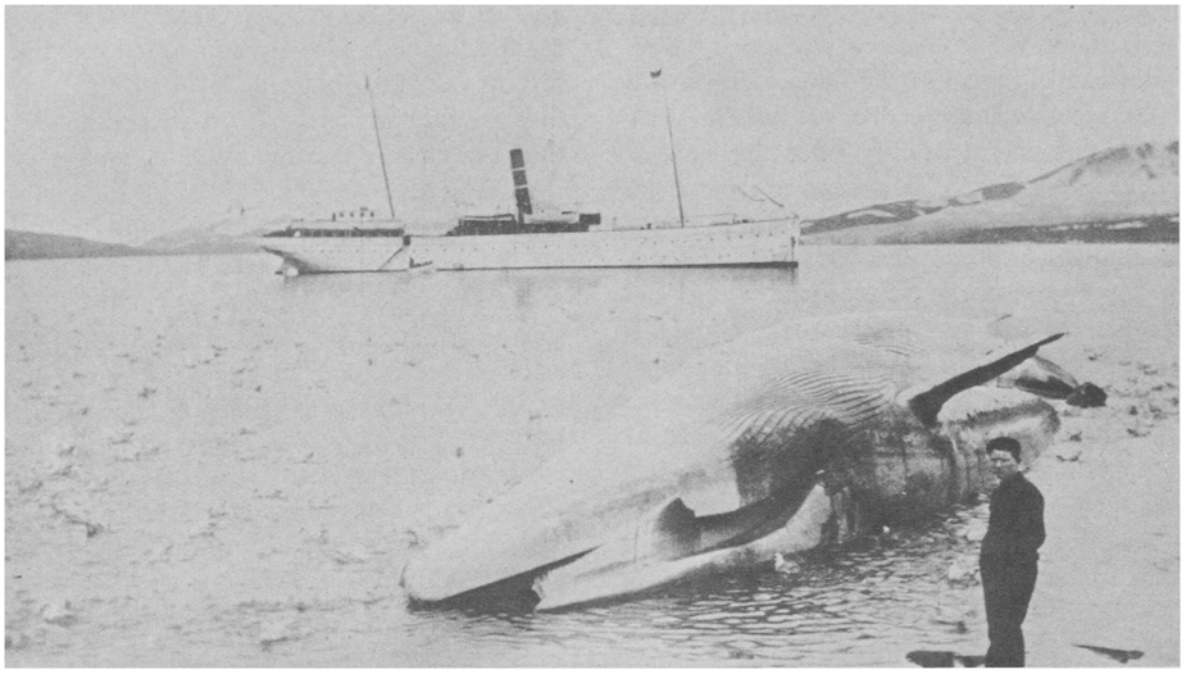

Gulls waiting for the cutting waste. Modern whaling is a matter of machinery, far different than in the days of Herman Melville

Modern Whaling*

By HARRY P. TREVITHICK
and
ALAN PORTER LEE

DURING recent years there has been a survival of interest in an oil which was in almost universal demand a century ago. Before the days of kerosene the illuminating oil in general use for household and street lighting was whale oil. In the early years of the nineteenth century the demand for this product became so extensive that the whales of the North Atlantic and Arctic regions were all but exterminated by the enterprising Yankee whalers sailing out of New Bedford and other New England ports.

As an illuminant, however, whale oil was subject to several severe criticisms. The burning oil gave forth an acrid fishy odor. The use of wicks was difficult because of excessive charring and the light obtained was at best fitful and smoky. With the advent of refined petroleum products the use of whale oil as a lighting fuel was doomed. The pursuit of whales continued, however, chiefly for the sake of whalebone and spermaceti (obtained from the heads of the whales), the spermaceti being a source of particularly fine lubricant materials.

In this way the Northern whales were practically exterminated, and the limited amount of whale oil that came into the world's markets was used for various industrial purposes, such as currying leather or oiling wool for combing.

The soap maker scorned whale oil as an ingredient of any but the cheapest grades of his product, because of its fishy odor, which invariably carried through saponification into the finished product, also because of the low titer of the oil, which made it unsuitable for firm soaps.

The modern whale oil industry is based upon a dual foundation of geographic exploration and laboratory research. Although Sir James Clark Ross, the great British naval explorer, had reported the presence of the "right whale" in Antarctic waters after his voyage of discov-

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ery in 1839-41, it was not until during the early years of the present century that hardy Norwegian whalers commenced to develop successful commercial whaling voyages into the Antarctic regions and it is only since the time of the world war that southern whaling operations have attained truly gigantic proportions.

The second tier of stone in the whale oil foundation is of course the science and art of hydrogenation, which has made whale oil available, not only for the manufacture of fine soaps, but also for use in shortening and margarine. All the unpleasant characteristics of natural raw whale oil are susceptible to complete elimination by proper refining methods, including hydrogenation, so that the material becomes suitable for use in choice soaps and in high grade edible products.

Whale Oil Collection

LEWKOWITSCH, in "Chemical Technology and Analysis of Oils, Fats and Waxes" recognizes five established grades of whale oil, Numbers 0 to 4, inclusive. These grades have been established for years and are based upon variations in color, odor and (loosely) free fatty acid content.

The Antarctic whaling expeditions are resorting so extensively to modern methods of recovery that their production of the lower grades of oil is dwindling rapidly, and the percentage yield of the higher grades (Nos. 0, 1 and 2), is steadily mounting. The completely equipped Antarctic whaling expedition of today represents a very heavy investment. It includes at least four ships, the mother ship or floating factory, three or more steam whale chasers or harpoon vessels, and often a tank steamer to convey the oil to market. The harpoon vessels are of the small steam trawler or seagoing tug type and size. It is their function to pursue and kill the whales, which are left secured to floating buoys for recovery and rendering by the floating factory. This rendering plant afloat is the elaborate center of the modern whaling system.

It is equipped with complete steam-rendering and open tank rendering facilities, and generally with a large entrance-hatch at bow or stern to facilitate drawing the whale into the hold of the ship, thus avoiding hoisting the heavy animal to the deck. In recent years many of the floating factories have installed dry-rendering or vacuum rendering, and preliminary refining equipment. It is to these innovations that the steady improvement in quality of the raw oil is due.

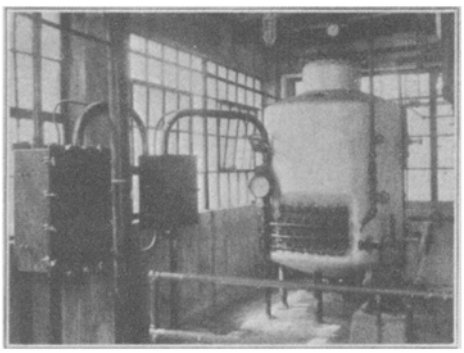
In the recovery of the oil as now practiced, all the meat of the whale is subjected to the rendering process, for the sake of the last vestige of oil, and the only possible use for the reduced proteins or rendering tank residues is as fertilizer. It is not inconceivable that progress in the design of rendering equipment will result in the production of residues of such superior quality that they can be used for hog and cattle feeding. A further possible refinement would involve applying standard packing house methods to whale slaughter and shipment of the meat in refrigerated ships to the world's markets, for human consumption. Whale steaks have been offered to a limited extent in this country and the meat is said to be palatable, but there is little likelihood of whale meat entering into serious competition with native beef at any time in the near future.

Volume of Whale Oil Production

BEFORE following the course of whale oil from floating rendering tanks through the various steps of preparation, refining and hydrogenation to its uses in soap and margarine, we will discuss briefly the magnitude of whaling operations and whale oil production in recent years.

In the season 1928-29, including the summer of 1929, in Antarctic seas there were produced 1,631,340 barrels of whale oil, in African seas 145,065 barrels and in all other areas 136,443 barrels, making a total of 1,912,848 barrels of oil from the world catch of whales. In the season 1929-30, including the summer of 1930, the Antarctic production was 2,560,277 barrels, that in African seas 148,944 barrels and for the remaining areas of the world's oceans 175,081 barrels, making up a total of 2,884,302 barrels. It will be seen that the percentage increase in 1929-30 over 1928-29 was 50.78 per cent.

In the season 1930-31 the records of Antarctic production show a gathering of 3,598,937 bar-



View of hydrogenation equipment

rels, while an estimated recovery from all other seas is 350,000 barrels, making a world total of 3,948,937 barrels, an increase of 36.91 per cent over the previous year and of 106.43 per cent over the 1928-29 season. The attached tables show a more complete distribution of whale oil production according to oceanic fishing areas and nationality of the fishers.

For comparison with production of other fats, the whale oil yield of 1930-31 has been converted to pounds on the basis of 6 barrels per ton of 2240 pounds. We can then make the following comparison of world production of fats in the season 1930-31.

(In millions of pounds)

Vegetable oils	17,390
Animal oils and fats	9,541
Fish oils	211
Whale oil	1,481
Total	28,623

Thus whale oil is seen to have constituted approximately 5 per cent of the world's available supplies of all fats during the 1930-31 season.

The fats with which whale oil enters into most direct competition are tallow and oleo stock. World production of these in 1930-31 was as follows, in millions of pounds:

Tallow (edible and inedible)	653
Oleo stock (inclusive of oleo oil and animal stearines)	214
Total	867

The year's production of whale oil is 70.82 per cent greater than the total of oleo stock and tallow of all descriptions. These figures throw considerable light on present market prices of tallow and of oils and fats in general. There is hope, however, that this overbalance of world supplies against demand for fats will be relieved by the agreement among producers to refrain from Antarctic whaling during the approaching season.

Whale Oil Processing

RETURNING to our floating rendering plant in Antarctic seas, we will endeavor to follow the progress of the oil from source to use. The small steam pursuit vessels range the sea for miles around the anchorage of the factory ship and attack the whale with explosive harpoons. Each whale killed is marked with the crew's distinctive flag and left attached to a buoy, to be towed at the end of the day to the headquarters ship. Here the work of getting the cetacean inboard and cut up (flensed) proceeds with haste, because delay means loss of quality in the rendered oil.

The best grade of oil (No. 0) is obtained from the pure blubber by boiling in water in open digesters, and this quality is pale in color and nearly neutral. No. 1 oil is obtained by more prolonged boiling with water in open kettles and runs from 1 to 2 per cent free fatty acid, being slightly darker in color than No. 0. No. 2 is obtained by pressure rendering of the residue from the open digesters. This oil is yellow or pale brown in color, having free acid content up to 5 per cent. No. 3 grade is obtained by pressure rendering of the entire flesh, rather than the blubber, together with some cuttings and trimmings from the blubber. It is pale to dark brown in color and may contain up to 10 per cent of free fatty acids. The lowest grade (No. 4) is recovered by digestion under pressure of the bones, offal and skin and all carcass scraps. It contains much albuminous matter and the free acid content may rise as high as 30 per cent.

The fact that whale oil is free from an excessive amount of fatty acids with high carbon content makes it, when hydrogenated, a superior soap-making material.

It is common practice to filter the better grades of oil immediately after the recovery, the poorer qualities being run to settling tanks from the rendering vats. Some attempts to apply vacuum dry-rendering systems are said to have been successful in materially reducing the quantity of low grade oils.

In the earlier days of the Norwegian Antarctic whale fisheries every factory ship was its own tank transport, remaining at the whaling grounds only until its tanks were filled and then proceeding to its market port. More recent practice inclines toward providing the factory ship with settling and reduced-volume storage

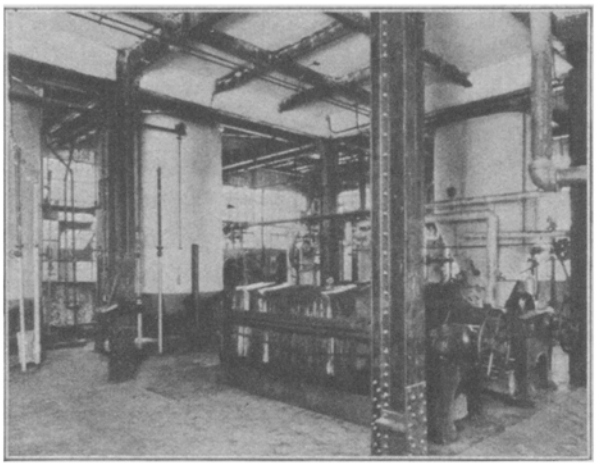


Illustration of refinery apparatus

tanks only, and providing a separate tank steamer to proceed rapidly to market as soon as filled, the factory ship remaining at the whaling station for longer periods to continue the killing and rendering work.

Before the discovery of hydrogenation, and to a much lessened extent since, whale oil has been grained and pressed for the removal of the palmitine (so-called "whale stearine"). The cold pressed whale oil thus produced provided a less smoky illuminant than the whale oil and had also more desirable properties as a leather dressing and lubricant. The methods generally employed for this cold pressing were and still are crude and wasteful of materials and labor in most cases.

> Whale oil constituted approximately five per cent of the world's available supplies of all fats during the 1930-31 season.

The oil is grained in barrels or tubs and transferred to bags for pressing in screw or lever presses. Slackening of demand for the cold-pressed oil will preclude, in all likelihood, the adoption of more economical methods for this purpose. The methods in use for production of winter cottonseed oil would seem ideally suited for application to the cold-pressing of whale oil.

The discovery of the practical possibility of catalytic hydrogenation of unsaturated fats opened to whale oil many fields of industrial application. The fact that whale oil is free from an excessive amount of acids containing twenty or twenty-two carbon atoms makes it, when hydrogenated, a soap-making material superior in quality to hydrogenated fish oils. The better grades of whale oil, when properly refined, and hydrogenated, furnish a suitable fat for use in margarines or shortenings.

Ceylon--Citronella Producer

(*Assistant Trade Commissioner Wilson C. Flake, Calcutta, India, and other sources.*)

Ceylon, a British island colony in the Indian Ocean about the size of the state of West Virgina, is an important source of essential oils and natural aromatic raw materials, particularly citronella, cinnamon bark, and cinnamon leaf oils. Renowned for centuries as a spice center, this island, although now somewhat less prominent as a source of such tropical products, still ships substantial quantities of cinnamon and cardamons and maintains a small trade in nutmegs, mace, and cloves. Certain quantities of cinnamon bark, cardamon, nutmeg, and mace oils are distilled from Ceylonese spice materials in foreign industrial centers which indirectly supplements essential oil supplies from that source.

Citronella Oil

Citronella oil, the principal essential oil contributed by Ceylon to world trade, is obtained by distillation from a coarse grass (*Cymbopogon nardus*) found mainly in the southwestern sections of the island. It grows to a height of about four feet and thrives in dry regions on hard gravelly soils. Successful cultivation of this oil-yielding grass in Ceylon has been attained in areas below an elevation of 1,000 feet.