it appears no less effective at higher concentrations of soap than at lower levels. The alcohol extraction method gave results comparable with those obtained by the Durst procedure at soap concentrations up to 100 pts./M², but it fails completely when approaching the 200-parts-per-million range. Even when eight extractions were made the alcohol failed to remove 20 per cent of the soap. The modified Durst method proved to be most satisfactory of the three. At low and medium soap concentration, the recovery was, for all practical purposes, quantitative. That it proved to be less efficient at the 200-part level is probably due to an insufficiency of acid used in the decomposition of the soap. Further study, and perhaps some modification, is probably necessary here.

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INTERNATIONAL DEVELOPMENTS IN OILS & FATS*

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17 BATTERY PLACE, NEW YORK

IN placing this paper before you, it is done more to give you an impression of the great importance of the world's industry in oil, fats and oil-bearing seeds. Very few people realize the magnitude of this industry and its far flung interests throughout the world, — from whale oil produced in the Antarctic in the South, to oils produced from various marine animals in the far North.

During the past year the demand for vegetable oils, both for edible and industrial purposes, indicated a decided increase over previous years. The United States, particularly, has continued to exert a powerful influence on the world markets for oil-bearing seeds and vegetable oils. The influence of bumper crops in the United States is of most importance and to a very great extent is a decided factor in regulating price levels of foreign oils.

The group of fixed or fatty oils, composed mainly of glyceride and fatty acids, is to be distinguished on one hand from the hydrocarbon oils of mineral origin, and on the other hand from the volatile or essential oils of vegetable origin.

Many of the fatty oils are of vegetable origin, being obtained from the seeds and nuts of a number of seeds and plants. At least 30 different trees and plants have been used for the production of oil on a commercial scale and a much larger number of varieties are known to contain oils which up to the present are not produced commercially.

Falling within the fatty oil group are several marine oils, notably whale oil. Animal products, namely butter, lard and tallow, remain the principal animal fats in commerce, but with the increasing demand for fats, the consumption of vegetable fatty oils has increased enormously.

The demand for fatty oils comes from many sources, of which the most important are the food and soap industries. There are no fatty oils equally suitable for all purposes, but by such processes as hydrogenation certain oils can be now adapted to uses for which they were not previously suitable. The effect has been to make the various oils more readily interchangeable in response to price fluctuations.

At the same time, some oils are more generally used than others for certain purposes. Thus, for the manufacturer of margarine, the most important vegetable oils are cocoanut, palm kernel, cottonseed, soya bean and peanut oil. For soap making, cocoanut, palm, and palm kernel are widely used, and also to a lesser extent, cottonseed and olive oils. For compound lards, cottonseed oil predominates while olive oil is important for salads and cooking. A drying oil is required in the manufacture of paint, varnish, and linoleum, and for these, linseed and tung oils are most generally employed, with soya bean and perilla oil as substitutes. Castor oil and rapeseed oil have special qualities rendering them suitable as lubricants.

In the same way, for the numerous other uses in which vegetable oils are employed in the producing and importing countries, there are generally certain oils which are preferred to others.

By far the greater part of the vegetable oils available in the United States and Europe are consumed, together with fatty oils and fats of animal and marine origin, in the production of soap, margarine, and edible fats.

With the principal oilseeds produced, after the vegetable fatty oils have been extracted either by crushing or with solvents, the residue, namely oil cake or meal, is available either as food for livestock or as a fertilizer.

Butter and lard although they are used at times as constituents of margarine and compound lard, compete with these finished products rather than with the alternative raw materials. On the other hand, tallow (which is a byproduct of the meat industry) is used extensively in soap, and also in the manufacture of candles.

Whale oil, the most important of the marine animal oils, through the great development which has taken place especially in the Antarctic, is now a very serious competitor of vegetable oils. Last year's production of whale oil in the Antarctic was approximately 600,000 tons. To give an impression of the magnitude of this industry, the new floating factory ships which proceed to the Antarctic each year for the production of whale oil are vessels running anywhere from 15,000 to 25,000 tons each. Last year there were 30 of these factory whaling ships used, attached to which ships were 176 killer boats. The number of men employed in these various ships totalled 9,321. The actual number of whales killed in the Antarctic was approximately 36,000.

A special international agreement, to which most of the principal countries are now parties, restricts the vessels to a specific period of fishing and each factory vessel to a maximum capacity of oil produced. The main idea of this international agreement is to eliminate the indiscriminate killing of whales which, if continued without cessation, would undoubtedly have resulted in the quick extermination of the whale. The regulations also stipulate that no whales under a specified length may be killed, the stringent enforcement of which under the international agreement is giving the industry a new lease on life.

* This discussion was presented at the Fall Convention of The American Oil Chemists Society, Chicago, October, 1938.

In the various countries throughout the world where vegetable oils and oilseeds are produced, especially in such countries as India, Java, Sumatra, Africa, and South America, during the past 20 years great developments have been accomplished, as prior to the war period (1914) vegetable oils and oilseeds were produced almost entirely by crude native methods, and these oils when imported into America or Europe were invariably used in the soap kettle. Today these countries have made very extensive developments with plantations. One of the outstanding examples of such performance is Sumatra, D.E.I., which is today the world's principal source of palm oil. This oil is obtained from fruits which are the product of the most recent agricultural and botanical developments. These palm fruits are plantation-grown and mechanically treated, with the result that the oil so produced is so vastly superior that one cannot even compare it with the native-grown palm oil of 1914.

The present being the day of chemistry, most of these great plantations have their own force of chemists. The various Government bureaus, through their Agricultural Departments, also retain numbers of chemists throughout the various producing countries who are there in what one might term an advisory capacity to the owners of the plantations. When problems arise as to unsatisfactory crops, or if a planter is not getting an average yield per acre from his trees, he can always call in the officials from the Agricultural Department, who in turn compare notes with the plantation's chemists on all points appertaining to cultivation. With this Government cooperation, these countries have considerably increased production and improved quality.

In these countries they do not consider reducing their crops per acre but endeavor to secure the maximum return per acre with the assistance of scientific development and scientific fertilization of the soil. The writer's attention has been drawn to certain instances where during a period of native production a crop of 15 cwts. per acre was considered satisfactory. Today a crop of 2½ tons per acre of the same production is considered only a fair yield.

At the same time, however, as the production of fats and oils is on the increase, so the increased fabrication of manufactured products is also being developed, and in countries where they are producing large quantities of raw materials they are now erecting their own factories to manufacture finished products. This is principally the case in the Far East, where manufacturing is becoming a very important industry both for edibles and soap.

Considering the enormous populations in the countries of the East, when manufacturing in these territories develops, a greatly increased world's consumption of oils and fats may be anticipated. These countries will, to a great extent, then be in a position to use more of their own raw materials rather than exporting these commodities to foreign countries, which countries in the past have been re-exporting a certain quantity of their manufactured products to the raw material producing territories.

Manufacturing in tropical countries is now possible owing to scientific production methods being introduced, combined with the greatly improved quality of the raw materials.

To give an impression of the figures on consumption of oils and fats, the latest statistics available indicate that 70.6 pounds of fat per capita were consumed in the United States during the year 1937. In the United Kingdom the consumption was 64.7 pounds per capita. These figures, of course, include fats and oils used in all industries.

So far as edible products are concerned, Germany is still by far the world's largest producer of margarine. According to last year's figures the production was:

Germany	369,000 tons
United Kingdom	181,000 tons
United States	176,000 tons

There are only two countries, namely the United States and the United Kingdom, which are of any importance as producers of compound lard. Production figures are:

United States	783,975 tons
United Kingdom	88,000 tons
Germany	18,000 tons

The principal countries of Europe, especially Germany, have been endeavoring during the past few years to obtain substitutes for fatty materials from products, both mineral and vegetable, which are available in their own countries. The general results have, up to the present, been considered satisfactory, and in Germany several of these substitutes are already being marketed. One detrimental factor against these substitutes, however, is that when prices of imported raw materials are at their present low levels, the production costs of such substitutes are invariably not competitive against the relative production costs of raw materials ordinarily used in that product; but at the same time, one must not lose sight of the fact that in the event of conditions arising whereby necessary raw materials are not available to these European countries, these substitutes will be of immense importance. Countries such as Germany and Italy are still continuing their experiments to take care of such a condition arising.

It is also very interesting to note that in the past few years very extensive research work has been done principally in Japan, Germany, and to a very great extent in Africa, in an endeavor to find a substitute for mineral oils. In the first two named countries they have been confining their investigations particularly to soya beans. We are advised that very satisfactory results have so far been obtained. In Africa they have recently been experimenting in manufacturing an oil from a mixture of Palm Oil and Peanut Oil, as a substitute for gasoline. So far these experiments have been confined to small African river craft but they are now considering using it as a fuel on some of the larger boats. This may eventually throw open an entirely new use for vegetable oils, especially in the country of production where vegetable oils are very cheap compared with the price of gasoline, which has to be imported.

The history and the romance attached to the production of oils and fats throughout the world is of such a lengthy character that it would be impossible to give extensive details in a short paper, but one must use a certain amount of imagination when working with these oils and fats, especially those that come from foreign countries, and think of the work and labor involved in their production and the thousands of miles over which they have to be transported before they reach the factories of America and Europe. During transportation the most modern methods must be used in handling so that the values of these commodities are not deteriorated in any way.

The statistics given herewith present our estimate of the world's production of fatty raw materials brought down to the basis of actual oil produced from the oilseeds and plants, and show the importations into the principal consuming countries. They may be of interest and will give an idea of the great extent of this industry.

ESTIMATED WORLD'S PRODUCTION OF OILS AND FATS

Oil-bearing Seeds	31,500,000 Tons of 2240 lbs.
Available for crushing	22,750,000 Tons of 2240 lbs.
Oil produced after crushing	6,500,600 Tons of 2240 lbs.
Production of other oils and fats	2,086,000 Tons of 2240 lbs.
Total Available Supply of Oils and Fats	8,586,600 Tons of 2240 lbs.

The largest oilseed production in the world is Cottonseed, amounting to ..... 9,325,000 Tons
The quantity of seed available for crushing would be about 8,000,000 tons, giving an oil equivalent of ..... 1,440,000 Tons
Peanuts are the next largest crop, the world's production being given as ..... 4,195,000 Tons
The quantity of seed available for crushing is 3,000,000 tons, giving an oil equivalent of ..... 1,080,000 Tons

The importations of oil-bearing seeds, oils and fats into some of the largest consuming countries are as follows:

	Oilseeds	*Oils & Fats (In tons of 2240 pounds)*	*Total Equivalent as Oil*
U. S. A.	1,082,295	790,743	1,209,871
Germany	1,644,019	436,388	995,343
United Kingdom	1,623,292	453,861	932,736
France	1,432,840	96,174	637,166
Holland	725,630	170,737	408,887
Italy	417,154	76,186	228,894
Denmark	438,703	43,305	171,428

Does Margaric Acid Occur In Alfalfa Seed Oil

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THE statement that a fatty acid of an uneven number of of carbon atoms has been found in nature always arrests attention because if, indeed, this be actually the case, then current views on the mechanism of fatty acid formation in the living organism require revision.

In this connection a brief literature review might not be without interest. Chevreul, some 120 years ago, coined the word "margaric" to fit, appropriately, the fatty acid of seventeen carbon atoms which he had isolated from "margarin." Heintz[1] later dared to question the existence of such an acid. With Krafft's[2] successful synthesis of a straight-chain saturated fatty acid of the same properties as were reported by Chevreul for his margaric acid there was re-opened the question of the validity of the latter's findings. Gerard[3], apparently encouraged by the success previously claimed by others in isolating this acid from natural sources hopefully gave the name daturic to one of similar composition, and allegedly isomeric with it, recovered from the seed oil of Jimson weed, *Datura stramonium* L. Soon after the turn of the century Holde[4] in an attempt at confirmation of not only the latter's conclusions but also those of others with respect to palm oil[5] and pig fat[6], although failing in his objective yet succeeded, by judicious crystallization, in demonstrating that what had been described by them as a chemical individual was nothing but a mixture of stearic and palmitic acids.

A more recently reported, and still unchallenged, source of this acid is the seed oil of the alfalfa plant, *Medicago sativa* L. On searching the later literature, and particularly the standard reference books and treatises in the fatty oil field, it was found that the conclusions of Jacobsen and Holmes[7] are most often cited in substance in support of the view that the biochemical synthesis of the fatty acids is not necessarily limited to those of an even number of carbon atoms.

We, too, in an earlier investigation of this oil[8] on making a fractional distillation of the methyl esters of the saturated fatty acids had obtained data, calculated from saponification values, which raised the hope that a heptadecanoic acid had been found at last. Lack of material, however, for making confirmatory tests by the mixed melting point technic and desire to apply phase rule principles to the study made necessary the treatment of a larger quantity of oil than had been available before in order to insure an adequate supply of saturated acids of which there are present here *ca 7* per cent[8]. To that end 100 pounds of seed which had been grown in Arizona, and described as "Registered Hairy Peruvian, 5-3 strain," was extracted with petroleum ether (38°-40°) which had been treated, in turn, with concentrated and fum-