the radio frequency impedance of a condenser by altering the characteristics of the dielectric medium between the plates of the condenser are related to frequency and indicated by a frequency meter. When oil is added to a standardized solvent, there is an increase in frequency which can be related to the concentration of the oil or fat in the solvent. This method provides the distinct advantage of rapidity which is sometimes of paramount importance.

The measurement of fat stability continues to be a major problem. Oxygen absorption methods appear to be gaining in popularity and they possess the distinct advantage of being a direct measure. The TBA test (thiobarbituric acid) has been investigated by many people. This is a colorimetric procedure, but whether or not it proves to be any better than other colorimetric tests remains to be seen.

Undoubtedly improvement in methods for the analysis of fats deserves a share of the credit for the advancement of fat and oil technology of recent years. Some of the areas mentioned herein will be improved and broadened in the future. New techniques and methods will appear as the needs of the industry dictate.

The problems connected with providing complete and objective methods with which to characterize and determine the ultimate composition of fats and oils has not been easy because of the complexity of these materials, but progress is in the air.

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Economics of World Supply of Edible Fats and Oils

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IT IS DIFFICULT to separate the economics of fats and oils supply from the demand for fats and oils. As with all goods and services, production is a function of demand. Any comments about the prospects for supply of the various fats and oils must be conditioned by considerations of use.

Similarly it is difficult to separate edible from nonedible fats. There are several fats and oils that go into two categories or more of use so that the whole structure is interrelated. Soybean oil, for example, is an edible oil but is also used extensively for industrial purposes. Tallow is primarily a soap fat but is extensively used for edible purposes. Most tallow is strictly inedible, but substantial quantities can go either way.

The edible fats and oils do not make up an homogeneous unit. They have different characteristics and different uses. At the same time several of them overlap the various uses so that they are competitively interlinked, but they are not widely interchangeable over the total usage of the several fats and oils.

Nearly all of the fats and oils are either by-products or joint products. Their production is a part of the production process of something else. Thus supply is partially a function of the demand for some other product. There is a wide range in the "other" product importance of the various fats and oils, ranging from, say, coconut oil for which oil is almost all of the value, to cottonseed oil which makes up a very small proportion of the value of cotton.

Resource Use

In a capitalistic, competitive, economic system productive resources are allocated on the basis of the value of the marginal product compared to the value of the marginal product of the resources when employed in alternative uses. This is the essence of the economics of supply. When a given set of resources, land, labor, and capital can be employed in the production of oil-bearing crops more profitably than in some other use, say grain, they will be used for oil-bearing crops. The converse is, of course, true.

However the whole of the world is not ordered in this fashion. There are extensive governmental programs and activities throughout the world that distort the economics of production. The extent of the distortion varies widely among the many countries involved. In some countries, like the United States, there is nearly complete freedom of employment of agricultural resources while in others, particularly those socialist countries where agriculture is ordered along delivery quota lines, resource use in the short run is very little responsive to relative profitability.

In looking at the long-run supply considerations, we must assume that resource use is responsive to relative profitability so that the basic economics of supply will prevail. This is a valid assumption. Even in those situations in which agriculture is ordered by government fiat, the relative profitabilities are the same as in less controlled areas. Misallocation results in a decrease in total production and so is not likely to be indefinitely continued. While there are limitations to the free flow of fats, oils, and oil-bearing materials among nations, they are not sufficiently great to avoid competition. These restrictions result in distortions, but in the final analysis nations will either produce or purchase fats and oils on the basis of the cheapest source. For example, the production and use of rapeseed is fostered in north Europe by governmental activity even though it is uneconomic. While the production and trade of total fats and oils is distorted, the total effect is small and should be expected finally to disappear. Similarly the production of peanuts in Africa is a part of the colonial scheme and is fostered by various devices. My argument here is that in the final analysis peanut production will increase or decrease, depending upon the economics of its competitive position relative to other oilseeds.

TABLE I

Fats, Oils, and Oilseeds (Fat or Oil Equivalent): Estimated World Production, Averages 1935–39 and 1950–54, Annual 1953–59, and Forecast 1960[a]

Commodity	Average 1935–39	Average 1950–54	1953	1954	1955	1956	1957	1958	1959[b]	Forecast 1960
	1,000 short tons	1,000 short tons	1,000 short tons	1,000 short tons	1,000 short tons	1,000 short tons	1,000 short tons	1,000 short tons	1,000 short tons	1,000 short tons
Edible vegetable oils[c]										
Cottonseed	1,355	1,730	1,945	2,005	2,010	2,090	1,970	1,945	2,170	2,250
Peanut	1,565	1,775	1,715	1,890	2,025	2,155	2,270	2,505	2,520	2,395
Soybean	1,030	2,055	2,250	2,230	2,530	2,740	3,000	3,210	3,685	3,670
Sunflower seed	625	965	970	1,100	865	1,325	1,425	1,115	1,595	1,300
Rapeseed	1,330	1,035	1,000	1,005	1,200	1,130	1,245	1,255	1,295	1,260
Sesame seed	715	745	770	780	790	645	625	560	665	680
Olive oil	975	1,080	870	1,300	1,120	820	1,200	1,240	1,125	1,460
Total	7,595	9,385	9,520	10,310	10,540	10,905	11,735	11,830	13,055	13,015
Palm oils[d]										
Coconut	2,135	2,085	1,995	2,165	2,230	2,425	2,410	2,170	2,000	2,000
Palm kernel	400	420	445	470	425	470	425	465	465	475
Palm	1,090	1,280	1,330	1,375	1,350	1,370	1,365	1,400	1,400	1,410
Babassu kernel	25	51	46	44	53	40	50	53	55	60
Total	3,650	3,836	3,816	4,054	4,058	4,305	4,250	4,088	3,920	3,945
Industrial oils[c]										
Linseed	1,145	1,110	1,020	1,095	1,020	1,100	1,370	1,065	1,110	1,140
Castor bean	200	220	220	220	215	215	250	230	225	240
Oiticica	10	10	9	6	13	14	11	17	1	10
Tung	150	123	127	123	107	120	150	137	135	135
Perilla	65	5	6	5	5	4	4	3	4	5
Total	1,570	1,468	1,382	1,449	1,360	1,453	1,785	1,452	6,475	1,530
Animal fats										
Butter (fat content)[c]	4,190	3,650	3,765	3,875	3,870	3,930	4,050	4,130	4,100	4,200
Lard	3,585	4,230	4,430	4,590	4,635	4,760	5,075	6,020	6,510	6,700
Tallow and grease	1,592	2,575	2,785	2,870	2,980	3,140	3,380	3,275	3,630	3,710
Total	9,367	10,455	10,980	11,335	11,485	11,830	12,505	13,425	14,240	14,610
Marine oils										
Whale	545	440	420	455	420	425	440	435	415	440
Sperm whale	30	80	55	80	100	120	110	135	125	125
Fish (including liver)	480	470	460	520	540	565	485	470	490	500
Total	1,055	990	935	1,055	1,060	11,110	1,035	1,040	1,030	1,065
Estimated world total	23,237	26,134	26,633	28,203	28,503	29,603	31,310	31,835	33,720	34,165
Per capita (pounds)	21.8	21.0	21.4	21.3	21.2	21.6	22.5	22.5	23.5	23.4

[a] Beginning with 1950, the years indicated are those in which the predominant share of the given oil or fat was produced from its related raw material.

[b] Preliminary.

[c] Estimates of U. S. oil production include actual oil produced plus the oil equivalent of exported oilseeds; estimates for other countries are based on the assumption that varying quantities of the oilseeds produced are crushed for oil.

[d] Estimated on the basis of exports and the limited information available on production and consumption in the various producing areas.

[e] 1934–38 average.

Compiled from official and other sources.

Classification of Fats and Oils

It is possible to separate the industrial from the edible fats and oils with only moderate error, but the edible-inedible group must be combined because of the large amount of substitution in use that takes place. The resultant edible-soap group consists of 17 principal fats and oils that can be put in four main categories. These are: liquid edible vegetable oils, including soybean, peanut, rapeseed, cottonseed, olive, sesame, and sunflower; palm oils, including coconut, palm kernel, palm, and babassu; animal fats, including butter, lard, tallow, and greases; marine oils including whale and fish oil.

This classification into four parts also nearly classifies various fats and oils by cultural type. It should be noted that, with the exception of olive oil, the first group is obtained from annually produced oilseed crops, the whole of the second group is of tree origin, the third group has its origin with land animals, and the fourth group is of marine animal origin. These cultural origins are important as we later consider supply prospects.

World Production

Table I[1] shows the world production of the principal fats and oils through 1960. Both the total and the *per-capita* production have increased since before World War II. The increase has continued to date; 1960 is forecast at about 107% of 1958, an increase greater than that of population. The increase has not been uniform among the various kinds of fats and oils. The edible vegetable oils increased 71% from prewar and 39% from the 1950–54 average. The palm oils have only a moderately larger production than prewar and very little larger production than the 1950–54 average. The industrial oils have had virtually no change in production during the past 25 years. Animal fat production increased 56% between prewar and 1960 and 40% from 1950–54 to 1960. Marine oil production has been essentially static.

It should be noted that in the animal fats by far the greatest increase was in tallow and greases, which are largely inedible. Butter production is currently at about prewar level. Lard production is up substantially from prewar and from the 1950–54 average. But this is deceptive. Much of it is a change from consuming fat as a part of pork to the separate rendering of lard.

Of a total increase in fats and oils production of 8,031,000 short tons from 1950–54 to 1960, 6,650,000 short tons were edible vegetable oils, butter, and lard. Of the remaining 1,381,000 short tons, 1,135,000 were tallow.

It thus becomes clear that the bulk of the increase in the world supply of edible fats and oils has been the result of increases in the vegetable oils group.

Changes in production by kinds from prewar to 1960 and from 1950–54 to 1960, thousand short tons, were as follows:

[1] Foreign Agricultural Circular FFO 5–60, U.S.D.A., FAS, February 18, 1960.

	Prewar to 1960	1950–54 to 1960
Cottonseed	+895	+520
Peanut	+830	+620
Soybean	+2,640	+1,615
Sunflower seed	+675	+335
Rapeseed	−70	+225
Sesame seed	−35	−65
Olive oil	+485	+380

It should be noted from the table that olive oil production in 1960 is not a good indicator of the rate of increase in olive oil production. Olive oil production appears to be increasing very slowly at the present time.

The upshot of all of this is that the increasing population of the world is heavily dependent on increases in soybean, peanut, cottonseed, and sunflower seed oils for the maintenance of *per-capita* supply.

Table II[2] shows the location of production by principal areas and countries of the world through 1958. There have been important shifts in the relative importance of the various areas.

	1934–38 to 1958	1948–52 to 1958
	%	%
North America	+108	+29
South America	+103	+27
Asia	+14	+16
Africa	+53	+27
Europe	+31	+34
U.S.S.R.	+168	+119
Oceania	+30	+32

Looked at differently, four countries accounted for 13 of the 20-billion pound increase from prewar to postwar. These are U.S.A., 7 billion; U.S.S.R., 4 billion; Argentina, 900 million; and Nigeria, 900 million. The bulk of these are U. S. soybeans and tallow, Russian cottonseed and lard, Argentinian sunflower seed, and Nigerian peanuts.

Per-capita production outside of these countries of major increases has declined by about 10% during the past 20 years.

Trade

I would now like to take a brief look at the trade effects of the changes in the kind and location of production. Table III[3] shows the prewar and postwar import-export balances. Western Europe was and is the major destination of the world's fats and oils exports. North America, the U. S. in particular, shifted from a major importer to the leading exporter. Latin America became an important exporter. Africa increased in importance as an exporter. There was a major decrease in Asian exports as population increased much faster than fats and oils production. China disappeared as an exporter.

The net effect of the changes was the shift in the supply of Western Europe from Asia, including China, to the United States.

Supply Response

I earlier developed the notion of the cost-revenue concept of supply response. This tells us nothing more than in the long run supply is determined by the relative profitabilities of producing the various crops. I wish now to turn to some of the more specific and short-term considerations affecting the supply of fats and oils. Following this background development, we can appraise prospective developments in the supply of the individual fats and oils.

Ease of Entry and Exit. The supply of a commodity does not change immediately as its relative profitability changes. Time is required to move productive resources into and out of use. The amount of time required varies greatly among the various oil-bearing materials.

Entry into and exit from the production of annual oilseeds as soybeans, peanuts, and sunflower seed is easy in most areas of the world. Most of the equipment required is readily adaptable from other uses. To a considerable extent equipment is very primitive, consisting of animal-drawn plows, hoes, etc. The cultural cycle is one year so that the land area devoted to production can be quickly changed.

Perennial tree crops require relatively long periods of time to bring into and move out of production. Coconut and palms require about seven years to reach the producing stage and continue to produce for several decades. Olive trees require about 15 years to reach maturity and continue to produce for several hundred years.

Palm and palm kernel oil is produced largely from native groves. These groves are initially in undeveloped areas and require extensive amounts of capital to develop a collection and marketing system, processing facilities, and the marshalling and training native workers.

Once capital is sunk in the production of perennial tree crops the annual costs of production are quite small. The capital cannot be removed except through continued production. Accordingly groves that are brought into production continue to produce for long periods of time.

Climatic Conditions. Some oil-bearing materials are adapted to a narrow range of climatic and soil conditions, and some areas are relatively unadapted to the production of any oilseeds or nut trees. North Europe, for example, can effectively produce only rapeseed. The perennial tree crop oilseeds are limited to tropical and subtropical areas. Peanuts require a sandy loam soil and a long growing season. Cotton cannot be produced in the northern latitudes.

In this connection soybeans present an interesting paradox. They are adapted to a wide range of soil and climatic conditions. However virtually all of the world's supply is produced in two relatively small areas, one in the central United States and the the other in the Japan, Korea, Manchuria, and North China area. Extensive efforts have been and are being made to increase soybeans in such other areas as Brazil and Spain, but these have met with limited success. Current efforts in Australia appear to be fruitful.

Oil-bearing materials are produced throughout most of the world because of the multiplicity of kinds of materials. There appear to be no serious climatic restrictions on the total potential supply. The limitation on soybean culture, for example, is one of relative profitability rather than adaptability.

The "Free Good" Concept. Edible fats and oils have some characteristics of free goods. The native palm and coconut groves are examples. The only cost

[2] Berg, Eric, "Structure of the Soybean Oil Export Market," Department of Agricultural Economics, University of Illinois College of Agriculture, AERR-30, January 1960, Table 8, p. 46.

[3] Berg, Eric, "Structure of the Soybean Export Market," Department of Agricultural Economics, University of Illinois College of Agriculture, AERR-30, January 1960, Table 12, p. 67.

TABLE II

World Production of Separated Food and Soap Fats and Oils,[a] Principal Producing Countries, 1934–38 and 1948–52 Averages and Annually 1953–1958

Countries	Average 1934–38	Average 1948–52	1953	1954	1955	1956	1957	1958[b]	Average 1954–58
	million lbs.	*million lbs.*	*million lbs.*	*million lbs.*	*million lbs.*	*million lbs.*	*million lbs.*	*million lbs.*	*million lbs.*
North and Central America									
Canada	397	558	615	637	688	774	791	873	753
Central America	428	591	683	807	888	944	992	988	924
United States	6,508	10,718	11,934	12,024	12,860	13,706	13,730	13,415	13,147
Total	7,333	11,877	13,232	13,468	14,436	15,424	15,513	15,276	14,823
South America									
Argentina	476	1,098	926	858	855	1,312	1,312	1,373	1,143
Brazil	683	791	820	924	939	944	944	999	950
Others	335	505	591	626	661	639	628	661	643
Total	1,494	2,394	2,337	2,408	2,455	2,895	2,884	3,033	2,735
Asia									
Ceylon	298	326	337	313	421	375	284	313	341
China, Mainland	6,852	6,468	6,817	6,841	7,269	7,295	7,626	7,529	7,312
India	3,898	3,880	3,832	4,149	4,616	4,147	4,460	4,405	4,355
Indonesia	1,517	1,340	1,468	1,636	1,534	1,526	1,495	1,340	1,506
Japan	320	174	331	300	381	408	379	370	368
Pakistan	481	575	593	595	639	650	644	631	632
Philippines	893	1,246	1,195	1,435	1,559	1,872	1,887	1,554	1,661
Malaya	342	320	340	370	348	362	333	326	348
Turkey	370	492	631	562	659	551	655	547	595
Others	642	527	679	712	736	734	825	739	749
Total	15,613	15,348	16,223	6,913	18,162	17,920	18,588	17,754	17,867
Africa									
Algeria, Morocco, Tunisia	311	203	425	309	267	134	370	163	249
Belgian Congo	397	606	633	664	668	741	774	791	728
French West Africa	747	646	672	747	686	752	820	935	788
Nigeria	1,219	1,486	1,836	1,936	1,799	2,028	1,720	2,119	1,920
Union of South Africa	60	198	251	302	289	313	289	282	295
Others	1,089	1,462	1,232	1,495	1,411	1,506	1,532	1,572	1,503
Total	3,823	4,601	5,049	5,453	5,120	5,474	5,505	5,862	5,483
Europe[c]									
Western Europe	6,731	6,715	7,020	8,331	7,959	7,738	8,459	8,830	8,263
Eastern Europe	1,724	1,521	2,033	1,971	2,169	2,125	2,132	2,235	2,126
Total	8,455	8,236	9,053	10,302	10,128	9,863	10,591	11,065	10,390
U.S.S.R.	2,388[d]	2,917	3,856	4,290	4,191	5,386	5,933	6,393	5,239
Oceania	1,232	1,217	1,420	1,404	1,493	1,594	1,587	1,605	1,537
Antarctic (whale oil)	961	765	750	802	734	736	761	730	753
World total	41,299	47,355	51,920	55,040	56,719	59,292	61,362	61,718	58,826

[a] Includes butter (fat), lard, soybean oil, peanut oil, rapeseed oil, cottonseed oil, olive oil, sesame oil, sunflower seed oil, corn oil, coconut oil, palm kernel oil, babassu oil, tallow and greases, palm oil, whale oil, fish and seal oils.
[b] Preliminary.
[c] Eastern Europe includes Albania, East Germany, Bulgaria, Hungary, Poland, Romania, and Czechoslovakia; Western Europe includes all others.
[d] 1940.
Source: Food and Agriculture Organization of the United Nations, Monthly Bulletin of Agricultural Economics and Statistics, Vol. VIII, No. 2, p. 2.

of increasing production at any given time is that of harvesting and marketing. The result is that, as prices are high, supplies from the native groves, all other things being equal, increase rapidly and, as prices are low, decrease rapidly.

The babassu palms in Brazil are the outstanding example. World production of babassu oil is small, yet there is a very large number of native trees that would yield a considerable amount of oil. The amount is conjectural. Some estimates place it at very high levels. The harvest of these nuts is not practical at current prices because of the high cost of transportation and processing and the lack of labor.

The existence of large unharvested native oil-bearing materials indicates that the value of other oil-bearing materials like the annual oilseeds derives from the lower harvest, processing, and marketing costs and higher quality rather than on a value of the material itself.

Process Development. The supply of fats and oils is considerably dependent on the development of extraction processes. I cite three examples.

First, there was a major increase in the production of soybean and cottonseed oil in the United States as the solvent-extraction processes were adopted. A high proportion of the world's oilseeds are processed by less efficient methods. A change in method would result in a major increase in world supply.

Second, a large proportion of the cottonseed produced in India is used as cattle feed and fertilizer. Prewar about 1% of the cottonseed was processed. By 1956 13% was processed, and by 1958 about 18%. Educational measures have been undertaken by the Indian government to induce farmers to have the seed crushed and to feed only the cake. In the early 1950's less than one-quarter of the crushing facilities were used. A limited improvement in this organization of the oilseed industry in India would result in a substantial supply increase.

Third, there has been a very rapid increase in the production of tallow in the United States during the

TABLE III

Net Imports (+) and Net Exports (−) of Food and Soap Fats and Oils, by Geographical and/or Political Divisions, Averages, 1934–38 and 1955–57

Region	Average 1934–38	Average 1955–57
	Billion lbs.	*Billion lbs.*
Western Europe	+6.4	+7.9
North America	+1.5	−3.1
Latin America	nil	+0.7
Africa	−2.0	−2.6
Asia[a]	−2.9	−1.5
Oceania	−0.7	−0.9
Antarctic[b]	−1.0	−0.7
U.S.S.R., Eastern Europe and China[c]	−1.1	−0.1

[a] Excludes China and U.S.S.R.
[b] Whale oil.
[c] Estimated from residual data.
Sources: Food and Agricultural Organization of the United Nations, Monthly Bulletin of Agricultural Economics and Statistics, Vol. VIII, No. 2, pp. 2 and 5; Commercial Reports.

past 20 years. A part of the increase is the result of increased rendering of inedible grease, but the increase is in large measure the result of increased collection of edible tallow and changed meat merchandising methods. How much further this development will proceed is conjectural. In some other countries, like Australia and Argentina, tallow yield per unit of beef is about the same size as in the U. S. However European yields are much lower. Technological developments of the same sort as in the U. S. are likely to take place in Europe.

Other examples could be enumerated, but these are sufficient to indicate that there are a lot of unprocessed fats and oils that can be added to supplies relatively easily.

Institutional Factors. Governments play important roles in determining the short-run supply of fats and oils. Minimum prices are guaranteed by most foreign governments (as well as the U. S.). In part these measures are the result of agrarian pressures. In import countries they are partially designed to increase self-sufficiency and conserve foreign exchanges. In export countries, outside of the U. S., support measures are designed to increase exports to earn foreign exchange.

Underdeveloped countries that support prices to increase foreign exchange are particularly vulnerable to decreases in world prices. They do not have the financial resources to support wide-scale subsidization. Decreases in world prices rather quickly force shifts of resources into alternative uses.

There are restrictions on utilization in some areas that affect indirectly the supply of products. An example is the set of restrictions on margarine in which the U. S. so long persisted. More directly, the production of butter in the U. S. is maintained at higher levels than would otherwise exist by price policies, in some areas that restrict consumption of whole milk.

The various institutional factors are transitory. They do not indefinitely persist contrary to the economics of resource use. Their primary effect is to delay adjustments so that when adjustments do finally occur, they are greater and have more violent effects.

Relative Demand. The most important factor that will affect the supply of the different kinds of fats and oils in the years ahead is the relative demand for fat and protein. The diets of many people in the world are now at a maximum level of fat content. This is particularly true in the highly developed, prosperous areas. In these same areas there is an expanding demand, *per capita*, for animal products. A supply of high-protein feed concentrates is essential to expansion of animal products. Such high proteins are largely derived from oilseeds.

In the underdeveloped areas of the world the intake of fats and oils *per capita* is much below that of the developed areas. How much it should be expanded is conjectural. There are big differences in the fat intake of people living in different parts of the world whose diets appear to be equally nutritious. For example, in 1955–57 the *per capita* fat intake in Russia was about 29 pounds, less than half of that of north Europeans. Yet the emphasis in Russia is on increasing animal products rather than fat. The greater dietary deficiency in the world is protein.

Oilseeds yield both fat and protein; one cannot be produced without the other. As the demand for protein increases relative to the demand for fat, there will be a shift from oil-bearing materials that are high in fat and low in protein to those that are high in protein and low in fat.

By-product Characteristics. A substantial proportion of the world's supply of fats and oils are by-products or joint products of other materials. Chief among the by-products are cottonseed oil, lard, tallow, and grease. Butter is difficult to classify. In some countries it is a primary product of part of the dairy industry. In others, as the United States, it is rapidly becoming a by-product. Leaving butter out of account, the strictly-termed by-products make up fully one-third of the world's fats and oils supply.

The proportionate importance of by-product sources of fats and oils is much greater in the United States than in the world as a whole. Nearly the whole of the supply, other than soybean oil and butter, is by-product in character.

Exactly when a by-product becomes a joint product and a joint product a primary product is not clearly defined. One can make one's own rule. However peanuts, olive oil, and the palm oils appear to be chief among the primary products.

The by-product supply is almost entirely dependent on the demand for production of the primary product. The joint product supply is responsive to the demand for both products. Primary product supply depends but little on demand for the by-product.

The appropriate conclusion is that while a substantial share of the world's fats and oils supply must be considered as immutable, there is a sufficiently large amount of the supply which is of joint-product and primary-product character that the aggregate supply is responsive to demand shifts.

Supply Elasticity. The world supply of fats and oils is relatively elastic, that is responsive to changes in prices relative to other prices. The strictly-termed by-product fats and oils supply can be increased or decreased as prices go below the cost of salvaging waste fats, particularly tallow, and up to levels that encourage maximum salvage.

The tree nut supply can be increased or decreased as the price makes harvest of native groves attractive or unattractive. Further the length of life of the cultivated groves is not very long, and they are of varying age. Each year some of them reach a point where they must be rejuvenated or abandoned; which decision depends upon profit prospects. Even olive trees can be more or less intensively fertilized, sprayed, etc.

The most important supply elasticity is provided by the annual oilseed crops. For the most part the productive inputs (land, capital, and labor) have alternative uses so that they can be brought into and out of oilseed production fairly quickly.

Further the annual oilseed crops have a range of fat to protein ratios. As the relative demands for fat and protein change, production can be shifted from one to the other so that the appropriate balance is maintained. These shifts have dislocating effects on the economies of the various producing countries.

Supply Prospects

The world is abundantly supplied with edible fats and oils at the present time. Measured in absolute terms against desires, there are, as is true of all economic goods, shortages. But measured in terms of effective demand as expressed through price, fat is

abundant. The level of fats and oils prices is about as little advanced from prewar levels as any of the world's commodities. This is particularly true in the western nations.

Animal-fat production will likely continue to increase. As the world's dietary level improves, there will be more of the by-products of meat available. This indicates increased supplies of lard and tallow. The production of butter seems to have reached a plateau and will likely decline as the quality of its substitute, margarine, improves.

The marine oil supply is quite stable. It is limited by international agreement. Large amounts of sunk capital are involved in its production. Thus neither an increase nor a decrease is in prospect.

The tree nut supply has been quite stable in recent years, varying only as weather conditions vary. The price appears to have reached a level low enough to discourage further capital investment. Two factors are working in the direction of limiting and decreasing production. First, the tree nuts are very high in oil as compared to protein. As the relative demand for protein increases, the competitive disadvantage of tree nuts will increase.

Second, the technology of margarine production in Europe is developing in a direction disadvantageous to coconut oil. For the past two years the price of coconut oil has been very high, comparatively, because of drought conditions in the Philippines. This has encouraged a shift from coconut oils to liquid oils. The technology of liquid oil use has advanced rapidly under the pressure of necessity. The gains of the liquid oil will likely prove to be permanent.

The most rapidly expanding segment of fats and oils supply is that of edible vegetables oils. The market for these oils will likely continue to expand at a rate not much, if any, faster than population increases. The rate of expansion of the total of this group will likely decrease. The market for other agricultural products will expand at a faster rate. This means that the prices of vegetable oils will continue to be relatively cheap for the foreseeable future.

The increasing demand for protein in relation to fat will result in shifts within the group. The production of oil seeds that are high in protein have a competitive advantage over those that are low in protein and will thus increase faster. This adjustment boils down to a focus on keen competition among soybeans, peanuts, sunflower seed, rapeseed, and sesame seed. The advantage in this competition lies strongly on the side of soybeans because of their relatively low oil content.

The adjustment in production of the various oilseeds will be impeded by institutional activities because of impacts on the economies of various countries. For example, the French have for some time protected the peanut economies of their African colonies. The Nigerian peanut activities have been and are being supported. But these are but passing phases of the longer-run adjustments.

Soybean oil is still not a preferred oil in many markets. It appears inevitable that its production will increase in the long run. It is therefore important that vigorous attention be devoted to the technology of its use.

Economic and Social Factors Affecting Changes in Worldwide Usage of Fats and Oils

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THE PURPOSE of this economic session is to survey the broad trends in world production and usage of fats and oils and the "conditions of change," presumably with a view to pointing up the potentials of the world market for American fats and oils. The United States has now become the major world exporter of edible fat material, soap fat and, at times, has been a leading postwar supplier of drying oils. By and large, foreign markets have fully absorbed our ever-increasing surpluses of these fats and oils and they also take almost 25% of our oilcake and meal production, either as such or in the form of oilseed exports. It is natural to ask whether the world's need for additional American material will continue to equal our need for finding still larger markets for our mounting production.

In surveying fat consumption around the world, we must look both at *per capita* levels and aggregate tonnages. Oil chemists are also interested in the specific end-products and the oil utilization patterns. To do justice to such an educative task would take not 45 minutes but 45 days, since there are wide differences even between countries with a similar economic or ethnic status. For example there are important differences in the fat consumption patterns of the U. S. A. and Canada and still more so between the countries of Western Europe.

Sociological Groupings

I will therefore paint with a broad brush, and for the sake of convenience and contrast I will group the world into three main categories of food-fat consumption:

A. Countries which are highly industrialized and urbanized, with good marketing and transport systems and a relatively high level of consumption of fats and food in general, *e.g.*, North America, Western Europe, Australia, etc.

B. Medium-developed economies, in varying stages of transition from low to high standards of productivity and national income, *e.g.*, Southern Europe, Soviet Europe, Argentina.

C. Under-developed or even primitive economies, based on peasant or subsistence farming, with relatively little industry and very inadequate transport or marketing facilities. In general such countries have a poor and unbalanced diet, low food-fat consumption and an even smaller use of soap fats or industrial oils. As examples I would