Review of Literature on Fats, Oils and Soaps for 1939*

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FAT trade, industry and literature during the first part of the year showed the same self-sufficient conditions as described in previous reviews. However, the abnormal international situation in the latter half of the year has required readjustments in foreign trade and has further emphasized a need for self-sufficiency; these trends will continue.

The foreign and domestic commercial and economic phase of the fat and oil industry have been summarized by C. E. Lund (*Soap 15,* No. 6, 27; *Fats & Trade Bull. Foreign and Domestic Comm. Feb.* 1940). The 1939 domestic production and consumption of fats were largest on record. There was a large increase in exports with slightly lower imports, a lower average price and about the same final inventory as in 1938. Lund's summary of statistical data is reprinted in this section of the review. In the more detailed report it was revealed that imports of babassu kernel, a source of coconut type oil, were twice that of the preceding year. A shift in the shipments of palm oil from the Dutch Indies to the United States instead of to Holland was due to war activities. This Dutch fat was considered contraband, because the ultimate destination of the greater portion of it had been to a nation which is now a belligerent.

PRODUCTION AND CONSUMPTION OF FATS AND OILS

(All data in million pounds)

Kind	Stocks Jan. 1	Imports	Production from domestic and imported raw materials	Exports	Stocks Dec. 31	Apparent Disappearance
Vegetable Oils						
1938	1,452	1,083	3,048	53	1,526	4,004
1939	1,526	1,008	3,070	126	1,436	4,042
Fish oils						
1938	216	85	248	5	259	285
1939	259	89	236	16	245	323
Animal Fats						
1938	315	7	4,877	223	451	4,525
1939	451	5	5,243	301	484	4,914
Greases						
1938	76	2	327	......	62	343
1939	62	4	381	......	60	387
Total						
1938	2,059	1,177	8.500	281	2,298	9,157
1939	2,298	1,106	8,930	443	2,225	9,666

The United States although being the most self-sufficient nation in fat products, still depended on imports for a large portion of her drying oils. This suggested that economy rather than self-sufficient rules still prevail, for satisfactory oils can be produced within her borders. With the restraint on China's trade, oiticica, perilla and treated castor oils have replaced much of the tung oil that had been used.

During the first seven months of the year the prices of fats, except drying oils, were lower than those of the preceding year. With declaration of war the prices rose, but soon declined. This decline, however, did not reach the low levels of the summer months.

A four year statistical review for the years 1934 to 1938 was issued by the Census Bureau. Guillaudeu (*Ind. Eng. Chem 31,* 158) reviewed the industrial utilization of fats and oils; statistics, availability and interchange were emphasized. Compilations of excise taxes on fats and oils, and legislation and decisions relating to oleomargarine were issued, respectively, by United States Tariff Commission and United States Department of Agriculture, Bureau of Agricultural Economics.

Activities dealing principally with self-sufficiency were evident to the highest degree in Germany. Here synthetic fat acids derived from petroleum paraffins have furnished material for technical products. This activity was not new, the literature of the past 25 years has contained information on preparing soap fats from paraffins. However, current rumors suggest that as an additional step, food fats are being prepared from high molecular weight paraffin hydrocarbons. According to an I. G. Farbenindustrie A.-G. patent (*Brit.* 506,092) the hydrocarbons are oxidized at below 140°, esterified with an alcohol; the esters of acids containing 10 to 20 carbons and material containing hydroxyl and carbonyl groups and lactones are separated by fractional distillation under reduced pressure. These fat acids are treated with glycerine to form glycerides and the product is mixed with vegetable or animal fats. General monographs on synthesis of fats were prepared by Foulon (*Mfg. Perfumer 4,* 150; *Seifensieder-Ztg. 66,* 245), Inhausen (*Kolloid-Z. 85,* 234), Rennkamp (*Z. physiol. Chem. 259,* 235), Schranth (*Chem. Ztg. 63,* 303), Wietzel (*Fette u. Seifen 46,* 21) and Wittka (*Seifensieder-Ztg. 66,* 666). Other divisions of this review especially the section on detergent, describe additional activity of this nature.

Attempts were made to prevent fat waste; sewage fats are recovered by means of special fat traps (Passavant—*Fette u Seifen 46,* 583). Fat may easily be recovered particularly from laundry waste water by precipitating the fat acids with calcium sulfate and removing the material with alkaline salt solutions. Seven American patents (Urbain and Steven—*U. S.* 2,171,197

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*This review is the report of the following committee for review of literature on fats, oils and soaps.

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to 2,171,203) also describe apparatus and methods for recovering fat acids from laundry waste.

Efforts toward self-sufficiency, economy and promotion were manifested in publications on the following subjects:

Fat economy in manufacture. Täufel—*Fette u. Seifen 46,* 1. Fincke—*Ibid.* 57.

Sunflower oil. Fischer—*Fette u. Seifen 46,* 88.

Rape seed. Dieterle—*Seifensieder-Ztg.* 66, 606. Gordienko—*Fette u. Seifen 46,* 682.

Whale processing. Peters—*Fette u. Seifen 46,* 190. Pecker—*Ibid. 46,* 682.

Fish Oils. Behre—*Fette u. Seifen 46,* 187. Steinmann—*Ibid.* 192. Pawelzik—*Ibid.* 195.

Cottonseed. Leaky—Southern *Power and Ind. 57,* No. 10, 37.

Lard. Tolman and Crapple—*Food Ind. 11,* 438.

Cocoa butter. Pichard—*Bull. Official Office intern. Cacao chocolat 7,* 333.

Castor oil. Miller—*J. Jamaica Agr. Soc. 43,* 25. Metcalf—*Am. Paint J. 23,* 14 (Feb. 27); *Official Digest Fed. Paint & Varnish Production Clubs 1939,* No. 186, 214.

Tung Oil (U.S.A.). Petterburg—*Am. Forests 45,* 7. Knight—*Paint Oil Chem. Rev. 101,* No. 9, 5.

Olive Oil (Turkish). Erhardt—*Seifensieder-Ztg. 66,* 243, 266, 285, 306, 326.

Linseed Oil as a food. R. Dieterle—*Seifensieder-Ztg. 65,* 941.

Forty-eight overlooked sources of fat in Germany. Wagner—*Seifensieder-Ztg. 66,* 779.

Poppy seed oil (Italian). Zanda — *Arch. farmacol sper. 67,* 163.

Lupin fats. Spirk—*Ceskoslov. Mydlar Vonavhar 16,* 28.

Coffee grounds fats. Martinenghi—*Olii minerali, grassi e saponi, Colori e vernici 18,* 112.

Cocklebur oil. Maksinmov—*Compt. rend. acad. sci. U.S.S.R. 20,* 381.

Rice Bran oil. Hidaka—*J. Soc. Chem. Ind. Japan. 42 B,* 219. Ueno and Ueda—*Ibid. 41 B,* 325. Ueno and Takeuti—*Ibid. 42 B,* 46. Ganchev —*Ann. univ. Sofia V. Faculte agron. sylvicult. 16,* 430.

The papers contain varied information on distribution, cost of production, chemistry of the oil, etc. References to other material that could be added to the above list appear with the charts on characteristics and composition of fats and oils.

Reviews on the fat and oil industry were prepared by Tainsh. (*Chem. & Ind. 58,* 587, 717) and Foulton (*Allgem. Oel u. Fett-Ztg. 36,* 158); recent trends in the industry were emphasized. A review by Anderson and Salisbury (*Amn. Rev. Biochem. 8,* 133) dealt principally with recent information on the chemistry of fats and oils.

PRIMARY TECHNICAL TREATMENT

Information under technical treatment appears principally in patent literature. Since this information is personal property and, in most cases recent and unevaluated, only brief descriptions and classification without extensive criticism can be presented. The original sources should be consulted for full information and elaboration of the ideas.

Comparative tests on metals for use in equipment for the fat, oil and soap industry were tabulated by Cox (*Trans. Am. Inst. Chem. Eng. 34,* 657) and Schober (*Fette u. Seifen 46,* 71) Dymshits (*Masloboino Zhir. Delo 14,* (4) 30) recommended ceramic linings for fat hydrolysis kettles and pointed out their economical advantages. The advantage of using centrifuges in rendering, drying and refining were pointed out by Schneider (*Fette u. Seifen 46, 77*) and Martin (*Ibid.* 82).

Rendering methods and machines were reviewed by Fiedler (*Fette u. Seifen 46,* 158) and Steinmann (*Ibid.* 192). A process described by Lock and Schweigart (*Vorratspflege Lebensm.-forsch.* 1, 216) comprised steaming and heating with brine at 103° followed by pressing to one per cent fat content in the residue. It was claimed that the crackling by-product produced was fit for human consumption. According to Steinmann (*Fette u. Seifen 46,* 18) vacuum rendering yielded by-product cracklings suitable for human food. Martin (*Ibid.* 82) recommended drum drying with centrifugal separation of fat for economical production of good quality meat scraps. A good feed by-product was also the aim of Hinko (*Ger. 681, 669 Cl. 53 g.*). His process comprised grinding, rendering by heating with dry air, and, in addition, the by-product feed was smoked. Trexler *(Austrian 156, 269 Cl 53c)* rendered by treatment in a centrifuge with dry steam at 200 to 450°. Patents issued to Sommermeyer *(Ger. 669, 451 Cl. 23; 671,138 Cl. 16, 674,459 Cl. 16)* were on improvements to the apparatus using drum sieves inside of closed drums and steam heat. An improvement in rendering in water at high temperatures and pressure was obtained by Kernot *(Brit. 468,061)* by the addition of a small amount of wetting agent, and by Haneschka *(U.S. 2,167,043; Brit. 505,844; Fr. 829,379)* by addition of ammonia and ammonium phosphates. Morlack *(Ger. 679,723 Cl. 23d)* designed a continuous rendering autoclave. Cracklings were degreased by boiling in 10 per cent sodium acid sulfate solution, adding water and boiling again (Liberman—*Mayasnaya Ind. U.S.S.R. 9,* No. 3, 14). This mixture on cooling separated into fat, emulsion, brine and sludge.

Fat may be rendered from sausage casings by drying, warming and progressively removing the melted fat by a wringing operation (Tolman and Dimond—*U.S. 2,171,611-2*).

Special rendering methods were devised for marine oils. Methods involving heating comminuated whole blubber to 50 to 70° and straining out the oil were patented (Hansen — *Norw. 60,018;* Mergell and Brinckman—*Brit. 490,180*). Heyerdahls' (*Brit. 504,-461,* Ger. 676129 Cl. 23a) whale rendering process comprised treating the comminuated parts with steam in a screening drum renderer. Bones, meat and blubber in admixture are rendered in the apparatus, Hempel (U.S. 2,156,985) rendered fish livers in a special apparatus and by a method which involves adjusting the pH to 8.5-12.5 and heating to 77-80°. Separation is by centrifuging. Before extraction, fish livers may be preserved with 1 to 8% boric acid or borax (Nitardy—*U.S. 2,171,594*).

A brief history of oil milling was prepared by Downs (*Oil Colour Trades J. 95,* 715). Modern methods for production of oils from seeds with theoretical chemical aspects of the seeds and process were reviewed by M. Singer (*Seifensieder-Ztg. 66,* 17, 545). Tests were made on ripening and drying seeds so as to prevent bad taste and odor in oils (Worsham et al.

—*Bull. Virginia Polytech. Inst. Eng. Sta. 36*). Treatment of soybeans with ethylene produced better taste and odor in the oil.

A huller capable of decorticating linseeds and other small seeds was developed (Owen—*Oil & Soap 16,* 55). With linseed it yielded 25 to 30 per cent clean hulls; however, these hulls contained 16 to 25 per cent oil which was characteristic of its structure rather than absorbed from the kernel. Decorticating hempseed, cantaloupe seed, rape seed, and certain varieties of mustard seed with the huller improved the oil color and increased the protein content of the residues. Tests on perilla seeds were inconclusive. Kolpakov (*Masloboino Zhir. Delo 14,* No. 4, 3) reported that the oil yield from sunflower seeds can be increased 10 per cent and a better cake can be obtained by reducing the hulls in the meals from 7-8 to 2-3 per cent. Other processing problems on sunflower seeds involved the use of the Skipin method for extraction (Shnaidman —*Masloboino Zhir. Delo 14,* No. 6 14; Skipin—*Ibid.* No. 5, 6; No. 6, 6; Shaidman—*Ibid.* No. 2, 8). Suggestions for improvements were made for this method which comprises special roasting and pressing technic; the oil produced was claimed to contain less cellulose matter and colloid phosphates than common pressed oils.

A special screw press for liquid or pulpy masses containing fats or oils was invented by Mayer *(Brit. 494,209).* A patent on a screw press was also issued to Stanley Hiller Ltd. *(U.S. 2,149,736).* A hydraulic press suitable for liquid cacao butter was designed by Hallstein *(U.S. 2,157,539).* A foots filtering device for attaching to a press was contributed by Fricke and Brunken *(U.S. 2,154,965).* A method designed for palm oil (Nyrop—*Brit. 497,547*) comprised straining the pulp liquor on vibrating screens and separating the oil in centrifugal separators.

With coconut milk a bacterial method can be used to liberate the oil (Soliven and de Leon—Philippine Agr. 27, 200). Pure cultures of bacteria isolated from fermented coconut milk were used.

A process for simultaneous extraction, fractionation, and refining was invented by Rosenthal *(U.S. 2,152,664-7).* Butane, propane, and other low boiling hydrocarbons were used as solvents. With extraction at low temperatures low melting fats were extracted; at successively higher temperatures products with successively higher melting points were obtained. The process includes complete equipment for crushing and crimping seeds, extracting, refining, and recovery of solvent. A method patented by Hansa-Muhle A.-G. *(Ger. 679,708 Cl. 12c; Brit. 507,465)* comprised solvent spraying the charge on a filter belt or sieve. Another invention (Fauth Patent A.G.—*Brit. 491,106*) was similar in principle but included a prepressing of the batch to which solvent was added. Column equipments for counter current extraction which were supplied with devices for removing the residue and the solvent containing oil were patented by Olier *(U.S. 2,150,608),* Bonotto *(U.S. 2,156,236)* and Lawrence *(U.S. 2,154,339).* Another continuous extractor contained grinding devices by which the seeds were ground to successively increasing fineness while passing through the solvent *(Reichert—U.S. 2,158,427).* Monssen *(Norw. 56,720)* suggested cooling the oil-bearing material to freeze water contained in it and maintaining the condition during extraction. Hildebrandt (*Fette u. Seifen 46,* 350) prepared a brief discussion on a few of the continuous extraction methods.

An invention by Grower *(Can. 378,341)* dealt with the use of paraffins from hexane to nonane inclusive as solvents for extraction of fats. The process included recovery of solvent from both oil and residue. Means of reducing the loss of petroleum solvent were suggested by Belozerov (*Masloboina Zhir. Delo 14,* No. 3, 8) and Oleshko (*Ibid. 14,* No. 4, 4).

Recent patent reviews on refining fats were prepared by Singer (*Seifensieder-Ztg. 66,* 93, 113, 131); Boone (*Soap 15,* No. 7, 30), and Wittka (*Allgem. Oel- u. Fett-Ztg. 36,* 51). A review on fish oils included patents on refining, deodorization, polymerization and hydrogenation (Davidsohn and Davidsohn—*Soap, Perf. & Cosmetics 11,* 901).

Refining of oleo oil was combined with rendering by Andersen-Orris *(Brit. 506,968);* after heating animal tissue to 75° the charge was neutralized with alkali, sprayed with hot brine and the neutral fat was filtered off. Beyer (Brit. 498,209) refined fats in two steps, first with caustic alkalies then with alkali silicates; washing and removing soaps was performed with potassium alum solution. Sullivan *(Brit. 505,210; Fr. 828,725)* refined palm oil by treatment with alkalies and alkali carbonates and deodorizing by distillation under vacuum. Hasko *(Hung. 119,434)* removed soap from neutralized castor oil with gasoline, benzene or toluene. Several improvements have been suggested for the continuous methods of refining (Shell Development Co. — *U.S. 2,164,189;* Refining Inc. — *U.S. 2,142,062, 2,150,732-3, 2,150,797, 2,157,069, 2,182,755;* De Laval Separator Co.—*U.S. 2,181,563*). The process comprises proportioning the refining agents entering the fat, flowing them through a reacting zone and separating foots from fat by means of centrifuges. The improvements were proportioning devices, methods of heating, arrangement of apparatus so that the process can be accomplished under pressure, means of speeding up the process and interposing a cooling stage between the heating and the separating units.

Patents on refining with ethanolamines dealt with removing the excess refining agent from refined fats (N.V. de Bataafsche Petroleum Maatschappij — *Fr. 838,843;* Shell Development Co. — *U.S. 2,164,012;* De Laval Separator Co.—*U.S. 2,157,882*).Two of the innovations involved washing out excess alkalolamines with acids and separating by means of centrifuges. The N.V. de Bataafsche Petroleum Maatschappij concern *(Dutch 44,533 and 44,008* was assignee to a process of extracting impurities from fats with amines in hydrated form and to the use of imines in the same process. Continuous counter current extraction processes have been developed for this type of refining (Shell Development Corp.—*U.S. 2,164,189*).

Schmidt *et al.* (*Ber. 72B,* 945) prepared detailed methods of deacidifying fats by means of carbodiimides. The dicylohexylacylureides of the fat acids were found to be difficultly soluble in fats and procedures taking advantage of this characteristic were recommended. The amount of reagent required can be calculated from the amount of alkali required to neutralize the oil. One to 30 hours time, depending on the fat, temperature, etc., were required for deacidification. The products of the reactions could be removed with centrifuges. Zetzsche and Frederich (*Ber. 72 B,* 1477) contended that no ureides were formed in the above process. They believed that two molecules of acid form an acid anhydride and a disubstituted urea.

Several miscellaneous refining processes were suggested. Corn oil may be refined by treatment with organic peroxides derived from the foots, and at 50 to 60° and in the presence of fullers earth (Kokatnur and Plantinga—*Can. 382,087*). Subjecting fats in the presence of carbohydrates to the action of bacteria or ferments was said to improve them (Ekhard—*U.S. 2,172,531*). One refining process comprised emulsification with skim milk which may contain alkali and electrolizing (Elact Ges. electrische App. G.m.b.H.—*Ger. 677,062. Cl. 23a*).

A review on refining of tall oil was prepared by Heller (*Chem.-Ztg. 63, 77*). The fat acids of this product can be separated by treatment with lye and extracting the resin acid soaps with hydro-carbon solvent, furfural and water (Gayer and Fawkes—*U.S. 2,166,812*) or the oil may be distilled under vacuum and the abietic acid separated by crystallization (Frankel and Pollak—*U.S. 2,143,345*). Tall oil can be deodorized by steam and separation of the settling (Gothner—*Swed. 92,743.*

The new bleaching agents announced during the year were magnesium silicate (Johns Manville Corp. —*U.S. 2,183,590;* Caldwell—*U.S. 2,163,525-7*), a charred mixture of phosphate rock, ammonium phosphate and carbohydrate binding material (Baugh & Sons Co.—*U.S. 2,170,601*), residues containing silica from the treatment of aluminum minerals (Chem. Fabrick Buckan—*Ger. 670,936 Cl. 23a*) and a solution of hydrogen peroxide and sodium nitrite (Urbain and Jensen—*U.S. 2,158,163*). Used absorbents have some reserve bleaching capacity; when used as a pretreatment on the oil they considerably reduced the amount of fresh and total absorbent necessary (Hassler and Hagbert—*Oil & Soap 16,* 188). Economies were realized both by reduction in the amount of absorbent necessary and by lessened oil retention. Palm oil may be bleached by decomposing the pigment with heat at 200 to 350° in absence of oxygen and hydrogenating to remove the decomposed pigment (Sullivan—*Fr. 828,725*). Heat bleaching methods were compiled by Boone (*Soap 15,* No. 2, 23).

A regeneration process for bleaching earths comprised heating them in hot water containing alkali silicates (Henkel & Cie G. m. b. H.—*Ger. 670,830 Cl. 21i*). The absorbed oil was recovered by the treatment.

The innovations recommended in deodorizing fats were deaerating the charge with vacuum before steaming (Foster Wheeler Corp.—*Brit. 505,810*) and the devising of equipment for continuous operation under vacuum conditions (Stewart—*U.S. 2,141,941*).

Innovations in splitting fats were principally improvements in the method of autoclaving with water (Metallges. A-G.—*Ger. 672,225 Cl.* 23d, *679,723 Cl. 23c;* Hoffman — *Ger. 677,957 Cl. 23d;* Eisenlohr — *U.S. 2,154,835;* Mills—*U.S. 2,156,863*). Novelties included splitting directly after hydrogenation, in the same apparatus and without removal of catalyst, a continuous process comprised a series of autoclaves; special heating coils were designed, as well as equipment to flow the fat upwardly through a column of hot water. Bag *et al.* (*Maslosboino Zhir. Delo 14,* No. 5, 21) split fish oils with sulfuric acid so as to obtain colorless and odorless split products. The current methods of splitting were reviewed by Heublyum (*Mfg. Perfumer 3,* 214) and Foulon (*Seifensieder-Ztg. 66,* 569). The former preferred the Twitchel method; Foulon's review dealt principally with the use of zinc oxide as the splitting agent. Lascaray (*Fette u. Seifen 46,* 628) observed that the temperature and amount and type of splitting agent affected the speed of splitting but did not influence the equilibrium of the reaction; the amount of water increased the limit of the reaction without influencing its speed. It was postulated that splitting in a heterogenous system was a homogeneous reaction which takes place at the boundaries of the phases. The theory indicated that splitting agents act through increasing the solubility of water in the fat phase.

An improvement in fat acid distillation apparatus by Ittner *(Brit. 496,175, 496,677)* was a form of heat exchange condensers in which the fatty acids for the distillation were preheated with the heat derived from condensing distilled fat acids. Another patent (New Process Fat Refining Corp.—*Ger. 665,874 Cl. 23d*) was on controlled heating procedure to get definite temperatures in various parts of the process. In the method by Apostel *(Brit. 500,375)* the fat acids were counter flowed against a heating gas. The continuous method of McCulloch *(U.S. 2,147,306)* comprised heating the stock to vaporizing temperatures and introducing it into fractionating zone.

Separation of fats into low melting and high melting constituent was possible by extraction with sulfur dioxide (Edeleau G.m.b.H.—*Ger. 669,620 Cl. 23a*). The reagent selectively extracts the unsaturated fat acids. Matumoto and coworkers (*Repts. Imp. Research Ind. Japan 19,* No. 10) found fish oils could best be fractionated into soap stock and drying oil by fractional distillation of fat acid methyl esters. The fractions destined to the protective coating field were converted into their glyceride esters.

Unique hydrogenation procedures were suggested for effecting desired reactions. Bollens *(Can. 381,887)* hydrogenated a portion of oil to the desired hardness, added more of the original oil and hydrogenated. The additions followed by hydrogenation were repeated until the whole batch was completed. Jenness *(U.S. 2,163,602-3)* controlled hydrogenation processes at uniform rate with special nickel: chromium or aluminum. catalysts. Oils hydrogenated by the process were resistant to reversion. Intermetal Corp. *(Fr. 830,778)* found advantages in hydrogenating soybean and fish oils at 147.7 to 165.5°. Petryaev (*Masloboino Zhir. Delo. 14,* No. 5, 17) hydrogenated porpoise oil one hour at 240-270° with 0.45 per cent nickel catalyst prepared from nickel formate to obtain a fat that melted at 43 to 45°. Seto and Sata *(U.S. 2,147,177)* subjected the hydrogenation charge alternately to a.c. and d.c. electrical discharge during hydrogenation. After hydrogenation d.c. current was used to draw the catalyst to the walls of the apparatus and the oil was removed. The catalyst remains in the apparatus for use with the next batch.

Bauer and Herzog (*Fette and Seifen 46,* 203) reported that at high temperatures the partial hydrogenation of poly-unsaturated fat acids as accompanied by wandering elaidinization of double bonds. Partial hydrogenation of linoleic acid at 100° led to the formation of a liquid 12-13 octadecenoic acid. With hydrogenation at 200° solid 12-13 octadecenoic was formed together with other isomers of oleic acid. The solic acid was the elaidinized form. According to Escourrou (*Bull. Soc. Chem. (5) 6,* 360 peanut oil unsaturated fat acids can be hydrogenated to one remaining double bond and stopped at that point with the use of Raney nickel catalyst at reduced pressure and a temperature of 180°. The product was chiefly isoöleic acid. This selectivity was not evident in hydrogenation at ordinary pressure. The same investigator *(Ibid. 191)* prepared directions for selective hydrogenation of coconut oil.

Data developed by Athavale and Jatkar (*J. Indian Inst. Sci. 21A,* 285) concerned the velocity of hydrogenation in a continuous process. The velocity with the same catalyst varied considerably with different oils. The optimum temperature for hydrogenation of oils was 180°. The continuous process of Technical Research Works Ltd. was described by Manderstam *(Oil & Soap 16,166).* Its outstanding features were: the catalyst may be reactivated for years without loss, there was no formation of free fat acids, filtration was eliminated, and installation was simple. Reviews on hydrogenation were also published by McCutcheon (*Can. Chem. Process Inds. 33,* 53), Whitner (*Oil & Soap 16,* 39), Etinburg (*Masloboino Zhir. Delo. 15,* No. 1, 14), and J. and A. Davidsohn (*Food 8,* 242). Methods of producing hydrogen gas for the process were briefly described by Hurst (*Oil & Soap 16,* 28) and Steinbrecker (*Oil & Soap 16,* 36). Kohler (U.S. 2,147,780) used a mixture of magnesium oxide, alkali carbonate and iron oxide as a catalyst in the preparation of hydrogen from steam and carbon monoxide.

Conjugated hydrogenation of soybean oil with propyl alcohol as the hydrogen donor can yield a product with practically the same fat acid composition as olive oil (Rush and Dvinyaninova—*J. Applied Chem. U.S.S.R. 12,* 428, 431), the presence of 4.8 isoöleic acid in the hydrogenated product being the only difference. Selective hydrogenation of linoleic to oleic acid was obtained by the process with olive, sunflower, and soybean oils.

Work on catalyst prepared by thermal decomposition in oil medium was reported by Russian investigators (Yamaguti *et al—J. Soc. Chem. Ind. Japan 42,* 215; *Bull. Waseda Applied Chem. Soc. 15,* No. 4, 1; Orlava—*Masloboino Zhir. Delo 14,* No. 4, 9). Copper: nickel formates prepared by the action formic acid on a 1:1 mixture of the carbonates gave an active catalyst suspension, while that made from mechanical mixture of the formates did not. According to Orlava the activity of the catalyst prepared from the formate was not affected in the presence of 50 per cent nickel sulfate when used at 250°. At 240° the activity was considerably reduced by 10 per cent nickel sulfate. With 10 per cent sodium formate the catalyst was inactive. The presence of zinc and nickel formates, sodium sulfide, and phosphorus reduced the activity. Kino (*J. Soc. Chem. Ind. Japan 42 B,* 189) found that nickel plus manganese catalyst acted like nickel alone, thorium was active, and zinc weakened the hydrogenation action. According to Ueno and Tazumi (*Ibid. 41 B,* 323) catalysts containing copper, nickel and cobalt were more active than those containing copper, nickel and manganese. Vanadium, calcium and magnesium also promoted the activity of nickel catalyst. Methods for preparation of catalysts of various copper:nickel ratios, their activity and information on their use were developed by several investigators (Laptev and Zolotareva—*J. Applied Chem. U.S.S.R. 11,* 1071, Botkovskaya and Dymshits—*Masloboino Zhir. Delo. 1939,* No. 2, 21; *Ueno et al.—J. Soc. Chem. Ind. Japan 41 B,* 298). A continuous catalyzer-reducing furnace consisted of a rotating steel tube, containing conveyor and devices for discharging the catalyzer into oil without coming in contact with air (Sieck—*Oil & Soap 16,* 24). The flow of reducing gas was counter current to that of the catalyst. Gwynn (*Ibid.* 25) reviewed all types of hydrogenation catalysts.

In removing copper nickel catalyst from fat with sulfuric acid, emulsification was prevented by addition of 0.1 per cent potassium dichromate (Yakubov—*Masloboino Zhir. Delo 1939,* No. 3, 17, No. 6, 16.) Several advantages were obtained when the catalyst was first concentrated by centrifuging. A procedure recommended by Guseva (*Ibid.* No. 3, 13) comprised treating with twice the theoretical amount of sulfuric acid (30%), blowing with air 18 to 20 hours and after cooling removing the fat layer and recovering catalyst. Sully (*Chem. & Ind. 58,* 282) recorded data on leaching sulfates from precipitated nickel carbonate. Optimum removal was with at least six washings. Passing the suspended precipitate through a colloid mill considerably improved the extraction of sulfates. Durrans and Sully *(U.S. 2,150,270)* devised a method of recovery without removal from oil. The suspension in oil was converted to the oxide with steam and this was reduced to nickel in the same suspension.

Activities in elaidinization were principally in the issuance of new catalyst patents (N.V.Bataafsche Petrol. Maat.—*Brit. 502,390;* Bertram—*Ger. 674,752; U.S. 2,165,530*). Sulfur dioxide, selenium or tellurium seemed to be active catalysts for the process. Elaidinization of linoleic acid yielded linolelaidic acid of melting point 28-29°, a liquid isomer and conjugated by-products (Kass and Burr—*J. Am. Chem. Soc. 61,* 1062).

A new method of hardening oils comprised heating the oil with salts of phosphoric acids and higher alcohol esters of fat acids (Irmen—*Brit. 503,607*). For example, 1,000 grams of olive oil and 70 of beeswax at 95 to 100° were stirred into a boiling solution of 30 grams of 1:1 mixture of trisodium phosphate and tripotassium phosphate in 2,000 cc. of water. On cooling the oil solidifies as a top layer.

A review on drying oils was prepared by Mundy (*Paint Varnish Production Mgr. 19,* 258, 281). Present conceptions of the polymerization reaction were discussed by Stark (*Nat'l. Paint Bull. 2,* 12, Oct.). Information on the development of peroxides and free fat acids during oxidation of oil by passing air through it and by exposing the films to sunlight were tabulated (Dzens—*Masloboino Zhir. Delo 14,* No. 6, 29). It was suggested that the peroxide decomposed not only by heat, but also by chemical reaction with oxidizable compounds such as aldehydes. Work by Morrell and Phillips (*J. Soc. Chem. Ind. 58,* 159; *Fette u. Seifen 46,* 541) on the course of oxidization revealed interesting information on the reaction. The gaseous hydrogen iodide method for peroxide determination was found to give total reactive oxygen from free peroxide, from the associated peroxide and from the ketol groups, both oxygen atoms of the peroxide groups being reduced. It is assumed that active oxygen is added to both "remote" and "near" double bonds; the "remote" polymerizes and the "near" active oxygen is partly transformed into the ketol group. The method of Lea was used to measure unchanged "near" peroxide. Experiments with various methods which gave results according to the activity of the reagent favored the assumption that the active oxygen was added to both "remote" and "near" linkings. The "remote" peroxide polymerizes and the "near" active oxygen was transformed partly into the ketol group. Diketo-substances were formed by stoving the substances in air. The activity of the unpolymerized peroxide could be the cause of surface condensation of moisture which eventually gives rise to bloom. It was suggested that yellowing of air dried white paints could be caused by formation of colored metallic salts of enolised diketo-oxidization products.

The studies on tung oils by Levy (*Recherches & inventions 19,* 11) produced information on analysis and on means of reducing certain unfavorable behavior of these oils. The wrinkling of the oils in presence of driers was avoided when the layer of the oil was thicker; as a consequence it dried more slowly. With oils in thin layers, a surface film formed rapidly, producing a wrinkled appearance. Tatimori (*J. Soc. Chem. Ind. Japan 42,* 162) found that a linear relation existed between the gelation time of tung oil and the percentage of added oleic acid up to 15 per cent. Constants for calculating the gelation time for additions of several fat acids and oils were listed. Gelation of tung oil was retarded by heat treating with sulfur, selenium, sulfides or selenides (Harper—*U.S. 2,152,642*). The treatment yielded a smooth glossy rapid drying oil. Caplan *(U.S. 2,176,058)* polymerized tung oil at 105° in the presence of diethyl sulfate. Cicoil, a substitute for tung oil prepared from oiticica oil, was described by Holdt (*Am. Paint J. 23,* 50; Mar. 6). Characteristics of the oil, its production and applications in varnish making were outlined.

The work on linseed oil covered various phases. In the early stages of development the iodine numbers of flaxseeds were low, and increased as the seed ripened (Ruchkin—*Biokhimiya 3,* 328). The drying rate was most rapid at the early stages; that is, as the seed ripened the time required for the oil to dry increased. Nicholson (*Ind. Eng. Chem. 31,* 1300) tabulated the effect of zinc oxide and titanium dioxide pigments on the oil. An increase in pigment reduced the oxygen absorption only slightly, but the loss in drying rate was pronounced. The color binding agents added to linseed oil dispersion were stabilized with one per cent of the sodium salts of any of several polyphosphoric acids (Henckel & Cie—*U.S. 2,150,060*).

Several new improvements were made in methods of treating drying oils. Benzoyl peroxide can be added to destroy natural anti-oxidants (Hodgins—*U.S. 2,167,206*). Certain plant pigments, photo-sensitizers, increased the speed of oxidation (Coe—*U.S. 2,165,130*). Fat acids could be heated to 260° under 500 atmospheres pressure and then esterified to produce a polymerized drying oil (Fawcett *et al.*—*U.S. 2,155,009*). Briscoe *(U.S. 2,166,539)* subjected the oils to distillation after partial polymerization, returned certain fractions of the distillate and repeated the treatment. A boiler for heat treating oils was patented by Wirth *(U.S. 2,146,164)*.

Processing of perilla oil has been the cause of serious fires. It was believed that sometimes the oil evolves heat spontaneously and rapidly when heated to 270° (Meyer—*Farben-Chem. 10,* 54). The precautions recommended were a slow rate of heating after entering the dangerous temperature zone, automatic devices for detecting dangerous rise in temperature, provisions for cooling, use of indirect heat and maintaining an atmosphere of carbon dioxide above the oil.

Aids to the use of fish oils in paints were developed by the Los Angeles Paint and Varnish Production Club (*Bull. 568,* 363; *Am. Paint Journal 23,* 14, Nov. 14). Clouding was shown to be a function of heating rate and temperature. The properties of special heat treated fish oils and their mixtures with other oils were tabulated. Takano's (*J. Soc. Chem. Ind. Japan 42 B,* 210, 212) experience indicated that factice made from herring and sardine oil by heating with sulfur was of inferior quality. Preparation of factice in carbon tetrachloride solution with sulfur monochloride was more successful. Behr *(U.S. 2,166,103)* divided heat treated sardine oil into drying and nondrying fractions by extracting with solvent ketones and higher alcohols. The drying properties of marine oil may be increased by contact with aqueous potassium permanganate solution (Hassard—*U.S. 2,160,861*). Reviews and general discourses on processing fish oils were prepared by Pawelzik (*Fette u. Seifen 46,* 195), Seerath and Pawelzik (*Farbe u. Loch 1939,* 65), Anderson (*Off. Digest Federation Paint & Varnish Prod. Club 1938,* 467), and Pamfilov and Ivanocheva (*Trans. Inst. Chem. Tech. Ivanova U.S.S.R. 1939,* No. 2, 93).

Aids to the use of soybean oil in paints were developed by the Chicago Paint and Varnish Production Club (*Am. Paint J. 23,* 16). Properties of 15 varnishes made by cooking various mixtures of tung, perilla, and soybean oils, with modified phenolic, maleic, and ester gum resins were listed. Not more than 50 per cent soybean oil could be used. Tung oil was most satisfactory for admixing. Kraybill and coworkers (*Ind. Eng. Chem. 31,* 218) demonstrated that phosphatides retard the drying rate of crude oils, other factors could also be involved.

One of the newest sources of drying oils is dehydrated castor oil. Munzel *(Fr. 830,494)* removed the water and prevented decomposition by treatment in presence of tungstic, molybdic, or undecylenic acid. Shuraev and Vasileva (*Masloboino Zhir. Delo 1939,* No. 2, 40) issued directions for the same process using sulfuric acid as the catalyst. Reviews on the subjects were prepared by Kaufmann (*Fette u. Seifen 45,* 451) and Adams *et al.* (*Nat'l Paint Varnish Lacquer Assoc. Sci. Sect. Circ. 568,* 359). The oil from the shell of cashew nuts was found to yield films particularly resistant to hydrochloric acid (Patel and Patel—*Ind. & News Ed. J. Ind. Chem. Soc. 1,* 83). Glyceral esters of talloil fat acids could also be used for making lacquers and paints (Freitag—*Oberflachentech 15,* 190).

Among other paint oil substitutes were new synthetic resins of the urea formaldehyde type (Neuss—*Ger. 670,634 Cl. 12 o*), reaction products of phthalic or adipic acids with non- or semi-drying oils (Blumer—*Ger. 672,287 Cl. 12 o*); Springer & Moller A.G.—*Ger. 676,258* 12 o), fat acid esters of pentaerythritol and *d*-mannitol (Blagonravova and Drinberg—*J. Applied Chem. U.S.S.R. 11,* 1642), and a special oil resin composition (Bakelite Corp.—*U.S. 2,152,633*).

Several means of making drying oils from hydrocarbons were suggested. The sludge obtained in the pyrolysis of mineral oils was freed from aromatic compounds, neutralized, mixed with anthracene, tar and water glass and heated to yield a good substitute (Yaroshevskii—*Russ. 46,315*). Petroleum hydrocarbons saturated with phosgene and passed at 200 to 450° over iron and aluminum oxides and coke yield artificial drying oils (Chernysher — *Russ. 47,023*). Nikolskiv *(Russ. 46,655)* fused naphthenic acids with hydroxides of aluminum and calcium and dissolved the product in naphtha to yield a satisfactory drying oil substitute.

Fat acid soaps of aluminum and iron containing promoters in hydrocarbon solvents were used to give varnish like films (Bradley—*U.S. 2,169,577*).

PRODUCTS

Miss Lowe and Miss Nelson's *(Agr.Expt.Sta.,Ames, Ia., Bull 255)* addition to their series of publications on the use of lard and other fats concerned the use of fats in plain cake. Time to reach a maximum volume during creaming of batter depended on the speed of agitation, the material used, the fat to sugar ratio and the temperature of ingredients. The time to reach maximum volume for 42 lards varied from 8 to 120 minutes; the softer lards creamed most rapidly. Smooth lards creamed to a higher volume than grainy lard when both were obtained from the same original lard. With one part of fat to 2.6 parts of sugar and creaming for 30 minutes at room temperature, at slow-speed with a kitchen mixer, the order of decreasing creamed volume was hydrogenated lard, hydrogenated cottonseed oil, open-kettle rendered lard. butter, and prime steam lard. Cake volumes were smaller with larger creamed volumes. The mixing methods whereby the egg was added late in combining processes gave best results. In most instances, higher cake scores accompanied larger creamed volume. Mitchell (*Oil & Soap 16,* 62) outlined the types of shortening that best met the various bakery practices.

During 1937 in Germany the ratio of fats used in bakeries was margarin 44, oil 21, tallow 31, butter 9, shortening 3.5 and others 6 per cent. In this country high taxes on margarin preclude its extensive use as a shortening in the bake shop.

Machines for mixing and quick cooling of shortening were designed by Hansen *(Brit. 502,304)* and Godfrey *(U.S. 2,174,364).* Such treatments improve texture, plasticity and appearance, and impart desirable culinary properties such as good creaming volume, optimum baking qualities and increased shortening power. Jenness *(U.S. 2,134,452)* described special means of controlling the plasticity of shortening by additions of completely hardened fats. The baking character of shortening or bakery products that require shortening can be improved by addition of special sulfated triglycerides (Harris—*U.S. 2,158,775*), tetraphosphoric acid esters of alcohols (Katzman—*U.S. 2,176,077-8*) or by dispersing a 10 per cent sugar solution in the shortening (Shou—*Brit. 487,111*). Meyer (*Seifensieder-Ztg. 66,* 825) vigorously condemned the use of soap in bakery products to make them lighter as suggested in some recent patents. Literature was cited to show that this effect was known as far back as 1893. A few legal prosecutions for using soap in place of eggs as emulsifiers in bakery products were cited.

Various fats used in deep-fat frying of dough mixtures at high altitudes were investigated (Thiessen—*Food Research 4,* 135). The fats showed consistent decreases in iodine value and smoke point and increases in acidity. The reheating and reuse of a fat up to 12 hours did not affect the quality of flavor of the product fried therein. Fat absorption was not dependent upon the kind of frying fat. The amount of fat absorbed varied with formula changes, temperature of cooking and amount of mixing. The high temperatures used for frying at low altitudes were not satisfactory at an altitude of 7200 feet.

Kneading and mixing apparatus for use in margarine manufacture was patented by Hammer *(U.S. 2,169,642)* and Schaub *(U.S. 2,166,197).* A margarine emulsifying apparatus that depends on the principle of atomizing a mixture of ingredients into a cooling chamber was patented (Kerr—*Brit. 488,556*). Hartung (*Fette u. Seifen 46,* 9) described the margarine making character of tallow and made a plea to extend its use. One manufacturer (Best Foods Inc.—*U.S. 2,167,113*) prefers making margarine from a fat containing a large amount of iso-acids; another (Fisher and Culkin—*U.S. 2,143,651*) patented a base containing 63 to 85 per cent milk or water, 0.5 to 15 of fat, 7.5-23 salt and 0.35 to 2 per cent water soluble gum. The base is added to shortening to yield margarine. Schou *(Brit. 496,166, 494,639)* continued his developments on oxidized fat emulsifiers for margarine by devising a method of using the material and improving its efficiency by reacting it with polyglycerols. The use of sodium alginate as a margarine emulsifier was also patented (Wilt—*U.S. 2,156,036*). Methods for preparing margarine emulsifiers and their properties were recorded by Palladina (*Masloboino Zhir. Delo 1939,* No. 2, 30). A confectionery cream was prepared by emulsifying partially hardened marine animal and fish oils with milk and a little glycerine and treating the homogenous mixture in a beater to add air.

More patents on incompletely esterified glycerol or polyglycerols have been issued (Harris—*U.S. 2,177,983-4;* Barton and Cox—*U.S. 2,167,144;* Eckey—*U.S. 2,182,397;* Lever Bros. & Unilever Ltd.—*Ger. 679,971 Cl. 12o*). Improvements include new methods of manufacture, new uses and reacting the products with phosphoric pentoxide. Erastova (*Org. Chem. Ind. U.S.S.R. 6,* 151) recommended lead oxide as a catalyst for preparation of mono- and diglycerides. Daubert and King (*J. Am. Chem. Soc. 61,* 3328) prepared specific *α, β* diglycerides of fat and aromatic acids by a new method and recorded some of their characteristics; however, the aim was not the preparation of emulsifiers. Other emulsifiers were a reaction product of phosphoric acid and fat for adding to eggs (Katzman—*U.S. 2,176,078*), the sediment separated from fish oils after purification and treatment with enzymes (Dogadkin and Lavrenenko—*Russ. 47,766*) and some special esters containing both alcphatic and cyclo radicals (Groves—*Brit. 500,032*).

Monoglycerylricinoleate has found application as a de-emulsifier for mineral oils (Powell—*U.S. 2,175,699*). Monoglycerides of drying oil fat acids can be utilized as solvents and reactants with natural resins in the varnish industry (Mundy—*Oil Colour Trades J. 94,* 1801). They were particularly useful for reacting with hard types of Congo resins and with oxidized rosins.

A historical review on winterizing cottonseed oil was prepared by Lee (*Oil & Soap 16,* 148). A salad dressing base which contains the fats, spices, salt, sugar, citric acid and emulsifiers was patented by Musher *(U.S. 2,170,518).* The product was marketed for converting to the finished dressing by further mixing with eggs and other ingredients. Separation of oil from peanut butter can be prevented by the addition of a small quantity of glycerine (Lenth—*Food Ind. 12,* 678).

Malowan (*Seifensieder Ztg. 65,* 988) described methods of aging and oxidizing olive oil so that it will yield stable emulsions suitable for the manufacture of cosmetic creams. Fiero (*J. Am. Pharm. Assoc. 28,* 598) recommended hydrogenated castor oil for this purpose. Typical formulas for the use of hydrogenated oils in lipstick, tissue cream and shaving cream were recorded by Allen (*Soap, Perfumery, Cosmetics 12,* 502).

New patented developments in high vacuum short-path distillation comprised improvements in apparatus and special uses such as concentrating vitamins, separating hydrocarbons from fats, fractionating fish oils and separating and concentrating butter flavor and vitamins *(U.S. 2,150,683, 2,165,378, 2,180,050, 2,180,052-3, 2,144,906; Can. 378,404; Fr. 834,532, 834,540, 834,935; Brit. 490,433, 501,841).* General literature reports on the process include a bibliography (Detwiler and Markley *Oil & Soap 16,* 2), a review (Burch and van Dyck *J. Soc. Chem. Ind. 58,* 39), a description of the process (Fawcett—*Ibid. 58,* 43, 50) and a discussion on its application for concentrating vitamins (Jewel et al. *Ibid. 58,* 56). Rawlings (*Oil & Soap 16,* 231) reported that the unsaponifiable of soybean and corn oils can be completely removed by distilling 3.6 per cent of the oils. This supplies a method of removing unsaponifiable without saponification or otherwise altering the physical properties of the glycerides. Odorous and coloring substances also distill off.

Dicarboxylic acids were prepared from unsaturated fat acids by treatment with alkali metal hypochloride in the presence of nickel oxide (Ralston et al.—*U.S. 2,133,008*). Paraxenylstearic acid, ethyl tolylstearate, methyl phenoxyphenylstearate and the *p*-methyl, chlorine, bromine and phenol derivatives were prepared from oleic acid by the Friedel-Crafts reaction and some of their characteristics recorded (Stirton and Peterson —*Ind. Eng. Chem. 31,* 856). Suggested uses were for lubricants, waxes, penetrants, and manufacture of soaps and other wetting agents. Ralston and Christensen *(U.S. 2,162,970)* patented methods of preparing cyclic substituted dichlorinated aliphatic hydrocarbons for similar uses.

Condensation of toluene and camelia oil was accomplished by heating in the presence of anhydrous aluminum chloride (Kimura and Turugi—*J. Soc. Chem. Ind. Japan 42B,* 193). The products had lower iodine and saponification values and higher indices of refraction and viscosities than the original oil. Ralston and Selby (*J. Am. Chem. Soc. 61,* 1019) recorded melting points of compounds formed on heating lauroyl, myristoyl, palmitroyl and stearoyl chlorides with sodium. The mechanism suggested for the reactions was:

$$\begin{aligned}&2\,\mathrm{ROCl} + 2\,\mathrm{Na} \rightarrow \mathrm{RCOCOR} + 2\,\mathrm{Na} \rightarrow\\&\mathrm{RC\,(ONa) : C\,(ONa)\,R} + 2\,\mathrm{RCOCl} \rightarrow\\&\mathrm{RCO_2CR : C(O_2CR)R.}\end{aligned}$$

Sebacic acid was prepared by heating derivatives of ricinoleic acid with alkali under pressure (Bruson and Covert—*U.S. 2,182,056*). The acid chlorides of fat acids may be prepared by heating with phosgene in the presence of and in contact with charcoal (Dierichs—*U.S. 2,156,177*).

A resumé of patents on the synthesis of higher aliphatic alcohols by hydrogenation of fat acids was prepared by Mullin (*Soap 15,* No. 3, 28). A new patent (Rittmeister—*Ger. 670,832 Cl. 12o*), on their production contained the information that better results are obtained if the fat acids are mixed with an alcohol of boiling point not more than 50° below that of the fat acids. Manufacture of the higher alcohols from low molecular weight aldehydes by condensation in the presence of oxides of metals of the second and third groups of the periodic system has been patented (I. G. Farbenind A.-G.—*Ger. 675, 658 Cl. 12o*). A series of investigations on manufacture of alcohols from oils was reported by Sinozaki and coworkers (*J. Agr. Chem. Soc. Japan 14,* 1113, 1117, 1123, 1129; *15,* 531, 537). Optimum working conditions for soy bean oil were reported as 320-40° for 6 to 10 hours with zinc-chromium catalyst. In preparing the catalyst from ammonium-zinc-chromate complex a 1:1 ratio of chromic oxide to zinc oxide was preferred. With perilla oil best results were obtained with zinc dust as a catalyst. This was further improved by hydrogenating in the presence of methyl alcohol. The methyl alcohol did not accelerate the reaction with other catalysts. Formulas for using fat alcohols in cosmetics were presented by Sedgwick (*Soap, Perfumery & Cosmetics 12,* 161). As ingredients of paper to induce water-proofness and to reduce noisiness were new uses for the fat alcohols (Arnold—*U.S. 2,142,986*). Under the action of chromium and aluminum oxide catalysts, fat alcohols undergo various reactions which may involve dehydration, dehydrogenation and cyclization (Komarewsky et al.—*J. Am. Chem. Soc. 61,* 2525). Some aromatic hydrocarbons were formed. The alcohols can be converted into fat acids by autoclaving with caustic soda (Hennig—*U.S. 2,159,700*). When the oils were hydrogenated at high pressures with additions of aluminum or zinc oxide in addition to the regular catalyst the final products were waxes that were similar to beeswax (Smozaki and Adati—*J. Agr. Chem. Soc. Japan 14,* 1135). Wax was also produced by heating wool fat with sodium (Friedrich—*Ger. 674,874 Cl. 23a*).

Dehydrogenation of the acids in castor oil that contained hydroxyl groups to yield ketostearin was accomplished by Lazier *(U.S. 2,178,760)* by heating the oil with nickel-kieselguhr catalyst to 273° for 6 hours. Cox *(U.S. 2,180,730)* patented the use of esters of ketostearic acid and an aliphatic alcohol as a plasticizer in lacquers and plastic compounds. Alcoholysis of fats for the production of plasticizers was accomplished by heating to 300° and at a corresponding pressure (Hansley—*U.S. 2,177,407*). The reaction products of fat acids and acids of the benzophenone series (Cornwell—*U.S. 2,170,632*) and oils treated with an oxide of a metal of group two of the periodic table (Nebel—*U.S. 2,168,040*) were also developed as plasticizers.

New resin and composition products included a Friedel-Crafts condensation product of fat acids and rubber (Ralston and Shelby—*U.S. 2,182,180*) and cellulose ethers of fat acids (Meyer—*U.S. 2,171,222*). In a report by Ralston (*Oil & Soap 16,* 215) it was pointed out that fat acid derivatives can be employed for the preparation of resins which possess distinctive properties such as flexibility.

Pyrolysis of coconut oil or lard with iron powder at 300-340° gave a distillate consisting mainly of 12-pentacosanone (Holleman and Koolhaas—*Rec. Trav. chim. 58,* 666). Fatty aldehydes were prepared by the action of formaldehyde vapors on fat acid soaps (Ralston and Vander Val—*U.S. 2,145,801*).

Continuing a very productive course of research Ralston and coworkers added new developments to their series on preparation of fat derivatives. Nitrile compounds were prepared by heating waste proteins of the packing, fish and leather industries with fats *(U.S. 2,164,284).* Separation of nitrile and hydrocarbon mixtures was by selective solvents e.g. carboxylic acids, phenols, and amines *(U.S. 2,145,802-4).* Polymerization of nitriles with aluminum oxide, phosphorus trioxide, sulfur mono-chloride or other catalysts followed by hydrolysis yielded aliphatic carboxylic acids *(U.S. 2,162,971, 2,175,092; Brit. 488,808).* Aliphatic thioamides were prepared by reacting aliphatic nitriles with sulfur and ammonium sulfide in an inert non-aqueous solution *(U.S. 2,168,847)*. Polyamines were prepared by hydrogenating nitriles *(U.S. 2,178,522)*. Nitriles and amines prepared from fat acid were recommended for use in concentrating ores by flotation *(U.S. 2,175,093, 2,168,849)*.

Nitriles were prepared by Niccdemus and Wulff *(U.S. 2,177,619)* by passing fat acids or their esters and ammonia over a dehydrating catalyst at temperatures between 320-420°. Greenhalgh *(Brit. 488,036)* synthesized nitriles by reacting phosgene with primary amides prepared from fat acids. Shatenshtein *(Russ. 50,964; J. Applied Chem. U.S.S.R. 11,* 967) obtained amides of fat acids and glycerine by treating fats with ammonia in the presence of ammonium chloride. The yields at various temperatures, pressures, and ratios of the reactants were recorded. Similar data were also recorded in English (Balaty et al.—*Ind. Eng. Chem. 31,* 280).

Amino ketones such as *p*-laurophenonetrimethyl ammonium methyl sulfate were prepared for use as insecticides (Geigy A.G.—*Swiss 200,365, 202,160-2*). Another fat derivative for use as an insecticide was prepared by heating glycerides with sulfur in the presence of a few crystals of iodine *(Dearborn—U.S. 2,169,793)*, Several characteristics and properties of methyl, ethyl, *n*-propyl and *n*-butyl esters of thio fat acids were recorded by Ralston and coworkers (*J. Org. Chem. 4,* 502).

Physical chemical data on zinc and magnesium oleates and their solutions in benzene were recorded (Bhatanager et al.—*Proc. Indian Acad. Sci. 9A,* 143). The information should be useful for compounding greases. Zinc oleate was regarded as a gel whereas magnesium oleate behaved more like a colloidal electrolyte containing ionic micelles. Metallic soap grease bases were patented by Meyers *(U.S. 2,151,641)*, and Orelup *(U.S. 2,147,713)*. The latter inventor added a dye belonging to the arcidines, rhodamines, eosines or similar classes so that the final lubricant product would have a fluorescent color. Metallic soaps were also prepared from the fat acid in pine oil (Stresen-Reuter and Rimpila—*U.S. 2,175,489-91*). Metallic fat acid soaps of aluminum and iron dissolved in hydrocarbon solvent were used to give varnish-like films (Bradley—*U.S. 2,169,577*). Metallic soaps were also used in the refining of cracked mineral oils to precipitate the mercaptans (Mizuta and Yoshimura—*U.S. 2,154,988*).

Belsani (*Chim. ind. Agr. biol. 15,* 78) fostered the production of castor oil as an Italian lubricant source. In an investigation of this lubricant Hawke and Segal (*J. Soc. Chem. Ind. 58,* 270) recorded that the heat treatment of this oil to render it soluble in mineral oils involved a decomposition of triricinolein to triundecenoin rather than a polymerization. Changes of physical and chemical characteristics of the oil with vigor of heat treatment were recorded. Papok and Kogteva (*Masloboino Zhir. Delo 15,* No. 1, 10) reported that thermal decomposition occurs at first and until 7 to 9 per cent volatile decomposition products distill off; polymerization and condensation then take place. Merriss *(U.S. 2,158,374)* patented the use of polymerized products of castor oil as emulsifiers for spray oils employed in the spraying of citrus fruits or oiling of textiles.

Several new methods for making certain fatty oils miscible in mineral oils were developed. Eichwald *(U.S. 2160,572)* polymerized oils in the presence of boron fluoride; Beyer *(Fr. 829,962)* preferred manganese dioxide, platinum sponge, nickel or thorium oxide as catalysts; Richardson *(U.S. 2,167,726)* first hydrogenated to an iodine value below 100 and then subjected the oil to the action of a silent electric discharge in order to polymerize it; and Froligh and Wasson *(U.S. 2,150,370)* claimed the use of special polymers prepared from semi-drying oils. A lubricating oil prepared by Neely and Kavanagh *(U.S. 2,163,622)* contained oleic and/or stearic acid. A lubricant patent by Ralston *(U.S. 2,141,142)* covered the use of a reaction product of sulfur monochloride and a nitrile derivative of fats. Sulfurized esters of fat acids for use as lubricants and method of manufacture were patented by Smith *(U.S. 2,179,065)* and Gottesmann *(U.S. 2,152,185)*.

In the past most attempts to prepare mineral oils from a vegetable source were by pyrolysis. New publications record results on pyrolysis of the whole mustard and castor bean seeds (Peng—*J. Chem. Eng. 5,* 10, 23). The castor beans yielded 20 per cent by weight gasoline and 5 per cent ammonia, in the form of ammonium sulfate. Hydrocarbons were also produced from fats by hydrogenation at high pressure (Mugisima—*J. Soc. Chem. Ind. Japan 42B,* 18). The products contained one less carbon atom than the original fat acids.

Several by-product developments from fats were suggested. Okano (*J. Agr. Chem. Soc. Japan 15,* 235, 238) isolated flavin from oil foots of soybean oil. Treatment of the foots with 50 per cent alcohol at 70° and settling yielded a middle alcohol layer which after removal of resins with lime and removal of saponins by acidifying yielded a residue which showed lactation promoting activity when fed to cows. Iwasa *(Ibid. 473)* prepared a caramel solution from soy bean foots. Hydrocarbons suitable for filling thermometers were obtained by vacuum distillation of fish oils (Baxter—*U.S. 2,169,192*).

The manufacture and uses of lecithin was reviewed by Eichberg (*Oil & Soap 16,* 51). The use of salt for precipitating phosphatides was patented by Thurman *(U.S. 2,150,732)*. Lishkevick (*Masloboino Zhir. Delo 1939,* No. 2, 6) separated the phosphatides of cottonseed, soy bean and rapeseeds into three fractions, i.e., acetone soluble, alcohol soluble and benzene soluble. The percentage of each fraction and their constituents were tabulated. The acetone fraction contained lecithin and cephalin, the alcohol fractions the same but in different ratios and the benzene fractions were practically all lecithin.

Fluid phosphatides for incorporation into soap were prepared by mixing the phosphatides with castor oil fat acids and a small amount of polyethanolamines (Braun & Rosenbusch—*U.S. 2,168,468*). Phosphatides were used as emulsifiers in brushless shaving cream by Kritchevsky *(U.S. 2,164,717)*. Another cosmetic emulsion patent (I. G. Farbenind—*Brit. 505,983)* claimed the use of water soluble constituents of phosphatides.

BIOCHEMICAL

The mechanism of fat oxidation in the living organism as evidenced by certain acid excretions and β-oxidation was reviewed by Verkade (*Fette u. Seifen 46,* 521).

Cavanagh and Raper (*Biochem. J. 33,* 17) investigated fat metabolism by the method of feeding rats fats containing deuterium and determining this constituent in various fractions of the body after various periods. After six hours, deuterium was present in considerable amounts in plasma glycerides, liver glycerides, and liver lipins, and in lesser amounts in kidney, plasma and adipose tissue. That in the liver glycerides decreased more rapidly in twenty-four hours than that in the liver lipins; the kidney and brain deuterium contents were not appreciably changed in twenty-four hours. The authors believed that the liver lipins may play an active part in fat metabolism. In work on preparing fats containing deuterium by cultures of *Endomyces vernales* for biological fat studies, Günther and Bonhoeffer (*Z. physik. Chem. A. 183,* 1) found that the ratio of inclusion of hydrogen and deuterium during fat formation was three to one in favor of the hydrogen.

A new "tagged" fat for fat transport studies was suggested (Miller, Barnes, Kass and Burr—*Proc. Soc. Exptl. Med. & Biol. 41,* 483). The tagged fat was conjugated linoleic acid methyl or glycerol ester prepared according to the method of Moore (*Biochem. J. 31,* 138) by prolonged saponification, followed by reesterification. The method for separating the body fat and qualitatively and quantitatively measuring it spectroscopically were presented. This same principal was evident in the newer biochemical investigations of Moore and coworkers (*Biochem. J. 33,* 1626, 1630, 1635). It was shown that an absorption at 270 mµ was caused by a fat acid containing three double bonds and one at 230 mµ by two such bonds in a fat acid. Catalytic reduction of tung oil changed the absorption maximum of the mixed fat acid from 270 to 230; the same change occurred *in vivo* when tung oil was fed to a hen or rat. This change was ascribed to the loss of one pair of the conjugated double bonds. The absorption at 230mµ was used as a criterion to measure deposition of poly unsaturated fat acids. The poly unsaturated fat acids of butter glycerides from cows on cod-liver oil containing feeds was greater than that of pasture butter. When the intake of poly unsaturated acids was low they were largely converted to the conjugated form.

A central control of the metabolism of fats was suggested by Sangen (*Acta Med. Scand. 97,* 427) because of the severe hyperlipemia which develops suddenly when the hemoglobin content and red blood count were reduced by sectioning the cord between the third and fourth thoracic vertebrae.

Hilditch and coworkers (*Biochem. J. 33,* 493) determined the component acids of a series of depot back fats from pigs on different planes of nutrition. On a restricted diet, deposition was slower and the fat was softer owing to increases in amounts of the unsaturated components. There were indications that the body of the animals synthesized glycerides of palmitic, oleic, and stearic acids. Linoleic and unsaturated C_{20-22} acids were derived from ingested fats. Work on land crabs of the Seychelles Island (Hilditch et al.—*J. Soc. Chem. Ind. 58,* 351) appeared to show that the depot fat was composed largely of glycerides deposited from ingested coconut fat.

Work on body fats of female goats, (Dhingra and Haneef—*J. Soc. Chem. Ind. 58,* 292) added more convincing evidence to the hypothesis that the lower fat acids of milk fat were formed at the expense of C_{18} acids.

Direct experimental evidence of the synthesis of fat acid from both carbohydrates and protein was obtained by Longenecker (*J. Biol. Chem. 128,* 645; *129,* 13; *130,* 167). From the non-lipid source 40 to 45 per cent of the fat acids were of the C_{16} series. The depot fat laid down in fasted rats on a high corn oil diet was found to be almost identical in fat acid composition with that of the corn oil itself. Substituting sucrose for part of the corn oil increased the proportion of C_{16} acids in the depot fat. Fasted rats on a high coconut fat ration deposited fat containing myristic and palmitic acids as the predominant saturated acids and oleic as the major unsaturated acid. The presence of dodecenoic acid and of larger amounts of tetra-decenoic acid than occur otherwise suggested that the rats were able to desaturate lauric and myristic acids. Hoagland and Snider (*J. Nutrition 18,* 435) in confirmation of Longenecker's reports, also recorded conclusive evidence that rats can synthesize fat from protein.

Several reports appear on the digestion of fats. Commercial samples of margarine were digested by pancreatic lipase at different rates; some even as fast as butter (Hartwell—*J. Soc. Chem. Ind. 58,* 165 T). Short chain hard fat acids were absorbed more efficiently than the longer chain acids (Rennkamp—*Ber. Verhandl. sächs Akad. Wiss. Leipzig Math. Phys. Klasse 91,* 61). Total absorption in some cases was less than 50 per cent. Werner *et al.* (*Z. physiol Chem. 257,* 1) added one carbon atom to the fat acids of cacao butter, resynthesized them to glycerides and investigated their behavior as fats. These "odd" fats behaved like normal cacao butter in animal experiments with respect to effect on the respiratory quotient lipase action, animal weights, iodine value of depot fat and carbon to nitrogen ratio in urine.

Fatty livers were produced in mice on high fat diets supplemented with cystine, methionine and homocystine (Singal and Eckstein—*Proc. Soc. Exptl. Biol. & Med. 41,* 512). Also, fatty livers were produced in guinea pigs on a scorbutogenic diet (Spellberg and Keeton—*Ibid.* 570). The process was slightly retarded by additional carbohydrates in the diet. The administration of choline to dogs with fatty livers produced a distinct reduction in the phospholipid content (Cedrangolo & Baccari—*Arch. sci. biol. Italy 24,* 311). At the same time there was a balance between disappearance of glycerine and formation of glycogen which suggested that phospholipids do not represent an intermediate stage in the transformation of glyceride lipids into glucides.

An investigation on the specificity and relationship between chemical structure and vitamin E activity was reported by Smith and coworkers (*J. Org. Chem. 4,* 298 to 262; *J. Amer. Chem. Soc. 61,* 2615, 3079). Several chemical reactions of the tocopherols, methods of determination, absorption spectra and like information were recorded. Karrer and coworkers (*Helv. Acta 22,* 65) demonstrated that the caproate, stearate, succinate and benzoate of synthetic *dl-a*(-tocopherol (vitamin E) had the same activity as the free tocopherol. Perrelli (*Quaderni mitriz 5,* 215) claimed that the vitamin E activity of tomato seed oil was equal to, if not greater than that of wheat germ oil. Muscular dystrophy was produced in rats by feeding a diet deficient in vitamin E beginning at birth (*Proc. Soc. Exptl. Biol. & Med. 41,* 453). Elevations of water and chloride concentration was noticed. Recovery was complete after two to three months on a diet containing wheat germ oil.

Olson (*Proc. Soc. Exptl. Biol. & Med. 41,* 653) was unable to substantiate the earlier reports that sesame oil contained a "T factor" which raised the platelet levels of normal children.

Herlitzka and Montuori (*Riv. patol. sper. 22,* 69) reported that administration of the so-called vitamin F, linolenic and linoleic acids, caused transitory, and in some cases, permanent disappearance of the symptoms of some allergic diseases. A short discussion of these two acids giving their distribution in various oils was written by Schwarz (*Seifensieder-Ztg. 66,* 455). Several publications may comfort those who fear that they lack this essential nutrient. Mackenzie *et al.* (*Biochem. J. 33,* 935) developed low-fat rations for laboratory studies which gave good growth and reproduction but contained as little as .0156 percent lipid. Other diets without vitamin E contained as low as .0056 percent lipids. According to Martin (*J. Nutrition 17,* 127) the minimum level of methyl linoleate for optimal growth of rats was below one drop per day. He proved that methyl linolenate could not replace methyl linoleate. Steenbock and coworkers (*J. Nutrition 17,* 115) report that the essential fat acids can be supplied to rats by daily feeding of any one of the following, ½ drop wheat oil, ½ drop corn oil, 10 drops coconut oil or 25 drops butter. Aeration and ultra-violet light did not destroy the curative effect of peanut or wheat germ oil.

Chemical analyses have indicated that lard contains no thiamin, thus justifying the conclusion that the vitamin B_1-sparing action of the fat cannot be attributed to actual administration of the vitamin but to the decreased metabolic requirements for thiamin when the fat content of the diet was increased (Melnick and Field—*J. Nutrition 17,* 223).

Lovern and coworkers (*Biochem. J. 33,* 338, 1734) separated the lipids of halibut intestinal oil into free fat acids, phosphatides, vitamin and cholesterol esters and a neutral oil. Both vitamin A and cholesterol were found esterified with all the various fat acids present, the amounts were proportional to the relative amounts of the acids present in the main fat extract. The evidence was in harmony with the hypothesis that vitamin A assists in fat absorption. Evidence indicating that whale-liver oil contains some hitherto unknown substance with the biological action of vitamin A was recorded by Willstaedt and Jensen (*Nature 143,* 474). Carotene was found to yield the same biological value when fed in lard, soy bean oil, cottonseed oil, devitaminized butter fat, hydrogenated vegetable fat, crude peanut oil or coconut oil (Steenbock and coworkers—*J. Nutrition 17,* 91). Inferior growth was obtained with solutions of carotene intriolein, linseed oil or refined peanut oil.

Vitamin assays included reports on the seasonal variation of vitamin A in the liver oils of stock fish and cape ling fish (Molteno and Rapson—*J. Soc. Chem. Ind. 58,* 297), the vitamin A and D content of Pacific fish oils (Agnes Morgan *et al.*—*Food Res. 4,* 145), the vitamin A content of Pacific salmon (Harrison *et al.*—*U.S. Bur. Fisheries, Investigational Rept. No. 40*), the vitamin A value of 45 Indian foods (De *et al.*—*Indian J. Med. Res. 26,* 435), of shark-liver oil (Rusoff and Mehrhof—*Poultry Sci. 18,* 339), of the blubber oil of hair seal and sea lion (Pugsley *et al.*—*Fisheries Res. Brd. Can., Progress Rpt. Pac. Sta. No. 36,* 10) of gray cod-, ling cod-, and red cod-liver and viseral oils (*Ibid.* 22), the vitamin D potency of British Columbian pilchard oil (*Ibid. 39,* 3) and the vitamin A and D potency of liver and viseral oil of gray cod *Ibid. 38,* 15). A review on marine animals as sources of vitamins A and D was prepared by Unger (*Fette u. Seifen 46,* 152). A fat with a high vitamin D content was extracted from cacao husks (Fincke—*Ger. 672,000, Cl. 12p*). New methods of concentrating vitamins comprised a high vacuum distillation method (Eastman Kodak Co.—*Brit. 487,367, Ger. 664,745 Cl. 12p;* Imp. Chem. Industries—*U.S. 2,143,587*) and a chromatographic method (Firm of E. Merck—*Brit. 491,653*). A product containing synthetic vitamin D was patented by Eastman Kodak Co. *(Brit. 491,007).*

Precautions necessary in fortifying livestock feeds with cod-liver oils were emphasized in publications by Skelley (*N. J. Agr. Expt. Sta. Bull 661,* 3) and Cruickshank (*Proc. 7th World's Poultry Congr., Cleveland, 1939,* 539). When fed to hogs the oil produced an off-odor in the pork; when it was fed to poultry off-odors appeared in eggs and flesh.

Sabalitschka (*Süddent. Apoth.-Ztg. 79,* 672) found no antimicrobic action in freshly prepared oils. Antimicrobic activity developed on aging or oxidation. Hoffman *et al.* (*Food Res. 4,* 539) on the other hand claimed that short chain fat acids have good fungistatic properties; results with fatty acids up to 14 carbon atoms and at *p*H 2 to 6 were recorded. The hypothesis was advanced that the shorter chain fatty acids may be important in the human dietary.

Reports of health hazards connected with the oil industry comprised a report on dermatitis from tung oil (Tupholme—*Brit. J. Dermatol. Syphil. 51,* 138) and a description of carbon disulfide poisoning as it affected several workers in the olive oil industry (Gallego—*Arch. Gewerbepath. Gewerbehyg. 8,* 124).

DETERIORATION

Resumés of theories, types of spoilage, and discussions on spoilage of fats and oils were prepared by Rathlef (*Mfg. Perfumer 3,* 73), Dagneaux (*Chem. Weekblad 36;* 179), Sporzynska (*Przemysl Chem. 22,* 3), Glimm and Nowack (*Fette u. Seifen 46,* 632).

A method for determining deterioration of fat in milk powders was based on determining the peroxide value of the fat (Smith—*J. Dairy Res. 10,* 294). Acetic acid and chloroform were used as the solvents for the fat and active oxygen was determined iodometrically.

The hydroxylamine-hydrochloride value was suggested as a new measure of rancidity (Romeo and Catalano—*Riv. ital. Profumi Piante officin 20,* 71). The sample was treated with hydroxylamine-hydrochloride and the hydrochloric acid liberated by oxime formation was titrated with potassium hydroxide. The rancidity was expressed as the amount of hydroxylamine-hydrochloride in milligrams required to react with all the oxo-compounds, in 100 grams of fat. Täufel and Klentsch (*Fette u. Seifen 46,* 64) suggested distinguishing between higher and lower aldehydes in spoiling fats. Chloroform and water solvents were used together in testing with fuchsine-sulfur dioxide solution. The low molecular weight aldehydes, formaldehyde to valeric, gave a red color in the water layer which was insoluble in chloroform, while higher aldehydes yielded a violet blue color in both water and chloroform layers.

A new test for rancidity, "Chlorophyll value" was devised by Coe (*Oil & Soap 16,* 146). The method depends upon the relative absorption of magnesium chlorophyll as indicated by the red fluorescence of chlorophyll when placed under an ultra-violet lamp equipped for fluorescence studies. Oils absorb or combine with chlorophyll to a considerable extent without fluorescing red, depending on the degree of oxidation, but as the oil becomes oxidized, it absorbs less chlorophyll and the color increases to a brilliant red under the light. Organoleptic state of rancidity was present in those oils yielding the brilliant red fluroescence. The test was simple and could be made in a few minutes.

Kaufman and Fiedler (*Fette u. Seifen 46,* 200, 210, 275, 288) recommended the use of the Mackey test to replace the manometric oxygen uptake methods for evaluating the stability of fats. The test indicates the presence of natural antioxidants and evaluate antioxidants and prooxidants. A patent on this type of test apparatus was issued to Stephenson *(Brit. 490,817).* Freyer (*Oil & Soap 16,* 191) reported three years of collaborative work on the Swift fat stability test with identical samples. Four laboratories obtained consistently good results; two obtained good results after a bad first year, and two failed to show agreement after two years experience. Freyer believes the method to be inherently sound when used painstakingly and with special regard to all necessary percautions.

Hillig (*J. Assocn. Off. Agr. Chem. 22,* 414) described a method of evaluating spoilage in canned sardines by measuring decomposition of the fat. Volatile free fat acid content was the criterion used. In sauce packed sardines, which contained added acetic acid, formic acid was determined on a distillate, to yield an index to the condition of the samples.

Deatherage and Mattill (*Ind. Eng. Chem. 31,* 1425) investigated autoxidation in a special apparatus which permitted the collection and analysis of the volatile products formed in the reaction, the measurement of oxygen consumption, and analysis of the oxidation residue. Data on oleic acid, some of its esters, isomers, and actadecene were tabulated and graphically presented with suggestions and structural equations for interpretation of probable reactions during autoxidation. The acids and esters appeared to be autoxidized in a similar manner to yield the same type of products. After formation of peroxides at the double bonds, the peroxides could cleave to give aldehydes; they could react with another double bond to give 2 molecules of ethylene oxide, or they could aid further oxidation of the carbon chain. The aldehydes formed also oxidized to acids. Oxido derivatives were among the main products of the oxidation process. The oxido derivatives were all of the same geometrical configuration and corresponded in each case to the high melting dihydroxy isomeric derivative of the original substrate. Briggs and Williams (*New Zealand J. Sci. Tech. 21B,* 47) investigated the oxidation of stearic acid in the presence of various prooxidants. Ogygen consumption and qualitative rancidity test data comprised most of the report. Mohr and Arbes (*Fette u. Seifen 46,* 678) disprove the hypothesis that the fishy flavor of spoiled butter is due to trimethylamine. Trimethylamine could be detected when added in small amounts to fresh butter but was not detected in spoiled butters.

Weber, Irwin, and steenbock (*Amer. J. Physiol. 125,* 593) demonstrated that active oxygen was responsible for the destruction of vitamin E in fats. No destruction was observed with fats heated under nitrogen reflux or with fats to which acrolein, allyl alcohol, or straight-chain aldehydes or ketones were added. Smith (*Biochem. J. 33,* 201) presented data on the disappearance of vitamin A in solutions containing peroxides. The oxidization of vitamin A gave rise to a product with unselective absorption at 328 m.u.: this fell back to its original value when allowed to stand in the dark. It was suggested that vitamin A undergoes reversible photochemical isomerism along with photochemical destruction during oxidation.

The effects of high temperatures on fats were investigated. Brambilla (*Ann. chim. applicata 28,* 444) heated oleic acid to 325° and identified carbon dioxide, caprylic acid and sebacic acid among the volatile products. Octene, decene, and hexadecene were isolated from the residue which consisted mainly of hydrocarbons. Köchling and Täufel (*Fette u. Seifen 46,* 206) tabulated data that showed the extent of the effect on heating at different temperautres on oils in various stages of oxidation. The heating increased the susceptibility of the oils to oxidation. Oxidation of peanut oil was accelerated by adding 2 cc. of heated oil to 15 cc. of unheated oil. Data on hydrolysis of beef tallow, lard, coco fat, palm kernel fat, sesame oil, peanut oil, olive oil, and triolein at temperatures between 60 and 120° for time intervals of 7 days were presented graphically by Glimm *et al.* (*Z. Untersuch. Lebensm. 78,* 285). The degree of splitting by heat was independent of the original content of free fat acids, but rose with increase in temperature and time of heating. Each vegetable oil showed a critical temperature above which an appreciable increase in splitting occurred within 3 days. The critical temperatures varied between 75 and 100°. No appreciable splitting occurred in beef tallow or lard at temperatures up to 60°.

With butter, the acidity, starter organisms, salt, and low-pasteurization temperatures favored oxidation during storage (Wiley—*J. Dairy Res. 10,* 300). Diacetyl or acetone had no effect. The results were said to indicate the presence in ripened pasteurized cream and in unripened raw cream of a fat-oxidizing enzyme which was most active at low pH and high salt concentrations. Similar information was recorded by Kretchmar (*J. Dept. Agr. W. Australia 15,* 330). It was found undesirable to store butter having a pH value greater than 7.1 or less than 6.3. Ritter and Nussbaumer (*Schweiz. Milchztg. 64,* 465, 526; *65,* 61) tabulated data on the stability of rendered butter fat. The rendering process removed natural antioxidants. The tendency to oxidize during storage was decreased by addition of eggs, vegetable and butter phosphatides, butter milk powder, oat flour, and hydroquinone. Similar data on lard showed the progress of oxidation and effect of several antioxidants and heat (Morvillez *et al.—J. pharm. chim. 29,* 159). The antioxidant effect of benzoin, balsam tolu, poplar buds, and tannin were evaluated.

Several new inhibitors against oxidation of fats were described. Mitchell *(U.S. 2,163,912)* patented the addition of hydrogenated refined soybean oil to alkali refined oleo oil. Sabalitschka and Böhm's *(Brit. 498,110; Fr. 839,514)* antioxidant had the formula RCOOR'N(R'')R''' where R was hydrogen, alkyl or aryl, R' was alkylene with not more than 4 carbon atoms, R'' was alkyl with not more than 3 carbon atoms, and R''' was hydrogen or an alkyl with not more than 3 carbon atoms. Kilgore *(U.S. 2,158,724)* patented the use of enol esters. Beta-phenyl thiourea or substituted thioureas were claimed to be good soap antioxidants (Martin—*U.S. 2,154,341*) and oxalic acid was suitable for fat acids (Wecoline Prod. Inc.—*U.S. 2,162,542*). Ascorbic acid inhibited ranciditification in water-oil emulsions (Gray—*U.S. 2,159,986; Food Industries 2,* 626). Phorphyrins inhibited the autoxidation of linseed oil (Hinsberg and Nowakawski—*Biochem. Z. 300,* 313). Diacetyl had a perservative effect in margarine (Schmalfuss—*Fette u. Seifen 46,* 719). Sodium bisulfite was recommended for hydrogenated cottonseed-oil shortening (Hoover and Moore—*Oil & Soap 16,* 212).

Several publications dealt with natural antioxidants. Macara *(Brit. 492,714)* extracted an antioxidant from roasted cacao bean. Antioxidants were obtained by short path distillation of oils (Fawcett—*Brit. 501,194;* Eastman Kodak Co.—*Brit. 507,471*). Hilditch and Paul (*J. Soc. Chem. Ind. 58,* 21) believe that the antioxidant power of naturally-occurring compounds is due to the presence of polyphenolic groups. Water extracts of roasted barley, a coffee substitute, were found to have antioxidant properties (Köckling and Täufel—*Fette u. Seifen 46,* 127). Maltol, 2-methyl-3-oxypyron, a constituent of barley which has functions similar to "inhibitols" was found to possess no antioxidant properties. The stabilization of fatty and other material with cereal flours was the subject of 17 patents (Musher—*U.S.* 2,176,022-38) and a few papers (Mueller and Mack—*Food Res. 4,* 401; Bull—*Food 8,* 281). Diemair and Fox (*Angew. Chem. 52,* 484) investigated the antioxidant capacity of oat oil. It was without effect in ultra-violet light. A 67 per cent retardation of peroxide formation was accomplished in the protected oil when it was tested by blowing with oxygen for one hour. In a series of tests the antioxidant value of oat oil varied with the methods and the criterion used for determining rancidity.

Tabulated data and graphs showed the effectiveness of various antioxidants for castor oil (Inman—*Ind. & Eng. Chem. 31,* 1103). Para- and ortho-hydroxy-benzene derivatives such as hydroquinone and catechol were strong antioxidants. Meta- isomers were weak. A review of oil antioxidants was prepared by Harry (*Mfg. Perfumer 4,* 82) and one on soap antioxidants by Smith (*Soap 15,* No. 1, 21).

The non-toxicity of gum guaiacum was demonstrated by Carlson *et al.* (*Food Res. 3,* 555).

Of 12 colored samples of cellophane the deep red, orange, violet, grass-green, and lemon yellow showed the greatest protection against the rancidifying effect of ultra-violet rays (Barton and Davies—*J. Soc. Chem. Ind. 58,* 189). No marked accelerating properties could be associated with visible wave lengths.

Storage tests were recorded on fat-containing food products. With meat kept at —18°, there was no change in the fat in more than a year's period (Novikova—*Kholodil'naya 16,* No. 4, 30). When stored at —8° deterioration could be detected chemically and organoleptically. A very visible yellowing was noticed at 6 months, at one year the color penetrated to a depth of 0.2 to 0.4 centimeters. Similar work was reported by Kiermeier and Heiss (*Z. ges. Kälte-Ind. 46,* 91,111). Storage of fat tissue for 4-5 months at —8° to —9° was unsatisfactory. At one year the only difference in results between storage at —15° and —21° was that at the latter temperature the odor was better; chemical tests for rancidity were the same. The tabulated information gave chemical reactions for oxides, aldehydes, and methyl ketones and degree of acidity. The effect of carbon dioxide, air currents, and occasional exposure was determined.

COMPOSITION AND CHARACTERISTICS

The major portion of the reports on composition and characteristics of fats and oils have been tabulated and are appended to this portion of the review. Another group of reports of this type contained interesting theoretical considerations or special tabulated data. Schwabe-Hansen (*Tids Kjemi Bergvesen 18,* 10) listed the characteristics of different layers of the blubber of whales; it was interesting to note that the middle blubber oil had the lowest iodine and thiocyanogen values. Lauro (*Oil & Soap 16,* 141-2) recorded collaborative analyses of the cottonseed oils of Texas and Georgia. Woodward (*Analyst 64,* 265) tabulated the fat acid composition of linseed oils of various geographical origin. Aitken (*Can. Grain Res. Lab. Ann. Rept. 12,* 74) tabulated analysis of various Canadian oleaginous seeds and their oils.

Lehberg and co-worker's (*Can. J. Res. 17 C,* 181) summary of characteristics of linseed oils at progressive stages of maturity indicated that maximum oil content was reached several days before visual maturity and unsaturation was higher under climatic conditions favoring slow maturity. Similar tabulated data on olive oils were prepared by Nichols and Friar (*Fruit Products J. 18,* 361, 374). Cruess et al. (*Ind. Eng. Chem. 31,* 1012) demonstrated that the oil content of olives could be used as a basis for indicating the maturity of the fruit.

Elaboration of the theories regarding the enzymes of cottonseeds by Meloy (*Oil & Soap 16,* 172) divides the activity into three stages: first a constructive stage during which oil is formed, the second was a dormant stage, and third a resuscitating stage which occurs through reabsorption of moisture. In the last stage oil and proteins are broken down.

An American Oil Chemists' Society Committee (*Oil & Soap 16,* 129) made a collaborative investigation of their official method for determining oil in commercial samples of soy beans. To obtain complete extraction of oil in 4-5 hours, it was necessary to regrind after partial extraction. This confirms earlier work by McKinney, Carter, and Jamieson (*Ibid. 11,* 252). McKinney and Freeman's (*Ibid. 16,* 151) method for determination of oil in tung kernel comprised 4 hours' extraction, grinding with sand and extracting for 2 more hours. The success of refractometric methods for determining the oil content of seeds has been confirmed by Littman (*Zeiss Nachr. II, No. 7,* 241), Jakobey (*Kiserletügyi Közlemenyek 42,* 115) Zeleny and Neustade (*J. Assocn. Off. Agr. Chem. 22,* 610).

A source of error in the use of sodium sulfate as a drying agent was pointed out by Schmidt-Nielson and Stene (*Kgl. Norske, Vid. Selskabs Forh. 11,* 137, 169). In grinding livers, pancreas, and fish muscles with the drying agent, the activity of lipase was increased thus yielding a fat with a high free fat acid content. The use of dry solvent and drying of the samples were emphasized as important precautions to heed in the determination of fat in bread and flour products (*Castagnou-Bull. soc. chim. 6,* 620).

A method for determining the fat in liver comprised treatment with 25 per cent potassium hydroxide, followed by treatment with sulfuric acid and extraction by shaking with petroleum ether and separating (Leites and Odinov—*Lab. Prakt. U.S.S.R. 1939,* No. 4, 14). Current micro-methods for determining the fat content of dairy products were described with suggestions for improvements (Ardenghi — *Rev. facultad cienc. quin. Uni. La Plata 13,* 111, 131).

Organic solvents for fat determination were compared by Jany and Morvay (*Z. Anal. Chem. 106,* 166). More extract and fat was obtained from egg yolk, cheese rind, and chrome leather with carbon tetrachloride than with several other solvents. Carbon disulfide was good with chrome tanned leather but was elsewhere distinctly inferior. Ether did not extract fat as well and dissolved more foreign material. Petroleum ether dissolved much less foreign matter but it also extracted less fat. Harrison (*J. Assocn. Off. Agr. Chem. 22,* 661) demonstrated that lower extraction values were obtained on fish meal after than before oxidation or aging of the meal.

A set of color standards made of solutions of inorganic salts was prepared by Osima and Sugawara (*J. Agr. Chem. Soc. Japan 15,* 653) for measuring the color of oils. The absorption spectra of the American Oil Chemists' Society color standards were recorded by Urbain and Roschen (*Oil & Soap 16,* 124). Bolton and Williams (*Oil & Soap 16,* 106) disagreed with the American Oil Chemists' method of determining color because no provision is made for considering the lightness or darkness of the oils. Means of reporting this factor were suggested.

Data on the viscosity of several oils and their polymerized products were tabulated (Isikawa and Toyama —*J. Soc. Chem. Ind. Japan 42,* 218). The oils with the highest iodine values generally had lower viscosities. This rule did not apply to oils containing special constituents as tung, coconut, rape, and others. Similar data on fat acids and equations for calculating the viscosities of fat acid mixtures from iodine values were developed by Ravich (*Compt. rend. acad. sci. U.S.S.R. 22,* 34.) Aubert and Pignot (*Ann. combustible liquides 14,* 7) report that the double refraction of an oil subjected to angular rotation between concentric cylinders was related to the velocity of rotation of the cylinders.

The freezing point, resolidification point and melting point of normal aliphatic acids from C_{14} to C_{34} (in even numbers) and of their methyl and ethyl esters were tabulated (Francis and Piper—*J. Am. Chem. Soc. 61,* 577). Graphical data on solidification point of fat acids of various animal fats were recorded by Koss (*Przemysl Chem. 22,* 411). Photomicrographs of polymorphic forms of the triglycerides of the fatty acid series C_{12} to C_{18} were prepared and their melting points determined by Grüntzig (*Z. anorg. allgem. Chem. 240,* 313). The relation of the melting points of the various forms was discussed. Greene (*Am. J. Pharm. 110,* 492) prepared photomicrographs of crystals of soaps of hydnocarpic acid which was derived from chaulmoogra oil.

The dilation number which is the ratio of volumes between liquid and solid phase of a fat was recommended as a useful characteristic for fat mixtures in connection with predicting sweating of cosmetic products (Willsmer—*Soap, Perfumery & Cosmetics 12,* 501). The test was carried out by measuring the volume of a weighed quantity of fat at a temperature well above the melting point, solidifying the fat and measuring its volume below the melting point. The ratio of liquid to solid phase could be calculated from the data.

Activities in determining consistency of fats comprised a tabulation of data obtained by the method whereby the fat was extruded through sieves (Wefelscheid—*Chem. Fabrik 1939,* 116). A new method for butter (Pasveer—*Chem. Weekblad 36,* 289) consisted of placing a cylindrical piece of butter between two plates, subjecting to pressure by causing a weight to fall on the top plate and then measuring the total length of two diameters across the butter disc.

Moisture determination methods for fats were evaluated by Joyner and Rini (*Oil & Soap,* 233). Absorption on calcium chloride was applicable except with samples containing residual solvents. The oven method was suitable except for coconut oils with high free fat acid content. Hot plate methods gave the highest results even when heating was stopped at the first trace of smoke that was visible under a strong beam of light. The moisture values determined by the use of an air oven should be corrected for oxygen absorption.

The changes recommended in the American Oil Chemists' Society method for determining free fat acids comprised permissible substitution of iso-propyl alcohol for formula —30 denatured ethyl alcohol and the use of a 0.025 per cent alcohol solution of aniline blue as an alternate indicator (*Oil & Soap 16,* 132). Thomson (*Ibid.* 221) pointed out that present disagreement of analysts on the contents of free fat acids within seed samples was due to the wide variations that may be found in the seeds. He suggested that better sampling methods were necessary. Bari (*Ber. ungar. pharm. Ges. 15,* 461) pointed out that large changes in other characteristics of certain fats were possible by removal of free fat acids. A method of determining air in shortening comprised calculation from weights of cylinders of shortening and deaired shortening (*Oil & Soap 16,* 158).

A method for determination of soap in refined oils by Schuette and Hine (*Oil & Soap 16,* 13) depended upon formation of the chloride salt on addition of hydrochloric acid. A similar method was described by Kaminskaya (*Masloboino Zhir. Delo 1939,* 23). Free alkali in fats can be determined from the difference of the alkalimetric determination of acid values in samples before and after centrifuging for 3 to 5 minutes.

O'Brien (*Australian Chem. Inst. J. & Proc. 5,* 329) selected the Wijs method for iodine value as most suitable. Vossgard and Bjorsvik (*Z. anal. chem. 115.* 195) made the same report with regard to analysis of marine fats. A simplified procedure which was satisfactory for iodine values between 8 and 190 was developed. Hoffman and Green (*Oil & Soap 16,* 236) confirmed an earlier report that halogenation with the Wijs solution was accelerated with mercuric acetate catalyst, thus speeding up the determination. Wan and Hu (*J. Am. Chem. Soc. 61,* 2277) worked with the Wijs reagent for developing a method for analyzing mixtures of acids in tung oil. The method depended on different rates of halogen absorption by oleic and eleostearic acid. Earle and Milner (*Oil & Soap 16,* 69) report that the iodine values by the Kaufmann method agree with those of the Wijs and Hanus except for tung and oiticica oil. Trappe (*Biochem. Z. 296,* 174, 180) pointed out several advantages of the Kaufmann method and modified it for use with samples as small as a few milligrams. Norman (*Fette u. Seifen 46,* 273) noted that the Kaufman method gave different values on wool fat according to the solvents used. The highest value, in chloroform, was considered nearest the true value. Similar but smaller differences were observed when the iodine value was determined by the Wijs method. Majors and Milner (*Oil & Soap 16,* 228) demonstrated that the iodine number of crude soybean oils could be calculated from accurately measured refractive indices. Waterman and van Vlodrop (*Cong. chim. ind. Compt. rend. 18 me. congr. Nancy 1938,* 340) observed that hydrochloric acid was fixed in china wood oil at temperatures between —80° and —5° yielding a product containing about 10 per cent chlorine, and corresponding to one molecule of acid per eleostearic group.

A report on analytical methods for fats and oils by Jamieson (*J. Assocn. Off. Agr. Chem. 22,* 605) contained the recommendation that the Kaufmann method for determining thiocyanogen value be made official. Tyutyunnkov and Urulyak (*Masloboino Zhir. Delo 14,* No. 5, 12) reported that the reagent for this characteristic also reacts with saturated alcohols, hydroxy acids, amino alcohols and oxidation and polymerization products of oils.

McKinney (*J. Assocn. Off. Agr. Chem. 22,* 618) reported that collaborators obtained better agreement in determination of Reichert-Meissel and Polenske values with the use of powdered pumice than with pieces of pumice as boiling assistants.

Weedon (*Fette u. Seifen 46,* 400) pointed out that errors arise in determination of the unsaponifiable matter in oil when the ether phase after extraction of soap solution is washed with water. Water hydrolyzes the soap residues on the glass walls of the separatory funnel and thus adds some free fat acid to the extract. Elimination of this error and simplification of the continuous extraction method for determination of unsaponifiable was obtained by Rogers (*Oil & Soap 16,* 127) by evaporating the petroleum ether extract to dryness, drying at 100° for 15 minutes, redissolving in petroleum ether, filtering, evaporating and weighing the unsaponifiable. Holweck (*Fette u. Seifen 46,* 551) preferred continuous extraction of unsaponifiable for greatest accuracy. He recommended that the soap concentration in the aqueous soap phase be kept below 8 g. per 100 cc.; otherwise excessively long extraction periods were necessary. In determining unsaponifiables Grossfeld (*Z. Untersuch. Lebensm. 78,* 273) observed that petroleum ether quickly extracts hydrocarbons from the alcoholic soap solutions whereas sterols were extracted less easily. This led to the development of a new characteristic for fats. The unsaponifiable of fat was mixed in a definite ratio with a fat acid soap and extracted once under fixed conditions and the weight of the extractives determined. Unsaponifiable samples that contained large amounts of hydrocarbons gave high values. If the fat acid soap used was made from palmitic acid the characteristic was called palmitic-hydrocarbon value.

A rapid method for estimating the rosin acids of tall oil was based on the usual assumption that rosin acids do not esterify with anhydrous alcohol in the presence of strong acids (Hastings and Pollak—*Oil & Soap 16,* 101).

Two new characteristics for fats and oils were suggested. One was a measure of the oxidation of an oil that takes place with sodium dichromate under fixed conditions of concentration, time and temperature (Alexander—*Analyst 64,* 157). In several oils this value was not proportional to the total unsaturation. Kurz (*Fette u. Seifen 46,* 397) suggested a "separation value" which would be a measure of the separation of fat acids of an oil or fat that can be obtained by shaking with two immiscible solvents such as alcohol and ligroin.

An improvement in the laboratory bleach test of soy bean oil was the addition of the bleaching earth before heating (Robertson et al.—*Oil & Soap 16,* 153). This procedure eliminated the necessity of observing a uniform rate of heating to a specified temperature. Calculations for crude cottonseed oil refining based on laboratory refining test and on moisture and insoluble determinations were proposed by W. J. Reese (*Ibid.* 61). Kraybill et al. (*Ind. Eng. Chem. 31,* 218) found a correlation between the Gardner break test and the percentage of phosphatides in crude soy bean oils.

Schuette et al. (*Oil & Soap 16,* 209) recorded solidification point curves for binary mixtures of capric, lauric, myristic, and palmitic acids. This information serves as a means of establishing the presence of two acids in a mixture of known molecular weight. This principle was used for the detection of myristic acid and to prove that margaric acid does not occur in alfalfa seed oil (*Ibid. 16,* 223). Smith (J. *Chem. Soc. 1939,* 974) used low-temperature crystallization from solvents for separating binary mixtures of fat acids. A similar technic was used by Riemenschneider (*Oil & Soap 16,* 207) to prepare pure methyl oleate. A method for analyzing mixtures of fat acids by the same author and Wheeler (*Ibid.* 219) contained recommendations for procedures to determine characteristics of the mixtures and for determining the saturated acids by the Bertram method to yield data from which calculations were made. With development of a new thermostat and filtration and extraction apparatus, Heiduschka and Böhme (*Z. Untersuch. Lebensm. 77,* 33) were able to determine stearic acid according to the Hehner and Mitchell method to a 1 per cent possible error. Methods of quantitative analysis of fat acid mixtures with the aid of selective oxidation were reviewed by Kaufmann and Fiedler (*Fette u. Seifen 46,* 569). Many of the methods were said to be of only scientific interest because they were too tedious. Hilditch and Pedelty's (*Analyst 64,* 640) method for determination of unsaturated minor components of fats comprised first separation by crystallization as the lithium salts from acetone, obtaining the ether insoluble bromo-addition products of the acetone soluble lithium salts for estimating C_{20} $_{-22}$ acids and using characteristics for calculating the constituents of the remainder.

Chromatagraphic adsorption technic was applied to fats by Kaufmann (*Fette u. Seifen 46,* 268) and Manunta (*Helv. Chim. Acta 22,* 1156). In Kaufmann's experiments with aluminum oxide the longest chain acid was preferentially adsorbed. With acids of the C_{18} series the more unsaturated acids were least adsorbed. Erucic acid was adsorbed in preference to oleic. Other results were on separation of acids of whale oils. Manunta obtained a nearly complete separation of a mixture of palmitic, stearic, and oleic acids by a column of magnesium sulfate. The palmitic acid remained in the upper part of the column, the stearic in the lower part, and the oleic was not adsorbed.

Hilditch and Jasperson (*J. Soc. Chem. Ind. 58,* 187) identical Δ-^{9} palmitoleic acid in soy bean oil. The same authors (*Ibid.* 241 T) supplied evidence of the presence of conjugated diethenoid acid in butter fat. The natural linoleic acid of seed fats was not present in butter. Their work on the linoleic acid of seed fats (*Ibid.* 233) led to the conclusions that natural and α-linoleic are stereochemically identical; β-linoleic acid is probably a mixture of about equal parts of cis-Δ-^{9}-cis-Δ-^{12}- acid and cis-Δ^{9}-trans-Δ^{12}-acid, whereas the isomerized form consists largely of the trans-Δ^{9}-trans-Δ^{12}-form. Work with bromination and alkaline permanganate oxidation products of α- and β-linoleic acids led Riemenschneider et al. (*J. Biol. Chem. 127,* 391) to the conclusion that α-, β- and natural linoleic acids were identical and had but one geometrical configuration.

Wan and Chen. (*J. Am. Chem. Soc. 61,* 2283) found differences in experimentally determinated and calculated molecular volumes of α- and β-eleostearic acid. These differences could not be accounted for by

CHARACTERISTICS REPORTED FOR VARIOUS FATS AND OILS

Oil or Fat Source	% of oil or fat	Density	Refr. Index	Acid No. or (% Acid*)	Sapon No.	Iodine No.	R-M No.	Polenske No.	Acetyl No.	% Unsap.	(SCN) No.	M.p.
Ailanthus glandulosa seeds[1]	35		1.4742^{20}	1.5	190	127.6						
Aleurites trisperma[2]		$0.9344^{15.5}$	1.4980^{25}	4.9	190.8	133.1	0.61					
Anona squamosa seeds[3]	15	$0.9127^{30/4}$	1.4660^{30}	5.28	188.76	80.92				0.35		
Argan tree kernel[14]		0.9160^{25}		3.0	190.4	96.4			1.81	0.36		
Ash-seed[5]		0.923^{18}		4.8	167	131.7	1.04	0.76		2.0		
Ben tree seed Kernel[16] *Moringa oleifera*	37.7		1.4651^{25}	0.74	186.4	68.02				1.5		
Brachychiton diversifolium seeds[7]	22.9	0.9236^{15}	1.4673^{25}		187.93	103.6				0.89		
Brazilian silk-cotton tree seed kernel[8]	37.8	0.936^{24}	1.4765	2.73	173	74		0.18				
Buffalo fat[9]		0.9254—								0.46—		
		0.9630^{20}	1.4741^{60}		190	19-30				0.71		52.7
Carob-seed germ[10]				6.3*	180.8	108.1				12.5		
Caster seed (grown in Belgian Congo)[11]	44-57	0.9620—	1.4768—	0.3—	179.07	79.32—			161.72—			
		0.9653^{15}	1.4784^{20}	2.8*	186.67	85.17			188.19			
Dum Palm kernels[15]	10			1.3*	225	33.11				1.9		
Galeopsis ladanum[18]	48-50	$0.9277^{20/4}$	1.4804^{20}	19.4	194	162.3			22			
Goat's foot[10]		0.914—			189—	64—				less than		
		0.919^{15}	1.4737	1.0*	200	78				1.5		
Koelreuteria paniculata seed[11]	20.9	0.9206^{15}	1.4723^{20}	1.1	190	89.8						
Lallemantia iberica F.M. seed[19]	35-36	$0.934^{20/4}$	1.484^{20}	0.5	189.9	192.4						
Lard (Portuguese from 2 yr.-old swine)[20]		$0.928^{20/4}$	1.4547^{50}	1.9	195.83	63.93	0.84					
Licania crassifolia B. fruit[21]		$0.9588^{15/15}$	1.5367^{20}	1.3	191.5	163.2				1.3	118.8	
Linseeds (Various origins)[22]:												
Indigene		$0.9344^{15.5}$	1.4800^{20}	3.05*	190.0	189.5				1.24	119.0	
Baltic		$0.9347^{15.5}$	1.4825^{20}	1.25*	189.0	195.3				1.26	115.0	
Calcutta		$0.9321^{15.5}$	1.4808^{20}	0.80*	190.3	182.4				0.73	113.0	
Plate		$0.9323^{15.5}$	1.4757^{20}	0.80*	190.2	180.7				0.78	115.0	
Locust (from S. America)[23]		0.8948^{50}			191.4	65.2				1.83		
Lumeque seed kernel[24] *Ximenia Americana*	53	$0.920^{20/4}$	1.475^{20}		165-175	80-95				0.5-5.0		
Mustard seed[25]												
White	46.2			2.6*	172	95				0.8		
Red	40.4			3.8*	174	103				1.1		
Black	38.8			3.9*	175	108				0.9		
Nyctanthes arbortristis seed[27]	14	0.9157^{30}	1.4675^{30}	15.75	185.5	82.25	0.1		19.28	2.4		
Okigisu fish[28] *Argentina kagoshimae*		0.9226—	1.4760—	9.5—	186.0—	148.3—						
		$0.9229^{15/4}$	1.4743^{20}	47.8	188.8	150.7						
Oroxylum indicum[29]	20	0.9062^{25}	1.4646^{25}	0.7	183.9	71.5	0.93	1.4	6.3	1.35		44.3
Papaw seed[30] *Asimina triloba*	38	$0.9296^{25/25}$	1.4728^{25}	6.4	194	113.5	1.05		18.11	0.8		
Pumpkin seed[31]	36.6			4.03	196.5	120.3	0.3		2.8	0.61	73.6	
Quisqualis indica L.[33]	9-12			19.2	201.4	59.8			20.5	1.4	51.6	
Salvadora oleoides seed[34]				1	241.5	5.5				0.7		
Salvadora persica seed[34]				2.2	234.9	6.1				0.8		
Santalum album seeds[35]		0.9356^{25}	1.4891^{30}	29	176	153	0.9		22	8.8	151	
Theobroma cacao L. seed[37]:												
germs	3.2			22.5-30.2	164.9-176.4	67.5-85.1			25.2-33.3	7.9-1.56		
seed shells	4.5			14-47	168.8-180.5				21.1-38.9	7.1-14.5		
cotyledons	1.9-2.5			2					3.9-7.6	0.20-0.34		
Tomato seeds[3]	18	$0.9167^{30/4}$	1.4700^{30}	6.98	202.63	121.5				0.76		
Torresea cearensis seeds[38]	28.14		1.4712	6.49	198.6	116.6						
Turtle (green) body	1.6	0.9127^{30}	1.4649^{30}	1.00	210.26	80.08				1.30		
Watermelon seed[40] *Citrullus Vulgaris*	26.52	$0.9197^{25/25}$	1.4669^{20}	0.42	197.4	133.8	0.29	0.72	7.5	1.19		
Western Soapberry tree seed[41] *Sapindus drummondii*	23-24	0.903—	1.4704—	0.3—	213—	81.5—					63.9	
		$0.917^{25/25}$	1.4722^{25}	0.9	219	83.5—	0.0	0.0	14.5	1.2	67.2	
Whale (Various parts of body):[42] Humpback (45 ft.)			1.4660—	0.31—	195.2—	122.6—				0.68—		
			1.4690^{40}	0.68	196.7	148.9				1.32		
Blue (80 ft.)			1.4619—	0.21—	191.0—	94.9—						
			1.4660^{40}	0.82	201.0	129.5						
Wool (Hungarian)[43]				0.—	88.1—	42.7—				40.0—		
				0.56	95.6	46.9				46.4		

SUPPLEMENT TO CHART ON CHARACTERISTICS

Oil or Fat Source	Hehner No.	Diene No.	Solidification Point
Aleurites trisperma[2]	......	43.2	......
Argan tree kernel[4]	......	......	24.8
Ash-seed[5]	94.5	......	......
Brazilian silk cotton tree seed kernel[8]	68.9	......	—13
Buffalo fat[9]	......	......	40.5-4.5
Goat's foot[10]	......	......	—10
Licania crassifolia B. fruit[21]	......	69.5	......
Oroxylum indicum[29]	93.26	......	......
Santalum album seeds[35]	......	3.9	......
Watermelon seed[40]			
Citrullus Vulgaris	89.2	......	......

FAT ACIDS COMPOSITION

Fat Source	Common Saturated Acids			Common Unsaturated Acids			Other Acids
	Myristic	Palmitic	Stearic	Oleic	Linoleic	Linolenic	
Aleurites trisperma seed[3]	——17.8——			11.3	18.8	......	Elostearic 49.4
*Ben tree seed[6]							
Moringa oleifera	1.5	3.6	10.8	68.9	3.8	......	Behenic 6.3, lignoceric 0.13
**Brachychiton diversifolium* seed[7]	......	7.58	5.40	64.67	11.32	......	
Castor seed[12]							
Ricinus Commums	......	2.4	......	7.4	3.1	......	Recinoleic 87.0, dioxystearic 0.6
Crabs(of Seychelles island)[13]	19.0	13.1	1.7	5.3	1.5	......	Octic 1.5, decoic 5.3, lauric 47.5, tetradecenoic 0.7, hexadecenoic 2.2 unsaturated C_{20-22}-2.2
Dika fat[14]							
Irvingia gabonenses	33.4	2.0	1.1	1.8	......	......	*n*-decoic 3.1, lauric 58.6
Goat (female) body[17]	2.8	27.5	26.0	34.8	2.3	......	Lauric 2.5, arachidic 2.2
Hodgsonia capniocarpa seed[18]	0.5	36.1	9.5	26.5	24.3	......	Arachidic 0.3, hexadecenoic 2.7
Locust (S. American) body[23]	——31.5——			43.1	16.4	......	
Lumeque seed[24]							
Ximenia Americana L.	......	......	4	54	10	......	Cerotic 2, Ximenic 25, lumequic 5
Mustard seed[25]	0.5	......	0.5	31.9	17.8	2.9	Behenic 3.9, lignoceric 1.4, erucic 41.9
Nasturtium seed[44]							
Tropaeolum majus	......	0.2	......	16	1.2	......	Erucic 82, behenic 0.8
Neem seed[26]							
Azadirachta indica	......	14.9	14.4	61.9	7.5	......	Arachidic 1.3
Pycnanthus Kombo[32]							
Myristica angolensis	39.7	3.7	......	11.4	......	......	Lauric 2.6, tetradecenoic 26.3 (non-fatty matter 16.3)
Quisqualis indica L.[33]	4.5	29.2	9.1	48.2	9.0	......	
Salvadora oleoides[34]	52.9	18.9	......	5.5	......	......	Decoic 1.5, lauric 21.2
Salvadora persica[34]	54.5	19.5	......	5.4	......	......	Decoic 1.0, lauric 19.6
Stillingia seed							
Stillingia sebifera	—— 6.2 ——			8.8	62.7	22.2	
Theobroma cacoa:[37]							
germ	—— 38.6-48.1 ——			9.8-44.8	14.8-42.3	......	
seed shell	—— 50.1-55.5 ——			31.9-40.5	7.8-14.5	......	
cotyledons	—— 59.7-65.3 ——			30.8-37.1	2.7- 4.0	......	
Virola nuts[32]							
Virola surinamensis	58.1	9.1	......	17.7	......	......	Decoic 0.2, lauric 11.5
Watermelon seed[40]							
Citrullus Vulgaris	......	8.84	5.61	13.03	68.38	......	Arachidic 0.72

*Data based on total oil.

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conjugation of double bonds, hence the authors were unable to give an explanation or interpretation of the results. Kass and Burr (*J. Am. Chem. Soc. 61,* 3292) converted the double bonds in natural linolenic to a conjugated system by prolonged heating with alkalies. The tetrabromide of this pseudo-eleostearic acid melts at 104.5° and the hexabromide at 152.5°.

Caproic, heptylic, caprylic, β-hydroxypelargonic, azelaic, and suberic acids were some of the products obtained by oxidation of ricinoleic acid under various conditions (Brady—*J. Am. Chem. Soc. 61,* 3464).

An oleic acid homolog of 30 carbon atoms, lumequic acid, was isolated from ximenia oil (Boekenoogen — *Fette u. Seifen 46,* 717). New acids named alepric, aleprylic, aleprestic, and aleprolic which are homologs of chaulmoogric acids were discovered in *Hydnocarpus wightiana* oil (Cole and Cardoso—*J. Am. Chem. Soc. 61,* 2349). Matuda and Ueno (*J. Chem. Soc. Japan 59,* 1061) isolated zoömeric acid and a C_{16} acid containing 3 double bonds from bonito oil. An acid of the formula $C_{15}H_{22}O_3$ and a lactone $C_{15}H_{18}O_2$ were claimed to be present in Castus oil (Ukita—*J. Pharm. Soc. Japan 59,* 231). Tuzimoto (*J. Soc. Chem. Ind. Japan 42B,* 22) reported the presence of a dibasic acid, $C_{23}H_{44}O_4$, in Japan wax.

Fractionation of the unsaponifiable of cacao germ and shell fats and shea fat were prepared and the characteristics of each fraction were recorded by Bauer and co-workers (*Ber. 71B,* 2223, *Fette u. Seifen 46,* 13, 506). α-Theosterol $C_{30}H_{50}O$, was isolated from cacao germ oil. The iodine value of the unsaponifiable was recommended as a supplementary analytical characteristic for fish-liver oils. A fraction having fungicidal properties was separated from tamari oil (Mijazi and Oguri—*J. Agr. Chem. Soc. Japan 14,* 1523).

A method of determining sterols described by Schramme (*Fette u. Seifen 46,* 443) was based on precipitating them from an alcohol solution of the unsaponifiable with digitonin. A literature review on the sterol components of fats and oils was compiled (*Seifensieder-Ztg. 66,* 425, 446, 465, 485, 505). Attempts to differentiate cholesterol and phytosterol by photographing the crystals in polarized light were unsuccessful (Hatherly — *Microscope and Entomol. Monthly 3,* 176).

Tuzimoto et al. (*J. Soc. Chem. Ind. Japan 41 B,* 320, 322, 410) and Toyama (*J. Chem. Soc. Japan 59,* 1193) isolated several alcohols and hydrocarbons from marine oils. Among these were octadecenol, hexadecenol, *n*-tetradecanol, *n*-hexadecane, pristane, hexadecene, and a hydrocarbon of molecular weight 1089. A long chain alcohol, $C_{30}H_{61}OH$ was isolated from African palm oil (Ungnade — *Oil & Soap 16,* 60). Isoöctadecene, *n*-eiosane, pentacosane, hexacosane, and *n*-heptacosane were identified in animal fats (Hadacek—*Priroda 29,* 20). The chief unsaturated hydrocarbons in animal fats were cerotene, cholestane, illipene, squalene, and illicene.

Information on gossypol included notes on its determination (Smith and Halverson—*Ind. Eng. Chem. Anal. Ed. 11,* 475) and confirmation of its conversion to the insoluble form during heat processing of cottonseeds (Goldovskii et al.—*Masloboino Zhir. Delo 14,* No. 5, 9).

As a miscellaneous group of fat constituent reports there can be added that iodine in cod liver oil was found combined with the fat acids (Schmidt—*Deut. Apoth.-Ztg. 54,* 807); that the foots of soybean oil contained 19 per cent lecithin, 6 cephalin, 7 seorin, and 1.5 sitosterol *d*-glucoside (Mori—*J. Agr. Chem. Soc. Japan 14,* 1404) and that the carotenoids of palm oil can be separated by chromatographic methods (Yamamoto—*Ibid. 15,* 521).

Work on recognizing adulteration of olive oil continued to be active. On pure Northern Tunis olive oils Marcille (*Ann. fals. 32,* 171) obtained Fitelson reactions that were as deep as those produced with olive oils containing up to 15 per cent teaseed oil. An American Oil Chemists' Society Committee (*Oil & Soap 16,* 181) recommended the test for detection of tea seed oil in olive oils after a thorough investigation. Pritzker and Jungkunz (*Z. Untersuch. Lebensm. 77,* 254) found that olive oil can be distinguished from tea seed oil by the time required to precipitate the lead salts of the fat acid; the former required one hour, the latter four. Grossfeld and Timm (*Ibid.* 249) recommend the iodine value of the unsaponifiable as a suitable characteristic for distinguishing the oil from other oils. Attempts to substitute other dyed oils for olive oils, in the Norwegian canning industries where the fluorescence tests are used, were detected spectoscopically (Lund *et al.—Tids Hermetikind 6,* 200). Paleni and Lorenzi (*Ann. chim. applicata 29,* 253) preferred the Tortelli and Ruggeri test for detection of olive and peanut oils. The test is based on the crystallization of solid acids separated from the total acids by 90 per cent alcohol. The tendency of linseed oil to produce a relatively stable foam on shaking could be used as a crude test to detect its presence in olive oil (Dieterle —*Seifensieder-Ztg. 66,* 54).

Because of identical characteristics, it was difficult to identify adulteration of almond oil with apricot kernel oil. A color reaction for this purpose comprised bleaching the sample with infusorial earth, adding 5 cc. of the oil to 1 cc. of a 2:1 mixture of concentrated sulfuric and nitric acids, shaking and allowing to stand (Martenenghi and Gaudalupi—*Olii minerali, grassi e saponi, colori e vernici 19,* 7). Pure almond oil remains colorless while products containing over 10 per cent apricot kernel oil show a characteristic orange color. A tabulation and description of the various color phenomena obtained by arsenic trichloride or antimony trichloride treatment of solutions of fats in benzene and chloroform containing acetone were recorded by Liebetanz (*Seifensieder-Ztg. 66,* 348).

The Reichert-Meissel value of normal butter shows such a great variation that adulteration of some butters would be possible with the Reichert-Meissel value still within the normal range (Swaving — *Lait 19,* 462). Periodic inspection of creameries was suggested as the only means of preventing adulteration in this manner. Creach (*Ann. fals. 32,* 4) listed qualitative tests for detecting adulteration of butter with several vegetable fats. Schloemer and Langmann (*Z. Untersuch. Lebensm. 78,* 293) suggested the determination of total value and residue value of the fat to distinguish between Roquefort cheese and the substitutes made from cow's milk. Mineral oil can be detected in butter by adding 1 cc. of clear fat to 1 cc. of 50 per cent potassium hydroxide solution and 25 cc. of 95 per cent alcohol in a test tube, and heating at 80° for 15 minutes (Bornmann—*J. Assocn. Off. Agr. Chem. 22,* 194). A turbidity after dilution with equal parts of water indicates the presence of 0.5 per cent or more of mineral oil.

A method of detecting animal fats in vegetable fat by Broge (*Fette u. Seifen 46,* 131) depended on cholesterol forming a dibromide insoluble in acetone whereas the vegetable sterols do not. A difference in intensity of yellow color in either extracts of fat samples from cattle and carabao meats permitted a differentiation of these meats with 97 per cent accuracy (Coronel and Tapacio—*Philip. J. Animal Ind. 5*, 5.

A recently described method for detecting minute quantities of petroleum spirits in vegetable oils is a modification of the Nastukov formalite reaction (Segal—*J. S. African Chem. Inst. 21*, 58). The sample saponified with potassium hydroxide under reflux, diluted with 50 cc. of water, concentrated calcium chloride is then added and the whole steam distilled. The formation of a red brown surface film or a precipitate on adding some of the distillate to a solution of 1 cc. of formalin in 20 cc. of concentrated sulfuric acid indicates the presence of petroleum spirits.

Many of the reports reviewed in this section were the work of several committees of oil and fat societies. In addition to these, there were other reports on modifications of existing methods and collaborative work. The societies reporting such information include the American Oil Chemists' Society, American Leather Chemists' Association, International Commission for Study on Fats, The German Fat Chemistry Society, and International Society of Leather Trades Chemists. The reports appear in the respective official journals and in some cases in pamphlet form.

DETERGENTS

Only a small part of the soap literature dealt with soap stock. Rayner (*Soap, Perfumery Cosmetics 12*, 49, 152, 324) prepared data on the characteristics imparted to soap by the stock. Solid fats, such as tallow and palm oil did not yield particularly hard soap, nor did liquid oils yield particularly soft soaps. Coconut and palm-kernel oils conferred hardness on soaps. Effect of milling and other processes on characteristics were also discussed. Moiseev (*Masloboino Zhir. Delo 1939*, No. 2, 26) stated that 10 per cent castor oil could be used in soap stock but such soap dissolved slowly and its lathering power was poor. A process of manufacturing soap from wool grease (Smith and Kampbell—*Brit. 470,715*) comprised saponification by anhydrous caustic with heating to 550°F. A patented soft soap base contained a 2:1 ratio of oil to resin (Bernege—*Fr. 837,509*). A mixture of coconut oil 45, tallow 40, mahua (mowrah or illipé) oil 10, and rosin 5 per cent was recommended for cold process soap manufacture by Shukla (*Indian Soap J. 5*, 329). The storage capacity of rapeseed fat soap increased with increasing amounts of added resinate soaps (Ignashev —*Masloboino Zhir. Delo 14*, No. 6, 24). Soaps with glasslike structure were prepared from soap stock containing saturated fatty acids that had been oxidized with peracids (Tyutyunnihov *et al.*—*Russ. 47,389*). Methods of bleaching the olive oil foots used as soap stock were reviewed by Stossel (*Soap 15*, No. 9, 25). The best grades can be bleached with benzoyl peroxide. Other processes discussed made use of chromates, chlorates, hypochlorites, and zinc persulfate.

Patents on preparing soap stock from mineral oils were still abundant (Colgate-Palmolive Peet Co.—*Can. 382,155-6;* Eastman Kodak Co.—*U.S. 2,159,984;* I. G. Farbenind A.-G.—*Brit. 487,317, 490,785, 494,-* I. G. Farbenind. A.-G.—*Brit. 487,317, 490,785, 494,-853, 500,746;* Henkel & Cie—*Brit. 489,443;* Welter—*Ger. 679,015;* V. Oelfabrike Hubbe & Farenholtz—*Fr. 837,251*). The innovations dealt principally with new catalysts, new solvent methods of removing the unsaponifiable and on the type of products recovered.

Mugisima (*J. Soc. Chem. Ind. Japan 42 B*, 17) prepared an organic soap base, cyclohexylamine, by high pressure hydrogenation of aniline. When cyclohexylamine oleate was added to textile oils the oils were easily removed by washing. A disadvantage of the products was their unpleasant odor.

To remove fat acids from tall-oil, they were esterified with an alcohol, the rosin acids saponified and removed in the form of rosin soaps by selective solvents (Gayer and Fawkes—*U.S.* 2,166,812).

A few developments dealt with saponification reagents. The use of mixtrues of waste sulfite lye and caustic for manufacture of soaps to use on painted surfaces was patented (Leyst-Kuchenmeister—*U.S. 2,158,663*). Zilske (*Allgem. Oil u. Fett.-Ztg. 35*, 388) recommended the use of a 9 to 1 mixture of caustic and potash lye in the manufacture of soap flakes. Optimum conditions recommended for saponifying mahua (mowrah or illipé) oil were 10 normal caustic and at 100° (Gobhil and Chatterji—*Indian Soap J. 5*, 101, 156). As much as 95 per cent can be saponified in 10 minutes with a high stirring rate. Alkylolamines were used as the saponification agent in one invention (Emulsol Corp.—*U.S. 2,173,448*).

Among the patents on soap compositions containing builders or the preparation of builders, those covering special phosphates, or mixtures of phosphates together with other builders were most numerous (Chemische Fabrik Joh. Benckiser—*Ger. 678,841;* Crites—*U.S. 2,142,180;* Dabsch and Vredenburg—*Ger. 682,329 Cl. 23c;* Du Bois Soap Co.—*U.S. 2,162,023;* Griffith Labs. Inc.—*U.S. 2,142,870;* Heilsberg & Co.—*Brit. 494,056, Fr. 828,233;* Henkel & Cie—*U.S. 2,141,189*; I. G. Farbenind. A.-G.—*Brit. 490,285;* Lever Bros. & Unilever Ltd.—*Brit. 492,719, Fr. 835,274;* Penn. Salt Manufg. Co.—*Fr. 830,533*). A patent issued to I. G. Farbenind. A.-G. *(Ger. 664,331 Cl. 23e)* covered the reworking of waste soap which consisted principally of silicas, into new soap as a filler. Caustic soluble hard wood was added to soap (Hecker Prod. Corp.—*U.S. 2,152,788*). With the use of methylcellulose as the builder it was claimed that the fat acids could be reduced to 30-32 per cent (Smith—*Am. Perfumer 38*, No. 3, 45). The addition to soaps of the viscid matter that naturally occurs in sea weeds was also patented (Couchman—*Brit. 498,692*). Alkali hypochlorites are added to soap for decolorization (Solvey & Cie—*Fr. 829,156 with addn. 48,865*). Boric, citric, and tartaric acids were said to confer a light color to soaps (Rost—*Ger. 671,332*).

Several patents dealt with the addition of organic solvents to soap (Hampton—*U.S. 2,143,066* Henkel & Cie. — *Ger. 676,659 Cl. 23e;* Roussy — *Fr. 833,932;* Vuylsteke—*Belg. 429,376;* Wöllner-Werke—*Ger. 667,-684 Cl. 23e*). The innovations comprised use of special petroleum fractions, special esters, of terpinolene, of turpentine and of mixtures of benezene, xylene and turpentine.

Additions to casein and condensation products of fat acids and hydrolyzed proteins to soaps were the subjects of some new patents (Schueller—*Brit. 488,-514, Fr. 831,655;* Sommer and Nassau — *U.S. 2,151,241;* Chem. Fabrik Grunan Landshoff & Meyer A.-G.—*Ger. 666,006 Cl. 23e*). Casein was especially recommended for shaving soaps. The patents on condensation products of hydrolyzed proteins and fat acids dealt with the purification of the material by precipitation with alkalies.

The superfatting agents patented during the year were ethers of glycerol and primary, alicyclic and naphthenic alcohols (Schrauth — *U. S. 2,152,022*), polyhydroxy alcohols (Rost—*Ger. 669,546 Cl. 23e*) and special organic esters containing one or more free hydroxyl groups (Henkel & Cie—*Ger. 671,711 Cl. 23e*).

Special adjuncts for cosmetic and medicinal soaps were patented. For addition to cosmetic soaps lecithin can be dissolved in either castor oil (J. D. Riedel, E. Häen A.-G.—*U.S. 2,168,468*), or in cyclohexanol or its esters (Ges. Fett- u. Öl-Raffination—*Ger. 666,208 Cl. 23e*). A brushless shaving cream comprised a mixture of oils and aromatic sulfonates (Ret Product Co. —*U.S. 2,167,206*). MacBroom (*Brit. 498,850*) improved shaving soap by additions of oxide, carbonate or citrate of lithium. Zinc white was said to increase whiteness, add antiseptic qualities, fix perfumes and reduce susceptibility to rancidity when incorporated into soaps (Foulon—*Allgem. Oel- u. Fett-Ztg. 36,* 12). Discoloration of antiseptic soaps containing hard-wood oil was prevented by additions of alkali metal bromides or iodides (Eastman Kodak Co.—*U.S. 2,153,143*). A fungicidal soap contained small amounts of sodium thiosulfate and copper sulfate (Corbett—*U.S. 2,160,834*). Sulfur can be incorporated in soap in the form of polysulfides (Carl Blank K.-G.—*Fr. 839,776*). A deodorant soap contained 10 to 20 per cent sodium bicarbonate (Cranor—*U.S. 2,177,055*). Chromium trioxide and hexamethyl tetramine rendered soaps perspiration preventing (Pick—*Brit. 506,903*). Some disinfectant soaps and cleaners contained potassium hypochlorite (I. G. Farbenind. A.-G.—*Brit. 490,092, Fr. 825,178*).

Other soap improvers included stabilizers and anticorrosion materials. A mixture of glycerine, higher alcohols and sodium phosphate was used as a stabilizer (Dabsch and Vredenburg—*Ger. 682,329 Cl. 23e*). Thiourea compounds were recommended as soap preservatives (Monsanto Chem. Co.—*U.S. 2,154,341*). Tin compounds were used to stabilize soap coloring materials (Heald—*U.S. 2,162,255*). Zinc salts were used as anticorrosive agents (Griffith Labs.—*U.S. 2,155,045-6*).

Several of the soap process inventions were on improvements in the continuous method of manufacture (Refining Inc.—*Brit. 491,315, U.S. 2,142,982-4, 2,146,661, 2,178,987-8;* Procter & Gamble Co.—*U.S. 2,159,397;* Dickinson and Moreton—*U.S. 2,136,283;* Lorenz Patent Corp.—*Brit. 504,117-8, Fr. 830,435;* Henkel & Cie—*Ger 669,153*). The improvements include equipment to make special types of soap, new methods of heating, method of removing glycerol by distillation, new proportioning devices and combining the process with spray drying. Inventions for batch systems include emulsifying apparatus for reactants (Gerber — *Brit. 503,315, Ger. 677,646*), the use of emulsifiers with a saponification accelerator so that the soap can be manufactured rapidly without heating (Gerber—*Brit. 494,276*) and the use of sodium carbonate at 80° for saponification of distilled fat acids (Heilsberg—*Ger. 684,100 Cl. 23e*). Tedious settling of nigre was evoided by treating the soap with "Blanket" and settling the alkali lyes (Zilske—*Seifensieder-Ztg. 65,* 315). O'Day and Jones (*J. Am. Pharm. Assoc. 28,227*) recommended that official United States Pharmaccopoeia soap preparation be made from soy and corn oil by the cold saponification process.

Hermada (*Seifensieder-Ztg. 65,* 411) reported that determinations of free alkali and salt content can be used for control work on curd and settled soaps. A soap was regarded finished when the free alkali was below 0.4 and the salt below 1.2 per cent.

Lascaray (*Fette u. Seifen 46,* 531) in a talk on saponification emphasized production of fat emulsion in solutions of fat so that intimate contact between the reactants is possible. Smith (*Chem. & Ind. 58,* 87) drew evidence from his own experience and that of others to prove that saponification was a homogenous reaction. He also produced evidence that in saponification with sodium ethylate alcoholysis takes place first.

Improvements in milled soap texture were obtained by forcing the soap through perforated plates into evacuated chambers to remove air and then plodding (Schwantes—*U.S. 2,146,770*). A special finely powdered spray dried soap was patented (Hecker Products Corp.—*U.S. 2,152,788*). Soap powder apparatus was designed by Ferdinand and Suchtelen (*Ger. 678,625 Cl. 23f*). A press for soap bars was designed by Fiala (*Ger. 671,800 Cl. 23f*).

A floating soap cake made by Jones (*U.S. 2,179,853*) contained a hollow center. Floating properties were induced in soap by moistening crumbled up dried curd soap with oil and kneading and molding (Braun—*Ger. 676,883 Cl. 23e*). Hekerek (*U.S. 2,182,293*) patented a method of attaching a cord to a bar of soap.

An improvement in the determination of moisture in soap by the distillation method comprised substituting anhydrous barium chloride in place of sodium acetate to prevent foaming (*Trusler—Oil and Soap 16,* 239). Distillation methods for determining moisture were declared unsuitable for sulfonated detergents because of the presence of volatile alcohols (Finken and Holters—*Fette u. Seifen 46,* 70). Titrimetric moisture determinations were recommended.

A method for determination of fat acids in soap depended on liberating the free fat acids in a special flask and reading the volume by means of graduates in the neck of the flask (Leue—*Fette u. Seifen 46,* 133). Another method was similar except that the fat acids were taken up in *α*-bromonaphthalene and determined refractometrically (Liebetanz — *Seifensieder-Ztg. 66,* 467). A method of determining the active ingredients of sulfonated products comprised solvent extraction to remove the products from the inorganic contaminants and determining loss of ignition (Hart—*Ind. Eng. Chem. Anal. Ed. 11,* 33).

A report by Strauss (*Seifensieder-Ztg. 65,* 429) dealt with precautions in using perchloric acid to oxidize the organic matter of soap preparatory to determining of sodium and potassium. A scheme for determination of fat acids, kaolin and albuminous material in soap (Soibel'man—*Masloboino Zhir. Delo 14,* No. 4, 12) comprised liberation of fat acids with inorganic acids and determining the fat acids by measuring volume; determination of kaolin and albuminous substance by dissolving a separate sample in alcohol: water (3:4) mixture, centrifuging out the kaolin, acidifying the liquid portion, addng more alcohol and centrifuging out the albuminous material.

The DGF method for determining caustic alkalies in presence of alkali carbonates in soaps was considered superior to other procedures by Bauschinger (*Fette u. Seifen 46,* 471). In this method a 2:1 mixture of alcohol and cyclohexane was used as a solvent and the titration was carried out at room temperature. Other publications on free alkali in soap were general discussions (Bauschinger—*Fette u. Seifen 46,* 69); Bergell—*Seifensieder-Ztg. 66,* 385).

A method of determining glycerol in soaps containing "tylose" depended on dialyzing the glycerol through parchment and determining by the usual dichromate method (Schulze—*Fette u. Seifen 46,* 66).

In determining the active oxygen in soaps containing perborates, Bergell (*Seifensieder-Ztg. 66,* 750) recommends the use of excess acids when builders were present. Ghose and coworkers (*Indian Soap J. 5,* 303) recommended determining iodine number of soap by reaction with definite amounts of hypochlorous acid and determining the unreacted hypochlorous acid. The test was suggested as a basis for certain soap specifications.

Miscellaneous tests in soaps included a stability test (Hitchcook and Divine—*Soap Gaz. & Perfumer 41,* No. 3, 9) and a method for static deformation modulus (Tyutyunnikov and Girshman—*Masloboino Zhir. Delo 1939,* No. 2, 22). In the stability test the soap was dried in a thin film and held 72 hours at 105°, the amount of free fat acids developed was the criterion for evaluating stability. The static deformation of soaps was measured under various loads. Kaolin and water glass increased the rigidity of soaps.

Complicated phase behaviors of soaps were studied by McBain, Vold and coworkers (*J. Am. Chem. Soc. 61,* 30, 37, 808; *Oil & Soap 16,* 48; *J. Phys. Chem. 43,* 1213). It was demonstrated that sodium palmitate exhibited 5 phases. These were curd fibers. subwaxy soap, waxy soap, subneat soap, neat soap and isotropic liquid. The phase relations in the system sodium palmitate-sodium laurate-sodium chloride at 90° were recorded for 2 ratios of palmitate to laurate and tetrohedral four-component diagrams were derived from the data. It was evident that a much larger number of separate phases exist in systems of soap and water than had previously been recognized, was presented.

According to McBain (*J. Phys. Chem. 43,* 671) conductivity and osmotic measurements indicated that only simple molecules and simple ions exist in dilute soap solutions. In concentrations of 0.2 to 0.5 molar the solutions may contain a small amount of colloid. Stariff (*Naturwissenchaften 27,* 213) with the aid of x-ray diagrams showed that colloidal particles were present at concentrations as low as 0.25 molar. He stated that small as well as large micelles were present between concentration of 0.1 and 0.25 molar; these, however, were considered different from those previously reported by McBain.

Surface tension data by Kulkarni and Jatkar (*J. Indian Inst. Sci. 21A,* pt. 34, 395) showed that more highly aggregated particles were less surface active than the simple molecules. The data recorded included both surface tension of soap solutions and interfacial tensions of the solutions against benzene. Henk (*Seifensieder-Ztg. 66,* 2) pointed out that materials depressing surface tension act as cleaning agents only if they promote dispersion of soil particles. For example a cation-active products as trimethyllaurylammonium chloride is unsuitable for cleaning as it neutralizes the charge on dirt particles and thus causes their adherence to textiles. According to Lottermoser (*Fette u. Seifen 45,* 595) errors in surface tension measurements become more serious with greater dilution of the soap solutions. The phenomenon may be caused by the tendency of atmospheric carbon dioxide to liberate free fat acids.

Draves (*Am. Dyestuff Reptr. 28,* No. 16, P421) considered the American Association of Textile Chemists and Colorists test the most accurate for evaluating wetting agents. The evaluation was based on the concentrations of wetting agent necessary to obtain a 25 second sinking of a standard cloth disk. Loewstein (*Soap 15,* No. 4, 31) and Fiero (*J. Am. Pharm. Assoc. 28,* 284) described photoelectric methods of evaluating cleanliness or whiteness of cloths used in washing test. The latter demonstrated that triethanolamine salts of fat acids had less detergent action than true soaps. The triethanolamine salts of mixed fat acids possessed detergent action in the order: tallow fat acids, coconut-oil fat acids and red oil. Creely and LeCompt (*Am. Dyestuff Reptr. 28,* 419) recommended that detergents test be planned with this application in mind.

Some reports presented comparative data on detergents. Sodium and potassium soaps of the same fat acid possessed emulsifying efficiency of the same order; ammonium soaps were inferior (King and Mukherjee—*J. Soc. Chem. Ind. 58,* 243T). Oleates were more efficient than stearates and much more efficient than palmitates. When sodium soaps of saturated acids were compared for their greatest hemolytic values they were arranged as follows: laurate, myristate, palmitate and stearate (Edwards—*J. Am. Pharm. Assoc. 28,* 209). At high temperatures the effect of the less soluble soaps was increased. Of the soaps tested sodium laurate was the most toxic to earth worm segments; the toxicity of the others was in the following descending order: myristate, oleate, ricinoleate, palmitate and stearate. Deichmüller (*Fette u. Seifen 46,* 645) reported that the sulfonate products, (Fewa, Igepon, lamepon, etc.) have weaker hemolytic effects than sodium oleate. Detergency tests showed that nigre of mowha-tallow mixture soaps was equal to that of the original soaps (Datta *et al.*—*Indian Soap J. 6,* 17). Some low molecular acids favoring wetting and some highly unsaturated acids favoring emulsification may have passed into the nigre.

Walter (*Fette u. Seifen 46,* 729) Van Antwerpen (*Ind. Eng. Chem. 31,* 64) and Cupples (*Soap 15,* No. 9, 30) recommended the use of sulfonated products. Their data present useful information on the properties of the various products, their washing effect, and special uses for which they have been proved most economical. A report on the constituents of the products was prepared by Koppenhoffer (*J. Am. Leather Chemist Assoc. 34,* 622). The following facts were recorded. Sulfonation of castor oil occurs predominantly at the hydroxyl group of the ricinoleic acid, with other oils it occurs at the double bonds of the more unsaturated acids. The free fat acids liberated by cod liver oil during sulfonation are partly oxidized.

Graphical data on solubility, density, viscosity and conductivity of C_{10} to C_{18} (even nos. only) sulfonates were recorded by Tartar, Wright and coworkers (*J. Am. Chem. Soc. 61,* 539, 544, 549, *J. Phys. Chem. 43,* 1173). The linear relationship of the solubility was lost at certain critical concentrations. Supporting developments were also obtained in density, viscosity and conductivity measurements at the critical concentrations. It was interpreted that the breaks occur when micelles appeared. Salt lowered the critical concentrations.

Birkeland and Steinhaus (*Proc. Soc. Exptl. Med. & Biol. 40,* 86) discovered that the growth of Gram positive bacteria and molds in nutrient agar was definitely inhibited by the presence of a sodium alkyl sulfate whereas most Gram negative bacteria grew freely.

The use of sulfonated castor oil in preparations containing water immiscible coal tar disinfectants (Gershenfeld and Witlin—*Am. J. Pharm. 111,* 314) and the use of sodium salts of petroleum sulfonates for flotation (Keck and Jasburg—*Eng. Mining J. 140,* No. 6, 49) were fostered. Deleterious effects of lauryl sulfate and sodium lauryl sulfo acetate which are used in dentifrices were recorded by Epstein *et al.* (*J. Am.*

Dental Assoc. 26, 1461). Local inflammatory effects in rats were more marked than those from soap.

Several improvements were made in glycerol recovery. Silicic acid was removed by successive treatments with hydrochloric acid and barium hydroxide (Keutgen —*Seifensieder-Ztg. 66,* 668). A distillation method for glycerol included promoting distillation by the aid of open-jet steam discharge into the body of glycerol (Ittner—*U.S. 2,164,274, 2,164,276*). Steam laden with glycerol in a recovery operation can be partially separated before condensation by special centrifugal separators (Müller—*Ger. 674,525 Cl. 23e*). Water insoluble fat acids can be used to remove certain organic impurities from glycerol lyes (Armour & Company—*U.S. 2,182,179*).

Work on developing non-fat sources of glycerol was active. Glycerol and ethanol were produced by yeast fermentation of black strap molasses (U. S. Indus. Alc. Co.—*U.S. 2,169,245*). Data on the influence of variations in the components of the system for enzymic synthesis of oleic acid and glycerol were presented by Benigno (*Enzymologia 5,* 293). Haehn *(Fr. 829,263)* patented the use of manganese and iron salts as catalysts for the yeast fermentation process. Henkel & Cie. *(Ger. 667,988, 682,911 Cl. 6b)* used selective solvents diethylene dioxide derivatives, for selectively extracting glycerol from fermented mash. Werner *(Ger. 684,014 Cl. 6b)* patented a distillation method.

Glycerol was recovered from distillation residues of fermented must by drying and extracting with alcohol (Mariller—*Fr. 829,539*), flocculating the suspended solids, precipitating other material by additions of sodium carbonate, and filtering and further concentrating by known methods (Soc. indus. de mouveaux appareils—*Brit. 490,783*). Glycerol was recovered from colloidal printer's wastes by dialisation (Haller and McLaren—*Brit. 496,681*).

In addition to the above notes on detergents there were several general discussions giving formulas, known procedures and like information. These are listed giving their subject matter, author and reference.

Soap builders: Meyer—*Fette u. Seifen 46,* 733; Kling and Schmidt—*Seifensieder-Ztg. 66,* 626; Augustin—*Ibid.* 711; Foulon—*Ibid.* 2; Roley—*Soap 15,* No. 1, 24; Vallance—*Ibid.* No. 10, 21; Glenn—*Soap, Perfumery & Cosmetics 11,* 1107; Heublyum—*Mfg. Perfumer 2,* 291; Angus—*Ind. Chemist 15,* 268; Oesterling—*Am. Dyestuff Reptr. 27,* 617P.

Use of acids derived from mineral oils, naphthenic acid and phenols for soap making: Minich and Levison—*Textile Colorist 60,* 698; Vallance —*Soap, Perfumery & Cosmetics 11,* 998; Ohl—*Allgem. Oel- u. Fett-Ztg. 36,* 70; Davidsohn and Davidsohn—*Soap 15,* No. 8, 21.

Fat acids: Pelikan—*Soap, Perfumery & Cosmetics 11,* 1018; Raynor—*Ibid.* 898; Wittka—*Seifensieder-Ztg. 66,* 153, 187; Dieterle—*Ibid.* 15; Davidsohn and Davidsohn—*Soap 15,* No. 8, 21.

Glycerol-recovery, uses, substitutes and market: Webb—*Soap Gaz. and Perfumer 41,* No. 2, 5; Watzinger—*Seifensieder-Ztg. 65,* 1021; Wigner—*Soap, Perfumery & Cosmetics 12,* 231; Bauschinger—*Fette u. Seifen 46,* 723; Dalton—*Soap 15,* 21; Hubscher—*Seifensieder-Ztg. 66,* 345.

Soap specifications: Anon—*Am. Soc. Testing Materials Standards* 1939; Das Gupta — *Indian Soap J. 6,* 25; Trevithick—*Ind. Standardization 10,* 10; Anon.—*Soap 15,* No. 5, 27, 28; *Anon.—Fed. Specification P-S-612.*

General information on soaps and wetting agents, including sulfonated products, quaternary ammonium derivatives, etc.: Creely—*Am. Dyestuff Reptr. 28,* No. 16, P419; Draves— *Ibid.* P425; Wakelin—*Chem. Products 1,* 133; Davidsohn and Davidsohn—*Soap, Perfumery & Cosmetics 12,* 417; Luten—*J. Org. Chem. 3,* 588; Warwicke—*Soap 15,* No. 10, 25; Joffe *et al.*—*Org. Chem. Ind. U.S.S.R. 5,* 392, 395, 396, 397, 399, 400; Jannaway—*Perfumery Essent. Oil Record 30,* 45; Bohanes— *Chem. Obzor 13,* 70; Kimura *et al.*—*J. Soc. Chem. Ind. Japan 42,* 121; Henk—*Seifensieder-Ztg. 66,* 2; Anon.— *Ont. Res. Foundation Bull 6,* No. 4; Warwicke— *Textile Colorist 61,* 315, 378; Labaune—*Rev. marques parfum. savon. 15,* 267, 292; Porchez—*Mécanique Tech. ind. chim. No. 284,* 32; Foulon—*Mfg. Perfumer 3,* 313.

Equipment for the soap industry: Tsekmann—*Fette u. Seifen 46,* 155; Matagrin—*Ind. chimique 25,* 435, 519; Wittka—*Chem. App. 25,* 353, 369; Atwood—*Instruments 12,* 167.

Cosmetic soaps: Pfaff—*Seifensieder-Ztg. 66,* 679; Augustin—*Ibid.* 315; Thomson—*Soap, Perfumery & Cosmetics 12,* 139; Tyler—*Soap 15,* No. 11, 21.

Soap defect, sweating and discoloration: Das Gupta—*Indian Soap J. 5,* 324; Wittka—*Allgem. Oel- u. Fett-Ztg. 36,* 14; Vallance—*Soap 15,* No. 3, 21.

Drying soap: Ghose—*Indian Soap J. 6,* 41.

Form of soap bars: Gabler—*Seifensieder-Ztg. 66,* 150, 184.

Soap texture: Silman—*Soap 15,* No. 5, 24.

Transparent soap: Fisher—*Soap Gaz. & Perfumery 40,* No. 7, 7.

Liquid soap: Ekmann—*Reichstoff Ind. Kosmetic 14,* 49.

Soap from marine fats: Palffy—*Vegyi Ipar 37,* No. 21, 4; Henk—*Seifensieder-Ztg. 65,* 962.

Rape seed oil soap: Engel—*Masloboino Zhir. Delo 14,* No. 4, 22.

Industrial soaps: Glenn—*Soap 15,* No. 11, 27.

Acceleration of saponification: Simmons — *Chem. Products 1,* 85.

Curd and base soaps: Krings—*Seifensieder-Ztg. 66,* 365.

Superfatting: Glenn—*Soap 15,* No. 9, 21.

Waste fat soap: Zilske—*Allgem. Oel- u. Fett-Ztg. 36,* 189.

Detergent action: Hulme—*Textile Recorder 57,* No. 8, 44.

Emulsifiers: Kadmer — *Seifensieder-Ztg. 66,* 171, 195, 215, 255, 277, 297, 317, 337, 357.

Organic solvents for soaps: Ohl—*Allgem. Oel- u. Fett-Ztg. 35,* 337.

German soap: Seckelson—*Soap 15,* No. 3, 24.

Japanese soap industry: Godbole—*Soap, Perfumery & Cosmetics 12,* 663.

New uses for soap: Smith—*Soap 15,* No. 6, 24.

Patents on non-soap wetting agents, textile assistants and like material will be listed with slight classification. Those dealing with sulfonated products of fats and fat derivatives were:

Beller and Owen—*U.S. 2,149,265.*

Böhme Fettchemie-G.m.b.H.—*Ger. 664,387 Cl. 12o. Ger. 671,882 Cl. 8o.*

Bowles and Kaplan—*U.S. 2,144,324.*

Böhme Chem. Fabrik—*Ger. 663,953 Cl. 12o.*

Can. Aniline and Extract Co.—*Can. 377,543.*
Chemische Fabrik Stockhausen & Cie.—*Ger. 668,902 Cl. 12o.*
Colgate-Palmolive Peet Co.—*Fr. 837,370.*
Corr—*U.S. 2,167,344.*
Emulsol Corp.—*U.S. 2,178,139, 2,184,770.*
Ferma Louis Blumer—*Ger. 682,590 Cl. 12o.*
J. R. Geigy A.-G.—*Brit. 506,610, Swiss 200,667.*
Harris—*U.S. 2,155,899, 2,166,141-5.*
Henkel & Cie.—*Ger. 675,934 Cl. 12s.*
Hasselstrom—*U.S. 2,154,616.*
Hirschberger—*U.S. 2,141,245.*
I. G. Farbenind. A.-G.—*Brit. 494,616, 500,550, 500,615, 503,235; Ger. 627,926, 664,176, 677,013 Cl. 12o; U.S. 2,167,325-6, 2,169,998, 2,170,380.*
National Aniline and Chem. Co., Inc.—*Can. 376,873; U.S. 2,136,379, 2,166,949.*
National Oil Products Co.—*Fr. 834,571.*
N. V. de Bataafsche Petrol. Maatschapij—*Fr. 840,778.*
Oranienburger Chem. Fabrik. A.-G.—*Ger. 663,984, 664,514, 666,828 Cl. 12o, 670,962 Cl. 8o, 672,350 Cl. 12o.*
E. I. du Pont de Nemours & Co.—*U.S. 2,139,377, 2,180,133.*
Procter & Gamble Co.—*Brit. 488,196, 489,097, 499,373, 499,452; U.S. 2,156,996, 2,166,314-5, 2,182,397.*
Schrauth—*Ger. 670,556 Cl. 8o; U.S. 2,163,133.*
Schirm—*U.S. 2,171,117.*
Soc. pour l'ind. chim. a Bâle—*Fr. 827,185.*
Standard Oil Development Co.—*U.S. 2,157,320.*
Röhm and Haas Co.—*U.S. 2,148,432.*

Patents on sulfonated derivatives of non-fat derived organic compounds were:

Am. Cyanamid & Chem. Corp.—*Brit. 504,417.*
Arkansas Co.—*U.S. 2,133,282.*
Böhme Fettechemie G.m.b.H.—*Ger. 665,237 Cl. 12o.*
Chem. Fabrik R. Baumheier Kom. G.—*Ger. 663,983 Cl. 12o.*
Colgate-Palmolive Peet Co.—*Brit. 506,337; U.S. 2,160,343, 2,149,661; Ger. 664,730 Cl. 12o.*
J. R. Geigy A.-G.—*Brit. 502,848; Ger. 677,126 Cl. 12q; Swiss 198,705, 199,780 Cl. 36o, 202,423-7 Cl. 36q.*
Grün—*U.S. 2,138,917.*
Henkel & Cie.—*Ger. 666,388 Cl. 12o.*
Hercules Powder Co.—*U.S. 2,148,087.*
Imp. Chem. Ind.—*Brit. 497,856-7.*
I. G. Farbenind. A.-G.—*Brit. 487,669, 492,905, 493,221, 495,414, 498,008, 499,144, 499,203; Fr. 835,406, 836,639; Ger. 672,370, 677,463 Cl. 12o.*
Kimbara—*Brit. 502,964.*
Monsanto Chem. Co.—*U.S. 2,135,978, 2,161,173.*
N. V. Bataafsche Petrol. Maatschappij—*Brit. 504,977.*
N. V. Chem. Fabrik "Servo"—*U.S. 2,140,882.*
Oranienburger Chem. Fabrik A.-G.—*Ger. 665,825 Cl. 12o, 666,626 Cl. 12q.*
Perlmutter—*Brit. 501,729.*
Petrov—*Russ. 46,319.*
E. I. du Pont de Nemours Co.—*U.S. 2,174,131.*
Procter & Gamble Co.—*U.S. 2,135,358.*
Reed—*U.S. 2,174,110.*
Röhm & Haas Co.—*Brit. 506,677; Fr. 830,851, U.S. 2,142,934, 2,171,498, 2,178,829-30.*
Shell Development Co.—*U.S. 2,152,292.*
Soc. pour l'ind. chim. a Bâle—*Fr. 836,554; U.S. 2,134,446, 2,168,660.*
Standard Oil Development Co.—*Brit. 494,859; U.S. 2,139,669, 2,153,286, 2,157,320, 2,162,269, 2,166,981.*
Sweeney—*U.S. 2,153,286.*
Vereinigte Glanzstoff Fabriker A.-G.—*Brit. 504,854.*

The detergent patents on sulfinic compounds of both aliphatic and aromatic organic compounds were:

Cohn and Katzman—*U.S. 2,166,127.*
Henkel & Cie.—*Ger. 671,827 Cl. 8i.*
E. I du Pont de Nemours & Co.—*U.S. 2,146,280.*

The detergent patents on nitrogen organic compounds *i.e.* amines, indols, amides, quaternary ammonia compounds, etc., were:

Böhme Chem. Fabrik—*Ger. 673,949 Cl. 12p.*
Chem. Fabrik vormals Sandoz—*Brit. 488,620, 490,567, 491,048, 496,611; Fr. 825,107; U.S. 2,149,527.*
Chemische Fabrik Grünau A.-G.—*Ger. 670,096-7 Cl. 12p.*
Courtaulds Ltd.—*Brit. 501,020.*
Deutsche Hydrierwerke A.-G.—*Fr. 832,102.*
Emulsol Corp.—*U.S. 2,176,896, 2,178,173-4.*
J. R. Geigy A.-G.—*Brit. 500,412; Fr. 840,734; Swiss 199,781, 200,669; U.S. 2,139,190, 2,153,707.*
General Aniline Works Inc.—*US. 2,147,401.*
Henkel & Cie—*Brit. 489,190, 493,865.*
Imp. Chem. Ind.—*Brit. 488,869; U.S. 2,146,392, 2,147,811.*
I. G. Farbenind. A.-G.—*Brit. 488,553, 498,136, 493,442; Fr. 836,873; Ger. 663,808, 663,845, 664,309 Cl. 12 o, 664,425 Cl. 12q, 664,818 Cl. 12s, 670,419 Cl. 12 o, 675,411 Cl. 12q, 677,898 Cl. 12 o; U.S. 2,143,388, 2,161,322.*
Kartaschoff—*U.S. 2,149,527.*
Kling and Gotte—*U.S. 2,143,986.*
Mauersberger—*U.S. 2,151,788.*
N. V. de Bataafsche Petrol. Maatschappij—*Dutch 46,546.*
N. V. Onderzoekingsinst. Research—*Brit. 493,592.*
E. I. du Pont de Nemours & Co.—*U.S. 2,159,967.*
Röhm & Haas Co.—*Brit. 494,766; U.S. 2,160,058.*
Soc. pour l'ind. chim. a Bâle—*Brit. 490,774; Fr. 830,125, 838,597; Ger. 675,479 Cl. 12 o, 675,480 Cl. 12p; Swiss 196,615, 199,451 Cl. 36 o.*

Some special esters and other organic compounds had dispersing, emulsifying, wetting and cleaning properties:

Duetsche Haughton Fabrik A.-G.—*Fr. 833,482.*
J. R. Geigy A.-G.—*Brit. 498,090; Fr. 838,538.*
Henkel & Cie.—*Brit. 501,408.*
I. G. Farbenind. A.-G.—*Brit. 493,109, 497,487, 499,870, 502,080; Fr. 838,863, 839,600; U.S. 2,133,480, 2,164,431, 2,174,760-2.*
Lever Bros. Ltd.—*U.S. 2,154,977.*
National Aniline & Chemical Co.—*U.S. 2,133,287.*
N. V. Chem. Fabrik "Servo"—*Brit. 489,026, 501,590.*
Röhm & Haas Co.—*Ger. 663,998 Cl. 12q; U.S. 2,148,103.*
Soc. pour l'ind. chim. a Bâle—*Swiss 201,948 Cl. 36 o.*
Societe sep.——*Fr. 832,442.*
Standard Oil Development Co.—*Brit. 500,377.*
Schwarz *et al.*—*Brit. 487,927.*