Review of Literature On Fats, Oils and Soap for 1942—Part 2*

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Deterioration

Laboratory control work in connection with deterioration of fats and oils includes tests for rancidity and stability. Investigations on the latter type were active. Sylvester, Lampitt and Ainsworth (*J. Soc. Chem. Ind. 61,* 165) devised means of automatically recording the course of oxygen absorption of fat samples at 100°. The shape of the curve obtained on a recorder was reproducible. Their results on induction periods of fats and on the effect of soybean flour as an antioxidant agreed with those obtained by means of successive peroxide determinations. An increase in temperature to 110° in the Swift stability test reduced the time to complete the test to 40% of that previously required (Mehlenbacher—*Oil & Soap 19,* 137). Ewbank and Gould (*Ibid.*, 205) in a comparison of the aeration and hot air oven methods of evaluating the stability of fats recorded that the latter gave shorter induction periods for the fats but the extent of oxidation over a relatively long period of time was less. When dry air was used in the aeration method, the induction period was shortened. The color reaction of pyrogallol with fat containing hydrochloric acid was said to indicate the tendency of the fat to become rancid (Goreglyad—*Lab. Prakt. U.S.S.R. 1938,* 72). The presence of α-dicarbonyl compounds in several oxidized fats has been demonstrated and tests for their detection were devised (Prill—*Oil & Soap* 19, 107).

OUTLINE

A. General
B. Technical Treatment
C. Products (except Detergents)
D. Deterioration
E. Biochemical
F. Characteristics and Composition
G. Detergents

Several investigators followed the course of fat oxidation. Glimm and Seeger's (*Fette u. Seifen 48,* 322) data contained iodine, thiocyanogen and active oxygen values of triolein, olive oil, butter fat and a butter fat containing a small amount of linseed oil. With radiation in yellow-red spectrum increase of active oxygen was regular up to the point where iodine and thiocyanogen values became about the same. From this point on, iodine value decreased while peroxide value remained about constant. The approach to the peroxide maximum was attended with a sharp rise in acid number, rise in saponification value and some polymerization. During illumination aldehydes showed only a slight increase, possibly because they were immediately oxidized to acids. Hendersen and Young (*J. Phys. Chem. 46,* 670) recorded the reaction kinetics between oleic acid and oxygen in the early stages. An equation for the rate of oxidation after the induction period was developed. Stability of oils produced in Argentina was recorded by Yalour and Szabo (*Tecnoquimica 1,* No. 2, 26). Data on the course of oxidation of drying and semi-drying oils by Treibs (*Ber. 75B,* 632) were intended for evaluating the film forming capacities. Effects of antioxidants and pro-oxidants on fats were treated in communications by Breivik (*Univ. Microfilms, Mich. No. 355,* 151 pp.), Boekenoogen (*Chem. Weekblad 38,* 658, 680, 692) and Henk (*Seifensieder-Ztg. 68,* 312). The finding that many carcinogenic hydrocarbons were powerful pro-oxidants by Lisle (*J. Soc. Chem. Ind. 61,* 148) suggested an hypothesis for cancer development.

Tests using storage technic were employed to ascertain optimum keeping conditions. The tabulations by Kiermeier (*Fette u. Seifen 48,* 326) were on many oils in tin cans at storage temperatures of —24 to 35°. There were insignificant differences in the samples stored 1 year in the range —24 to 10°, while between 10 and 35° spoilage rose with the temperature increases. Similar work by Clarenburg (*Tijdschr. Diergeneeskunde 68,* 192) with beef suet showed that filled cans were in good condition after 18 months, partly filled samples became rancid in 7.5 months and the samples that were sterilized spoiled in only 2 months. In both the above communications aldehyde reaction and acidity were used in judging the condition of the fat. Jakobsen *et al.* conducted canning experiments with sardines in polymerized marine and cod-liver oils of different rancidities as well as in olive oils (*Tids. Hermetikind. 27,* 255). It was claimed that rancidity decreased during storage. For instance, rather rancid cod-liver oil could be used in packing sardines and the products became satisfactory after 8 months' storage.

Golumbic (*J. Am. Chem. Soc. 64,* 2337) demonstrated that some of the antioxigenic substances other than tocopherols in fresh vegetable oils occur in a colorless form. Isolation and concentration were accomplished by chromatographic adsorption and the use of selective solvents. The properties indicated a possible quinol form, and the substances were devoid of vitamin E activity. Thaler and Schottmayer (*Fette u. Seifen 49,* 646) also investigated tocopherol, vitamin E concentrates and residues from the manufacture of these. The contributions were graphical presentations of the Lea value over an 80-day period of oleic acid, ethyl oleate and rape oil samples containing the products. The data confirmed past work of Mattill, Golumbic and coworkers. Swift, Rose and Jamieson's (*Oil & Soap 19,* 176) graphical data on the antioxidant activity of α-tocopherol indicated a greater effect at lower levels of concentration. This suggested that reactivity of this stabilizer was toward

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the active oxygen and that the rate and extent of peroxide accumulation during the induction period were dependent on the tocopherol content. Cephalin fractions greatly increased the protective activity of α-tocopherol, but not in proportion to the amount used. Quackenbush, Cox and Steenbock (*J. Biol. Chem. 145,* 169) found α-tocopherol and hydroquinone were equally effective antioxidants for carotene in linolates *in vitro.* After extraction with water only the tocopherol treated samples remained stable, thus suggesting a cause for the low protective power of hydroquinone in animal tests. The use of lipophilic antioxidants for carotene in oil solutions was recommended. The greatly enhanced antioxygenic activity of quinones and tocopherols obtained in fats with phosphoric acid was believed by Golumbic (*Oil & Soap 19,* 181) to be due to the acid partly reducing *p*-quinones to hydroquinones. With tocoquinones cyclization as well as reduction occurs and tocopherol was thereby regenerated. Polyphenols such as trihydric phenols and gallic acid were effective stabilizers in both animal and vegetable fats and they enhanced the stabilization by natural vegetable antioxidants (Golumbic and Mattill—*Oil & Soap 19,* 144). This communication also reviewed the differences in protective action of antioxidants on animal and vegetable fats. The effectiveness of antioxidants in whole milk powders was classified in 3 groups by Hollender and Tracy (*J. Dairy Sci. 25,* 249). Gum guaiac and hydroquinone were most effective; ascorbic acid and sodium citrate, intermediate; and butyl ester of tyrosine, Avenex, Enzylac and bacterial culture, least effective. According to McLeod (*Oil & Soap 19,* 53), 0.5% southern sweet gum increased the stability of lard from 7 to 17 hours as determined by the Swift accelerated stability method. Maleic acid, disodium phosphate and *p*-hydroxypropyl benzoate inhibited rancidity in coconut oil, while zinc chloride and citric acid had no influence (Roduta and Dyogi—*Univ. Philippines Nat. and Applied Sci. Bull. 8,* 211). According to Jung (*Contrib. Biol. Lab. Sci. Soc. China Zool. Ser. 15,* 137), the order of effectiveness for the vegetable flours as inhibitors of rancidity on lard, peanut oil or rapeseed oil was: mung bean, pea, wheat bran, broad bean, lotus and taro. The influence of feeding antioxidants to rats on the development of rancidity in their fat was investigated by Overman (*J. Biol. Chem. 142,* 441). Differences in stability were due partly to thinness or fatness of the animal and partly to diet. Ascorbic acid feeding together with low per cent gain in weight resulted in significant increase in resistance of the fat to rancidity.

Some of the chemical antioxidants patented during the year were gallic acid esters (Sabalitscha and Böhm—*Brit. 542,833*), floating aqueous solutions of sodium sulfite (Hickman and Baxter—*Can. 403,495*; *U. S. 2,282,054*), organic hydroxamic acids (Dietrich —*U. S. 2,279,973*), organic acids such as tartaric, citric and maleic with special processing (Baxter and Jakobsen—*U. S. 2,269,243*), hydrogenated tocopherol concentrates (Taylor and Jakobsen—*U. S. 2,267,224*), monochloroacetic acid (Schapiro—*U. S. 2,264,593*) and alkali metal thiocyanates (Martin—*U. S. 2,293,-330*). The latter two respectively were for use in mayonnaise and in soap. Musher's (*U. S. 2,273,062, 2,282,779-820, 2,290,064*) patents on enhancing keeping qualities of fats and fatty foods contained descriptions of special treatments with cereal grains, variously processed cereal grains, seeds, seed germs, sugar, caramelized sugar, milk-solids-not-fat, proteins and carbohydrates, organic acids and other known antioxidant materials. Coe and Coe (*U. S. 2,272,964*) removed natural pro-oxidant material from oils by percolation through powdered sugar.

A method of stabilizing soybean oil against reversion comprised hydrogenating to an iodine value of 75 at temperatures less than 110° (Gudheim—*U. S. 2,293,729*). Reversion or tallowiness of *premier jus* and butter fat was attributed to decomposition products of carotinoids (Hinko—*Fette u. Seifen 49,* 19).

Data on production of methyl ketone from fats by mold by Thaler and Eisenlohr (*Biochem. Z. 308,* 88) sustained the Wieland hypothesis of α- and β-dehydrogenation to unsaturated acid, development of β-hydroxy acid and then β-ketone. A lipoxidase enzyme preparation from defatted soybeans catalyzed the uptake of 1 mole of oxygen by linoleic acid and 2 moles by linolenic acid, but had no effect on oleic acid (Süllmann—*Helv. Chim. Acta 24,* 1360). According to Inoue and Sintani (*J. Agr. Chem. Soc. Japan 17,* 559) enzymes hydrolyze the higher fat acids more readily than the lower from the glycerides of coconut oil; with cottonseed oil the saturated acids were more readily liberated than the unsaturated.

The work on deterioration of butter fat dealt mainly with spoilage by enzymes or bacteria. General information on the subject was prepared by Davies (*J. Indian Chem. Soc. Ind. & News Ed. 4,* 150). The quality measurement tests investigated were colorimetric determinations of the extent of hydrolysis (Knaysi and Guthrie—*J. Dairy Sci. 25,* 589). A test on storing butter 6 years at —10 to 0° showed that pasteurization of the original cream should be for 30 minutes at 73.9° to inactivate enzymes and that the presence of salt, acid or both decreased the storage capacity of the butter (Scheib *et al.—Ibid.* 25). Krukovsky and Herrington (*Ibid.* 234) demonstrated that lipolysis of butter by natural milk enzymes was inhibited at 5° F. or lower. According to Thornton and coworkers (*Sci. Agr. 22,* 277, 347, 438, 552), *Pseudomonas putrefaciens* produced a "sweaty feet" odor on the surface of heated butter under neutral or slightly acid conditions. Many spoiled butters had low bacterial counts. Schloemer (*Z. Untersuch. Lebensm. 81,* 97) recommended aluminum foil wrappers for butters to prevent superficial yellowing during prolonged storage.

Physiology and Biochemistry

The controversy over the nutritive value of butterfat versus substitutes was represented in 4 papers. In Euler's *et al.* (*Arkiv. Kemi Mineral Geol. 15B,* No. 8, 3 pp.) experiments, rats on a basal ration containing margarine gained an average of 96.7 g. while those on the same basal ration containing butter gained 77.0 g. during the same experimental period. The average weights of the rats at the beginning of the test were approximately the same. The margarine fed rats presented a better appearance and seemed stronger in the second to the third week on the diet. Contrary results were obtained by Freeman and Ivy (*J. Dairy Sci. 25,* 887) in similar experiments. These investigators compared evaporated milk with "filled milk" in which the natural fat was replaced by coconut oil. Similar work with calves by Gullickson *et al.* (*Ibid.* 117) also demonstrated the superiority of but-

terfat in young animal rations. The possibility of a new growth factor in butter was discussed by Boer (*Acta Brevia Neerland Physiol. Pharmacol. Microbiol. 11,* 180).

Work on the nutritive value of shortenings by Hoagland and Snider (*U. S. Dept. Agr. Tech. Bull. No. 821,* 11 pp.) demonstrated that the digestibility of lard was superior to that of other types of shortening. The digestive coefficients were lard 91.2-95.4, vegetable shortening 84.6-91.5 and mixed shortening 83.5-87%. No significant differences in the average growth promoting value were noted among the 3 groups. Reder (*Poultry Sci. 21,* 528) recorded that rats absorbed egg oil more readily than cod-liver oil. Among herbivorous animals, guinea pigs tolerated diets containing as much as 30% fat, but they did not utilize hard fats well; rabbits and sheep absorbed hard fats as well as soft, and rabbits resembled guinea pigs in being able to absorb castor oil (Paul and McCay—*Arch. Biochem. 1,* 247). Rats readily absorbed paraffins when their diet contained oleic acid, cholesterol or other emulsifiers (Fraser *et al.* —*Nature 149,* 167). Evans *et al.* (*Proc. Soc. Exptl. Biol. & Med. 51,* 222) found that mannide monooleate was neither acutely nor chronically toxic to white rats. No damage was observed to the important viscera of rats or monkeys after an 8-week feeding period with this glyceride substitute. Such products were prepared in England for food purposes toward the close of the first world war owing to the war demand for glycerol.

Several communications pointed out advantages of having fats in the diet. Young rats from mothers on natural foods containing 45% fat made better growth and contained more dry matter and fat in 13 out of 15 paired comparisons with young rats from mothers on a similar diet containing 9% fat (Maynard and Rasmussen—*J. Nutr. 23,* 385). According to French (*Ibid.* 375) excellent growth was obtained in rats on diets containing 5, 15 and 28% fat but 45% fat diets resulted in less growth. Utilization of calcium was highest on the lowest fat diet. However, Booth, Henry and Kon (*Biochem. J. 36,* 445) demonstrated that in high phosphorus-low calcium rachitic diets 25% vegetable oil devoid of vitamin D exerted a greater calcifying effect than a similar diet in which most of the fat was isocalorically replaced by starch. Heywang's (*Poultry Sci. 21,* 521) statistical data showed no significant differences in the hatchability of hens' eggs in relation to the fat content of the diet. Schmalfuss (*Fette u. Seifen 18,* 278) raised egg laying 13% by feeding hens 0.8 grams of cod-liver oil per day. His results on calf feeding showed that replacement of whole milk with skimmed milk plus cod-liver oil did not affect the growth of the animals. Milk and butterfat production was increased by feeding cows shark liver oil containing high concentrations of vitamin A (Jensen *et al.*—*J. Dairy Sci. 25,* 931). However, feeding as much as 90 cc. of the shark liver oil per cow per day tended to increase the normal rate of decline of milk production with the advance of lactation. Lucadou (*Klin. Wochschr. 20,* 115) calculated that the feeding of 5 grams of bakers' yeast in the drink of German dairy cows would increase the butterfat yield 10%; an amount covering the present deficiency and equal to the extra butterfat imported in the years 1936 and 1937. General communications on the role of fat in the diet were prepared by Bloor (*J. Am. Med. Assoc. 119,* 1018), Schmalfuss (*Fette u. Seifen 49,* 511) and White (*Oil & Soap 19,* 103). The latter believed that soldiers should receive 35-40% of their calories from fats. Specifications for edible oils and fats used by the U. S. Army were discussed by MacDonnell (*Ibid.* 14).

The reviews on fat metabolism (Chargaff—*Ann. Rev. Biochem. 11,* 235; Chaikoff—*Physiol. Revs. 22,* 291) emphasized new methods and tools such as radioactive isotopes, other labeling agents, ultracentrifuge and electrophoresis apparatus. Reiser (*J. Biol. Chem. 143,* 109) by chemical methods observed no change in the phospholipid or cholesterol content of the duodenal mucosa of swine during absorption of fat and found no triglycerides in the fasting duodenal mucosa and only small amounts during absorption. A theory to explain why contrary results were observed by histological methods was presented. MacLachlan *et al.* (*Ibid.* 473) used mice for fat metabolism studies because during fasting all their available stored fat was rapidly mobilized. During the first 2 days of fasting a large excess of fat was deposited in the liver. The liver water and chloride content decreased markedly during the first 2 days of fasting and thereafter increased to the original values. This suggested that during the third and fourth days of fasting some other metabolic process occurs. In 4 days' fasting 80% of the α-lecithin and β-cephalin disappeared, while β-lecithin and α-cephalin remained about constant. Block (*Proc. Soc. Exptl. Biol. & Med. 49,* 496) observed that obese subjects remained in positive ntirogen balance during a prolonged period of undernutrition. Bazilevich and Pravdina (*J. med. Ukraine 10,* 1253) recorded that very old persons had a higher total lipoid content in their blood than normal young or middle aged subjects. This hyperlipemia was not caused by a predominant accumulation of cholesterol or any of the other fractions in the blood, but was a more or less uniform increase of all lipids.

Conrad and Scott (*Poultry Sci. 21,* 407) presented evidence to indicate that in the laying hen most of the total fat acids of an egg yolk meal were absorbed by way of the portal system rather than the lymphatic system.

Somogyi and Weichselbaum (*J. Biol. Chem. 145,* 567) obtained ketonemia and ketonuria in subtotally depancreatized dogs with fatty livers. This and the fact that diabetic patients have an increase in ketonemia and ketonuria after a glucose meal was interpreted to demonstrate that carbohydrates exert a ketone sparing action in various tissues and consequently inhibit the burning of ketone bodies. A decrease of the ketonic level in normal persons after injection of glucose was attributed to the fat- and protein-sparing effect of carbohydrates in the metabolism of the liver (Somogyi—*Ibid.* 575). Wesson (*Endocrinology 29,* 900) reported that rats maintanied for several months on a fat deficient diet became deficient in a factor contained in fat which was necessary for normal carbohydrate metabolism. Mulder and Crandall (*Am. J. Physiol. 137,* 436) observed that the brain of a dog which had been fed fat a sufficient time not only to develop ketosis but to become habituated to the ketotic state did not burn acetone bodies. Work with dairy cows by Shaw *et al.* (*J. Dairy Sci. 25,* 909; *Rept. New Eng. Assoc. Chem. Teachers 43,* 125) showed that short chain fat acids of milk fat did not decrease nearly as much by

ketosis as by a short period of fasting. The per cent of short chain fat acids was much more closely associated with food intake than with level of blood glucose, lactic acid or acetone bodies.

The effect of removal of the adrenals upon fat absorption was a controversial subject. Bavetta and Deuel (*Am. J. Physiol. 136,* 712) reported that adrenalectomy in rats inhibited the absorption of both hydrogenated cottonseed and corn oils but not of tributyrin and sodium butyrate. This was interpreted to suggest that the adrenal glands play a role in the absorption of the longer chain fat acids. Barnes, Rusoff and Burr's (*Proc. Soc. Exptl. Biol. & Med. 49,* 84) data in similar tests showed no significant change in the rate of absorption of corn, olive or hydrogenated vegetable oils or mutton tallow after adrenalectomy. The conclusion that lungs do not actively participate in fat metabolism was drawn from data which showed no significant changes from normal in the lipid content of the lungs during active absorption of fat or during fasting (MacLachlan—*J. Biol. Chem. 146,* 45). Gemmill (*Physiol. Revs. 28,* 32), in a review on fuel for muscular exercise, collected experimental evidence to indicate no direct utilization of fats by muscle. The indirect utilization of protein or fat must be an efficient process since the exclusive feeding of these substances to man does not have a marked effect on muscular efficiency during short periods of exercise.

Cook (*Nutr. Abs. & Revs. 12,* 1) reviewed the literature on cholesterol metabolism.

Reviews on the mode of occurrence of fat acid derivatives in living tissues and on the composition of the depot fats of aquatic animals and fish were prepared by Lovern (*Dept. Sci. & Ind. Research Food Invest. Spec. Repts. Nos. 51 and 52; Chem. & Ind. 61,* 335). Hilditch and coworkers (*Biochem. J. 35,* 932; *36,* 98; *J. Soc. Chem. Ind. 60,* 305; *61,* 169) presented new analytical data on the composition of fats deposited by animals and birds. Part of the data are tabulated in the next section of this paper. The distribution of the unsaturated fat acids in the glycerides of whale oil was recorded. In work on sheep body fats, 2 groups of ewes were fed on restricted and full diets; then the diets were interchanged and continued until the weights were completely reversed. The general tendency on a restricted diet was to mobilize the same proportions of fat acids as those added on intensive feeding. Some slight differences were observed. The proportion of palmitic acid in the mobilized fat was slightly higher than in the deposited fat while that of oleic and stearic acids was correspondingly lower. The sheep body fats resembled ox and pig depot fats in that they were mainly composed of palmitodi-"oleins" and "oleo"-palmitostearins, together with "oleo"-dipalmitins, stearodi-"oleins" and minor amounts of other mixed glycerides. The characteristic differences of milk fats from cows on summer and winter diets were directly connected with change in the components of their feeds. Finnish butterfat was very hard during the winter months (Storgards—*Meijerit Aikakausk 1939,* No. 1-2, 27). This was attributed to the winter fodder such as potatoes, sugar-beet slices and marrow-stem kale. The adaptability of rats for studies of chemical relationship between food ingested and the softness of body fat was studied by Schulz *et al.* (*Iowa Agr. Expt. Sta. Ann. Rept. 1939,* 85; *1940,* 110). Iodine values varying between 64.97 and 107.47 were obtained in the body fats of rats fed various fats and oils. Supplemental feeding of carotene lowered the iodine number of the depot fat while methionine increased it. Neal (*So. Med. J. 34,* 153) reported that a necrosis of hog fat tissue previously attributed to feeding lipase containing peanuts was probably due to a parasitical infestation. Huffman and Duncan (*Mich. Quart. Bull. 24,* 54) suggested the possibility of studying the relation of food fat to milk fat by using fat soluble dyes. Feeding Sudan III or Sudan IV imparted a pronounced pink color to butterfat; perfect purple gave a pronounced green color and nigrosine black yielded a pink butterfat.

Extensive studies were made on the relation of the liver to fat metabolism. In reducing the fat in fatty livers of depancreatized and pancreatic-duct ligated animals, inositol was less effective than the pancreatic extract, lipocaic (Owens *et al.—Fed. Proc. pt. 2, 1,* 65). Lipocaic deficient animals required less insulin and were very sensitive to small amounts of this drug (Dragstedt *et al—Ibid.* 22). Depancreatized dogs on meat diets developed fatty livers, but when water soluble substances were removed from the meat no very pronounced degree of fat infiltration of the liver was observed (Ralli and Rubin—*Am. J. Physiol. 138,* 42). It was suggested that this type of fatty livers was due to a state of protein depletion brought about by impaired digestion and absorption of proteins, and to the presence in meat of substances capable of producing fat infiltration of the liver. Simultaneous oral administration of lipocaic and cholesterol to rabbits prevented rise in cholesterol fraction of the blood lipids and the fatty livers caused by the latter (Vermeulen *et al.—Arch. Surg. 44,* 260).

Liver damage caused by excess cystine was modified by various diets. Hemorrhage was least severe with low fat diets, necrosis most severe with synthetic diets and fat infiltration was consistently present with diets low in protein and high in fat (Earle and Victor—*J. Exp. Med. 75,* 179). Addition of 1% choline inhibited fat infiltration but did not protect the liver against damage by cystine at a level of 5% in a diet low in protein and high in fat. The liver lesions could be prevented by addition of protein and molasses to the diet (Webster—*J. Clin. Investigations 21,* 385). Methionine as such was superior to the methionine in casein for the purpose (Treadwell, Groothius and Eckstein—*J. Biol. Chem. 142,* 653).

Several communications contained information on the liver fat abnormality caused by diets low in choline. According to Channon *et al.* (*Biochem. J. 36,* 214) the extent of fat infiltration was related to the proportion of C_{14} to C_{18} saturated acids in the diet. Stetten *et al.* (*J. Biol. Chem. 142,* 629; *144,* 175) recorded that liver fat resulting from dietary deficiency of choline was poor in lecithin. Adding cystine and homocysteine to the diet yielded livers abnormally high in lecithin; ethanolamine and serine produced no increase. Mulford and Griffith (*J. Nutr. 23,* 91) observed that cystine or methionine increased deposition of fat in liver and improved growth and efficiency of utilization of food in young rats on a low choline diet. Working with purified diets Engel (*Ibid. 24,* 175) observed that fatty livers occurred on prolonged feeding of diets deficient in pyridoxine or essential

fat acids. He believed that pyridoxine and a source of essential fat acids were necessary in the diet for choline to function properly as a lipotropic agent. Fatty liver was also included as one of the symptoms of riboflavin deficiency (Potter *et al.—Ibid.* 449). The choline-like activity of several compounds was investigated by Welch and coworkers (*J. Biol. Chem. 144,* 581; *146,* 19). The data indicated that the intact molecule of choline, rather than its labile methyl group, was responsible for its lipotropic action.

A miscellaneous group of data was recorded on fat metabolism in the liver. Data on carbohydrate tolerance of animals with fatty livers were obtained by several groups of investigators (Deuel and Davis —*J. Biol. Chem. 146,* 649; Treadwell *et al—Ibid. 143,* 203; Samuels *et al.—Proc. Soc. Exptl. Biol. & Med. 49,* 456). Damaging the liver with carbon tetrachloride decreased the utilization of fat acids (Winter—*J. Biol. Chem. 142,* 17). Fatty livers were produced in guinea pigs when the diet contained 20% fat as cottonseed oil or butterfat, but diets containing 20% hydrogenated vegetable oil or only 5% fat were said to be better utilized (Spellberg *et al.—Arch. Path. 33,* 204).

Burr (*Fed. Proc. 1,* 224) with the assistance of personnel of the Works Project Administration compiled a review on the significance of essential fat acids. According to Williamson (*Biochem. J. 35,* 1003) the epidermis of rats on fat-free diets became thicker and more differentiated. Supplements of unsaturated fat acids reduced the defect to nearly normal. Histopathological observations on essential fat acid deficient rats revealed lesions in kidneys, livers and in some cases in the adrenal cortex (Engel—*Ala. Agr. Expt. Sta. 50th Ann. Rept.* 27). Heart muscle and spleen were normal in all cases. The lack of essential fat acids did not affect the incorporation of labeled fat acids into the liver phospholipids (Burr *et al.—Proc. Soc. Exptl. Biol. & Med. 51,* 235). Work by Smedly-Maclean and Hume (*Biochem. J. 35,* 990) indicated that a large supply of unsaturated fat acids was necessary for the formation of new tissue but not for normal metabolism.

Quackenbush, Steenbock and coworkers (*J. Nutr. 24,* 213, 225, 393; *J. Biol. Chem. 145,* 163) recorded several observations on the effect of limiting the amounts of unsaturated fats in the diet of rats. Reproduction and lactation tests demonstrated that the requirements for the essential acids were higher than previously estimated. Ethyl linolate and ethyl arachidonate prevented or cured dermal symptoms and made possible the production of normal young while ethyl linolenate was ineffective. The development of acrodynia in rats on a low-fat diet was also associated with a decrease in body fats and an increase in the iodine value of the fats. Either linoleic ester or pyridoxine plus pantothenic acid increased the fat, decreased its iodine value and cured the skin lesions. The symptoms of fat deficiency and lack of normal deposition of fat in the body with diets low in fat and high in carbohydrates can thus be due to the lack of several dietary essentials.

Dietary fat and fat metabolism during certain diseased conditions interested a few investigators. Tannenbaum (*Cancer Research 2,* 460, 468) and Lavik and Baumann (*Ibid. 1,* 181) observed the increases in tumor formation on diets containing fat. The latter believed that the tumor-promoting activity was in the fat acid fraction. Ethyl laurate was as effective as natural fat; glycerol and unsaponifiable fractions had only slight activity. Truttwin (*Wien. klin. Wochschr. 54,* 512), believing that the unsaturated constituents accelerated tumor formation, recommended only the more saturated fats, *i.e.,* coconut oil, as suitable in the diet of cancer patients. Smedley-MacLean and Hume (*Biochem. J. 35,* 996) observed a lowering of the unsaturated fat acids in the subcutaneous tissue of rats accompanied development of tumors. McCoy (*Pub. Health Repts. 57,* 1727) in a review on treatment of leprosy, emphasized that chaulmoogra oil was of little or no value. Since fat is an essential factor in gallbladder emptying mechanism, Curl (*J. Am. Med. Assoc. 119,* 607) recommended that high fat diets precede cholecystography.

An epidemic of dropsy in India was traced to the adulteration of the mustard oil used for food with the seed oil of *Argemone mexicana* (Bhattacherjee—*Calcutta Med. J. 36,* 350; Tribedi and De—*Ibid. 37,* 209; Chopra *et al.—Indian Med. Gaz. 75,* 261; Lal *et al.—Indian J. Med. Research 29,* 813, 839). A toxic alkaloid was isolated from suspected oil samples.

A review on fat soluble vitamins was compiled by Morton (*Ann. Rev. Biochem. 11,* 365). New analytical data included the vitamin A content of liver and depot fat of 16 Indian fish (Seshan—*Indian J. Med. Research 27,* 711), vitamin A and D content of several Bengal fresh and salt water fish (Basu *et al.—Ibid.* 721, 865), vitamin A and D potency of liver, intestine, body and offal oils of shad and mackerel (Pugsley *et al.—Can. J. Research 20D,* 167), seasonal variation of vitamin A in butter (Morton *et al.—J. Soc. Chem. Ind. 60,* 310) and seasonal variation of vitamin D in butterfat (Henry and Kon—*Biochem. J. 36,* 456; *Chem. & Ind. 61,* 96). Several investigators recorded that the absorption of vitamin A increased with increase of fat in the diet (Muelder and Kelly—*J. Nutr. 23,* 335; Russell *et al.—Ibid. 24,* 199). Bomskov and Ruf (*Klin. Wochschr. 19,* 647) claimed that the improved absorption depended upon the amount of unsaturated fat acids in the diet. Abramson and Brunius (*Acta Physiol. Scand. 3,* 164) found the growth promoting value of β-carotene the same whether dissolved in peanut oil or in margarine. Vitamin A added to fats used in bread, biscuits and cakes was relatively stable while in pie crust considerable destruction occurred (Rice *et al.—Oil & Soap 19,* 164). Biotin was inactivated by rancid fats or fats with high peroxide values (Pavcek and Shull—*J. Biol. Chem. 146,* 351).

In the opinion of Mattill and Golumbic (*J. Nutr. 23,* 625) the oxidative destruction of vitamin E in the presence of readily autooxidizable fats is responsible for the various disorders produced in animals and birds; cod-liver oil has no toxic action, but merely hastens the disappearance of vitamin E. The resistance of the tissue fats of rats to rancidity can be increased by the feeding of ascorbic acid (Overman—*J. Biol. Chem. 142,* 441).

Characteristics and Composition

The tables appended to this section of the review give data on the characteristics and composition of oils from those communications which could be represented best in this way. A miscellaneous group of analyses were intended for special purposes. Puffeles

(*Analyst 67,* 226) demonstrated that oil from olives affected by the olive fly had a greater degree of acidity than oil from hand-picked olives that were unaffected by this parasite. According to Anderson (*Dept. Trade & Commerce Board Grain Commissioner, Lab. Winnipeg Ann. Rept. 15,* 37), the oil content of seeds from sunflowers grown 6 inches apart in the row was considerably higher than that from plants spaced 36 inches apart. He also recorded that the oil content of flaxseed tended to be inversely related to the iodine value of the oil. A flax variety obtained by crossing Burbank Golden and B-Golden was fostered because it produced a good yield of seeds with excellent oil characteristics (Heggeness—*N. D. Agr. Expt. Sta. Bimonthly Bull. 3,* No. 4, 7). Indigenous castor seeds of Java averaged 45% oil (*Landbouw 17,* 476). Zollikofer (*Schweiz. Miltztg. 67,* 95) tabulated the characteristics of several European butters. Swiss butter showed the least seasonal differences. Podol'skaya (*Klim. Referat. Zhur 1940,* No. 9, 36) observed a decrease in carotenoids in cottonseed during ripening. The difficultly extractable fat acids associated with various starches were believed to be adsorbed (Lehrman—*J. Am. Chem. Soc. 64,* 2144). Analyses of Argentine rapeseed (Yalour — *Rev. facultad cienc. quim. U. La Plata 16,* 145) and German winter rapeseed (Lowig and Baumgartner—*Forschungsdienst 9,* 496) were recorded. Good quality Fiji copra contained 66-68% oil, 5% moisture and less than 1% free fat acid (Blackie—*Agr. J. Fiji 12,* 68).

Plans, recommendations, discussions and reports on collaborative work were prepared on the moisture, unsaponifiable color, iodine value, thiocyanogen value and titer test by the American Oil Chemists' Society (A.O.C.S.) (Mehlenbacher *et al.* — *Oil & Soap 19,* 145), on titer test, artificial dyes and detection of olive oil by Association of Official Agricultural Chemists (Fitelson—*J. Assoc. Off. Agr. Chem. 25,* 726), on identification of foreign material in seeds by the German fat chemists (Kaufmann — *Fette u. Seifen 49,* 629) and on methods of sampling, grinding and determining moisture and fat in seeds by the same group (Grietmann—*Ibid.* 401). The report of the cooperative work of the International Fat Commission of 1938-9 was translated into English (Dollear and Morgan—*Oil & Soap 19,* 28, 98).

Kaufmann and Keller (*Fette u. Seifen 49,* 93) investigated the determination of moisture in rapeseed by various methods. Constant weight was attained with the ordinary oven method at 105° in 5½ to 7½ hours and in 1½ to 2 hours in the Brabender apparatus. With distillation methods, toluol, benzol, cyclohexane, benzine (b.p. 90-95°) and *n*-heptane were suitable; xylol was unsuitable. Distillation with *n*-heptane was preferred. Titration methods checked gravimetric methods. Mohr and Baur (*Molkerei-Ztg. 55,* 31) demonstrated that moisture determinations on butters by distillation with immiscible solvents were unsatisfactory. Their rapid method depended on heating the sample with acetyl chloride. A collaborative report on moisture in soybeans advised heating in an air oven at 105° for 6 hours (*Oil & Soap 19,* 158).

Refractometric procedures for determining fat or oil in milk, dairy products, cocoa, chocolate, oil seeds and soap products were recorded by Leithe (*Chem.-Ztg. 65,* 209). Paleni (*Fette u. Seifen 49,* 275) preferred the Besson apparatus and petroleum ether as the solvent for fat determinations. Data with the Soxhlet extractor were lower than those of the Besson extractor. Neustadt's (*Ind. Eng. Chem. 14,* 431) modified Soxhlet extractor shortened the extraction time. A rapid simple extraction procedure using chloroform as the solvent published by Sabine (*Chemist Analyst 30,* 79) was suitable as a control procedure for chocolates. A control procedure used for dog food by which some of the non-fat material was first hydrolyzed gave results of 0.34% higher than those of official methods (Rendle—*J. Assoc. Off. Agr. Chem. 25,* 86). A new method for oil in fish liver comprised weighing a finely chopped sample, transferring to a Babcock bottle with an equal amount of water and determining fat in a manner similar to that used on dairy products (Johnston—*Fisheries Research Board Can. Prog. Rept. Atlantic Stas. No. 32,* 11). Harrison (*J. Assoc. Off. Agr. Chem. 25,* 877) found petroleum benzine and ethyl ether extracting methods inaccurate for measuring fat content of fish meals. Bognár (*Fette u. Seifen 48,* 332) published details of a fat procedure for dairy products based on hydrolyzing the protein with acid and extracting with solvent. To insure thorough mixing of dairy product samples he advised adding a pinch of carbon black and mixing until it was a uniform gray. Micromethods for determination of both fat and moisture in oil seeds were issued (Gorbach — *Ibid. 49,* 553). Kaufmann and Keller (*Ibid.* 272) designed an apparatus for the simultaneous determination of fat and moisture. The moisture was distilled with heptane vapors and condensed in a measuring tube. The returning heptane was used as the solvent for fat determination.

A novel procedure for the determination of the germ content of corn was devised (Grandel—*Fette u. Seifen 49,* 5). The weighed samples were fed to rats in screen bottom cages. The animals first bit off the root tips and then ate the germ, allowing root tip and non-germ portion of the kernel to fall through the screen where they may be collected and weighed. Analyses showed that degerminating with rats was more efficient than by manual methods. Data on several varieties of corn were tabulated. The method was useful as a control procedure in the dry degermination process.

A photometric method for determining acetone-insoluble material in soybean oil was developed by Murray and Oberg (*Ind. Eng. Chem. Anal. Ed. 14,* 785). A direct empirical relation was found between acetone-insoluble and "break" of solvent extracted oil. The test could be used in place of the break test or foots test for evaluating the quality of soybean oil. A review of methods of evaluating crude vegetable oils by refining tests was prepared by Bailey, Feuge and Bickford (*Oil & Soap 19,* 97). The limitations of the test for the present and future processing procedures were emphasized. The Refining Test Committee of the A.O.C.S. tried the centrifuge in the test with favorable results (Mitchell—*Ibid.* 160). Modifications and recommendations for the bleaching test (Freyer—*Ibid.* 147) and determination of soap in refined oils (Crapple—*Ibid.* 131) also appeared in committee reports of the A.O.C.S. An investigation of methods for determining unsaponifiable matter in oils showed that the method of the Society of Public Analysts (British) effected practically complete extraction of added unsaponifiable matter while the Fat Analysis Committee and modified Kerr- Sorber meth-

Oil or Fat Source	% Oil or fat	Density	Refr. index	Acid No. or (% free fat acids)	Sapon No.	Iodine No.	(SCN) No.	Acetyl No. or (OH No.)	R-M No.	Polenske No.	% Unsapon.	Melting point	Solidification point	Diene No.	Hexabromide No.	Carbonyl No.
Avena elatior[2] fruit	4.4	$0.9194^{25/12}$	1.4666^{40}	43.3	185.6	101.2					4.3-6.9					
Avocado pulp, liquid portion[3]		$0.9159^{25/25}$	1.4692^{20}	7.4	197.4	70.9		7.7	3.0	0.3	1.1					
Baboon, sacred[4] *Papio hamadryas*				8.4	195.8	77.0					0.1					
Buchanania latifolia[5]				32.7	193.2	63.4										
Cat[4]				64.4	199.1	43.6					0.6					
Chia seed[31] *Salvia hispanica*	25.0			2.4	192.5	206.1	127.9				0.6					
Cornus officinalis[6]	6.91	0.9645^{15}	1.4849^{15}	3.4	196	112		23.4								
Croton sparsiflorus[7]	38.44	$0.9270^{30/4}$	1.4709^{40}	9.18	189.5	172	90.41	0.02	1.10	4.18	1.36				10.99	
Emu[4]					194.5	65.8					0.3					
Fig Seed (Indian)[32] *Opuntia ficus*	6.3				194.1	125.2			0.44		1.73					
Giant panda[4]				3.0	197.9	64.8					0.1					
Grape seed (*Argentina*)[8]	10.72	0.9254^{15}		(6.05)	188	125			0.46				—12			
Grey Lag Goose[4] *Anser anser*				41.2	248.8	57.1					0.2					
Kangaroo[4] *Macropus major*				3.4	196.8	50.1					0.2					
Lallemantia royleana seeds[10]	10.8	0.9162^{32}	1.4212^{30}	2.07	191.2	108.5					0.28					
Lion[4]				16.6	191.4	41.0					2.6					
Neem or Margosa tree seed[11]		0.9129^{31}	1.4658^{31}	11.2	195.6	69.2					1.9					
Parinarium corymbosum seed kernels[12]	78.7	$0.9686^{27.5}$	1.5169^{25}	0.7	188.3	142.2			0.2		0.2			61.4	0	111.8
Parinarium (six) seed kernel[12]	60.8	$0.9552^{27.5}$	1.5144^{25}	0.4	191.9	131.0								56.1	0	
Parinarium glaberimum seed kernels[12]	52.2	$0.9551^{27.5}$	1.5578^{25}	0.4	196.0	170.1					0.5			105.6	0	
Parinarium scabrum seed kernels[12]	39.1	$0.9447^{27.5}$	1.5287^{25}	13.7	193.9	158.3					0.5			77.6	0	
Pentadesma butyracea seed [13]	31.7		1.4583^{40}		190.0	46.6						36.5		0.65		
Puhwang seed[14]	20.3	$0.9256^{25/15}$	1.4740^{25}	19.1	193.96	130.8			0.22	0.42	3.64					
Pulan seed kernel[15] *Calophyllum inophyllum*	72.5	0.928^{15}	1.4776^{40}		196.0	86.0					1.50	8.0	4.5			
Ragweed seed[17] *Ambrosia eliator*	18.31	$0.9210^{25/25}$	1.4686	(3.17)	189.2	140.7	81.0					1.84				
Ratkeliya tree seed kernel[18] *Litsea longifolia*	29.0			38	237.7	13.0					7.2				8.6	
Rye germ[19]		$0.9277^{20/4}$	1.4795^{20}	24.5	179.8	134.9	76.4	(19.2)			1.0					
Sawfish[20] *Pristis pectinatus*																
Liquid portion		0.9202^{15}	1.4660^{45}	(16)	189	108.5		1.1			3.5	29.0				
Solid portion		0.9363^{15}	1.4631^{45}	(16)	186	93.7		1.3			4.7	37.5				
Shark (lemon) liver[23] *Hypoprion brevirostrus*					172	143					2.94					
Shark (dusky) liver[23]					171	125					3.13					
Shark (Neko-Buka) liver[24] *Squalus mitsukurii*	85.1	0.8584^{20}	1.4865^{30}	0.7	28.45	315.42					87.51					
Shark (sand) liver[23] *Odontaspis littocalis*					172	145					3.13					
Sheep tail [21]					217-246	60.8-69			0.65-0.70	0.30-0.55		33.4-44.0				
Sheep kidney[21]					205.0-208.4	42.4-49.6						47.5-54.7				
Sheep (Somali) rump[4]				52.0	195.0	49.0					0.5					
Shorea robusta Borneo tallow kernels[25]				1.8	187.9	41.2					0.7	34-36				
Sloth bear *Melursus ursinus*				1.8	198.6	60.3					0.8					

CHARACTERISTICS OF FATS REPORTED DURING THE YEAR *(Concluded)*

Oil or Fat Source	% Oil or fat	Density	Refr. index	Acid No. or (% free fat acids)	Sapon No.	Iodine No.	(SCN) No.	Acetyl No. or (OH No.)	R-M No.	Polenske No.	% Unsapon.	Melting point	Solidification point	Diene No.	Hexabromide No.	Carbonyl No.
Solanum indicum seeds[26]		$0.9156^{15.5}$	$1.4671^{15.5}$	17.8	177.6	121.5		44.4			2.0					
Sumac berries[27] *Rhus glabra*	10	0.9072-$0.9814^{20/20}$	1.588-1.502^{20}	1.98-2.75	192-200	40.1-85.0										
Tomato seed of Argentina[28]	33.1	0.9206^{15}	1.4771^{15}	3.2	192.09	112.6		28.34	0.51	0.28	1.45					
Tung nut of Sukhum U.S.S.R.[29]		0.9366^{20}	1.5238^{20}	0.5		164.5					0.3					
Zamia palm seed *Macrozamia reidlei*[30]	28.2		1.4630^{25}	7.2	213.0	61.1										

FAT ACID COMPOSITION

Oil or Fat Source	Common Saturated Acids			Common Unsaturated Acids			
	Myristic	Palmitic	Stearic	Oleic	Linoleic	Linolenic	
Annan Urusi mesocarp[1] *Rhus succedanea*		8.2	4	8			Lignoceric 2, beneiconsanedicarbonic 2
Avocado pulp, liquid portion[3]	2.1	25.3	0.6	62.6	6.0	trace	
Baboon, sacred[4] *Papio hamadryas*	3.2	18.9	5.8	53.8	13.2		C_{14}(—2H) 0.8, C_6(—2H) 3.8, C_{20-22}(unsatd.) 0.5
Buchanania latifolia[5]	0.14	28.73	8.08	57.05	5.44		[Unsaponifiable 0.56]
Cat[4]	3.6	29.2	16.6	40.8	1.9		C_{14}(—2H) 1.2, C_{16}(—2H), 4.3, lauric 2.4
Emu[4]	0.9	17.5	10.1	62.2	5.2		Arachidic 0.6, C_{14}(—2H) 0.9, C_{16}(—2H) 2.1, C_{20-22}(unsatd.) 0.5
Giant Panda[4]	5.0	26.4	6.7	45.1	11.9		Lauric 0.4, C_{14}(—2H) 0.9, C_{16}(—2H) 3.6
Gray lag goose[4] *Anser Anser*	8.2	20.3	5.6	41.6	6.6		Lauric 12.3, C_{14}(—2H) 0.6, C_{16}(—2H) 2.5, C_{20-22}(unsatd.) 2.3
Japan wax[9] *Rhus succedanea*	1.9	67.5	11.6	———	13.6	———	Arachidic 0.04, behenic 0.01, dicarboxylic 5.3
Kangaroo[4] *Macropus major*	4.7	25.5	14.1	45.5	2.6		Lauric 0.2, C_{14}(—2H) 0.4, C_{16}(—2H) 2.7 arachidic 1.5, C_{20-22}(unsatd.) 2.8
Lallemantia royleana seeds[10]		10.1	3.2	59.4	26.1		[Unsaponifiable 0.28]
Lion[4] *Panthera leo*	4.9	28.9	17.8	40.3			Capric 1.4, lauric 1.1, arachidic 0.1, C_{14}(—2H) 0.6, C_{16}(—2H) 1.9, C_{20-22}(unsatd.) 3.0
Neem or *margosa* tree seed[11]		13.9	18.2	52.6	13.6		Arachidic 1.8
Parinarium corymbosum seeds[12]		4.9	6.5	7.3	5.2		Licanic 58.2, eleostearic 11.8 [Glycerol 4.2, unsaponifiable 0.2]
Pentadesma butyracea seed[13]		7.3	38.5	47.5	1.5		[Glycerol 4.3, unsaponifiable 0.9]
Pumpkin seed[16] *Cucurbita pepo*		———26.7———		21.5	α-2.67 β-39.13		
Ragweed seed[17] *Ambrosia eliator*		5.5	4.8	19.9	69.8	trace	
Ratkeliya tree seed kernel[18] Litsea longifolia		3.1	2.2	5.5			Lauric 81.9 [unsaponifiable 7.2]
Rye Germ[19]		———11.45———		18.47	63.29	1.30	[Unsaponifiable 1.00]
Shark liver[22] *Carcharodon carcharias*		12		35	10		C_{16}(—2H) 27, C_{20}(—8H) 3, C_{20}(—10H) 3, C_{22}(—8H) 6.
Sheep (Somali) rump[4]	2.2	23.0	14.9	55.7	0.8		C_{14}(—2H) 0.3, C_{16}(—2H) 2.5, C_{20-22} (unsatd.) 0.6
Shorea robusta kernel[25]		4.5	44.2	42.2	2.8		Arachidic 6.3
Sloth bear[4] *Melursus ursinus*	2.6	28.7	3.4	50.5	1.0		C_{14}(—2H) 1.4, C_{16}(—2H) 10.6, C_{20-22}(unsatd.) 1.8
Tung nut of Sukhum U.S.S.R.[29]		———6.0———		5.0	8.8	0.5	Eleostearic 73.6 [Glycerol 4.2, unsaponifiable 0.3]
Whale (Antarctic)[23]	9.3	15.45	2.80	———35.2(—2.5H)———			Lauric 0.2, arachidic 0.3, C_{14}(—2H) 2.5, C_{16}(—2.1H) 14.4, C_{20}(—7.2H) 13.6, C_{22}(—10.1H) 5.9, C_{24}(—10.4H) 0.2

ods did not (Kirsten—*J. Assoc. Off. Agr. Chem. 25,* 728).

Methods for some of the physical tests on oils were improved. Whyte (*Oil & Soap 19,* 199) designed a special cabinet for reading color. A review of methods of determining and expressing consistency of fats was prepared by Rich (*Ibid.* 54). He emphasized that the expression of consistency should give the degree of workability for the standpoint of the baker or housewife. A new instrument for butter measured the resistance to cutting by wire (Colby—*J. Dairy Research 12,* 329, 337). Compression methods were said to show a lack of reproducibility because of splitting or crumbling of the sample.

The physical test data prepared by Ralston and coworkers (*J. Am. Chem. Soc. 64,* 2739; *Oil & Soap 19,* 126; *Ind. Eng. Chem. 34,* 1104) were on the fat acids. The refractive indices for each saturated acid from caproic to stearic between 20 and 80° were straight line functions of the temperature with an abrupt change in slope at 40°. Densities at 80°, molar volumes, molar refractivities, freezing points and boiling points of the acids were also recorded. Maximum depression of the solidification of any given acid by water was greater than that for the next higher member of the series. Saturation with water reduced the solidification point of stearic acid 0.5°. The colloidal behavior of dodecylamine in water, ethanol and benzene was also recorded by the same group (*Ibid.* 2824). Microscopical determinations of melting points by Kaufmann and Schubert (*Fette u. Seifen 49,* 16) gave double meltings for tristearin at 55 and 73 and for trimyristin 48 and 57°. Heretofore, these melting points were respectively listed as 55 and 72 and 49 and 55. Work on flash and fire points of vegetable oil showed that the values were slightly higher on peanut than on cottonseed oil and the hydrogenation improved the oils in this respect (Morgan—*Oil & Soap 19,* 193). Data on the dielectric strength of several vegetable oils and the effect of moisture on this value were tabulated by Chakravaty and Mahanti (*Indian J. Phys. 16,* pt. II, 82). The spreading coefficient of oil was recommended as a new criterion for measuring degree of oxidation of drying oil being processed for paint (Rugg—*Natl. Paint, Varnish, Lacquer Assoc. Sci. Sect. Circ. No. 629,* 449).

Newly published methods for determining unsaturation of fats and oils were based on the use of bromine as the reagent (Burton and Robertshaw—*J. Intern. Soc. Leather Trades Chem. 25,* 349; Jasperson—*J. Soc. Chem. Ind. 61,* 115). With tall oil, Chapman *et al.* (*Oil & Soap 19,* 214) recommended the Wijs iodine method and determinations on 4 samples in which the excess reagent varied. The results were plotted and the iodine value at the desired excess was read from the curve. Bolton and Baskett (*Analyst 67,* 254; *Chem. & Ind. 61,* 249) observed that iodine values were a good index of the relative firmness of pig back depot fat. According to Johns (*New Zealand J. Sci. Tech. 22A,* 248) the iodine values of swine fats were in the following descending order: boars, sows and hogs (castrated or spayed animals). In a single animal the degree of saturation of the fats in descending order were caul, flare, inner back and outer back. Methods for evaluating polyunsaturation, *i.e.,* thiocyanogen value, were not improved by the use of toluol, benzol, hexahydrotoluol, nitrobenzene, pentachloroethane, acetylene tetrachloride or formic acid as solvents (Kaufmann and Groose-Oetringhaus—*Fette u. Seifen 49,* 194). A stabilization of the thiocyanogen solution, to the extent that constant titration was obtained for 10 days, was possible by addition of a small amount of iodine.

Bickford *et al.* (*Oil & Soap 19,* 23) investigated the possible reactions that might occur during determination of degree of conjugation in unsaturated fats or in the technical processes in which the fats are reacted with maleic anhydride. At 200° methyl oleate reacted with 1 mole, methyl linoleate with 2 moles and methyl linolinate with 2.5 moles of maleic anhydride when an excess of anhydride was present. Methyl stearate reacted negligibly. Speculations as to the structure of the addition products were presented. McKinney *et al.* (*Ibid.* 141) recommended determining the maleic anhydride value according to the Ellis-Jones method for detecting adulteration of tung oil.

Methods of approximating composition of mixed glycerides present in natural fats from the proportions of their component fat acids were discussed by Hilditch and Meara (*J. Soc. Chem. Ind.* 61, 117). The analytic methods for determining the fat acids of teaseed oil were reviewed by K. F. Mattil (*Univ. Microfilms Mich. No. 374,* 95 pp.). Fractionating fat acids by the use of selective solvents on their brominated addition products was encouraged for studying the film forming capacity of natural triglycerides (Treibs—*Ber. 75B,* 652). Cassidy (*J. Am. Chem. Soc. 63,* 2735) separated mixtures of higher saturated fat acids by adsorption on carbon from solutions. A similar procedure was used by Walker and Mills (*J. Soc. Chem. Ind. 61,* 125) to separate the fat acids from linseed oil into groups possessing different levels of unsaturation. Data on the adsorption behavior of triglycerides were developed by Claesson (*Arkiv Kemi, Mineral. Geol. 15A,* No. 9, 1). Retardation volumes of the samples on 22 mm. of active carbon from 1% ether solution were trilaurin 9.3, trimyristin 9.8, tripalmitin 21.0 and triolein 9.7 cc. Preferential adsorptions occurred from solutions of fat acid mixtures. A new technic for separation and identification of fat acids consisted of converting them into hydroxamic acids and fractionating with selective solvents (Inoue *et al.*—*J. Agr. Chem. Japan 17,* 411, 491, 771). Separation of saturated from unsaturated fat acids and isolation of linoleic, linolenic, oleic and elaidic acids from various oils was claimed by the investigators. Bomer and Stather (*Fette u. Seifen 49,* 243) isolated 10-11, oleic acid from hydrogenated sunflower oil. A solid conjugated linoleic acid, melting at 57°, was isolated from the isomerized products of dehydrated castor oil (von Mikusch—*J. Am. Chem. Soc. 64,* 1580). An investigation on isolating methyl arachidonate also contained a spectroscopic and analytical study of this fat acid derivative and its isomerized and oxidized products (Mowry *et al.*—*J. Biol. Chem. 142,* 671, 679). The structure assigned to the acid was 5,8,11,14-eicosatetraenoic acid. Partial oxidation of ricinoleic and ricinelaidic acids resulted in the formation of 4 distinct diastereoisomeric 9,10,12-trihydroxystearic acids.

Work on the isolation of non-glyceride compounds from fats included the isolation of 3 isomeric sterols of the formula $C_{29}H_{48}O.\frac{1}{2}H_2O$ from alfalfa seed oil (King and Ball—*J. Am. Chem. Soc. 64,* 2488), the

separation of several C_{23} and C_{25} alcohols from the liver oil of *Squalus suckleyi* (Toyoma and Takahasi—*J. Chem. Soc. Japan 60,* 1177), a sterol of formula $C_{27}H_{39}O$ from balsam seed oil (Tutiya—*Ibid. 61,* 717), and pristane ($C_{18}H_{38}$) and zamene $C_{18}H_{36}$ from Bonito oil (Matuda—*Ibid.* 197). The unsaponifiable matter of West African plantation palm oil contained the following pigments: α-, β- and γ-carotene, lycopene, neolycopene, lutein, neolutein and a carotenoid intermediate between α- and β-carotenes (Hunter *et al.—Biochem. J. 36,* 697).

A few publications contained information on detection of certain oils and determination of adulteration. The titer test was recommended for detection of adulteration of Chinese vegetable tallow (Ho and Liu—*J. Chem. Eng. China 8,* 11). Bömer and Kappeller (*Fette u. Seifen 49,* 353) recommended elaidinization together with fractional crystallization for investigating olive, peanut and soybean oils. Broge (*Ibid. 48,* 333) preferred the Bellier values as a means of detecting peanut oil in olive oil. The Bellier value of many Brazilian oils was tabulated by Silveira (*Ind. y quim. 4,* No. 3, 70). Pavolini and Pavolini (*Olii minerali, grassi e saponi, colori e vernici 21,* 233) listed 17 plants whose seed oils gave the Halphen reaction. The Kreis-Roth method for detecting peanut oil in oils, fats or soaps was modified (Pritzker and Jungkunz — *Mitt. Lebensm. Hyg. 33,* 75). The method depends on the separation of arachidic and lignoceric acids. Suitable constants for the identification of fats in confectionery products were discussed by Langwill (*Manufg. Confectionery 22,* No. 1, 11).

Specifications were issued for dehydrated castor oil (Scofield—*Natl. Paint, Varnish, Lacquer Assoc. Sci. Sect. Circ. No. 621,* 124). An A.O.C.S. committee prepared standards for whale, neatsfoot, teaseed and oiticica oils, cocoa butter, North American lard and beef tallow (Lauro—*Oil & Soap 19,* 140).

Detergents

Little work was done on soap stock. A soap stock which yielded readily soluble soap contained 10 to 30% saturated acids having more than 18 carbon atoms, at least 30% saturated acids and not more than 30% palmitic acid or a mixture of palmitic and stearic acids whereof the stearic acid did not exceed 15% of the total fat acids in the soap. The other saturated acids were of lower molecular weight than palmitic (Oakley—*Brit. 521,566*). A stock for shaving soap contained 60 to 80% palmitic and 40 to 20% stearic acids (Meyers—*U. S. 2,298,019*). A distillation fraction from marine oil fat acids containing principally fat acids of 18 carbon atoms with less than 3% C_{20} to C_{22} fat acids yielded suitable soap (Armour & Co.—*Brit. 533,846*). Mild soap could be made from oils containing low molecular weight acids by removing by distillation the fat acids having less than 12 carbon atoms (Lever Bros.—*U. S. 2,300,416*). One soap formula contained high molecular weight, dihydric unsaturated alcohols (Deutsche Hydrierwerke A.-G. — *Ger. 681,225 Cl. 23c*). Humphrey (*U. S. 2,285,333*) hydrogenated the rosin intended for soap stock. A stock obtained from alkali refining of vegetable oil consisted of soap and other detergent compounds resulting from the thermal decomposition of the proteinaceous and other materials originally present in the soap stock (Refining, Inc.—*U. S. 2,299,603*). Advantages were found in mixing scrap soap with sodium carbonate or weak caustic solutions before incorporation with the fat or oil which forms the remainder of the soap stock (Keeble—*Brit. 534,809*). Methods of purifying fat residues from the fat test on dairy products so that these could be reclaimed for soap manufacture were issued by Roeder (*Molkerei-Ztg. 55,* 143).

Several methods of improving soaps appeared. The newly patented stabilizers against rancidity were a reaction product of an aliphatic ketone and ammonium thiocyanate (U. S. Rubber Co.—*U. S. 2,305,043*) and α-stannic acid (Lever Bros.—*Brit. 544,863*). Soaps containing halogenated fat acids were stabilized by heating in inert atmosphere to a temperature above the melting point but below the decomposition point (Colgate-Palmolive-Peet Co.—*U. S. 2,279,734*). The addition of hydrosulfites to synthetic fat acid soaps improved the color and odor of the products (Owen—*U. S. 2,274,632*). Formic acid was used to lower the pH of soap (Pratt — *U. S. 2,279,248*). Added special fat acid amine derivatives (Steindorff *et al.—Ger. 680,245 Cl. 23e*) or alkylolamines and phosphates (Volz *et al.—Ger. 719,734 Cl. 23e*) reduced the tendency of the soaps to precipitate calcium salts. Soaps containing about 40% sulfonated oils were good substitutes for coconut, palm kernel and like soaps (Wittka—*Fette u. Seifen 49,* 113; Cagliotti —*Italian 380,441*; Colgate-Palmolive-Peet Co.—*U. S. 2,294,075*). Para-octyl-phenoxy-acetic acid rendered hard soaps more water soluble (Procter & Gamble—*U. S. 2,263,729*). The germicidal soaps patented contained calcium hypochlorite (Mathieson Alkali Works —*Fr. 852,048-9*) and chloramine-T (Smith—*U. S. 2,296,121*) as the germicidal ingredients. A special soap comprised the reaction mixture of 80% whole milk, an amine soap of a fat acid and a sweet cream buttermilk powder (McCormick—*U. S. 2,276,409*).

Walther (*Deut. Washerei-Forsch. Ber. 7,* 92, 107, 121) fostered the use of metasilicates in laundries by emphasizing their harmlessness to fabrics and their bleaching effect. A polemic between de Wijs (*Chem. Weekblad. 37,* 482) and Smit and van Vreeswijk (*Ibid.* 511) treated the possibility of washing with soda and water glass without soaps. Manufacturing procedures for detergent silicates were patented by Baker (*U. S. 2,282,018*) and J. Crosfield & Sons (*Brit. 534,745*). The same concern (*Brit. 521,910*) described a cleaner made of sodium silicate and 5% soap and processed in a manner that the specific gravity did not exceed one.

Several soap formulas contained inorganic phosphorus compounds. Small amounts of various phosphates were used to improve the solubility and prevent calcium salt precipitation (Lever Bros.—*U. S. 2,277,728-30*). Lind (*Ger. 707,120, 703,604 Cl. 8i*) added the reaction product of orthophosphoric acid and hydrogen peroxide or other oxygen yielding mixtures to soap. Alkali phosphates prevented efflorescence in soaps containing sodium carbonate (Heald —*U. S. 2,278,352*). Other patents dealing with soaps containing inorganic phosphates included using mixtures of phosphates, silicates and sodium carbonate as the inorganic builder (Refining Inc.—*U. S. 2,271,407-8*; Jasco Inc.—*U. S. 2,274,584*), the technic for manufacturing such products (Kokatnur—*U. S. 2,285,093*) and a detergent containing phosphates, soap and fat acid sulfates (Colgate-Palmolive-Peet Co.—

Brit. 535,809). Harris, Eck and Cobbs (*Oil & Soap 19,* 3) fostered the use of tetrasodium pyrophosphate with wash tests demonstrating its superiority to certain other inorganic soap builders.

Several other soap stretchers were described. Croulard (*Fr. 851,812*) prepared soap containing up to 90% barium sulfate. Methyl acrylic acid and its polymers improved soaps highly filled with talc (Gröner — *Ger. 711,700, 719,348 Cl. 23e*). Bergell (*Ger. 682,068 Cl. 23e*) recommended adding 20% powdered sodium bicarbonate while the soap was hot and molten. Gaver (*U. S. 2,300,413*) saponified the soap stock with alkali metal starchate. Instructions for making various soaps containing starch were issued by Krings (*Deut. Parafüm-Ztg. 24,* 408, 428).

Most interest in fat saponification was centered on continuous processes. The improvements in the systems were various new procedures and devices, as centrifuges, driers, means of mixing and counter flowing reactants, etc. (Colbeth — *U. S. 2,270,856;* Mills—*U. S. 2,287,698;* Lorenz—*U. S. 2,262,950;* Refining Inc.—*U. S. 2,271,406, 2,283,776; Brit. 519,516, 519,565;* Scott—*U. S. 2,300,749, 2,302,382*). Data on a process of saponifying fats in a small pilot plant at high temperatures with anhydrous alkali in the presence of a hydrocarbon diluent showed that 86% of the glycerol could be recovered and the residual kerosene solvent in the soap could be reduced to less than 0.4% (Jacobs—*Ind. Eng. Chem. 34,* 322). A new soap making process which allowed almost complete recovery of glycerol comprised methylation of the fats, separation of glycerol and saponification of the ester (E. I. duPont de Nemours & Co.—*U. S. 2,271, 619; Brit. 543,604;* Bradshaw— *Soap 18,* No. 5, 23). Saponification with a mixture of potassium hydroxide and alkali hypochlorite was patented (Deutsche Solvay-Werke A.-G.—*Ger. 704,880, Cl. 23e*).

Proteins from house grease and some crude vegetable oils were salted out of soap by adding 40° Be sodium silicate with a silicon dioxide content of at least 2½ times the sodium oxide content (Treffer—*Soap 18,* No. 1, 24). The success of the process depended on having the soap completely neutral. The salting out process in coconut oil soap manufacture required at least 20% sodium hydroxide. As an economic measure, to avoid neutralizing the spent lye, Worsley (*E. African Agr. Research Sta. Amani Ann. Rept. 13,* 11) recommended that the lye be used for the saponification of another oil such as cottonseed or kapok and produce a soap capable of being salted out with salt. The patented methods of removing unsaponifiable from soaps prepared from oxidized petroleum hydrocarbons were various procedures and systems for distilling the non-soap portion (Jasco Inc.—*U. S. 2,287,128;* Noblee & Thörl G.m.b.H.— *U. S. 2,283,456; Ger. 703,634 Cl. 23e;* Märkische Seifen-Industrie—*Ger. 704,428, 706,951 Cl. 23d*).

Mills (*U. S. 2,295,594-6*) adjusted chilling, extruding, spray drying and milling conditions in the manufacture of bar, powdered and flake soaps so that substantial amounts of the products were in the β-phase. The improvements realized in the soaps were greater solubility and better sudsing. Soap agitated at 65 to 125° and 100 pounds per square inch pressure and solidified by releasing would have a density less than water (Bodman—*Brit. 539,718*). A special press for manufacture of floating soap sealed an air chamber in the bar centers (Jones—*U. S. 2,271,979*). Special dies for soap plodders were designed by Pears and Slack (*Brit. 545,116, 545,118*). Walter (*U. S. 2,299,958; Can. 402,646*) improved the process by which soap was extruded in small hollow strands and dried on moving beds. Subjecting soap to a steaming and a drying zone after it was in bar, tablet or flake form improved the gloss and transparency (Lever Bros. & Unilever Ltd.—*Brit. 538,675, 538,934*). Other soap inventions were means of inserting insignia (Garvey *et al.—U. S. 2,296,842;* Block—*U. S. 2,292,359*), a machine for cutting soap (Chaney—*U. S. 2,280,373*), a special cake form (Swanson—*U. S. 2,271,959*) and a soap mitt containing floating soap (Botelho—*U. S. 2,269,871*).

Considerable physical chemical information on soaps and soap solutions was recorded. Bretteville and McBain (*Science 96,* 471) discovered x-ray evidence for a third crystallographic form of sodium stearate. Ross (*J. Phys. Chem. 46,* 414) discussed the electron microscope and x-ray diffraction photographs that have already been recorded in the literature and proposed that a correlation be sought between the orientation displayed in them. McBain (*Advances in Colloid Sci. 1,* 99) discussed solubility and related factors in detergent action. Surface tension curves for 35 detergents were included. McBain with coworkers (*J. Phys. Chem. 46,* 429) also prepared solubility curves for sodium palmitate in glycerol, diethylene glycol, palmitic acid, isopropyl, ethyl, *n*-heptyl and *n*-cetyl alcohols, *o*-, *m*- and *p*-cresols, *n*-heptane, *n*-cetane and Nujol. The colloidal nature of these systems was indicated by formation of gels, jellies and liquid crystalline phases by the occurrence of syneresis and by the appearance of sharp elbows in the solubility curves, often attributed to the formation of micelles. Palit (*Current Sci. 10,* 436; *J. Indian Chem. Soc. 19,* 271) observed that a mixture of a monohydric and a polyhydric alcohol had a strong solvent action on soaps, but individually they were nonsolvents at ordinary temperatures. Data on the solvent action of the C_1 to C_4 alcohols with various glycols, glycerol and aliphatic and aromatic hydrocarbons were developed.

X-ray and viscosity investigations on soap solutions were reviewed by Hess (*Fette u. Seifen 49,* 81). New measurements and data were recorded by Kiessig (*Kolloid-Z, 96,* 252), Stauff (*Ibid.* 244), Philippoff (*Ibid.* 255), Ekwall (*Ibid. 97,* 71) and Lamm (*Ibid. 98,* 45). In general, ionization occurred at low concentration; above a critical concentration spherical micelles were formed, and at the approximate concentration corresponding to a minimum in the conduction curve the formation of large foil-like shapes was assumed. According to Stauff the diameter of the spheres was about 48 Å, the foil thicknesses were about 250 Å and their other dimensions a multiple thereof. Similar data on soap and other surface active agents and a discussion of arrangement of the soap molecule appeared in Kiessig's communication. Lamm observed that micelle formation moved to lower concentrations as the carbon chain was increased and was further lowered by the presence of salt. For example, the transportation of sodium laurate occurred at 0.025*N*, while in 0.1*N* KOH and 1*N* KCl the formation of the micelles was complete at 0.005*N*.

Philippoff's contribution included viscosity curves, x-ray patterns and a model proposed for the small micelles of potassium laurate. Viscosity and surface tension data on soap-phenols-water systems were recorded by Angelescu, Manolescu (*Ibid. 96,* 75) and Golubkova (*J. Phys. Chem. U.S.S.R. 15,* 198). In interfacial tension work with paraffin oil and water, Cavier (*Compt. rend. 213,* 70) observed that sodium dibromoricinoleate was more surface active than sodium ricinoleate, and α-bromolaurate was more surface active than the laurate.

Standard methods for sampling and analysis of commercial soap and soap products were revised and issued by an Am. Chem. Soc. Committee (Smither *et al.—Ind. Eng. Chem. Anal. Ed. 14,* 558). General methods for evaluating wetting agents were published by the A.A.T.C.C. (*Am. Assoc. Textile Chem. & Colorists 19,* 248, 303).

Matt (*Chem. Analyst 30,* 79) reported moisture in soft soap as the loss in weight after heating 30 minutes at 100° under a 15-20 inch vacuum. The dehydration of crystals of inorganic soap fillers or builders by boiling in nonaqueous liquids was recorded by Trusler (*Oil & Soap 19,* 1). These data have analytical significance upon applying distillation methods for the determination of moisture in soap products. A conductometric method of rapidly approximating the active ingredients of commercial wetting agents was developed by Percy and Arrowsmith (*Ind. Eng. Chem. Anal. Ed. 14,* 151). A committee of the Am. Assoc. of Textile Chemists and Colorists has shown that the steam distillation method for determining immiscible organic solvents volatile with steam in wetting agents was reliable even in the presence of coconut oil fat acids (Hart—*Am. Dyestuff Reptr. 31,* 64). A method of determining fat acids in soap comprised acid hydrolysis, solvent extraction and drying (Kedvessy—*Ber. ungar. pharm. Ges. 17,* 506). Advice on similar methods by Grossfeld (*Chem.-Ztg. 65,* 153) and Lund and Arstad (*Tids. Kjemi Bergvesen Met. 1,* 32, 83) dealt with preventing losses of lower fat acids through their solubility in water. Zile and Blank (*Oil & Soap 19,* 156) used a Schrötter alkalimeter apparatus for determining carbon dioxide in soap products.

The Soap Analysis Committee of the A.O.C.S. recommended official adoption of a volumetric method for determining sodium pyrophosphate in soap (Sheely—*Oil & Soap 19,* 211). Cohn and Kolthoff (*Ind. Eng. Chem. Anal. Ed. 14,* 886) precipitated the pyrophosphate with cadmium and polarographically measured the amount of cadmium in the precipitate. A system for estimating the ortho-, pyro-, meta-, and polyphosphates in the presence of one another was developed by Jones (*Ind. Eng. Chem. Anal. Ed. 14,* 536). The composition, buffer capacity, titration curves and pH of several soap builders were recorded by van der Hulst and Schuffelen (*Chem. Weekblad 38,* 134).

A miscellaneous group of data included the foam formation and foam stability of several washing agents (Pankhurst—*Trans. Faraday Soc. 37,* 496), the conductance of several alkyl sulfates and sulfosuccinates (Haffner *et al.—J. Phys. Chem. 46,* 662) and adsorption of wetting agents by wool (Le Compte and Creely—*Am. Dyestuff Reptr. 31,* 121). Morgan and Lankler (*Ind. Eng. Chem. 34, 1158*) recommended alkyl aryl sulfonate detergents for cleaning metals. Amine emulsifiers were identified by conversion into aromatic sulfonyl derivatives and determining physical constants (Shupe—*J. Assoc. Off. Agr. Chem. 25,* 227).

A small laboratory machine for evaluating washing agents contained devices for repeatedly passing a test ribbon through a solution of the sample and between rollers (Hesse—*Fette u. Seifen 49,* 436). Gould and Selheimer (*Soap 18,* No. 3, 29) described the construction and operation of a low cost, laboratory sized reflectometer designed to measure the degree of whiteness of standard launderometer washing test samples of cloth. The pharmacology of soap was represented in a few papers. Lane and Blank (*J. Am. Med. Assoc. 118,* 804) prepared a good review on the effects of soaps and other washing agents on the skin. Soaps increased the toxicity of phenol solutions (Welch and Brewer—*Am. J. Pub. Health 32, 261*). Tergitol wetting agents were only moderately toxic in single doses, and in the usual effective concentrations of 0.05 to 2% their acute toxicity was of no importance (Smyth *et al.—J. Ind. Hyg. Toxicol. 23,* 478). In repeated doses they had a slight cumulative action. Soaps reduced the toxicity of several bacterial toxins when tested by Shwartman response (Mason—*J. Bact. 43,* 54). Between 4.2 and 4.5 mg. of various soaps caused complete 2-hour inhibition of 0.17 mg. of crystalline trypsin (Peck—*J. Am. Chem. Soc. 64,* 487).

The following references are most conveniently listed for this paper. They deal with general reviews, discussions, formulas, etc.:

General soap and glycerol manufacturing communications. Lee—*Chem. & Met. Eng. 49,* No. 5, 125; Snell—*J. Chem. Ed. 19,* 172; Ittner—*Ind. Eng. Chem. 34,* 253; Vallance—*Soap, Perfumery and Cosmetics 15,* 154; Stein—*Seifensieder-Ztg. 68,* 257, 267; Löffl *Ibid.* 291; Levitt—*Indian and Eastern Chemist 22,* 189; Hetzer—*Fette u. Seifen 49,* 47.

Fillers for soap. Meyer—*Seifensieder-Ztg. 67,* 225, 236, 246.

Design for soap factory. Löffl—*Seifensieder-Ztg. 68,* 247.

Soybean oil soap. Ruemele—*Allgem. Oel- u. Fett-Ztg. 38,* 161.

Detergents from petroleum. Flett—*Chem. Eng. News 20,* 844.

Cold saponified coconut oil soaps. Cook—*Tecnoquimica (Buenos Aires) 2,* No. 6, 32.

Fat acids (for soap making). Good—*Soap 18,* No. 5, 19.

Salt water soap. Naylor—*Soap 18,* No. 11, 21.

Liquid soap. Levitt—*Chem. Ind. 50,* 362.

Shaving soap. Anon.—*Fette u. Seifen 49,* 52.

Saddle soaps. Smith—*Soap 18,* No. 6, 30.

Rug and upholstery cleaners. Small—*Chem. Ind. 51,* 738.

Cleaners for varnished surfaces. *Ibid.* 384.

Detergents in the dairy industry. Schwartz—*J. Milk Technol. 4,* 258; Scales—*Food Ind. 14,* No. 4, 51.

Soap in the rubber crisis. Anon.—*Soap 18,* No. 11, 28.

Chemistry of sudsing, washing, cleansing, etc. Hetzer—*Fette u. Seifen 49,* 364.

Soap specifications. Trevithick—*Soap Blue Book 1942,* 139.

Silica builders. Bolton—*Ind. Eng. Chem. 34,* 737; Köhle—*Seifensieder-Ztg. 67,* 373; Foulon—*Allgem. Oel- u. Fett-Ztg. 38,* 125.

Tylose filler formulas. Hermada—*Seifensieder-Ztg. 68,* 343, 353.

Sodium percarbonate soap powder. Angus—*Ind. Chemist 18,* 28.

Sulfite waste liquor used in soap. Juschtin—*Z. Papier, Pappe, Zellulose u. Holzstoff 59,* 5; Burger—*Seifensieder-Ztg. 67,* 243.

Perfuming soap. Chaleyer—*Soap Blue Book 1941,* 131; Ruemele—*Deut. Parfüm-Ztg. 25,* 346.

Glycerin production. Feld—*Seifensieder-Ztg. 67,* 261; Voye—*Ibid.* 251; Gordijenko—*Ibid.* 335, 349; Govan—*Oil & Soap 19,* 79; Ohl—*Allgem. Oel- u. Fett-Ztg. 37,* 69; Daum—*Chem. Ind. 51,* 522.

Fermentation glycerol. Duchenne—*Proc. 16th Ann. Congr. 5 African Sugar Tech. Assoc. 1942,* 45.

Glycerin uses. Levitt—*Chem. Ind. 50,* 34.

New patents on treating soap or fat splitting lyes containing glycerol were a prerefining by removing certain organic impurities with solvents that do not dissolve glycerol (Armour & Co.—*Brit. 535,418*) and an improvement in concentrating apparatus (Davey and Ittner—*U. S. 2,281,534*). Two patents were on concentrating fermentation glycerol (Mnookin—*U. S. 2,275,639*; Soc. ind. nouveaux appareils—*Fr. 49,972*). Van de Griendt patented (*U. S. 2,266,941*) a method of concentrating synthetic glycerol. Parodi-Delfino (*Swiss 213,251 Cl. 36o*) prepared glycerol and propanediol by the hydrogenation of carbohydrates.

Analytical investigators working with glycerol devised a modified procedure for obtaining total residue in crude glycerol (Govan—*Oil & Soap 19,* 27), a method of determining glycerol by oxidation with periodic acid (Bradford *et al.*—*Ibid.* 189) and advice for the use with the dichromate method (Van Zile—*Ibid.* 165, 180).

The patents on non-soap type detergents, which include methods of manufacture, definite compounds, uses, etc., will be listed with only slight classification.

Those on sulfonated fat products were:

Allied Chem. & Dye Corp.—*U. S. 2,271,635, 2,283,199, 2,290,870.*

Alrose Chem. Co.—*U. S. 2,277,805.*

Am. Cynamid Co.—*U. S. 2,295,831.*

Am. Hyalsol Corp.—*U. S. 2,256,877, 2,275,413.*

Böhme Fettchemie G.m.b.H.—*Ger. 683,569, 704,336 Cl. 12o.*

Chem. Fabrik von Heyden A.-G.—*Ger. 709,420 Cl. 12o.*

Colgate-Palmolive-Peet Co.—*U. S. 2,285,773, 2,289,044, 2,303,582, 2,304,767; Brit. 537,255, 538,374-5, 538,407-8.*

Day *et al.*—*U. S. 2,293,026.*

Deutsche Hydrierwerke A.-G.—*Ger. 706,122 Cl. 8o.*

Dow Chem. Co.—*U. S. 2,281,249.*

Dreger and Ross—*U. S. 2,290,583.*

E. I. duPont de Nemours & Co.—*Brit. 522,840.*

Fiero—*U. S. 2,300,780.*

General Aniline & Film Corp.—*U. S. 2,267,731, 2,273,974.*

Gunther *et al.*—*Ger. 719,004 Cl. 12o.*

I. G. Farbenind. A.-G.—*Fr. 850,753, 852,565, 853,686; Ger. 681,338, 682,195, 703,953, 705,179, 705,357, 707,023, 717,680, Cl. 12o, 717,938 Cl. 8k.*

Institute of Paper Chem.—*U. S. 2,297,986.*

Mathieson Alkali Works—*Can. 403,649.*

Monsanto Chem. Co.—*U. S. 2,298,650-1, 2,298,696.*

N. V. de Bataafsche Petrol, Maatschappij—*Brit. 532,539; Ger. 705,224, 717,384 Cl. 12o.*

National Oil Products Co.—*U. S. 2,268,127, 2,268,141, 2,280,118, 2,285,337; Fr. 852,077.*

Procter & Gamble Co.—*U. S. 2,283,437-8, 2,289,391.*

Solvay Process Co.—*U. S. 2,303,212.*

Stirton *et al.*—*U. S. 2,302,070.*

Unichem. Chemikalien Handels A.-G.—*U. S. 2,277,325, 2,292,997-8.*

Detergents, wetting agents and compounds for like uses were prepared by sulfonation of petroleum, coal by-products and other hydrocarbons:

Colgate-Palmolive-Peet Co.—*U. S. 2,285,390.*

G. & A. Laboratories, Inc.—*U. S. 2,288,804-5.*

General Aniline & Film Corp.—*U. S. 2,268,140, 2,282,928.*

Guild—*U. S. 2,303,932.*

J. R. Geigy A.-G.—*Ger. 706,199 Cl. 12o.*

Henkel & Cie. G.m.b.H.—*Ger. 683,316 Cl. 12o.*

Imperial Chem. Industries Ltd.—*Brit. 537,841.*

I. G. Farbenind. A.-G.—*U. S. 2,268,126; Brit. 532,700; Fr. 851,565; Ger. 704,353, 704,948, 718,348 Cl. 12o.*

Marvel—*U. S. 2,268,157.*

Monsanto Chem. Co.—*U. S. 2,267,687.*

National Oil Products Co.—*Fr. 852,588.*

Reed—*U. S. 2,263,312.*

Röhm & Haas—*U. S. 2,301,561.*

Shell Development Co.—*U. S. 2,278,064.*

Soc. pour l'ind. chim. a Bale—*Ger. 705,356, 705,529 Cl. 12o; Swiss 210,984 Cl. 36p.*

Solvay Process Co.—*U. S. 2,265,993.*

Standard Oil Development Co.—*U. S. 2,295,065.*

Sulfonated nitrogen containing organic compounds as amides, imides, amines, etc. were suitable as wetting agents:

Alframine Corp.—*U. S. 2,264,766.*

Am. Hyalsol Corp.—*U. S. 2,256,877.*

Am. Cyanamid Co.—*U. S. 2,265,942, 2,265,944, 2,286,364, 2,305,083.*

Deutsche Hydrierwerke A.-G.—*Ger. 714,394 Cl. 12o.*

E. I. duPont de Nemours & Co.—*Brit. 537,841; U. S. 2,302,598.*

J. R. Geigy A.-G.—*U. S. 2,264,436; Swiss 210,987 Cl. 36a, 211,780-8 Cl. 36o, 211,790, 211,792, 211,795 Cl. 36q, 212,786, Cl. 36o, 212,788 Cl. 36q, 213,547-51 Cl. 36o, 213,562-5 Cl. 36q.*

General Aniline & Film Co.—*U. S. 2,257,148, 2,271,707, 2,272,489.*

Imperial Chem. Industries Ltd.—*Brit. 531,691.*

I. G. Farbenind. A.-G.—*Ger. 703,953, 705,132 Cl. 12o.*

Katz—*Brit. 538,859.*

Lever Bros.—*U. S. 2,279,314.*

Reed—*U. S. 2,276,090.*

Röhm & Haas Co.—*U. S. 2,275,378-9.*

Soc. Chem. Ind.—*U. S. 2,264,927.*

Soc. pour l'ind. chim. a Bale—*Swiss 210,960, 210,962, 210,975-6, 210,979 Cl. 36o, 210,980-1, 212,640, 213,253, 214,093 Cl. 36p.*

Waldmann and Chwala—*Austrian 158,406.*

Many nitrogen containing compounds as alkylolamides, amines, amides, quaternary ammonium derivatives, amidines, etc. were patented as wetting agents:

Alien Property Custodian—*U. S. 2,305,460.*

Am. Cyanamid Co.—*U. S. 2,258,320, 2,274,474, 2,284,086; Brit. 540,376.*

Böhme Fettchemie G.m.b.H.—*Ger. 705,355 Cl. 8o, 719,633 Cl. 12p.*

Carbide and Carbon Chem. Corp.—*U. S. 2,267,965, 2,275,470.*

Compagnie nationale matieres colorantes et manuf. produit chim. du Nord reunies establissements Kuhlmann—*Brit. 543,092.*

Deutsche Hydrierwerke A.-G.—*Ger. 704,388 Cl. 12p, 706,122 Cl. 8o.*

E. I. duPont de Nemours & Co.—*U. S. 2,268,395, 2,279,138; Brit. 535,577.*

Eastman Kodak Co.—*U. S. 2,299,782.*

Emulsol Corp.—*U. S. 2,291,634, 2,299,756, 2,303,366, 2,304,830.*

J. R. Geigy A.-G.—*U. S. 2,276,587; Brit. 533,800, 534,129, 538,718; Swiss 205,898 Cl. 36q, 210,977 Cl. 36o, 210,986 Cl. 36q, 211,778-9 Cl. 36o, 211,791 Cl. 36q, 212,562-4 Cl. 36o, 213,052 Cl. 36p.*

General Aniline & Film Corp.—*U. S. 2,256,186, 2,257,183.*

Harris—*U. S. 2,255,252.*

Hentrich *et al.*—*U. S. 2,295,655, 2,298,533, 2,306,440.*

Imperial Chem. Industries Ltd.—*U. S. 2,303,191.*

I. G. Farbenind. A.-G.—*Brit. 520,394; Fr. 852,792; Ger. 682,393 Cl. 12q, 682,579 Cl. 8o.*

Kritchevsky—*U. S. 2,260,384.*

Lever Bros.—*U. S. 2,279,314.*

Monsanto Chem. Co.—*U. S. 2,267,205.*

Morton Chem. Corp.—*U. S. 2,306,095.*

Orthner *et al.*—*Ger. 718,071 Cl. 12o.*

Parke Davis & Co.—*U. S. 2,274,807.*

Pollak—*U. S. 2,257,481.*

Procter & Gamble Co.—*U. S. 2,265,838.*

Shell Development Co.—*U. S. 2,294,259.*

Soc. pour l'ind. chim. a Bale—*U. S. 2,279,497; Brit. 533,073, 533,219, 537,221, 538,121; Swiss 210,958-9, 210,961, 210,974, 210,977-8 Cl. 36o, 210,982-3, 211,243-7 Cl. 36p, 211,655, 211,657 Cl. 36o, 211,660 Cl. 36p, 212,403 Cl. 36o, 213,378 Cl. 36p, 213,419 Cl. 24a, 213,557, 214,770-6, 214,779-82 Cl. 36o, 214,784-6 Cl. 36 p.*

Standard Oil Development Co.—*U. S. 2,293,265.*

Röhm & Haas Co.—*U. S. 2,264,358, 2,284,118.*

United Shoe Machinery Corp.—*U. S. 2,280,830.*

J. B. Williams Co.—*U. S. 2,277,015.*

Wolf—*Ger. 703,501 Cl. 12o.*

Some patented wetting agents were organic compounds containing only the elements carbon, hydrogen and oxygen, except that one series of patented compounds contained halogens:

Dow Chem. Co.—*U. S. 2,276,116-17.*

General Aniline & Film Corp.—*U. S. 2,265,194.*

Monsanto Chem. Co.—*U. S. 2,283,214.*

Röhm & Haas Co.—*U. S. 2,266,737.*

Standard Oil Development Co.—*Brit. 533,327.*

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