Report of the Literature Review Committee *

24th Annual Review of the Literature on Fats, Oils, and Detergents. Part II.

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Nutrition, Physiology and Biochemistry

FAT NUTRITION. Lectures, reviews and general information communications pertinent to fat in nutrition are on the following topics: fats in the diet (Griffity—*J. Am. Med. Assoc. 164,* 411). nutritive value of fats and oils (Kaneda—*Abura Kagaku 6,* 2), biochemical and nutritional aspects of fats (D'Ambrosio—*Sci. aliment. 1,* 9; Desnuelle—*Rev. franc. corps. gras 4,* 427), role of unsaturated fat in infant nutrition (Hansen—*Am. J. Public Health 47,* 1367), role of unsaturated fat in adult nutrition (Beveridge—*Ibid.* 1370), significance of fats in nutrition (Dam—*Fette-Seifen-Anstrichmittel 58,* 977), metabolism of essential fatty acids (Majima—*Nisshin Igaku 43,* 542), influence of dietary inedible animal fat, aureomycin, and diethylstilbestrol on fattening steers (Erwin—*Univ. Microfilms, Ann Arbor, Mich. Publ. No. 20476,* 89 pp.), nutritional value of polymerized fats (Witting—*Ibid. No. 18212,* 58 pp.), metabolism of lipides (Kennedy—*Ann. Rev. Biochem. 26,* 119), nomenclature of enzymes of fatty-acid metabolism (Beinart *et al.—Science 124,* 614), conversion of fatty acids to carbohydrate (Weiman *et al.—Physiol. Res. 37,* 252), current concepts of intermediary fat metabolism and ketogenesis (Engel—*A.M.A. Arch. Internatl. Med. 100,* 18), and regulation of fat formation (Masoro—*Bull. Tufts New England Med. Center 2,* 169).

The biological utilization of fats is evaluated on the basis of several criteria with rats (Cayama—*Arch. venezolanos nutric. 6,* 139). Here, rate of absorption of various fats is similar; growth is greatest with lard, second with coconut oil, and other edible vegetable oils follow; cottonseed oil which shows a poor weight response is highly absorbed; and caloric efficiencies of lard and vegetable oils are similar and are superior to hydrogenated oils. Corn varieties of high-oil, high-protein content induce better growth in rats than regular corn; however, high-oil corn germ samples result in poorer growth than regular corn germ (Reussner & Thiessen—*J. Nutr. 62,* 575). Rations containing butter and vegetable oil margarine, respectively, show no significant difference in regard to reproduction and lactation when tested with rats (Dryden *et al.—J. Nutr. 61,* 185). Rats fed fatty alcohol esters of sperm whale oil or sperm whale oil containing the fatty alcohol esters suffer from seborrhea and succumb; whereas the glycerides of this oil are digested as easily as butterfat (Fujii & Okura—*Nippon Suisan Kabushikikaisha Kenkyusho Hokoku No. 8,* 35, 39). Large amounts of rape seed oil in rat rations reduce growth but the rats do not succumb as has been reported in some earlier work (Alexander & Mattson—*Fed. Proc. 16,* 379; Beare *et al.—Can. J. Biochem. & Physiol. 35,* 1225). Other observations of feeding substantial amounts of the oil are a longer life span and increase of cholesterol in the adrenal cortex, liver, and feces (Beare—*Food Manuf. 32,* 378). These characteristics of the oil are attributed to its erucic acid, the effects of which are reduced on hydrogenation. Dietary supplements of erucic acid in rations of rats reduce fertility by reduction in spermatogenesis in males and impairment of mammary development and lactation in females (Carroll & Noble—*Can. J. Biochem. & Physiol. 35,* 1093). Rapeseed-oil-fed rats are also characterized by a high storage of erucic acid in the spleen (Bernhard—*Bull. schweiz. Akad. med. Wiss. 12,* 189).

Fat in the nutrition of farm animals is being evaluated as a basis for economical and judicious incorporation of low cost fats in feed formulation. Pigs fed up to five percent sardine oil gain weight faster than controls, at 5–10% the rate is about the same as groups on basal ration, and at 15% of the oil in the ration they go off feed and fail to grow properly (Oldfield *et al.—Com. Fisheries Rev. 19,* No. 4a, 11; *J. Animal Sci. 16,* 917, 922). Generally, however, levels over five percent reduce carcass quality because of fishy odor and taste. Those fed polymerized sardine oil gained weight less quickly than controls, but carcass quality is equal to controls and superior to groups on crude or refined sardine oil. Fats in general are not very well digested by suckling pigs and guinea pigs (Lloyd *et al.—J. Animal Sci. 16,* 377, 383). Here, there is an inverse relationship between mean molecular weight of the fatty acids and apparent digestibility; digestibility increases as the animals age up to eight weeks; and these relationships are not significantly altered by variations in degree of unsaturation. Increasing increments of dietary fat in the ration of the weanling dog increase the protein requirements (Ontko *et al.—J. Nutr. 62,* 163). The work on supplementing dairy cow rations with fat shows that milk (Stull *et al.—J. Dairy Sci. 40,* 1238), and fat content of the milk (van Laarhoven—*Off. Org. Kgl. Ned. Zuivelbond. 45,* 564; Eskedal—*Beretn. Forsogslab. 268,* 5) are increased. Ruminants (sheep) are able to utilize lower fatty acids for energy, and synthesis of protein and body fat (Armstrong *et al.—Brit. J. Nutr. 11,* 392, 413). Corn oil and tallow when fed at a 12% level are utilized by the chick to the extent of about 90 and 73%, respectively, as measured by intestinal absorption (March & Biely—*Poultry Sci. 36,* 71). In this study two samples of hydrogenated fat

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are utilized only to the extent of 23 and 44 percent, respectively. In another study, 5–10% of animal fat added to a laying ration deranges lipide metabolism by one or more of the following symptoms: elevated plasma cholesterol and total lipide, excess deposits of body fat, friable and fatty livers, fatty deposits around kidney, and greater severity of aortic atherosclerosis (Weiss & Fisher—*J. Nur. 61*, 267). Carcass quality of chickens fed up to two percent added tallow in their rations is good, but menhaden oil at 0.5% and higher induces fishy off flavors (Carlson *et al.—Food Tech. 11*, 615). Caged bees fed vegetable oil succumb quickly, but when the oil is fed in candy at 1–2% level, their lives are not shortened and they build thicker, heavier cell walls than colonies fed candy without oil (Örösi-Pal—*Mehészet 4*, No. 5, 87).

New information is recorded on essential fatty acid deficiency and metabolism of essential fatty acids. The deficiency may be produced by severe caloric restriction and is accelerated by dietary supplements which induce hypercholesterolemia (Aases-Jorgensen & Holman—*Fed. Proc. 16*, 142). Essential fatty acid deficiency in young swine is not characterized by consistent or early skin lesions as in other species, but causes high mortality and may lead to impairment of the arterial walls (Hill *et al.—Proc. Soc. Exptl. Biol. 95*, 274). These acids are required for the development of the pink bollworm (Vanderzant *et al.—J. Econ. Entomol. 50*, 606). The increased oxygen consumption observed as a part of the fat-deficiency syndrome in rats is not due to hyperthyroidism (Morris *et al.—Fed. Proc. 16*, 90). The ability of liver mitochondria of fat deficient rats to oxidize a number of the Krebs citric acid cycle intermediates at a faster rate than normal mitochondria is a newly observed syndrome of essential fatty acid deficiency (Levin *et al.—J. Biol. Chem. 228*, 15). In rats on a fat free diet there is a decrease of polyunsaturated acids in the blood cholesterol esters and an increase of monoenoic acid at the expense of saturated acid components in the blood glycerides and phospholipides (Mukherjee *et al.—Ibid. 226*, 845). More detailed analysis with fat-deficient dogs shows lowered serum levels of di-, tetra-, penta- and hexaenoic acids in all lipide fractions, but higher levels of trienoic acids in the cholesterol esters and phospholipide fractions (Wiese *et al.—J. Nutr. 63*, 523). Similar studies with essential fatty acid deficient chicks are interpreted to indicate that dienoic acid is converted to tetraenoic and pentaenoic acid, and possibly also to hexaenoic acid (Bieri *et al.—Arch. Biochem. Biophys. 68*, 300). In similar studies a decrease in dienoic fatty acid with concurrent increase in the trienoic acid of the whole body of fat-deficient chicks is interpreted to indicate that the former are converted to the latter (Dam *et al.—Acta Physiol. Scand. 37*, 142). Also when rats are fed methyl linoleate as the sole source of fatty acids the milk contains significant quantities of di-, tri-, and tetraenoic acids (Hallinger & Schultze—*Proc. Soc. Exptl. Biol. Med. 96*, 473). The observation that serum lipides in infants on low fat formula show extremely low values in di- and tetraenoic fatty acids and high values for trienoic fatty acids is discussed with regard to fat deficiency in infants and as a clinical sign of fat deficiency (Hansen *et al.—Fed. Proc. 16*, 387). However, in applying such criteria, one must be aware that the normal content of such components differs widely with the species. Thus, dienoic acid at 4.6% is high in steers as compared to 2.4 and 2.7% in the dog and rabbit, and tetraenoic acid at 12.9% in the dog is markedly high in contrast to the average of 2.9% in the rabbit (Evans & Oleksyshyn—*Am. J. Physiol. 187*, 596). The depot and organ lipide composition picture of rats through essential fat deficiency and rehabilitation with diets supplemented with essential fat show that the fatty acid distribution is typical of the state of fat deficiency even after growth is resumed (Mead—*J. Biol. Chem. 227*, 1025).

The observations that high dietary levels of hydrogenated peanut oil damages testes, kidneys, and skin of rats is interpreted by one group of investigators to indicate that isomers formed during hydrogenation could be in part responsible (Aases-Jorgensen—*3e Congr. intern. biochem. 1955*, 117; *Brit. J. Nutr. 11*, 298, 426). This effect is counteracted by linoleates. Another group of investigators found no evidence of antimetabolic activity effects from the isomers of hydrogenated fats (Alfin-Slater *et al.—Fed. Proc. 16*, 379; *Proc. Soc. Exptl. Biol. Med. 95*, 521; *J. Nutr. 63*, 241). Their comprehensive tests involved feeding isomerized fats through 46 generations of rats, judging on the basis of weight, reproduction, lactation, longevity, histopathological examination, and utilization of essential fatty acids. The isomers are shown to be harmless, digestible and of full nutritive value. It is probable that the work of Holman *et al.* (*Proc. Soc. Exptl. Med. Biol. 96*, 705) may explain the disagreement between the two studies just cited. They found that prolonged ingestion of high levels of saturated fat may lead to a relative deficiency of essential fatty acids.

Fat nutrition in relation to other dietary components is also investigated. With pups, a 20% fat in the diet needed 25% protein to obtain a maximum growth response, and further increases of protein are required when the fat content is increased (Ontko *et al.—J. Nutr. 62*, 163). In work with rats wherein the dietary protein is held constant and the other energy sources varied between fat and carbohydrate, the results indicate that the amount of fat does not affect nitrogen retention nor efficiency of calorie utilization, but that the protein to calorie ratio is the important factor in interpreting results (Yoshida *et al.—Ibid. 63*, 555). Results from similar work show disadvantages of fat in contrast to carbohydrates as the source of calories, but these disadvantages are overcome by increasing riboflavine and choline or methionine in the fat rich diets (Koyanagi & Katsumata—*Nippon Nogeikagaku Kaishi 30*, 683). The observation in regard to riboflavin is also observed on work with cats and is interpreted to indicate that the high carbohydrate diets induce more synthesis of riboflavin in the intestines than do high fat diets (Gershoff & Hegsted—*Fed. Proc. 16*, 386). Investigations on why feeding fat ameliorates the development of pyridoxine deficiency suggest that it may be indirectly the result of the animal eating less protein and therefore it needs less pyridoxine (Williams & Cohen—*Ibid.* 402). In growing animals, calcium and phosphorus utilization from isocaloric diets is best when fats supply 5 to 20% of the caloric energy (Vasil'eva—*Voprosy Pitaniya 15*, No. 6, 11).

It is postulated that prefeeding of high-fat diets induces changes in the organism which permits higher sustained rates of heat production in the cold (LeBlanc—*Can. J. Biochem. & Physiol. 35*, 25). This postulation results from the observation that the large amount of fat accumulated in animals fed a high-fat diet cannot explain, either as a source of energy or as an insulator, the superiority of such diets in maintaining rectal temperatures at high cold levels.

A decrease of the duration of thiopental anesthesia (sleeping time) by a fatty meal or intravenous administration of fat emulsion is said to be produced by virtue of the chylomicronemia which the fats develop (Anderson & Magee—*J. Pharmacol. Exptl. Therap. 117*, 281; Blaskovics & Winters—*Fed. Proc. 16*, 283). In one of these studies *(B. & W.)* it is also observed that there is a three-fold increase in thiopental concentration in the small intestines of the fat-fed rats in contrast to the controls.

With highly unsaturated oil in diets, rat incisor teeth become white and histological alterations are apparent (Irving—*J. Dental Res. 35*, 930). Both changes are averted by dosage with vitamin E.

Because fats and oils, heat-abused in the laboratory, have been reported to be impaired, this possibility is now more practically studied on commercial frying operations. One study of 34 samples of used fats obtained from restaurants, bakeries and producers of potato chips showed that even the most severe usage causes only slight decrease in caloric availability and slight increases in liver size in tests with rats (Rice *et al.—Fed. Proc. 16*, 398). Another survey of operations of 86 different potato chip manufacturers shows that the frying fats decrease about 1% in iodine value and that this is of no nutritional significance (Melnick—*J. Am. Oil Chemists' Soc. 34*, 351). In another cooking investigation, used lard produced better growth in rat tests than unheated lard, whereas heated olive oil or butter induce less growth than the unheated fat (Selva—*Boll. soc. ital. biol. sper. 32*, 1059).

In a laboratory test, where sesame oil is abusively heated, the absorption by rats is poor and the calcium in the ration is not absorbed as well as from control rations (Sinka *et al.—Indian J. Physiol. & Allied Sci. 10*, 76). In similar work with abusively heated and oxygenated peanut oil, the rats fed the oxidized-heated oil as 20% of the diet did not grow as well as the controls (Dangoumau—*Rev. franc. corps gras 4*, 541). More comprehensive studies, in which thermally oxidized and thermally polymerized oils are investigated, are recorded on fish oil, corn oil, hydrogenated shortening and lard (Johnson *et al.—J. Am. Oil Chemists' Soc. 34*, 421, 594; *Proc. 8th Conf. Am. Meat Inst. 1956*, 15). Here, thermal oxidation reduces *in vitro* hydrolysis by pancreatic lipase, and *in vivo* absorption rate from rats intestines; and ratio of liver to body weight is increased. The thermally polymerized oils are toxic to rats. At low protein level the growth depression and toxicity of the oils are partially overcome by supplementation of the diet with pyridoxine. Riboflavin aids the animals in coping with autoxidized fat but did not contribute protective action against thermal polymers. In the above studies more thermal damage occurs with those oils high in linoleic acid content. In

heat polymerized menhaden oil the non-urea-adduct-forming fraction of the distilled esters is toxic to rats to a degree comparable with the toxicity of a similar fraction from heated linseed oil (Common *et al.—J. Nutr. 62,* 341). Here, also toxicity is associated with polymerized polyunsaturated acids.

Injected oxidized squalene, linoleic acid and simpler peroxides kill rats more quickly than peroxides developed in the body by X-irradiation (Horgan *et al.—Biochem. J. 67,* 551). Since this may be a question of distribution, the total evidence in this work is consistent with the view that radiation toxicity is due to initiation of chain autoxidation of essential fatty acids producing lethal doses of peroxides in sites not reached by vitamin E. Rats fed emulsified cottonseed oil after 1000r X-irradiation die sooner than irradiated controls force fed water (Akin *et al.—Radiation Res. 6,* 543).

Breeding studies with rats on diets containing the polyoxyethylene partial ester emulsifiers show that survival of newborn litters is somewhat diminished with several of the emulsifiers at 10% level and in all at the 20% level (Oser & Oser—*J. Nutr. 60,* 489; *61,* 149). Increasing the fat level of the ration improved survival in tests with some of these emulsifiers. The clinical and metabolic observations in this work reveals no indication of the existence of any recognizable nutritional deficiencies.

Some fat nutrition studies pertain to observations under intravenous feeding. A "stearin" fraction from beef fat, melting at 53–55°, administered intravenously into dogs is highly lethal, whereas emulsions of the softer fraction of the fat, melting at 25–28° is well tolerated by dogs and monkeys (Payne *et al.—Surg. Forum, Proc. 41st Congr. Am. Coll. Surgeons 1955,* 24). At autoclaving temperatures a type of browning occurs in emulsions containing phospholipides which involves reaction of glucose with both lecithin and cephalin (Benerito *et al.—Proc. Soc. Exptl. Biol. Med. 94,* 47). The reaction is responsible for the formation of a colloidal material in the emulsion which may be involved in certain adverse physiological results occasionally experienced with their use. In one study on intravenous fat emulsions containing soybean phosphatide and Pluronic F-68 as emulsifiers adverse physiological reactions are reduced from 51% of the subjects to 33% by purification of the phosphatides used (Mueller—*J. Lab. Clin. Med. 50,* 257). In a comparison of parenterally administered fat emulsified with Tween 80, Span 20, gelatin, and polyvinylpyrolidone, respectively, in dogs, intravenous injections cause cardiovascular changes; whereas subcutaneous injections are well tolerated (Tritapepe—*Atti. soc. lombarda sci. e biol. 11,* 30).

A correlation between the rapidity of clearing and the febrile response after infusion of fat into the human blood is interpreted as evidence that the fibrile response may be due to rapid oxidation of the fat with resultant endogenous heat production and should be considered a physiological reaction in susceptible individuals (Mueller—*J. Lab. Clin. Med. 50,* 267). In this work a clearing test is devised which measures the rapidity at which blood is cleared of infused fat. Emulsions containing cottonseed oil, soybean phosphatides, Pluronic, and dextrose improve clearing activity and increase migration (electrophoretic) of lipoproteins, but with injections of protamine all these phenomena and clotting time of the blood are reversed to normal conditions (Lever & Baskys—*J. Invest. Dermatol. 28,* 317, 321). Small intravenous doses of soybean phosphatides cause little change in blood coagulation; large doses are anticoagulant probably through depressing prothrombin (Spaet & Kropatkin—*Proc. Soc. Exptl. Biol. Med. 95,* 492). Data from a comprehensive clinical study of intravenous fat alimentation show: there was no change in blood clotting time in 10 of 38 patients; there was no outstanding change in platelet counts of 11 patients after 600 cc. of intravenous fat emulsion; and nitrogen balance after gastric resection was not affected by 1000 cc. of fat emulsion given daily (Shingleton *et al.—Surg. Forum, Proc. 41st Congr. Am. Coll. Surgeons 1955,* 18). Negative nitrogen and potassium balances produced by caloric privation are significantly decreased when 15% fat emulsions providing 1200–1400 cal. per day are given intravenously (Bentley *et al.—J. Lab. Clin. Med. 48,* 184).

INTESTINAL ABSORPTION OF FATS. Many mechanisms occurring from the time a fat is ingested until it leaves the intestines complicate methods and interpretation of results from investigation on absorption of fats. Because some information is pertinent to such studies, although not specifically involving determinations of absorption, the results are cited in the foregoing along with material on absorption of fats.

Where the rate of absorption of fat is calculated from the amount recovered from the intestines of rats, a correction should be applied for the amount of fat retained in the stomach (Tidwell & Johnston—*Proc. Soc. Exptl. Biol. Med. 94,* 150). This retention might be the result of either some effect of the fat itself or to the physical or emotional state of the experimental animal. The composition of lipide recovered from the small intestines of man fed butterfat is very similar to that found in the small gut of dogs fed cottonseed oil (Knoebel & Nasset—*J. Nutr. 61,* 405). In this investigation data and information are presented on the rate of digestion and absorption of fat, and on hydrolysis and resynthesis of fat in man and dog. In a polemic on exchange of fatty acids among separate glycerides occurring in the intestinal lumen, the manner of calculating such exchanges is discussed (Bergström—*J. Am. Oil Chemists' Soc. 34,* 250; Reiser—*Ibid.* 251). In ruminants, the factors of synthesis of fats from non-fatty material and hydrogenation of ingested fat are involved in fat digestion to a great extent (Shorland & Weenink—*Biochem. J. 67,* 328; Hartman—*J. Am. Oil Chemists' Soc. 34,* 129; Pennington & Pfander—*Biochem. J. 65,* 109). In the horse *trans* fatty acids are formed by bacteria in the intestines, but unlike in ruminants these are not absorbed; probably because the formation may be in the post-absorptive region of the intestines (Hartman *et al.—Nature 178,* 1057).

Iodine-131-labeled triglycerides are being used in studies on digestion and absorption of fats. Labeling fat in this manner does not affect its properties in respect to lipolysis and incubation with fecal homogenates (Pover *et al.—Congr. intern. biochem., Brussels 1955,* 119). The iodine-131 appears and disappears in lymph triglycerides and phosphatides thus permitting a convenient manner for tracing absorption and fate of fats in the body (McCandless & Zilversmit—*Fed. Proc. 16,* 85). It is suitable for studying both orally and intravenously administered fat (van Handel & Zilversmit—*Ibid.* 131). The technique is used to demonstrate that the third quarter of the intestines of rats is the main site of olive oil absorption (Chandler & Benson—*Gastroenterologia 85,* 160). It is being used in clinics to study and observe patients with chronic pancreatitis, malabsorption syndromes, and subtotal gastrectomies (Spencer & Mitchell—*Am. J. Digestive Dis. 2,* 691; Isley *et al.—Proc. Soc. Exptl. Biol. Med. 94,* 807). Another simple fat absorption test for clinics is based on serum turbidity (Osmon *et al.—J. Am. Med. Assoc. 164,* 633).

Some recorded data seem pertinent to techniques where absorption or digestibility is based on the blood lipide behavior after fat ingestion. Total lipides and phosphatide contents of serum of infants are recorded for hourly intervals up to five hours after nursing (Cipolloni—*Riv. clin. pediat. 8,* 428). Based on fat content in the blood after administration, triolein is absorbed as well as is butter (Eggstein & Dörner—*Verhandl. deut. Ges. inn. Med. 62,* 503). In this work mono-, di- and tristearin do not increase fat in blood, probably because of slow rate of absorption; and similar results with tricapryl, tricaprin, and trilaurin are explained on the basis of rapid rate of distribution in the body after absorption.

The particulate blood fat level response is highest after triglyceride and diglyceride ingestion than after ingestion of monoglycerides or free fatty acids (Tidwell—*Am. J. Physiol. 189,* 537; *Fed. Proc. 16,* 400). Feeding the monoglyceride with olive oil improved their absorption. The observations are discussed with respect to hydrolysis and interchange of fatty acids during absorption. In similar work with D-labeled palmitic acid, the monopalmitin is absorbed more completely than the free acid, or tripalmitin, but more slowly than the tripalmitin (Buensod & Favarger—*Helv. Physiol. et Pharmacol. Acta 14,* 299). Rats fed diets high in free oleic acid excrete a lipide containing two atoms of calcium, 2 moles of oleic acid and a mole of phosphate (Field & Treadwell—*J. Biol. Chem. 233,* 743). The formation of this lipide in the intestines greatly impairs the absorption of administered oleic acid. The absorption of oleic acid from the ileal loops of dogs is not improved by desiccated ox bile, but may be increased by including sodium bicarbonate in the perfusion, by Nembutal anesthesia and by atropine administration (Annegers—*Fed. Proc. 16,* 4; *Am. J. Physiol. 191,* 75). Rats absorb methyl eicosenate and methyl erucate to the extent of 90–95% when fed at 5% of the diet (Hopkins *et al.—J. Am. Oil Chemists' Soc. 34,* 505). After 12 weeks on the diet those fed the former have 28% eicosanic acid in their body fats; those fed the latter have body fats containing 12% erucic acid.

The absorbability of saturated fats including fully hydrogenated lard, saturated monoglycerides or acetylated monoglycerides derived from lard are improved by adding lard or unsaturated fatty material to the diet (Herting *et al.—Fed. Proc. 16,* 388). There is no change in digestibility of soybean oil when fed to human subjects for four weeks at the rates of 30–110 g. per day (Hayami *et al.—Ann. Rept. Natl. Inst.*

Nutr., Tokyo, 1956, 12). The absorption coefficient of fat in premature infants on a human milk diet is a little less on pasteurized milk or milk supplemented with acidified skim milk than with the fresh raw milk (Lust *et al.—Semaine hop. Ann. pediat. 32,* 3547).

Some fat absorption studies pertain to the function of pancreatic juice during the process. When pancreatic juice is excluded, utilization of both unsaturated and saturated fats is impaired (Ivy *et al.—Acta Physiol. Scand. 38,* 207; Karvinen *et al.—Am. J. Physiol. 188,* 61; *189,* 113). This and other data from the work suggest: that on exclusion of the pancreatic juice more endogenous lipides are eliminated; desaturation of saturated fat by pancreatic dehydrogenase is not essential for absorption of saturated fat; and fat utilization is more closely correlated with melting point than with saturation. Administration of pancreatic lipase with an olive oil test meal to human subjects accelerates the development of maximum in blood neutral fat and also results in an increase of lipide in the β-lipoprotein fraction (Gronow *et al.—Klin. Wochschr. 34,* 860). When pancreatic lipase is applied to powdered hard fat and to olive oil emulsions, respectively, it is adsorbed on the hard fat and in the emulsion it attaches to the fat at the interfaces in a manner that resists removal (Sarda *et al.—Biochem. et Biophys. Acta 24,* 425). In one fat absorption study such factors as bile acids, intestinal juices, emulsification, hydrolysis and resynthesis are investigated in relation to entry of lipides into the intestinal cells, their exit from these cells, and their fate in the cytoplasm (Frazer *et al.—Gastroenterologia 85,* 146). The results from administration of olive oil, oleic acid and combination of these are interpreted with regard to the resynthesis that takes place before absorption.

Glycerol-1,3-C^{14} administered to subject can be traced in the serum triglycerides, phosphatides and α- and β-lipoprotein. The development of peak activities and the distribution of the activity in the above named fractions are recorded for patients with idiopathic hyperlipemia (Gidez & Eder—*Fed. Proc. 16,* 186).

INTERMEDIATE METABOLISM OF GLYCERIDES. The term intermediate metabolism, for this review, involves transport from the intestines, synthesis occurring in tissues, biological oxidation, storage, and catabolism.

The belief that the free fatty acids occurring in the lymph lipide during fat absorption are original constituents rather than the result of hydrolytic processes in the lymph is substantiated by tests in which five differently labeled free fatty acids are traced into the lymph (Borgström & Tryding—*Acta Physiol. Scand. 37,* 127). Labeled fat transport studies show that stearate and oleate appear in the blood triglyceride fractions during the first two hours; after that stearate is mainly in phospholipides; and ingested linoleate appears largely as phospholipide and significantly as sterol ester (Mead & Fillerup—*J. Biol. Chem. 227,* 1009).

Factors other than ingested fat that affect blood lipide concentrations are investigated. In rabbits, injections of large doses of cobalt chloride cause important increases in blood lipides (Berthaux & Cophignon—*Compt. rend. soc. biol. 150,* 2154). The mechanism of this action is obscure. The plasma lipide levels of young pigs after a 16–18 hour fast show a significant relationship to the ability of animals to gain weight (Bowland & Hironaka—*J. Animal Sci. 16,* 62). Such a measurement when taken from pigs at 100 lbs. weight is useful for predicting fat and lean content of pig carcasses at market weights. Emulsified fat infused into pancreatectomized dogs is cleared from the blood at a normal rate if the animal is receiving insulin whereas without insulin the injected fat is cleared slowly (Waddell & Geyer—*Proc. Soc. Exptl. Biol. Med. 96,* 251). This suggests that the clearance of fat from the blood is dependent upon carbohydrate utilization. In this work the rise and fall of blood cholesterol is likewise dependent upon the supply of insulin. In rabbits treated with prednisone, the neutral fat fraction increases more than the phospholipides and cholesterol (Ratti & Salteri—*Atti. soc. lombarda sci. med. e biol. 12,* 86). This hyperlipemia is reduced by simultaneous administration of methionine and choline. Hyperlipemia produced by injection of adrenaline also involves increases in the neutral fat fraction of the lipides (Dury—*Circulation Res. 5,* 47). Force-fed adrenalectomized rats gain weight at the same rate as normal force-fed controls; thus indicating that no deviation in total metabolism of fat results from lack of adrenal glands (Cohn & Joseph—*Am. J. Physiol. 189,* 68). The hypophysectomized rat utilizes more exogenous and endogenous fat than normal controls (Matthews *et al.—Ibid. 188,* 308). This increased utilization is accompanied by a slight hyperlipemia which may be accounted for by an increase in serum cholesterol, a decreased fat content of the liver and an increase of total body fat.

On clearing lipides from blood by injections of heparin, there is a rapid fall of tri- and diglyceride concentration and an increase in monoglycerides (Carlson & Wadström—*Clin. Chim. Acta 2,* 9). This suggests that the clearing reaction involves hydrolysis of triglycerides similar to the action of pancreatic lipase on fat emulsions. Engelberg (*J. Applied phys. iol. 11,* 155) indicates that endogenous lipoprotein lipase is the major plasma enzyme involved in splitting neutral fat, and also that a lipase similar to pancreatic lipase may be present in small amounts. On injecting butter emulsion in dogs the pseudocholinesterase activity of the plasma behaves as a lipase (Pettoni—*Atti e mem. accad. patavina sci. lettere ed arti Pt. II, 65,* 132). The hyperlipemia that occurs after administration of the surface active agent, Triton, may be the result of coating of the plasma lipoprotein, thus inhibiting natural lipoprotein lipase action (Schotz *et al.—Am. J. Physiol. 188,* 399).

The total lipide and phosphatide content of rat lungs doubles eight hours after ingestion of 1.5 ml. of olive oil and subcutaneous injection of phosphorus compounds (Schrade & Biegler—*Klin. Wochschr. 34,* 1247). The data suggest that the lungs have an active role in lipide metabolism.

Much work on fat metabolism concerns deposition and removal of fat from the liver. In the production of fatty livers in rats through choline deficiency, the dietary and depot fats are both involved in the formation of the liver lipides (Wagner *et al.—Hoppe-Seyler's Z. physiol. Chem. 306,* 96). Rats fed a diet containing 30% butterfat require a higher level of choline to reduce the level of liver fat to within normal range than do rats fed a diet containing 30% of corn germ oil (Benton *et al.—Proc. Soc. Exptl. Biol. Med. 94,* 100). Cystine, methionine, trytophane or all three of these amino acids do not affect these results. In another test where butter is compared with linseed oil at the 17% level there is no significant difference in liver fat, but non-fat fed controls had less fat in their livers (Allegri *et al.—Rass. fisiopatol. clin. e terap. 29,* 325). Methionine or cystine supplementation of low protein diets is not as effective in lowering fat and cholesterol in rat livers as equivalent amounts of intact protein (Okey & Lyman —*J. Nutr. 61,* 103). Feeding excess methionine in a low protein diet to rats accelerates the loss of body fat and increases the production of liver cholesterol (Roth & Milstein—*Arch. Biochem & Biophys. 70,* 392). The body fat lost is most probably used for production of the acetate to be funneled into cholesterol production in the liver. Methionine prevents the lipide accumulation in the liver that is induced by administration of ethionine whereas lipocaic and pancreatic anti-fatty liver factor do not (Sachdev—*Indian J. Med. Res. 45,* 227). The fatty livers induced by administration of triethylcholine or ethionine derivatives involve increases of neutral fat and cholesterol but the phospholipide content of the livers remain the same (Okuzono—*Kumamato Med. J. 9,* 61). Methylthiouracil induces a fatty infiltration in the livers, which is prevented by simultaneous administration of insulin and glucose (Pyatnitskaya—*Problemy Endokrinol. i Gormonoterap. 2,* No. 4, 96). A cold environment greatly reduces the tendency to fatty liver production (Treadwell *et al.—J. Nutr. 63,* 611). Phytol is established as a lipotropic factor in young, growing rats kept on a choline-free diet (Bernhard & Ritzel—*Z. physiol. Chem. 295,* 187). Acute fatty infiltration occurs on intravenous administration of various rare earths (Kyker—*Fed. Proc. 6,* 207).

Depancreatized baboons in which diabetes is controlled by administration of insulin do not develop fatty livers (Gilman & Gilbert—*S. African J. Med. Sci. 21,* 46). Thus neither lipocaic nor pancreatic juice plays a part in preventing fatty liver in the baboon, as they apparently do in other species. Adrenalectomized rats do not show fatty infiltration of the liver after ethanol intoxication, whereas intact controls do (Mallov & Gienke—*Am. J. Physiol. 189,* 428). This suggests that the adrenalectomized rats catabolize fat in their livers more rapidly than do fed intact rats.

Injection of an enzyme complex comprising D-amino acid oxidase, lipoxidase-citrogenase, and tyrosinase in rats on a choline-free diet causes a partial decrease of fat in the liver (Schulze & Krüskemper—*Verhandl. deut. Ges. inn. Med. 62,* 497). The choline oxidase activity of dietary produced fatty livers is lower than that of normal livers, but in the presence of ethylenediaminetetraacetic acid the activity is equal to that of the normal liver (Friedel—*Hoppe-Seyler's Z. physiol. Chem. 304,* 91). The reduced oxygen uptake of dietary produced fatty livers is raised by addition of succinate, whereas salts of fumaric, malic, aspartic, glutamic, and tartaric acids do not affect the respiration rate (Frunder & Friedal—*Ibid. 295,* 77). This indicates a deficiency in the diphosphopyridine nucleotide

systems. In producing fatty livers by dietary means, a decrease in adenosine triphosphate and an increase in adenosine diphosphate in the liver is evident very early and is quite marked when the fatty livers are developed (Dianzani—*Biochem. J. 65,* 116). Supplements of carnitine and choline, respectively, act differently in choline-deficient rats for the former augments ketogenesis in livers while the latter enhances complete oxidation of fat to carbon dioxide (Fritz—*Am. J. Physiol. 190,* 449; Fritz & DuPont—*Ibid.* 453). Impairment of oxidation to carbon dioxide in fatty liver slices in the presence of octanoate occurs with excess formation of ketone bodies (Rees & Kline—*Ibid.* 446).

In a search for clinical tests that diagnose fatty livers it is observed that under fatty liver conditions patients show a decreased rate of excretion of bromsulphalein; increase of urinary bile pigments, serum β-globulin and cholesterol; decrease of serum albumin; positive thymol turbidity reaction; and a normal cephalin flocculation test (Jansen—*Deut. med. Wochschr. 81,* 742).

Much information pertains to synthesis of lipides by liver fractions. Dituri *et al.* (*J. Biol. Chem. 226,* 407) demonstrate that some of the essential enzymes for lipogenesis are located in the mitochondria of the liver cells and that adenosine triphosphate (ATP), diphosphopyridine nucleotide (DPNH) and coenzyme A (CoA) are required for incorporation of acetate and pyruvate into fatty acids by particle-free extracts of liver. The main products of synthesis with mitochondria are triglycerides; phospholipides are formed at a half to a third of the rate of triglycerides; and very little cholesterol esters are formed (Stein *et al.*—*Biochem. & Biophys. Acta 26,* 286). In such systems α-glycerophosphate acts as the glycerol donor (Stein & Shapiro—*Ibid. 24,* 197). In a series of work on this system at the University of Wisconsin it is observed, that synthesis of fatty acids is catalyzed by at least four different subfractions derived from the soluble fraction of pigeon liver; that the cofactors required are ATP, CoA, glutathione, DPNH, manganese, isocitrate and triphosphopyridine nucleotide, and that palmitic acid and progressively smaller amounts of myristic, lauric, and decanoic acids are formed (Gibson *et al. Ibid. 23,* 219; Wakil *et al.*—*Ibid. 24,* 453; Porter *et al.*—*Ibid. 25,* 35, 41. Similar observations are made from work on the enzyme system of chicken livers (Tietz—*Ibid.* 303) and of pig livers (Derks & Moore—*Fed. Proc. 16,* 171). Langdon (*J. Biol. Chem. 226,* 615) believes that the fatty acid synthesis in rat livers occurs in the soluble cytoplasm of the cells and may occur exclusively there. In this process TPNH serves as an electron donor for the reduction of α-, β-unsaturated acyl CoA derivatives. In the entire system of breaking down fatty acids and resynthesis, at low concentrations the fatty acids are oxidized, but at concentrations of 10^{-3} *M* and higher they inhibit their own oxidation, the oxidation of pyruvate, and those of the acids of the tricarboxylic acid cycle (Scholefield—*Can. J. Biochem. & Physiol. 34,* 1211, 1227). In this work, the presence of decanoate, which inhibits oxidation of pyruvate, is associated with a phosphorylation process which is uncoupled by the decanoate. The presence of short chain acids of C_3 to C_5 inhibit acetate metabolism without affecting incorporation of acetate into synthesized fatty acids (Masoro *et al.*—*Arch. Biochem. & Biophys. 68,* 270). This suggests that the acids exert a regulatory action on acetyl metabolism.

A fatty acid-activating enzyme preparation from hog-liver particles is described, which in the absence of added CoA catalyzes the formation of inorganic pyrophosphate, adenosinemonophosphate, and hydroxamic acid from ATP, fatty acid, hydroxyl amine and magnesium ion (Jencks & Lipmann —*J. Biol. Chem. 225,* 207). The function of butyryl adenylate in the fatty acid-activating system involves reaction with pyrophosphate to form ATP and with CoA to form butyryl CoA (Lee Peng—*Biochem. et Biophys. Acta 22,* 42). Tests with several fatty acyl adenylates, show that the acetic derivative can replace ATP and acetate; and hexanoyl and octanoyl adenylates are readily oxidized and replace the ATP requirement for oxidation of hexanoic and octanoic acids, respectively (Whitehouse *et al.*—*J. Biol. Chem. 226,* 813).

Acetate is incorporated to a greater extent into phospholipides than into phosphorus-free lipides when incubated in liver slices in an atmosphere of 95% oxygen, whereas the inverse is true for systems with less oxygen (Lands—*Fed. Proc. 16,* 208). Biotin-deficiency, which induces greater oxidation of acetate in animals, does not seem to decrease the rate of lipide synthesis in the liver (Gram—*Ibid.* 387). Administration of pituitary growth hormone reduces the rate of incorporation of pyruvate and acetate into fatty acids and phospholipides by rat liver slices, whereas the incorporation of these into cholesterol is stimulated (Greenbaum & Glascock—*Biochem. J. 67,* 360). Results in another study indicate that growth hormone is not ketogenic and does not increase the rate of catabolism of fatty acids by the liver (Perry & Friesen —*Can. J. Biochem. & Physiol. 35,* 497). The liver of adrenalectomized rats utilizes fatty acids rapidly, shows increased ketone formation and decreased synthesis of fat from acetate (Perry & Bowen—*Am. J. Physiol. 189,* 433). With this increased utilization of fat by the liver the fat in body depots is gradually mobilized. In a broad study of synthesis of lipides by rat liver homogenates it is observed that: alloxan reduces synthesis of cholesterol and fatty acids; insulin reduces cholesterol synthesis but increases fatty acid synthesis; and starvation reduces carbon dioxide production with no greater tendency to degrade preformed cholesterol than normal rat livers (Scaife & Migicovsky—*Can. J. Biochem. & Physiol. 35,* 15). Thyroxine interferes in the lipide metabolism of liver by favoring phosphorylation (Bertolini & Guardamagna —*Giorn. biochim. 5,* 357). Rats fed Aureomycin metabolize fats in the liver and deposit fat in the body similar to control animals (Anderson & Coniglio—*Proc. Soc. Exptl. Biol. Med. 96,* 352). Data presented here is of interest in view of conflicting reports on effects of antibiotics on liver lipides, mobilization of fat from body stores, and absorption of fat from the intestines.

In studies wherein fat emulsions are perfused through isolated livers *via* the portal vein, it is observed that methionine and vitamin B_{12} greatly accelerate phagocytosis and lipide formation in the Kupffer cells thus promoting oxidation to the ketone stage, and that riboflavin appears to be indispensable for the later stage of fat metabolism (Seno—*Arch. Japan Chir. 24,* 179).

The sciatic nerves of rats pretreated with a cholinesterase inhibitor metabolize lipide precursors at a rate less than nerves of untreated control animals (Karnovsky & Majno—*Congr. intern. biochim., 3e, Brussels 1955,* 85). Acetate and octanoate perfused into monkey brains are used for synthesis of fatty acids and sphingolipides but not for cholesterol (Sperry *et al.* —*Ibid.* 42).

Propionate and malonate are metabolized to fat by adipose tissue at 100–200 times faster than by liver tissues (Feller & Feist—*J. Biol. Chem. 228,* 275; *Fed. Proc. 16,* 36). The observations are discussed with respect to mechanisms of fat synthesis in adipose tissue. Mesenteric adipose tissue of starved rats takes up fatty acid from media at a much greater rate than the tissue of starved rats that are refed before dispatching; the activity in normal fed controls is intermediate (Shapiro *et al.*—*Biochim. & Biophys. Acta 23,* 115). The mechanism involved is discussed.

A partially purified enzyme preparation extracted from lactating rabbit mammary gland catalyzes the synthesis of even-numbered-chain fatty acids from C_4 to C_{18}, with the shorter-chain acids preponderating (Popjak & Lauryssens—*Biochem. J. 65,* 348). Studies in which radioactive metabolites are injected into cows show that: carbonate is fixed into the glycerol of the milk fat but only to a small extent into the fatty acids; acetate is the principal butterfat precursor whereas propionate appears mainly in the carbohydrate; butyrate is used to form both milk fat and carbohydrate; and the carbon of formate only appears in the glycerol radical (Rogers & Kleiber—*Biochim. & Biophys. Acta 22,* 284). Acetate injected into one quarter of the milk cistern of a lactating cow is used to synthesize butterfat in that quarter with very little diffusion into the other three quarters or into the rest of the body (Rogers & Kleiber—*Proc. Soc. Exptl. Biol. Med. 94,* 705). When the supernate of rat liver, that is capable of a very low order of lipide synthesis, is added to mammary homogenate from lactating rats the rate of incorporation of acetate into lipides is increased about 35% (Hirsch & Munson—*Fed. Proc. 16,* 196).

Housefly larvae are able to synthesize body fat from dietary protein or cholesterol without any source of fatty acids or carbohydrate in the medium (Levinson & Bergmann—*Biochem. J. 65,* 254). During the development of ascaris eggs to the vermiform stage lipides are converted to carbohydrates (Passey & Fairbairn—*Can. J. Biochem. & Physiol. 35,* 511).

In the dehydrogenation of fatty acid derivatives of CoA, strong complexes of enzymes and substrate are formed (Beinart & Page—*J. Biol. Chem. 225,* 479). The observations are discussed with respect to the mechanism by which flavoproteins catalyze the dehydrogenation. The kinetics of this reaction are also used to interpret the mechanism of dehydrogenation (Hauge—*J. Am. Chem. Soc. 78,* 5266). In the cytochrome c reductase system, triglycerides catalyze or restore activity to the system by releasing endogenous vitamin E to the active sites of the enzyme (Donaldson—*Proc. Natl. Acad. Sci. U.S. 43,* 364).

In fasted rats, administered serum bound C^{14}-labeled palmitate is efficiently converted into carbon dioxide as measured by radio activity of expired air; whereas in rats fed carbohydrates only small amounts of labeled carbon dioxide appear in expired air (McCalla *et al.—Arch. Biochem. & Biophys. 71,* 346). Under physiological conditions ascorbate catalyzes the oxidation of saturated fatty acids to carbon dioxide (Geyer *et al.—Arch. Biochem. & Biophys. 70,* 129). A study of metabolism of 2,2,17,17-tetramethylstearic acid in rats shows that: 36–40% appears in the lymph, wherein 83–87% is in esters, 10–14% is present as free acid and 3% as phospholipide compounds; no significant portion of its carbons is expired as carbon dioxide; and most of the acid absorbed is excreted *via* bile as the dicarboxylic acid formed by oxidation of the terminal methyl group (Tryding & Westöö—*Arkiv. Kemi 11,* 291). The structure of dicarboxylic particles isolated from the urine indicate that the original tetramethylstearic acid is split at both odd and even carbon atoms between the positions of branching.

In the biosynthesis of the fatty acids of the plasma of man from administered acetate-1-C^{14} the highest concentration of radioactivity appears in the palmitic acid fraction followed by those of stearic and oleic acids (Lipsky *et al.—J. Clin. Invest. 36,* 233). In this work, the absence of demonstratable activity in the linoleic fraction signifies the lack of endogenous formation of this polyunsaturated acid.

A study of the metabolic pathway of linolenate-1-C^{14} shows that linolenate does not contribute appreciably to synthesis of linoleic acid and that it is not converted to arachidonic but to a different polyunsaturated acid, possibly eicosapentaenoic (Howton & Mead—*J. Biol. Chem. 224,* 841). The appearance of large amounts of tetraenoic acid in the red cells and heart muscle of guinea pigs fed methyl linoleate as the only lipide indicates that this fatty acid is the precursor of arachidonic acid (Bieri *et al.—Biochim. et Biophys. Acta 23,* 650). Poultry rations containing linseed oil induce increase in both linoleic and linolenic acid content of egg fat, whereas soybean and safflower oil only increase the linoleic acid content despite the fact that soybean oil contains 7–8% of linolenic acid (Fisher & Leveille—*J. Nutr. 63,* 119).

The influence of rations containing peanut, cottonseed, soybean, and corn oils; peanut, palm kernel, soybean and coconut meals on the amount and composition of back fat and leaf fat in the pig are recorded (Witt—*Fette-Seifen-Anstrichmittel 59,* 736). Although amount and quality of bacon and lard are the interests in this work the data have implication in fat metabolism. In similar work the influence of changing the kind of fat in pig diets is related to composition and firmness scores of the carcass (Blumer *et al.—J. Animal Sci. 16,* 68). The average backfat thickness of male swine is significantly increased as a result of chlortetracycline supplementation of feed; but this effect is compatible with a trend toward greater over-all carcass fatness (Kelly *et al.—Ibid.* 74).

Following tung oil feeding to cows, increased amounts of conjugated dienoic acid appear in all plasma lipide fractions, and increased amounts of conjugated trienoic acid are found in sterol esters, and possibly in the phospholipides, but not in the glycerides (Garton *et al.—Biochem. J. 67,* No. 3, 20-IP).

The relationship of iodine values to content of individual fatty acids, and relationship of oleic acid, respectively, to stearic, palmitic, and palmitic plus stearic, and palmitic plus oleic to stearic acids from analyses of many beef, pork and horse fat samples are presented graphically and regression equations, correlation coefficients and other statistical data are calculated (Dahl—*J. Am. Oil Chemists' Soc. 34,* 81, 349). The physiological bases for the correlations or their lack are discussed in regard to fate of feed fats, formation of fats from carbohydrates, and mechanism of fat synthesis in these species. With increasing storage of neutral fat in the perirenal fat depots of the albino rat increases also occur in cholesterol, cholesterol esters, and water per unt nonlipide dry weight (Boyd & Lower—*Can. J. Biochem. & Physiol. 35,* 157).

Observations are made on some phases of fat mobilization from body depots. In fasted rats, calories needed for survival are derived mainly from fat depots and a small proportion from protein (Hagan & Scow—*Am. J. Physiol. 188,* 91). With prolonged fasts up to 27% of the calories may be derived from protein. Whenever fat is rapidly mobilized to or from adipose tissue, acetal phosphatides and total phospholipides are greatly increased (Yarbro & Anderson—*Proc. Soc. Exptl. Biol. Med. 95,* 556). A specific hormone extract of hog posterior pituitary induces rapid mobilization of fat when administered to laboratory animals (Seifter & Baeder—*Ibid. 95,* 318, 747). Administration of the hormone induces hyperlipemia and subclinical fatty livers, and with fasted animals these fat loads are intensified. An active lipide mobilizer dialyzed from the plasma of cortisone-treated horses is tentatively identified as a peptide (*Ibid.* 469). Such lipide mobilizers do not alter the characteristic fall in concentration of serum lipides that follows evisceration-hepatectomy (Kaplan & Jacques—*Fed. Proc. 16,* 69). This suggests that liver and/or viscera are essential for the lipide mobilizers to produce a hyperlipemia. A water soluble material extracted from spleen has lipide mobilizing activity; whereas an extract from the lipide portion of the spleen had anabolic properties (Meduri & Notario—*Arch. sci. med. 103,* 179). These contrariwise effects are discussed with regard to the spleen being involved in the regulation of intermediary fat metabolism. Epinephrine administration induces rise in serum triglycerides, whereas cortisone or ACTH do not (Kaplan *et al.—Am. J. Physiol. 191,* 8). Injection of adrenaline activates a lipolysis of the depot neutral fat (Wadström —*Nature 179,* 259). The fat metabolic processes that are intensified by thyroidin are reduced by castration, extirpation of the thyroid gland, and administration of insulin (Tors'ka—*Fiziol. Zhur. Akad. Nauk Ukr. R. S. R. 3,* No. 3, 92). The turnover rate of endogenous total body fat is almost twice as rapid in hypophysectomized rats than in normal rats (Matthews *et al.—Am. J. Physiol. 188,* 308).

PHOSPHOLIPIDES, CHOLESTEROL, AND LIPOPROTEINS. Most of the information on these lipides is pertinent to the study of diseases, particularly atherosclerosis, and will be cited under lipides in the diseased state.

Some reviews and general information communications pertinent to the non-triglyceride lipides are on: structure of brain tissue lipides (Lebaron & Folch—*Physiol. Revs. 37,* 539), acetalphospholipides of brain tissue (Ansell & Norman—*Congr. intern. biochem. Résumés 3e Congr., Brussels 1955,* 81). biosynthesis of cholesterol (Hake—*Univ. Microfilms, Ann Arbor, Publ. No. 19827,* 120 pp.), regulatory mechanism of the blood cholesterol (Favarger—*Ann. biol. clin., Paris, 15,* 156), biochemistry of cholesterol (Paget—*Ibid.* 127), and state and role of the circulating cholesterol (Tayeau—*Ibid.* 177). In a symposium on the chemistry and metabolism of phosphatides, the papers presented contain information on sphingolipides, glycolipide chromatography, structure of lecithins, inositol phosphatides, quantitative partition of acetal phospholipides and free lipide aldehydes, acetal phosphatides, nitrogenous constituents of animal tissue lipides, quantitative chromatography of phosphatides, cephalin separations, biosynthesis of phospholipides, and biosynthesis of phosphatides in brain and nerve (various authors—*Fed. Proc. 16,* 816–855).

The chromatographic separation of the mixed phospholipides from rat liver, beef liver, and yeast on a single silicic acid column is described (Hanahan *et al.—J. Biol. Chem. 228,* 685). A method for estimation of lecithin, cephalin, and sphingomyelin in the human erythrocyte is based on calculations from determinations of total choline, nonlipide choline, total phosphorus, lecithin-choline, and lecithin plus phosphorus (Formijme *et al.—Clin. Chim. Acta 2,* 25). Peptides associated with the lipides of human serum are of constant composition whether separated by dialysis, chromatography or partition between two solvents (Cheftel *et al.—Bull. soc. chim. biol. 39,* 291). In a study of human-brain lipides at various ages in relation to myelination, data are recorded on the cerebroside, cholesterol, phosphatide, lecithin, sphingomyelin cephalin A and cephalin B in the cortex and white matter from brains of humans of various ages from birth to 65 years (Tingey—*J. Mental Sci. 102,* 851). Analytical data on the lipid content of the adrenal cortex of the rat during regeneration after denucleation show that the phospholipides increase whereas cholesterol changes very little (Pellegrino & Torcigliani—*Boll. soc. ital. biol. sper. 32,* 1331). In a characterization of serum lipides by electrophoretic separation followed by elution technique, phospholipides and sphingolipides are separated and estimations are made of the amount of protein in phospholipides of albumin and α-globulin type *versus* protein of β-globulin type (Wunderly—*Naturwissenschaften 42,* 579). The major component of lipides of ram spermatozoa are aldehydogenic lipides of a choline base (Lovern *et al.—Biochem. J. 67,* 630).

Intestinal absorption of phospholipides is increased with simultaneous administration of triglyceride or cholate whereas ingestion of excess cholesterol or phospholipides appears ineffective (Byers & Friedman—*Am. J. Physiol. 191,* 87). Serum phospholipide increases are induced by choline administration, and with removal of choline containing food, a significant decrease in serum phospholipides occurs (Rosenfeld & Lang—*Can. J. Biochem. & Physiol. 35,* 845). Alimentary lipemia in dogs does not appear to increase the disappearance of injected labeled plasma phosphatides from the blood or the synthesis of hepatic and intestinal phospholipides (McCandless & Zilver-

smit—*Ann. J. Physiol. 191,* 174). Choline, betaine, and inositol stimulate biosynthesis of phospholipides in animals on a low protein diet (Snyder *et al.—Proc. Soc. Exptl. Med. Biol. 96,* 670). The order of effectiveness for this purpose and for lipotropic effect is in descending order, as listed.

In incorporation of phosphorus from orthophosphate into the phospholipides of rat livers, most of it goes to make phosphatidic acids (Marinette *et al.—Biochim. et Biophys. Acta 25,* 585). These phosphatidic acids may act as precursors of D-α,β-glycerides and thus furnish the glyceride moiety of glycerophosphatides (Weiss *et al.—Nature 178,* 594). A single injection of CoA stimulates liver phosphalipide synthesis in choline-deficient and pantothenic-deficient rats; oxalacetate stimulates it in choline-deficient rats (Cornatzer *et al.—Proc. Soc. Exptl. Biol. Med. 94,* 363; *Congr. intern biochem. 3e Congr. Brussels, 1955,* 61). In an *in vitro* study of formation of inositol containing lipides by guinea pig kidney preparations the various factors required for synthesis are elaborated (Agranoff *et al.—Biochim. et Biophys. Acta 25,* 445). Very comprehensive work of this type is done with regard to synthesis of the phospholipides in rat-brain dispersions (McMurray *et al.—Biochem. J. 66,* 621). Skin does not directly synthesize phospholipides but extracts them from either circulating plasma following passage through the liver or directly from nutritional sources (Leonardi *et al.—Z. physiol. Chem. 295,* 310).

The plasma phosphoprotein in the estrogenized cockerel is exclusively hepatic in origin (Vanstone *et al.—Can. J. Biochem. & Physiol. 35,* 659).

The prominence of the atherosclerosis problem has intensified interest in developing clinical methods for determination of cholesterol in blood. New procedures are described for applying the Liebermann reaction for this purpose (Lemaire *et al.—Ann. biol. clin., Paris, 15,* 333; de Traverse *et al.*—Ibid. 236, 257; Lapin—*Sbornik Nauch. Trudov Samarkand Med. Inst. 11,* 103; Francke—*Lebanese Pharm. J. 5,* 36; Mangin & Mangin—*Bull. soc pharm. Nancy No. 32,* 7). In some communications various modifications of Liebermann methods are evaluated (Vannini—*Arch. E. Maragliano patol. e clin. 12,* 793; Guillot—*Ann. biol. clin., Paris, 15,* 263, 324). Where paper chromatography is applied, means of determining the cholesterol and its various derivatives are also given (Michalec —*Naturwissenschaften 42,* 509; Fieser *et al.—J. Org. Chem. 22,* 1380; Zimmerman & Braese—*Pharmazie 11,* 715; Martin—*Biochim. et Biophys. Acta 25,* 408). There are also new procedures for estimation with digitonin (Kabara—*J. Lab. Clin. Med. 50,* 146; Liebschutz—*Rev. asoc. bioquim. arg. 21,* 203). Modifications and evaluations are made for the methods based on iron reagent (Herrmann—*Proc. Soc. Exptl. Biol. Med. 94,* 503; Rosenthal *et al.—J. Lab. Clin. Med. 50,* 318; Rice & Lukasiewicz—*Clin. Chem. 3,* 160; Henly—*Analyst 82,* 286; Zak—*Tech. Bull. Registry Med. Technologists 27,* 71). A known fluorometric procedure is modified to gain rapidity (McDougal & Farmer—*J. Lab. Clin. Med. 50,* 485). The optical density of turbidity provoked in serum by sodium alcoholate and the content of total cholesterol are correlated to serve in a turbidity method for analysis (Velu & Velu—*Ann. Biol. clin., Paris, 14,* 676). The cephalin-cholesterol precipitation test is modified to improve rapidity (Bunch—*Tech. Bull. Registry Med. Technologists 27,* 143).

Three compilations of data on cholesterol content of foods are published (Hayes & Rose—*J. Am. Dietetic Assoc. 33,* 26; Heyrowsky *et al.—Caspis lekuru ceskych 96,* 657; Sevcikova—*Vyziva lidu 11,* 44).

Relatively high contents of linoleic, linolenic and arachidonic acids are found in the sterol-ester fatty acid mixture of plasma lipides of the cow (Garton *et al.—Biochem. J. 67,* 340, 345). This suggests that dietary polyunsaturated fatty acids which escape hydrogenation in the rumen may be preferentially esterified with cholesterol during or subsequent to their absorption from the alimentary tract. Fecal microorganisms do not synthesize significant amounts of sterols from acetate but are capable of degrading both cholesterol and β-sitosterol (Coleman & Baumann—*Arch. Biochem. & Biophys. 72,* 219). When 7-dehydrocholesterol is fed to rats 7-coprostenol appears among the intestinal sterols (Coleman & Baumann—*Arch. Biochem. & Biophys. 71,* 287). Cholesterol feeding has no significant effect on vitamin A stores in female rats, but the liver vitamin A levels of adult males are significantly lowered (Green *et al. —Biochem. J. 67,* 223, 235). The excess cholesterol which is synthesized in dogs with biliary fistulae can not be controlled by daily feeding of physiological amounts of bile or cholic acid (Kelly *et al.—Fed. Proc. 16,* 71). Biliary excretion of bile acid and cholesterol by bile fistula rats is determined in the interest of knowing how much of these are prepared by liver.

Various phases of biological synthesis of cholesterol are investigated. Injected acetate appears in the squalene and lanosterol of intestines and of liver (Schneider *et al.—J. Biol. Chem. 224,* 175). This work also demonstrates the presence of an intermediate in the conversion of lanosterol to cholesterol. The cholesterol contents of the liver and plasma of lymph-fistula rats are several times that of normal rats (Swell *et al. —Science 125,* 1194). These results are interpreted with respect to regulation of lymph cholesterol. The blocking of synthesis of cholesterol from liver slices of biotin-deficient rats and resumption in presence of dimethylacrylic acid signifies that in biotin deficiency the carboxylation step necessary in the synthesis is blocked (Jacobsohn & Corley—*Fed. Proc. 16,* 200). The ability of slices of liver from x-irradiated rats to incorporate 10 times as much acetate into cholesterol as that of controls may be due to some deficiency in the substrate (Bucher *et al.—Ibid.* 17). A study of the correlation that exists between cholesterol inhibition and elongation of the carbon chain of saturated acids suggests that the site for the inhibition is at the stage where acetoacetate is formed from acetyl CoA (Wood & Migicovsky—*Can. J. Biochem. & Physiol. 35,* 645). In a comprehensive study of synthesis of cholesterol in tissues it is observed that: in aortic tissue of rabbit and chicken, synthesis is 0.5% of that of liver; synthesis in the liver tissue is decreased in thyroid-deficient female rats or by oophorectomy; whereas in the male it is increased by pretreatment with estrogen or tetraiodothyroacetic acid, while castration is without effect (Noble & Boucek—*Fed. Proc. 16,* 94). In another study double-labeled acetate is used to support the concept that rates of equilibration of synthesis vary widely in different tissue (LeRoy *et al.—J. Lab. Clin. Med. 49,* 858). In this work the synthesis observed in skin is at a slow rate. In other work on synthesis of cholesterol by skin, the response of the skin to various hormones is described (Kandututsch—*Fed. Proc. 16,* 69), and intermediates formed are compared with those formed in the synthesis by liver (Brooks & Baumann— *J. Biol. Chem. 229,* 329). In children the squalene content of sebum is lower and the cholesterol content is higher than in adults (Boughton *et al.—Biochem. J. 66,* 32). The poor synthesis of cholesterol from injected acetate by mature rat brains suggests that some "barrier" substance may be present (Nicholas—*Fed. Proc. 16,* 324). This greater incorporation of acetate into cholesterol by brain of younger rats is also true of incorporation of injected pyruvate (McMillan *et al.—Proc. Soc. Exptl. Med. Biol. 96,* 738). Feeding of squalene to rats leads to greater synthesis of cholesterol in the liver and prevents uptake of acetate into the sterols, whereas farnesol feeding has neither of these effects (Karniven & Laakso—*Fed. Proc. 16,* 70).

Mechanisms involved in the biosynthesis of cholesterol are studied. Certain aspects of the mechanism are derived from observations on biosynthesis from precursors such as: zymosterol (Alexander & Schwenk—*Arch. Biochem. & Biophys. 66,* 263, 381; Johnston & Block—*J. Am. Chem. Soc. 79,* 1145), β-hydroxy-methyl-δ-valerolactone (Isler *et al.—Chimia, Switzerland 11,* 167), mevalonic acid (Wright & Cleland—*Proc. Soc. Exptl. Biol. Med. 96,* 219), and squalene and lanosterol (Tehen & Bloch—*J. Biol. Chem. 226,* 921, 931; Olson *et al.—Ibid.* 941). In tests on finding possible carboxylic acid intermediates, neither β,β-dimethylacrylic nor β-hydroxyisovaleric acid appears to be an obligatory precursor, β-methylglutaconic can be a precursor, and α-phenylbutyric acid probably inhibits cholesterol synthesis (Adamson and Greenberg—*Biochim. et Biophys. Acta 23,* 472). A block produced in the biosynthesis of cholesterol by liver of starved rats is located in the pathway between β-hydroxy-β-methylglutaric acid and squalene (Scaife & Migicovsky—*Can. J. Biochem. & Physiol. 35,* 615).

Cholesterol biosynthesized by liver slices from acetates, respectively labeled at the methyl and carboxyl groups is analyzed to show origin of all 27 carbons (Cornforth & Gore— *Biochem. J. 65,* 94). These data are in harmony with the theory that squalene is a precursor.

When cholesterol-4-C^{14} is metabolized to hydroxycholesterol the C^{14} appears in the 25th and 26th carbon and no radioactivity appears in the acidic steroids of the bile (Frederickson & Ono—*Biochim. et Biophys. Acta 22,* 183). *In vivo,* cholesterol is a precursor of estrone (Werbin *et al.—J. Am. Chem. Soc. 79,* 1012).

The prominence of the atherosclerosis problem has encouraged many studies on quantitative evaluation of serum lipoprotein fractions. Many of these analytical studies also contain some quantitative data under normal and diseased conditions to demonstrate the clinical usefulness of the tests. Due to limitation of space and in accord with the desire for brevity these publications are classified and cited without details. Most of the methods make use of electrophoresis technique for the

purpose (Brown *et al.—Proc. Exptl. Biol. Med. 92,* 587; Nury & Smith—*Clin. Chem. 3,* 110; Wang & Aldersberg—*Circulation Res. 5,* 288; Dangerfield & Smith—*J. Clin. Pathol. 8,* 132; *Congr. intern. biochem. 3e, Brussels 1955,* 124; Lloyd & Stewart—*Ibid. 9,* 248; Hirsch & Cattaneo—*Klin. Wochschr. 34,* 581; Schettler *et al.—Ibid.* 684; Fischer—*Ibid.* 849; *35,* 268; Cagli *et al.—Boll. soc. ital. biol. sper. 32,* 573; Antonini & Sodi—*Ibid.* 687; *Sperimentale 106,* 423; Lemaire *et al.—Ann. med., Paris, 57,* 5; Uriel & Grabar—*Bull. soc. chim. biol. 38,* 1253; Haag—*Ann. biol. clin., Paris, 14,* 465; Fassina—*Giorn. biochim. 6,* 91; Jencks & Durrum—*Congr. intern. biochim. 3e, Brussels, 1955,* 145; Bramezza—*Friuli med. 12,* 441). The ultracentrifuge method of isolation of β-lipoproteins is modified to gain rapidity (Oncley *et al.—J. Am. Chem. Soc. 79,* 4666). In the high speed centrifugation of serum the cholesterol that rises to the surface is associated with chylomicrons and that which does not rise and is a part of the readily extractable cholesterol is present in lipomicrons (Forbes *et al.—Proc. Soc. Exptl. Biol. Med. 95,* 546). β-Lipoproteins prepared by the ultracentrifuge have been fractionated to various ranges of densities and the distribution of the cholesterol, phospholipides, and peptide nitrogen among these is recorded (Oncley & Mannich—*Congr. intern. biochim. 3e, Brussels, 1955,* 144). One analytical study shows the relations of the electrophoretically defined lipoproteins to the fractions isolated by the centrifuge (Pezold *et al.—Clin. Chim. Acta 2,* 43). Lipoproteins are also isolated into fractions of high and low density by adsorption on freshly precipitated calcium oxalate and elution of the precipitate with various solutions (Sandor *et al.—Compt. rend. 244,* 524; Burstein & Samaille—*Congr. intern. biochim. 3e, Brussels, 1955,* 143). β-Lipoproteins and euglobulins of cerium are precipitated with 25% polyvinylpyrrolidone solution (Burstein—*Ibid.* 3189). At pH 7.5–8.6 β-lipoglobulins are the only proteins in human serum that are adsorbed on certain macromolecular polysulfate esters (Bernfeld *et al.—J. Biol. Chem. 226,* 51). With carboxylate resin the β-lipoproteins are adsorbed at pH 7 (Batchelor—*Fed. Proc. 16,* 8). Fractions obtained by precipitation of serum with zinc hydroxide and elution with various solvents are characterized in regard to the distribution of the various lipides among fractions (Delsal—*Compt. rend. 224,* 2252). Visualization of individual serum lipoprotein molecules is possible by separation with the ultracentrifuge and observation by electron microscope technique (Hayes & Hewitt—*J. Applied physiol. 11,* 425).

Serum lipoprotein data are recorded to serve as reference for physiological studies and for possible uses in clinical work. With immature new born infants β-lipoproteins are higher than α-lipoproteins on the first day; in the course of a few days the β/α-lipoprotein ratio decreases from 5–8 to 2.2–3.4 (Moggi—*Riv. clin. pediat. 57,* 64; Moli—*Ibid.* 834). When nursing infants are fed a formula containing emulsified coconut oil, serum β-lipides increase during the first hour thereafter and return to normal within the second hour (Mugnaini—*Med. intern. 64,* 289). In a study of normal serum lipoprotein distribution as a function of age and sex, data are recorded of the mean percentages of four lipoprotein components of individuals aged 12–100 years (Goldbloom *et al.—Bull. N. Y. Med. Coll. Hosp. 19,* 50). In pregnancy there is generally a low level of lipoprotein which contains a preponderance of complexes of low dimensions, but with preëclampsia the opposite is true (Ciulla—*Ann. ostet. e ginecol. 78,* 287). The lipoproteins in normal urine are separatable into α_1, α_2, β- and γ-fractions by techniques which are useful in studying patients and the course of treatments applied (Schrade *et al.—Klin. Wochschr. 34,* 903). Serum lipide changes are recorded in 11 female baboons through the menstrual cycle, pregnancy, lactation, and abortion (van Zyl—*J. Endocrinol. 14,* 309). The data are useful when these animals are used for vascular disease studies.

Various properties of lipoproteins are described. Ether removes almost all the cholesterol from the low density lipoproteins at 4°; whereas high density lipoproteins are relatively resistant to ether extraction (Avigan—*J. Biol. Chem. 226,* 957). The observations are discussed with respect to structures of the fraction. The specific activity of administered radioactive phosphorus in α- and β- lipoproteins is the same and remains so for eight days after tracer administration, thus suggesting exchange of phospholipides between lipoprotein "molecules" (Florsheim & Morton—*J. Appl. Physiol. 10,* 301). These data support the view that lipoproteins may consist of protein and lipide micelles held in loose ionic association. Work in which labeled alanine is traced indicates that there is greater turnover of lipoproteins than other serum proteins and that the high and low fractions of lipoproteins are metabolically and chemically distinct (Eder & Steinberg—*Proc. Soc. Exptl. Biol. Med. 95,* 429). Lipoproteins are also characterized as to molecular weight and to carbon- and nitrogen-terminal amino acids (Shore—*Arch. Biochem. Biophys. 71,* 1). Phospholipides have been identified which contain amino acids other than serine (Westley *et al.—J. Biol. Chem. 229,* 131). Leucocyanidol of *Arachis* which in 0.35% concentration precipitates almost all lipoproteins of fresh blood serum will precipitate only a small fraction when the serum has aged (Tayeau *et al.—Bull. soc. pharm. Bordeaux 95,* 202, 206). This is attributed to lecithinase B decomposing lecithins with time and the fatty acids released affect other lipides and protein through various reactions. Injected aged lipoproteins are removed more quickly from circulation than fresh lipoproteins (Spitzer & Spitzer—*Fed. Proc. 16,* 122). They also produce antiserums after repeated injection (DeLalla *et al.—J. Exptl. Med. 106,* 261).

In vitro data are developed on lipide-protein reactions and interpreted with respect to structure and properties of natural lipoproteins. Thus, products formed by the interaction of lecithin and ovalbumin are investigated with regard to electrophoretic behavior, thermodynamic considerations, and binding of phosphorus, and the data are discussed with regard to type of bindings that may occur (Inoue—*Acta Schol. Med. Univ. Kioto 34,* 276, 294, 301). Among various proteins, each combines with different amounts of sterols and other lipide fractions (Vendt—*Vitaminy Kiev. Akad. Nauk Ukr. S.S.R., Sbornik 2,* 30). The data in this work are discussed with respect to groups through which binding takes place and the stability of resultant combination. Structures of films of proteins on lipides are said to be comparable to the structure of cell membranes (Eley & Hedge—*Discussions Faraday Soc. 21,* 221). The energetics of such systems are also measured (Eley & Hedge—*J. Colloid Sci. 12,* 419).

LIPIDES IN DISEASED STATES. Most of the information on this subject pertains to atherosclerosis. Involved in the study of this disease are hypertension; abnormalities in serum fat, cholesterol and lipoproteins; turbidity of serum; blood clotting behavior; synthesis, absorption and transport of lipides, and other lipide science. Many lipide studies of the non-diseased conditions are cited here because they serve as a basis for recognizing abnormalities in the disease.

The reviews, general dissertations, and editorials pertinent to atherosclerosis and coronary diseases are written on: dietary fats and the epidemiology of coronary heart disease (Keys *et al.—Am. J. Public Health 47,* 1520), experimental and clinical evidence relating the effect of dietary fat upon the health in man (van Itallie—*Ibid.* 1530), dietary fat in human nutrition (Olson—*Ibid.* 1537), role of butterfat in nutrition and atherosclerosis (Kummerow—*J. Dairy Sci. 40,* 1350), dietary fats and their relationship to atherosclerosis (Pollack—*Circulation 16,* 161), lipides and the problem of atherosclerosis (Morton—*J. Sci. Food Agr. 8,* 445), fats in human nutrition (Anon.—*J. Agr. Food Chemistry 5,* 564), nutrition problems in the lipide field (Lundberg—*Fette-Seifen-Anstrichmittel 59,* 811), cholesterol in relation to atherosclerosis (Eagle—*Proc. 8th Conf. Res. Am. Meat Inst., Univ. Chicago, 1956,* 1), essential fatty acids, degree of unsaturation and effect of corn oil on the serum cholesterol level in man (Keys *et al.—Lancet 272,* 66), lipoprotein metabolism in the etiology of atherosclerosis (Anfinsen—*Minn. Med. 38,* 767), macromolecular lipoproteins in atherosclerosis (Rosenfeld—*Am. J. Clin. Nutr. 5,* 286), serum lipoprotein and newer views on fat transport in blood (Fasoli—*Arch. studio fisiopatol. e clin. recambio. 20,* 713), serum lipoproteins in experimental atherosclerosis (Correia—*Compt. rend. soc. biol. 150,* 2286), fat metabolism, obesity, and hypercholesterolemia (Goldner—*Med. clin. N. Am. 39,* 845), hormone factors in the pathogenesis of atherosclerosis (Barr—*Minn. Med. 38,* 788), biochemical syndromes of human atherosclerosis (Lemaire *et al.—Presse med. 64,* 1129), atherosclerosis and fat content of the diet (Page *et al.—Circulation 16,* 163), and dietary fat with regard to arterial fatty plaques (Reiser—*J. Am. Oil Chemists' Soc. 34,* 84).

The subjects treated in a series of papers on clinical diagnosis in coronary disease are: graphic and laboratory diagnosis (Master—*J. Am. Med. Assoc. 165,* 1771), master two-step test (Russek—*Ibid.* 1772), changes in muscle enzymes, erythrocyte sedimentation rate and C-reaction protein in myocardial infarction (LaDue—*Ibid.* 1776), early changes in the T-wave in coronary disease (Burch—*Ibid.* 1781), and vectorcardiographic diagnosis of coronary artery disease (Wolff—*Ibid.* 1784). An equation, which is said to predict coronary heart disease, is defined as 1/10 times the sum of the S_f 0–10 and S_f 12–400 serum lipoproteins as measured by the ultracentrifuge (Gofman—*Ann. N. Y. Acad. Sci. 64,* 590; Nichols *et al.—U. S. Atomic Energy Comm. U.C.R.L—3451,* 20 pp.). This relationship is named the "atherogenic index." In patients less than 50 years old with coronary artery atherosclerosis, the peak in radio activity after administration of

radioactive fat is delayed and is considerably higher than in normal individuals (Likoff *et al.—Circulation, 16,* 908). It is suggested that the test may predict angina or myocardial infarction. Serums of hypercholesterolemic rabbits when pulsated for 72 hours at 300 mm. mercury to 0 mm. mercury pressure with a pulse rate of 80 produce birefringent deposits in excised pieces of rabbit aortas (Evans *et al.—Circulation Res. 5,* 17). This birefringent material can be detected in serum before lipoid degeneration of the arterial intima becomes apparent.

A symposium on measuring the risk of coronary heart disease in adult population groups contains papers on: the cardiologist enlists the epidemiologist (White—*Am. J. Public Health 47,* April Suppl., 1), an evaluation of the prevalence of arteriosclerosis heart disease in Framingham, Mass. (Dawer *et al.—Ibid.* 4), an examination of 1,913 men office workers for ischemic heart disease (Doyle *et al.—Ibid.* 25), a clinical status of 2,252 persons in Los Angeles under observation for 2–3 years (Chapman *et al.—Ibid.* 33), an epidemiological investigation of coronary disease in the California health survey population (Drake *et al.—Ibid.* 43), implications to the biostatistician (Ciocco—*Ibid.* 58), implication to the nutritionist (Schrimshaw—*Ibid.* 60), and summary (Watt—*Ibid.* 63). Practically all the studies on coronary diseases involve physiology and biochemistry of lipides because they contain information on lipemia, cholesteremia, lipoprotein fractions of the serum, and fat in diets.

Many other studies on serum lipides in normal and atherosclerotic persons were done cooperatively or individually to further knowledge regarding coronary diseases. Measurements of S_f 12–20 and S_f 20–100 lipoproteins and serum cholesterol made on 10,690 men and 3,404 women are related to race, age, sex, blood pressure and weight (Lewis *et al.—Circulation 16,* 227). In work with Indian subjects, serum cholesterol content is found to increase with age and weight, is 16% higher in nonvegetarians than in vegetarians, but is independent of smoking, alcohol habits, and racial differences (Nath *et al.—Indian J. Med. Res. 45,* 217). In Japanese people, the serum cholesterol levels are significantly lower than that of Americans and there is some correlation to the intake of animal fats (Nakagami—*Nippon Seirigaku Zasshi 19,* 453). Isocaloric substitution of 50 g. of butter or margarine for rice in the customary diet of Japanese miners raises serum cholesterol 17.1 mg. % above controls, but has no significant effect on distribution of the α- and β-lipoprotein fractions (Keys *et al.—Am. J. Clin. Nutr. 5,* 245). Costa Ricans at all ages have mean cholesterol values slightly higher, with only minor differences in lipoproteins, than rural Guatemalans, but much lower than North Americans (Schrimshaw *et al.—Circulation 15,* 805). Since Costa Ricans show very little atherosclerosis, the data suggest that the diseases can be more closely related to serum cholesterol content than to the lipoproteins of low densities. A suggestion is made that Navajo Indians be more thoroughly studied in atherosclerosis research because of their low mortality from cardiovascular diseases (Smith—*Public Health Repts. 72,* 33). In Yugoslavia where there are districts where dietary fat is of animal origin, vegetable origin, and a low dietary fat area, respectively, there is no significant departure from linearity in age trends of serum cholesterol for any area; however, in the animal fat district the mean cholesterol curve is higher than in vegetable fat and low fat dietary districts (Brozek *et al.—Am. J. Clin. Nutr. 5,* 279).

A new survey of serum cholesterol and phospholipide concentrations in old age show that similar courses of changes occur in mid- and north-Europeans (Schettler—*Experimentia, Suppl. No. 4,* 164). In this work test meals of 0.5 g. butter per kg. body weight produce greater increase in total serum turbidity and chylomicrons in older than in younger subjects, and responses of older atherosclerotic subjects are essentially the same as normal subjects of the same age. One survey is on the blood pressure of healthy individuals aged 65–106 years (Master *et al.—Proc. Soc. Exptl. Biol. Med. 94,* 463). Serum cholesterol data on 88 atherosclerotic patients between 60 and 89 years of age indicate that terminal weight loss from wasting disease show no relationship to serum lipide concentration and antemortem serum cholesterol levels are constant for as long as four years (Paterson & Derrick—*Can. J. Biochem. & Physiol. 35,* 869). In senile and arteriosclerotic dementia serum lipoproteins are within the same range (Antonini *et al.—Rev. Patol. nervosa e mentale 78,* 13). Among school children, serum cholesterol content is highest in those of urban upper-income families, intermediate in those of urban lower income families and lowest in those of lower-income rural families (Schrimshaw *et al.—Am. J. Clin. Nutr. 5,* 529).

Sclerotic lesions are not evident in coronary arteries of fetuses; in infants early stages of arteriosclerosis are present and most frequently begin at 3–4 months of age; and in older children there is an apparent decrease in the rate of intimal fibrosis (Moon—*Circulation 16,* 263). These lesions of the coronary arteries of young individuals are identical with the early phases of arteriosclerosis in adults. In a survey of over 1,000 autopsies, of persons aged 1–40 years by means of the Sudan IV stain test, every case beyond the age of three years shows some degree of staining of the intima of the aorta, and the degree increases strikingly between the ages of 8 to 18 years (Holman *et al.—Fed. Proc. 16,* 360). The data are interpreted to suggest a relationship of atherogenesis to the hormonal changes at puberty. Alkali phosphatase staining technique reveals that capillaries occur in the superficial layers of the intima in early atherotic lesions of the aorta in man (Paterson *et al.—A.M.A. Arch. Pathol. 64,* 129). Such vascularization may actually precede the recognizable signs of the disease. Filtration characteristics of human serums under pressure through iliac arteries differ with different subjects and unfilterable residues are high in cholesterol (Rugarli & Villa—*Giorn. gerontol. 5,* 541). The results are interpreted with regard to causes of atherosclerosis. The lipide plaques in the aorta parallel the composition of the blood lipides and reflect changes in the solvent to solute proportion in plasma (Hirsch *et al.—A.M.A. Arch. Pathol. 64,* 117). Although the lipide deposits in liver, spleen and lungs may be resorbed, those in arteries tend to remain. An analytical survey of aortas shows that: cholesterol rises with age, with onset of vascular disease, and is highest in diabetics; calcium and phosphorus increase slowly with age but rapidly in arteriosclerosis; and sugar lipides are constant in normal, but high in degenerative diseased individuals (Hevelke—*Deut. Arch. klin. Med. 203,* 528). The "cholesterol" from atheromatous arteries appears to be a complex mixture rather than pure cholesterol (Devis—*Ann. biol. clin., Paris, 15,* 55). In a survey of serum lipoproteins in preclinical and in manifest ischemic heart disease on 115 men: 28 with healed mycardial infarctions have high serum cholesterol and β-lipoprotein levels, whereas 20 with angina pectoris and 27 obese hypertensive individuals have lipide patterns similar to 76 men free of ischemic heart disease (Doyle *et al.—J. Chronic Dis. 6,* 33). In one survey, 40- to 49-year old patients with myocardial infarctions have higher serum cholesterol values than normal subjects, but in the higher age groups this difference is decreased or disappears (Biörck *et al.—Acta Med. Scand. 156,* 493). Tests on serums of 42 patients with proven arteriosclerosis show increased cholesterol and lipoprotein levels in 25, increased cholesterol alone in 9, increased lipoprotein alone in 4; and in most glycoproteins are increased (Voigt & Gadermann—*Clin. Chim. Acta 1,* 364). Considerable variations in serum lipide fractions are also observed among 15 patients with arteriosclerotic gangrene of limbs (Cenciotti—*Arch. patol. e clin. med. 33,* 108). There is lower concentration of heparinoid substance and higher concentrations of glycoproteins in serums of atherosclerotic patients (Antonini—*Experientia Suppl. 4,* 176). Hyperlipemia is also characterized by an increase in the amount of serum γ_2-glyco-proteins (Sohar *et al.—J. Lab. Clin. Med. 49,* 716).

Superimposition of arterial injury in hypercholesterolemic monkeys appears to induce, in a few weeks, a degree of arterial degeneration with intimal thickening and atheromatosis which simulates that occurring in humans over a period of years (Taylor *et al.—Fed. Proc. 16,* 374). Rabbits infected with human type bacilli by intravenous administration and fed 450 mg. daily doses of cholesterol develop lesions in their aortas resembling those seen in human arteriosclerosis (Bagolan & Serpieri—*Sperimentale 106,* 244). In rats in which various degrees of cholesterolemia is induced, there is a positive correlation between cholesterolemia and cardiovascular effects as measured by sudanphilia (Andrus *et al.—Fed. Proc. 16,* 350).

Various aspects intrinsic to atherosclerosis and the same aspect under normal conditions are experimentally investigated in chickens and laboratory animals. Among chickens, the plasma cholesterol does not vary significantly from 8 to 57 months of age, whereas in roosters it is constant between 8 and 25 months and then rises markedly (Weiss—*Proc. Soc. Exptl. Biol. Med. 95,* 487). In young leghorn pullets, average plasma cholesterol content is 116 mg. %, a few days after beginning of egg laying it is 285 mg. %, and it gradually declines to between 190 and 250 mg. % while egg laying is going on (Leveille *et al.—Ibid. 94,* 383). A mathematical equation developed from the relationships between the degree of atheromatosis, and the cholesteremia and β-lipoprotein concentrations may be used to calculate the reliability of the cholesterol-fed cockerel as an experimental animal for ather-

osclerosis studies, but is unsatisfactory for estimation of lesion score (Tennent *et al.—Ibid. 96,* 679). However in one attempt to assess cholesterol in the pathogenesis of atherosclerosis, some chickens developed atherosclerotic lesions without undergoing hypercholesteremia (Gour & Tayal—*J. Assoc. Physicians, India, Jan. 1957*). In experimental administration of cholesterol and peanut oil to chicks, as is done in atherosclerosis studies, there is a decrease of tetra-, penta-, and hexaenoic fatty acids in the liver (Dam & Nielsen—*Acta Physiol. Scand. 37,* 359).

Lipide data are recorded on the dog that may serve as useful reference in using these animals in atherosclerosis research. Variations in the glyco- and lipoproteins in the serum of dogs of different ages as determined by electrophoresis are published (Groulade & Groulade—*Compt. rend. 243,* 611). In the dog two-thirds of the plasma lipides is attached to the α-lipoprotein, whereas in man the same proportion is attached to the β-lipoprotein (Sordi *et al.—Sperimentale 107,* 94). Dog serum is also markedly high in heparinoid substance. Endogenous cholesterol in the blood of the dog is synthesized principally in the liver (Tennent *et al.—J. Biol. Chem. 228,* 241). Dogs maintained hyperlipoproteinemic through feeding of cholesterol for 50 weeks deposit cholesterol in their coronary arteries in amounts correlating well with the degree of hyperlipoprotenemia induced (Milch & Weiner—*Fed. Proc. 16,* 322). In another similar test in which grossly elevated hypercholesterolemia and serum β-lipoprotein levels are maintained for periods of 3.5–4 years, the dogs did not show abnormalities in the cardiovascular system or in the liver (Shull & Mann—*Am. J. Physiol. 188,* 81).

The severity of atheroma resulting from cholesterol feeding in rabbits is said to be closely correlated with serum cholesterol and β-lipoprotein levels (Day & Wilkinson—*Australian J. Exptl. Biol. Med. Sci. 34,* 423). In normal rabbits phospholipide development in the descending aorta is greater than that of the aortic arch, but this distinction in phospholipide synthesis is not found in cholesterol-fed rabbits, possibly because of the development of atheromatous lesions (Dury—*Proc. Soc. Exptl. Biol. Med. 94,* 70). Rabbits on a high-cholesterol diet show changes in basal metabolism which correlate with the extent of atherosclerosis developing in the animals (Samoshkin—*Doklady Akad. Nauk S.S.S.R, 113,* 227; *Arkh. Patol. 19,* No. 5, 38). Rabbits fed 0.5 g. cholesterol and 5 ml. olive oil daily for 12 weeks develop macrocytic anemia which may be the result of liver damage (Srivastava *et al.—J. Sci. Ind. Res., India 15C,* 170). Administration of dehydrocholesterol to rabbits prevents development of cholelithiasis (Mosbach & Bevans—*A.M.A. Arch. Pathol. 64,* 162). On transferring rabbits from low to high altitudes, a significant increase in all serum lipide fractions develops (Lalli—*Riv. med. aeronaut. 20,* 37).

In dairy cattle variations in plasma cholesterol levels are 97.7% of the total variance and in the single animal variations are observed due to age, pregnancy, parturition, and lactation (Lennon & Mixner—*J. Dairy Sci. 40,* 1424). Calf aorta nourished *in vitro* with bovine blood containing labeled acetates synthesizes twice as much cholesterol from acetate at 100 mm. than at 200 mm. of mercury pressure (Werthesen *et al.—Circulation Res. 4,* 586).

In the rat fed a low cholesterol diet, endogenous synthesis contributes 67–80% to the composition of serum cholesterol, whereas with 2.0% cholesterol in the diet 10–26% is derived from endogenous synthesis (Morris *et al.—J. Biol. Chem. 224,* 1039). A major factor controlling the rate of synthesis in the liver may be the amount of cholesterol entering the plasma by the lymph route (Swell *et al.—Science 125,* 1194). Cholestanol, when metabolized by rat, appears as such in the liver, none is converted to liver cholesterol, and it is degraded to the same bile acids as is epicholesterol and 4-cholestenone (Harold *et al.—J. Biol. Chem. 224,* 609. The amount of cholesterol transferable in the rat as measured by replacement with ingested labeled cholesterol is about 50% (Chevallier—*Arch. sci. physiol. 10,* 249). In this work the amount of transfers occurring in various organs, glands, muscles, bones, etc. are measured. Incidentally, none is transferred from the brain. Studies on excretion of sterols by rats show that: ratio of 7-cholestenol to cholesterol excreted increases with age, penicillin and sulfasuxidine depress excretion of coprostanol concurrent with corresponding increase in excretion of cholesterol, and sterol is essentially the same on a fat free diet as on 20% lard (Coleman & Baumann—*Arch. Biochem. Biophys. 66,* 226). Normal rats excrete an average of about 15μg. of cholesterol in urine daily plus 2 μg. of a fast-acting sterol; with mice, excretion is respectively 2 μg. and 0.2 μg. (Finlayson & Baumann—*Am. J. Physiol. 190,* 297). These excretions of sterols vary with age, sex, species, and strain.

Data from several studies on normal metabolism of cholesterol may serve as reference in research on atherosclerosis. Comprehensive work on metabolism of cholesterol by Ivy and co-workers (*J. Applied Physiol. 11,* 1, 8, 143; *Am. J. Physiol. 187,* 615; *190,* 214) revevals the following: the intestinal endogenous sterol pool is 1400 $\pm$ 740 mg. per day; on a low fat diet an individual absorbs about 2 g. per day of exogenous cholesterol plus 0.98 g. of endogenous sterol; the average daily synthesis of cholesterol by the body is about 2100 mg.; the amount catabolized is 1680 mg.; 1460 mg. per day is converted to bile acid; excretion of endogenous cholesterol is 421 mg. per day; pancreatic juice has no significant effect on elimination of endogenous cholesterol; unsaturated fats reduce the absorption of dietary cholesterol; and stearic and palmitic acids do not influence absorption of endogenous and dietary cholesterol.

Cholesterol absorption is increased when administered in emulsions with oleic acid, taurocholate and albumin, but this increase in absorption rate is much less marked when albumin is absent (Vahouny *et al.—Am. J. Physiol. 188,* 342; *191,* 179).

Many communications pertain to the effect of dietary fats on lipide syndromes associated with atherosclerosis. Addition of linoleic acid or beef fat to a fat-free diet raises the total-cholesterol content of rat tissues (Gersno *et al.—Arch. Biochem. Biophys. 68,* 314). With such administration of linoleic acid, both the free- and ester-cholesterol increase; whereas with beef fat in place of linoleic acid, ester content increases and free cholesterol decreases. Rape oil causes a marked increase in adrenal cholesterol when fed to rats or mice, but has no such effect on rabbits, guinea pigs, chickens, and dogs (Carroll—*Proc. Soc. Exptl. Biol. Med. 94,* 202). The courses of the early rises in cholesterol, fat, and phospholipides in the serum of man induced by ingestion of fat-rich meals are measured (Havel—*J. Clin. Invest. 36,* 848). Similar work in which the effect of both dietary fat and weight reduction on serum levels of β-lipoproteins is measured, is interpreted to support the concept that body leanness and restriction of fat may be important in preventing human atherosclerosis (Walker *et al.—Circulation 15,* 31). One recommendation for patients with coronary heart diseases is a restriction of fat in the diet (Kuo—*J. Am. Dietetic Assoc. 33,* 22) and another is to restrict refined cereals and saturated fats (van Handel *et al.—Lancet 272,* 245).

In one study a diet high in butter is found to increase serum total lipides, cholesterol, turbidity and prothrombin complex, and reduce heparin tolerance in normal and atherosclerotic subjects (Salvini *et al.—Giorn. gerontol. 5,* 48). Similar data are reported in another study in which high-butter test-meals are used in an effort to find metabolic defects in atherosclerotic individuals (Horlick—*Circulation Res. 5,* 368). These effects of butter are said to be dependent partially upon the unsaponifiable fraction (Beveridge *et al.—Can. J. Biochem. Physiol. 35,* 257). Feeding butter to two-year old boars results in an elevation of serum cholesterol; whereas feeding isocaloric quantities of corn oil did not (Bragdon *et al.—Proc. Soc. Exptl. Biol. Med. 95,* 282). However, after nine weeks on these diets the animals show the same incidence of atheromata as control animals on the basal diet. Addition of either butterfat or sunflower seed oil to a "Purina Chow" diet increases serum cholesterol levels in rats (Grunbaum *et al.—Ibid. 94,* 613).

When lard is used in fatty liver inducing diet with rats, liver liposis appears centrilobular and in portal zones whereas with synthetic saturated triglycerides liposis is restricted to portal zones (Williams *et al.—Fed. Proc. 16,* 377). In this work cardiovascular lesions appeared in only one animal in the synthetic triglyceride group.

Among communication on saturated *versus* unsaturated fats in atherosclerosis one finds various investigators producing and citing data to support their individual views or hypothesis. In accord with the noncritical aspect of this review these papers are cited with brief indication of results. Thomas *et al.* (*A.M.A. Arch. Pathol. 63,* 571) reports that butter and margarine increase lesions in experimental arteriosclerosis whereas corn oil does not. In 11 patients whose serum lipides had been lowered by decreasing animal fats in the diet, the addition of corn oil to the diet increased average cholesterol and low density lipoproteins in one patient, but had no effect in the other 10 (Engelberg—*J. Chronic Dis. 6,* 229). Shapiro *et al.* (*Circulation 16,* 937) find that corn oil does not reduce the hypercholesterolemia of some patients with acute coronary occlusion. These results are distinctly different than other clinical and laboratory reports. Dietary animal fats are no

more atherogenic in cholesterol-fed cockerels than cottonseed or corn oil (Stamler *et al.—Fed. Proc. 16,* 123). In rabbits fed cholesterol, administration of polyunsaturated fatty acids lowers all serum lipide fractions (Taupitz & Wietek—*Arzneimittel-Forsch. 7,* 119). On feeding monkeys labeled cholesterol in lard the serum cholesterol rises twice as high and disappears more slowly than when the cholesterol is administered with corn oil (Portman & Sinisterra—*Fed. Proc. 16,* 397). In a similar comparison of butter fat, olive oil, safflower oil, and corn oil the high depressant action of serum cholesterol by corn oil is not accountable on the basis of unsaturation nor on content of essential fatty acids (Armstrong *et al.—Proc. Soc. Exptl. Biol. Med. 96,* 302). In a survey in which tung oil is among the oils investigated, this oil produced the highest hypercholesterolemia and sudanophilia test and corn oil counteracted this effect (Hegsted *et al.—Circulation 16,* 479; *J. Nutr. 63,* 273). These results suggest that linoleic acid does not account for the cholesterol lowering effect. A survey based on fractions of corn oil indicates that the cholesterol depressant factor is in the most volatile fraction (Beveridge *et al.—Can. J. Biochem. & Physiol. 35,* 257). This fraction contains most of the unsaponifiable material and has a slightly lower iodine value than other fractions. Sunflower seed oil given to six men with occlusive vascular disease reduced serum cholesterol levels in four of the patients (Williams & Thomas—*Lancet 272,* 428). In another test with sunflower oil, the fall in cholesterol level induced is associated with an increase in bile excretion (Gordon *et al.—Nature 180,* 923). Intravenous infusions of 10% cottonseed oil or triolein emulsions clear serum hypercholesterolemia and turbidity in primary hypercholesterolemia but is not very effective in idiopathic hyperlipemia (Lever & Waddell—*J. Invest. Dermatol. 25,* 233). A comparison of the effects of lard *versus* cottonseed oil on plasma and liver cholesterol levels in cholesterol fed rats is interpreted with regard to the need of essential fatty acids to reduce serum cholesterol and for transport and metabolism of cholesterol (Aftergood *et al.—J. Nutr. 62,* 129). In similar work there is a rise of serum cholesterol with diets containing olive oil but no rise occurs when soybean oil is fed with the cholesterol (Seskind *et al.—Fed. Proc. 16,* 371). The observations that highly purified soybean oil reduces serum lipides in idiopathic hyperlipemia whereas addition of soybean phospholipides is without effect suggests that the unsaturated acids are the serum lipide depressing constituents (Everett *et al.—Proc. Soc. Exptl. Biol. Med. 95,* 500).

Data in tests on the effect of various fats upon experimental hypercholesterolemia in the rat show that the product obtained by multiplying the essential fatty acid content by the total saturated fatty acid content has a high degree of negative correlation with the serum cholesterol values produced (Hegsted *et al.—J. Nutr. 63,* 377). In another study on relationship of fats to serum cholesterol response it is calculated that 1 g. of saturated fat offsets the effect of 2 g. of linoleic acid, that oleic acid has very little effect, and that the magnitude of the response is related to the duration of diet change and intrinsic cholesterol level (Keys *et al.—Circulation 16,* 480). In similar work it appears that the serum cholesterol responses to various fats correspond roughly to the principle that saturated fats promote higher serum cholesterol levels than polyunsaturated fats but neither degree of saturation nor content of linoleic acid fully explains the results (Anderson *et al.—Ibid. 62,* 421). Here, coconut oil is less hypercholesterolemia promoting than would be predicted from degree of saturation or content of essential fatty acids; sardine oil is less cholesterol depressing, and corn causes greater depression than would be expected from either essential fatty acid or degree of unsaturation theories. Cottonseed oil induces lower serum cholesterol levels than coconut oil, whereas the former induces higher storage of liver cholesterol (Okey & Lyman—*Ibid. 61,* 523). Ingestion of olive oil induces comparative low liver cholesterol, but peanut oil causes fairly high values (Okey *et al.—Fed. Proc. 16,* 394). In cholesterol-fed pigs feeding oleate or saturated esters is more conducive to development of atherosclerosis than feeding linoleate (Peifer & Lundberg—*Ibid.* 232). A clinical comparison of pure polyunsaturated and monounsaturated acids, and phosphatides for control of hypercholesterolemia indicates that only the polyunsaturated acids lower serum cholesterol levels (Kinsell *et al.—Circulation 16,* 479). In another clinical study with hypercholesterolemic patients, serum cholesterol values are progressively decreased throughout a two-month period by feeding 25 ml. of essential fatty acids daily (Nothman *et al.—Circulation 16,* 920). An analysis of blood lipides indicated that there is no difference in the amounts of essential fatty acids in patients with coronary diseases and normal controls (James *et al.—Lancet 1957, I,* 705). This observation does not support theories involving essential fatty acids as a factor in coronary diseases. *Trans* fatty acid content of the normal human liver, heart, and aortic tissues are within the same general range as in atheroma from subjects who have died of atherosclerosis (Johnston *et al.—Science 126,* 698). In one dissertation on deficiency of unsaturated fatty acid as a cause of coronary thrombosis, atheroma, and other arterial pathology, the mechanism is explained on the basis that the unsaturated fatty acids in oxidizing create some type of electric power which cannot be replaced by oxidation of saturated acids or water-soluble substances (Price & Beutner—*Fed. Proc. 16,* 102). Here, it is said that predominant nutrition with saturated and hydrogenated fats deplete the stores of unsaturated fats in the body and finally arrest the heart.

Several sound statistical analyses of data available in the literature and independently produced, exonerate fats as cause of coronary diseases. The results of Morris (*J. Am. Med. Assoc. 164,* 599), show that: he is unable to trace any correlation between mortality and coronary heart disease and trends in fat consumption; the trend of butterfat consumption in Great Britain shows less than no correlation to the steep increase in the number of coronary deaths since 1943; in Norway where there is a high consumption of margarine, there are fewer cases of fatal coronary thrombosis than in New Zealand where little margarine is eaten; if the Norwegians are protected by fish, this does not explain why Aberdeen reports twice the coronary death rate of Oslo; and in terms of essential fatty acids, the only available data for Great Britain give no support to the hypothesis that the population is suffering from a deficiency of these nutrients. In a similar treatment of the subject, Yudkin (*Lancet 1927, 2,* 155) finds that the epidemiological data do not support the current hypotheses relating dietary fats to coronary thrombosis, and he believes that both the proponents and the opponents of the dietary hypotheses are quoting only those data which support their views. In the analysis of statistics by Weiss & Mattil (*J. Am. Oil Chemists' Soc. 34,* 503), correlations are evident between consumption of meat, eggs and fats with the incidence of deaths because of heart diseases; but the highest coefficient of correlation is shown with the total caloric intake. The comparison of fat intake with incidence of clinical coronary artery disease by Friedman & Rosenman (*Circulation 16,* 339) also show that hypotheses relating increase incidence of coronary heart disease and high fat intake are not proven and are probably untenable. The data on women do not support the suggestion that immunity is entirely the result of some endocrine-induced protection against the supposed atherogenic properties of a high fat diet.

Since coronary thrombosis involves clotting of blood some studies approach the coronary diseases and their intrinsic factors such as dietary fat, abnormal distribution of serum lipides, etc., through work on the clotting of blood. For those readers interested, the recent literature on blood coagulation is written on: method for estimating the clotting accelerator activity in plasma after ingestion of fat (Tilden & Shipley—*Circulation 5,* 298), methods for comparing effects of various fats on fibrinolysis (Scott & Thomas—*Proc. Soc. Exptl. Biol. Med. 96,* 24), inhibition of fibrinolysis *in vivo* by feeding cholesterol (Kawaan & Fadzean—*Nature 179,* 260), blood coagulation following oral administration of butter (Lasch & Schimpf—*Deut. Arch. klin. Med. 203,* 146; Buzina & Keys—*Circulation 14,* 854); effect of isocaloric meals of butterfat, corn oil, coconut oil, and sardine oil, respectively, in regard to shortening blood coagulation (Keys *et al.—Circulation 15,* 274), butter *versus* margarine and blood coagulation (Maclagan & Billimoria—*Lancet 271,* 235), effect of butter, margarine, and vegetable oils in a meal of eggs on blood coagulability (O'Brien—*Ibid.* 232), plasma lipides and coagulation of blood (Sohar *et al.—Am. J. Clin. Pathol. 27,* 503; Salvini *et al.—Arch. studio fisopatol. e clin. ricambio 20,* 605), thromboplastic cell components the lipoproteins of erythrocytes, and platelets (Shinowara—*J. Biol. Chem. 225,* 63), coagulation factor in cholesterol atherosclerosis of rabbits (Sharma *et al.—Indian J. Med. Res. 44,* 691), thromboembolism and systemic arteriosclerosis (Rabin *et al.—A.M.A. Arch. Path. 64,* 75), and the thrombin of the lipoprotein lipase system (Pilgeram & Tu —*J. Applied Physiol. 11,* 450).

The reduction of serum cholesterol or atheroma or both by oral administration of β-sitosterol in laboratory animals, monkeys, or patients is demonstrated in several investigations (Heptinstall & Porter—*Brit. J. Exptl. Pathol. 38,* 49; Best & Duncan—*Ann. Internal Med. 45,* 614; Levkoff & Knode—*Pediatrics 19,* 88; Riley & Steiner—*Circulation 16,* 723; Kritchevsky & McCandless—*Proc. Soc. Exptl. Biol. Med. 95,* 152). Beveridge *et al.* (*Fed. Proc. 16,* 11) consider the plasma cho-

lesterol depressant effect of corn oil dependent to a large extent upon its sterol content. The effect of safflower oil and β-sitosterol are similar in magnitude; in combination the magnitude of serum cholesterol depression, although not additive, is 60% greater than that of either agent alone (Farquhar & Sokolow—*Circulation 16,* 877). The effect of safflower oil, therefore, depends on factors other than its contents of sitosterols. The hypocholesterolemic effect of β-sitosterol acts through inhibiting cholesterol absorption and results only when β-sitosterol is present in the gut (Best & Duncan—*Circulation 16,* 861). Dihydrocholesterol decreases serum cholesterol but unlike β-sitosterol it does not reduce liver cholesterol or reduce atherosclerosis in rabbits (Beher *et al.—Circulation Res. 5,* 202). The inhibition of cholesterol absorption by phytosterols could be explained by assuming that acceptor lipoprotein becomes partially blocked with foreign sterol, thereby reducing its capacity for the transfer of the natural animal sterol (Glover & Green—*Biochem J. 67,* 308).

The reduction of serum cholesterol (Küchmeister *et al.—Med. Klin., Munich, 51* 1455), the increase in migration velocity of β-lipoprotein (Sachs & Danielson—*Proc. Soc. Exptl. Biol. Med. 93,* 22), and the increase in clotting time of blood (Silver *et al.—Am. J. Physiol. 190,* 8) through oral administration of phospholipides are measured. Brain phospholipides are fractionated into components having, respectively, accelerating and inhibiting effects on blood coagulation (Barkhan *et al.—Lancet 271,* 234). Continuous elevation of plasma phospholipides in the rabbit by continuous infusion of a suitable phosphatide quickly leads to hypercholesterolemia (Friedman & Byers—*Proc. Soc. Exptl. Biol. Med. 94,* 452). This treatment causes a marked resolution of atherosclerotic infiltration and cholesterol deposits in hypercholesterolemic rabbits (Friedman *et al.—Ibid. 95,* 586). Orally administered sphingomyelin and cerebrosides mixtures or emulsifying agents reduce induced hypercholesterolemia in dogs (Rolfo *et al.—Arch. sci. med. 103,* 272, 282). Cerebroside-rich brain extracts increase the turnover rate of serum cholesterol but have very little influence on serum phospholipides (Jones *et al.—Proc. Soc. Exptl. Biol. Med. 96,* 442). After biliary obstruction, the hyperphospholipidemia caused chiefly by cholate accumulation also induces a rise in plasma cholesterol (Friedman *et al.—Am. J. Physiol. 191,* 551).

The low serum cholesterol values in peoples living on low-fat intake are not related to the amount or kind of protein in their diets (Keys & Anderson—*Am. J. Clin. Nutr. 5,* 29). The levels of dietary fat in mature rooster rations do alter serum cholesterol levels when the level of dietary protein is inadequate (Kokatnur *et al.—Fed. Proc. 16,* 389). Administration of cholesterol in low-protein rations of chicken produces severe aortic atheroclerosis and fatty degeneration of the liver (Nikkilä & Ollila—*Acta Pathol. Microbiol. Scand. 40,* 177). High vitamin-high protein diets tend to protect chicks against the hypercholesterolemic and atherogenic effects of cholesterol-fat ingestion (Pick *et al.—Fed. Proc. 16,* 101).

The observation that the degree of postprandial lipemia may be decreased by all factors which increase carbohydrate metabolism calls attention to considering the effect of carbohydrate in relation to the amount of fat in dietary fat studies (Albrink & Man—*Am. J. Digestive Dis. 2,* 649). The addition of pectin to a basal diet containing cholesterol fed to rats increases the excretion of fecal saponifiable and nonsaponifiable lipides and decreases the absorption of exogenous cholesterol (Lin *et al.—Am. J. Physiol. 188,* 66). The uptake of dietary cholesterol is greater in chicks on purified diets containing sucrose as the sole carbohydrate than is the case in chicks on similar diets with glucose as the carbohydrate (Grant & Fahrenbach—*Fed. Proc. 16,* 50). In the rat a lipemia effect that is induced by protamine is abolished by feeding carbohydrates (Bragdon *et al.—Am. J. Physiol. 189,* 63). Rats fed alcohol with a 1% cholesterol diet deposit less cholesterol in liver and adrenals than non-alcoholic fed controls (Morgan *et al.—Ibid.* 290).

Dietary stresses with dogs involving periods of high calorie diets to produce marked obesity alternated with low calorie diets of horse meat to cause marked weight loss results in hypertension which persists even after the animals are maintained for 34 months on a normal kennel diet (Wilhelmj *et al.—Proc. Soc. Exptl. Biol. Med. 95,* 801). Overeating in human subjects increases serum cholesterol usually in proportion to the weight gain (Anderson *et al.—J. Clin. Invest. 36,* 81).

In a clinical study patients with coronary disease had occasions of rise in serum cholesterol values, which in most cases corresponded to periods judged as particularly stressful for the individuals (Hammarsten *et al.—Circulation 16,* 890). In another study of 82 patients with high content of serum lipides, cholesterol levels fall as a consequence of stress and then slowly increase (Kutschera & Rettenbacher—*Wien. klin. Wochschr. 69,* 259). In tests on physical activity versus dietary fat with respect to levels of serum cholesterol and other lipides in man, the total calories derived from fat had a greater effect than exercise (Taylor—*Proc. Soc. Exptl. Biol. Med. 95,* 383; *Fed. Proc. 16,* 128). Differences in physical activity also do not explain the large differences in serum cholesterol found when different population groups with different dietary habits are compared (Keys *et al.—J. Clin. Invest. 35,* 1173). Observed differences among atherosclerotic patients and among normal individuals with respect to serum turbidity and lipemia response to high fat and cholesterol meal is explained on the basis of difference in physical activity and physiological state of the individuals (Gottfried *et al.—Am. J. Clin. Pathol. 27,* 422). In cholesterol-fed cockerels, exercise reduces hypercholesterolemia and formations of atheromatous plaques (Wong *et al.—Fed. Proc. 16,* 138). Like results are obtained with rabbits (Kobernick *et al.—Proc. Soc. Exptl. Med. Biol. 96,* 623). With mice, exercise reduces serum cholesterol in some females whereas in other females and in males there is no change (Peltonen & Karonen *et al.—Ann. Med. Exptl. et Biol. Fenniae 34,* 246). Among cholesterol-fed roosters, those that appear most aggressive have lower plasma and aortic cholesterol contents than passive individuals, but the extent and degree of coronary atherosclerosis is the same in the two groups (Uhley *et al.—Proc. Soc. Exptl. Biol. Med. 96,* 244).

Ethionine supplementation of a high fat diet appears to prevent production of aortic sclerosis in rats (Kleinerman *et al.—Fed. Proc. 16,* 362). Choline-deficient diets reduce serum low-density lipoproteins, α-lipoproteins and serum cholesterol in rats; and on addition of cholesterol to such diets hyperlipemic or hypercholesterolemic states are not produced (Wilgram *et al.—Circulation Res. 5,* 111). Administration of lipotropic agents to cerebral atherosclerosis patients with mental symptoms improves the mental conditions and the serum lipide picture in most of them (Lindqvist & Isaksson—*Acta Med. Scand. 156,* 109).

The significance of various vitamins in atherosclerosis and the intrinsic serum lipide picture is actively investigated. α-Tocopherol and methionine together, but not alone, prevent hypercholesterolemia in cholesterol- or high-fat-fed rats (Jones *et al.—A.M.A. Arch. Pathol. 63,* 593). Administration of large doses of tocopherol to arteriosclerosis patients yields improvement in symptoms and well being of the subjects (Straface & Gastaldi—*Semana med. 110, 1,* 360). Induced hypercholesterolemia is reduced by oral administration of large amounts of ascorbic acid (Anderson *et al.—Fed. Proc. 16,* 380; Booker *et al.—Am. J. Physiol. 189,* 75). Intravenous administration of ascorbic acid to atherosclerotic patients with hypercholesterolemia causes an abrupt drop in serum cholesterol within hours (Sedov—*Terap. Arkh. 28,* No. 2, 58). One survey of women in institutions shows that with a slight rise in serum cholesterol there is a concurrent rise in ascorbic acid in elderly women, but not in younger individuals (Walker *et al.—J. Nutr. 60,* 517). In the normal guinea pig there is more cholesterol in the adrenals and liver than in the scorbutic animal (Robinson *et al.—Fed. Proc. 16,* 108). Whole body treatment with small doses of x-rays causes considerable decreases in ascorbic acid and cholesterol of the adrenal gland in rats (Baldini—*Rass. med. sper. 2,* 153). Prompt and sustained reduction of blood cholesterol levels is obtained in nearly all hypercholesterolemic patients who receive large doses of nicotinic acid (Parsons & Flinn—*J. Am. Med. Assoc. 165,* 234; *Circulation 16,* 923).

Pyridoxine deficient monkeys are quite susceptible to arteriosclerosis (Mushett & Emerson—*Fed. Proc. 16,* 367; Greenberg & Moon—*Ibid.* 188). Vitamin B_{12} deficiency induces hypercholesterolemia (Hsu & Chow—*Ibid.* 63). An atherosclerotic-like vascular disease is produced rapidly by a combination of hypercholesterolemia and hypervitaminosis D (Trueheart *et al.—Ibid.* 374; de Langen & Donath—*Acta Med. Scand. 156,* 317). The total and free cholesterol levels increase by combined administration of vitamins A and E whereas E alone causes only a slight rise in the total cholesterol level, which did not change with heparin (Gervasoni & Vannotti—*Schweiz. med. Wschr. 86,* 708). An analytical survey of anti-atherosclerotic substance reveals that vitamin A and A plus E decrease plaque lipide content with little alteration in collagen and connective tissue, whereas lipotropic factors, pyridoxine and choline are without effect on lipide content, but decrease collagen (Weitzel & Buddecke—*Klin. Wochschr. 34,* 1172; Weitzel *et al.—Hoppe-Seyler's Z. physiol. Chem. 304,* 247).

Data on normalizing the serum lipide picture in atherosclerosis or in various experimentally produced hyperlipemias with heparin are recorded (Gilert-Queralto *et al.—Med. Clin., Barcelona, 24,* 18; Coppo—*Giron. gerontol. 4,* 599; Galletti &

Abbati—*Ibid. 5,* 679; Guarini—*Boll. soc. ital. biol. sper. 32,* 724; Piccardo & Guarri—*Ibid.* 729; Nikkilä & Niemi—*J. Gerontol. 12,* 44; Kuo *et al.*—*Am. J. Med. Sci. 232,* 613; Day *et al.*—*Australian J. Exptl. Biol. Med. Sci. 35,* 277; Getz & Bloomberg—*S. African J. Med. Sci. 21,* 144; Hood & Angervall—*Acta Med. Scand. 158,* 13; Angervall & Hood—*Ibid. 157,* 407). The lipemia clearing activity which is elicited in rat plasma by intravenous heparin injections is accelerated by high dosages of cortisone, stress, adrenalectomy and hypophysectomy and is inhibited by stilbestrol and anterior pituitary extracts (Constantinides *et al.*—*Can. J. Biochem. & Physiol. 35,* 503). Serums from patients with primary and secondary hyperlipemia inhibit the clearing activity present in normal serum after intravenous administration of heparin (Klein & Lever—*Proc. Soc. Exptl. Biol. Med. 95,* 565). In normal lipemic dogs, clearing response to intravenous heparin can be consistently modified by rebreathing or with sodium cyanide (LeQuire *et al.*—*J. Lab. Clin. Med. 49,* 869). Rabbit serum cholesterol injected into rats is cleared by phagocytosis of the reticulo-endothelial cells whether the cholesterol is in the form of chylomicra or not (Neveu *et al.*—*Am. J. Physiol. 187,* 269). In serum clearing tests *in vitro* there is a rapid exchange between albumin-bound unesterified fatty acids and the glyceride fatty acids of the chylomicrons (Borgström & Carlson—*Biochem. et Biophys. Acta 24,* 638). It is suggested here that the clearing factor attacks the glyceride ester bonds in the α-position preferentially. One investigation indicates that the clearing factor in tissues rather than circulating clearing factor is primarily responsible for clearing and that the need for the fat as an energy source determines to some extent, the rate at which the fat is removed from the blood (Cleland & Iacona—*Fed. Proc. 16,* 383). The observations that phenol induces turbidity in serums and that serums from subjects receiving heparin injections show decreased phenol turbidity owing to presence of less β-lipoprotein led to a suggestion for using this technique for approximating β-lipoprotein in place of the time-consuming isolation by ultracentrifugation (Scanu *et al.*—*J. Applied Physiol. 11,* 17). A quantitative procedure for estimating the amount of clearing factor in serum is based on liberating fatty acids of Tween 60 upon incubation, which in turn produce calcium soaps, the turbidity of which are measured in a spectrophotometer (Katz—*J. Appl. Physiol. 10,* 519).

Autopsy studies show a decrease in atherosclerosis in men medicated with large doses of estrogens, a marked increase in atherosclerosis in women with estrogen level reduced by ovariotomy, and low incidence of severe atherosclerosis in women with mammary carcinoma (Rivin & Dimitroff—*Semana med. 1956, 2,* 669). Treatment of atherosclerotic patients with ethynylesthadiol induced no changes in the serum lipoprotein picture (Gibson—*U. S. Armed Forces Med. J. 7,* 1561). In adult male rats, small amounts of estradiol or estriol elevates serum cholesterol (Priest *et al.*—*Proc. Soc. Exptl. Biol. Med. 96,* 298). In women without signs of ovarian activity, administration of estrogen increases serum lipides; and administration of androgens in women reduces serum fat and cholesterol (Berezin & von Studnitz—*Acta Endocrinol. 25,* 427). The urinary estrogen ratios are higher in subjects with previous myocardial infarction than in control subjects (Bauld *et al.*—*Can. J. Biochem. & Physiol. 35,* 1277). Androgens and dl-ethionine reduce serum high density lipoproteins, cholesterol and phospholipides in the dog (Furman *et al.*—*Am. J. Physiol. 191,* 561). Testosterone reduces the degree of Sudanophilia and hypercholesterolemia in female rats whereas the reverse occurs with males and castrates (Fillios & Andrus—*Fed. Proc. 16,* 356). Administration of prednisone to cholesterol-fed rabbits increases all fat fractions of the blood (Ratti—*Arch. Studio fisiopatol. e clin. ricambio 20,* 645). Injection of desoxycorticosterone brings about an increase in esterification of serum cholesterol (Wahl—*Ann. biol. clin., Paris, 15,* 349). During desoxycorticosterone produced hypertension in rats the sodium and potassium contents of the aortas are increased (Tobian & Redleaf—*Am. J. Physiol. 189,* 451). Administration of ACTH consistently produces atherosclerosis lesions in the rat, an animal hitherto resistant to experimental atherosclerosis (Waxler & Miller—*Circulation 16,* 950). Lipemia induced in humans by cortisone is due to increased plasmogen, cholesterol esters, and triglycerides (Seckfort *et al.*—*Klin. Wochschr. 34,* 464). Hypothyroidism induces atherosclerosis or the concurrent blood picture of the disease (Roszkowski & Oester—*Fed. Proc. 16,* 332; Ericksson—*Proc. Soc. Exptl. Biol. Med. 94,* 582; Rosenman & Friedman—*Am. J. Physiol. 187,* 381; *188,* 295; Wakerlin *et al.*—*Circulation Res. 5,* 426). Successes of various types are demonstrated in the treatment of atherosclerotic patients and experimental atherosclerotic animals through administration of thyroid substances (Gofman *et al.*—*U. S. Atomic Energy Comm. U. C. R. L. 3534,* 16 pp.; Chakravarti *et al.*—*Indian J. Med. Res. 44,* 677; Lehr & Martin—*Proc. Soc. Exptl. Biol. Med. 93,* 596; Barnes & Barnes—*Fed. Proc. 16,* 7).

Some work involves the status of various chemicals in regard to atherosclerosis and hyperlipemia. The lipemia syndromes produced by oral administration of the wetting agents tradenamed Triton are measured (Schön & Gerb—*Arzneimittel-Forsch. 7,* 307). Hypocholesterolemia through oral Triton administration is attributed to increased intestinal absorption of cholesterol and inhibition of coprostanol formation from cholesterol (Wells—*Arch. Biochem. Biophys. 66,* 217). The hypercholesterolemia which develops from injected Triton is said to be due to mobilization from tissues through a sequestering mechanism (Friedman & Byers—*Am. J. Physiol. 190,* 439; *Fed. Proc. 16,* 41) or to coating of plasma lipoproteins by the wetting agent resulting in their faulty catabolism (Schotz *et al.*—*Am. J. Physiol. 188,* 399). Other chemicals that induce hypercholesterolemia are potassium iodide (Balaguer-Vintro—*Rev. españ. fisiol. 10,* 1) and *N*-sulfanilyl-N^2-butylcarbamide (Härtel & Antilla—*Arzneimittel-Forsch. 6,* 701). Oral administration of thiotic acid increases deposition of cholesterol in liver (Costa & Abbona—*Arch. E. Maragliano patol. e clin. 13,* 425).

The reduction of either atherosclerotic lesions, Sudanophilia, hypercholesterolemia, or associated syndromes with various chemicals is described. The chemicals involved in the communications are: magnesium salts (Hellerstein *et al.*—*Fed. Proc. 16,* 359), vanadium compounds (Eades & Gallo—*Ibid.* 176; Mountain *et al.*—*Proc. Soc. Exptl. Biol. Med. 92,* 582), chlorpromazine (Wilens *et al.*—*Ibid. 93,* 121), camphoric acid ester of α,4-dimethylbenzyl alcohol (King *et al.*—*Ibid.* 443), α-(biphenylyl) butyric acid (Garattini *et al.*—*Experientia 12,* 347), β-phenylbutyrate, 4-cholesterone (Steinberg & Fredrickson—*Ann. N. Y. Acad. Sci. 64,* 579), chlorpromazine Hydergin, phentolamine, phenoxybenzamine (Hollister *et al.*—*J. Chronic Dis. 6,* 234), phenylethylacetic acid, biphenylylethylacetic acid (Garattini—*Giorn. biochim. 5,* 429), 12 derivatives of phenylacetic acid (Garattini *et al.*—*Arch. intern. pharmacodynamie 109,* 400), 1-(*p*-cyclohexyloxyphenyl)-amine, 1-(*p*-isopropyloxyphenyl)ethylamine (McCoubrey—*Nature 179,* 46), ethyldicumarol (Bernard-Griffiths—*Therapie 10,* 756), ethylenediamine tetraacetic acid (Supniewski *et al.*—*Dissertationes Pharm. 9,* 53), toluidine blue (Day *et al.*—*Australian J. Exptl. Biol. Med. Sci. 34,* 415) and sulfated alginic acid (Constantinides *et al.*—*Arch. Pathol. 62,* 369). Small daily doses of fluoride do not increase serum cholesterol (Buttner & Muhler—*J. Nutr. 63,* 263). 4-Cholestenone reduces serum cholesterol through inhibiting cholesterol synthesis in the liver (Steinberg *et al.*—*Fed. Proc. 16,* 255). However, this steroid loads the body with cholestenone-like compounds that may induce arteriosclerosis (Tomkins *et al.*—*Science 125,* 936). The alleged ability of triiodothyroacetic acid to reabsorb cholesterol from atheromatous lesions is disproven (Pitt-Rivers & Trotter—*Brit. J. Exptl. Pathol. 38,* 97). Porcine elastase is ineffective for the same purpose (Tennent *et al.*—*Science 124,* 588).

A practical plan for long-term treatment of hypertension with drugs by cooperation of patients living at home is discussed (Hoobler—*J. Am. Med. Assoc. 165,* 2143). Death rate in myocardial infarctions are decreased by early use of anticoagulants such as coumarin and indanedione compounds (Wright—*Ibid.163,* 918). Another author believes that anticoagulant therapy, which has certain hazards, is neither necessary nor desirable for patients who have been classified as good risks (Russek & Zohman—*Ibid.* 922). In a third communication on the subject the author preferred treatment by control of fat in the diet rather than using drugs (Wilkinson—*Ibid.* 927).

A novel approach in investigating treatments for atherosclerosis is to dilate the vessels. The vasodilator effects of sodium nitrite and of papaverine-HCl is more intense in rabbits with cholesterol-atherosclerosis than in normal animals (Mironenko—*Farmakol. i. Toksikol. 19, Suppl.,* 10; *20,* No. 1, *28*). Experiences with treating hypertensive patients by surgical removal of obstructive arteriosclerotic lesions in the renal artery are recorded (Poutasse & Dustan—*J. Am. Med. Assoc. 165,* 1521). In work which is part of an extensive project on applying microbiology to the multiple sclerosis problem, 21 soil actinomycetes and bacteria are isolated that include forms capable of digesting and growth on the ether extractable lipides from human atherosclerotic aorta plaques, cholesterol, cholesterol esters, glycerides, and phospholipides (Schatz *et al.*—*J. Appl. Bact. 20,* 30).

The lipide picture is studied in many other diseases. The cholesterol in the seromucoid fraction on serums from patients with lymphomas and metastatic carcinomas is increased and that in acute leukemias and certain liver diseases is decreased (Moschides *et al.*—*Proc. Soc. Exptl. Biol. Med. 96,* 52). Abnormalities in serum lipides, usual excesses of one or more

fractions, are observed and in some cases measured under the following diseases: lipemia retinalis (Franklin & Weissman—*Ann. Internal. Med. 46,* 413), presbycusis (Maggio & Perrella—*Arch. ital. laringol. 65,* 121), pathological pregnancy (Ciulla—*Boll. soc. ital. biol. sper. 32,* 1133), progressive muscular dystrophy (Dryer *et al.—Proc. Iowa Acad. Sci. 63,* 398), paroxysmal nocturnal hemoglobinuria (Munn & Crosby—*Proc. Soc. Exptl. Biol. Med. 96,* 480), familial hypercholesterolemic xanthomatosis (Leonard *et al.—Lancet 271,* 1239; Godal—*Acta Med. Scand. 156, Suppl. 319,* 125), castellanosis (Bellelli & Caraffa—*Riv. ital. igiene 16,* 412), hyperthyroidism (Giraud *et al.—Montpellier med. 44,* 610), and disturbances of the pituitary-adrenal axis (Leupold & Büttner—*Klin. Wochschr. 34,* 1088). Disequilibriums in serum lipide fractions occur under treatment with many hormone substances and in bacterial toxonosis (Wöhler & Ghiassi—*Arch. Exptl. Pathol. Pharmakol., Naunyn-Schmiedeberg's 230,* 161). Blood cholesterol content of malarial patients is normal in 45% of the cases, low in 51% and high in 4% (Garkusha *et al.—Sbornik Nauch. Trudov Samarkand. Med. Ind. 11,* 225). Chronic plasmapheresis in the dog results in elevated plasma cholesterol concentration (Sellers *et al.—Proc. Soc. Exptl. Biol. Med. 95,* 67). No consistent deviation of serum lipoproteins are evident in otosclerosis (Hlavacek & Opplt—*Casopis lekaru ceskych 96,* 198). In pathological states that involve elevated serum cholesterol there is also an accumulation of cholesterol in the spleen (Stefanini *et al.—J. Lab. Clin. Med. 49,* 900). Extraction of the nondiseased part of the skin of patients with chloric acne or with Mason's eczema yields higher amounts of lipides than are obtained from skin of normal controls (Buckup & Szakall—*Berufsdermatosen 5,* 181). Fat in the urine is a common finding in patients subjected to trauma (Morton—*Can. Med. Assoc. J. 74,* 441). Tetraethyl lead poisoning in rabbits causes a considerable drop of both the free and esterified portions of adrenal cholesterol (Morelli & Preziosi—*Rass. med. sper. 1,* 43).

Some work on lipides in disease pertains to enzymes associated with fat metabolism. In the brain of rats infected with Japanese B encephalitis or neurotropic influenza the tributyrinase increases and butyric acid oxidase decreases; and in lymphocytic choriomeningitis there is a reduction of activity of both enzymes (Hirota—*Virus, Japan, 6,* 338). The esterase in livers undergoing necrosis through inhalation of chloroform by the animal disappears rapidly (Verne & Hebert—*Ann. histochim. 1,* 3). A simple technique based on Michel's hydrogenionometric method to determine cholinesterase is developed and applied in surveys of serum cholinesterases in many hepatic, digestive, and neoplastic diseases (Takahashi—*Bull. Yamaguchi Med. School 3,* 155, 167, 179, 199). The plasma triglyceride esterase and cholinesterase in various species are measured to serve as reference data for transferring experimental animal toxicity data to man (Blumenthal & Woodard—*Fed. Proc. 16,* 283). In 13 of 15 pregnant wormen, in healthy and unhealthy states, the parenteral administration of vitamin E daily caused a drop of cholinesterase (Solla—*Minerva ginecol. 9,* 512). Both total body X-irradiation and injected plutonium produce an increase in the cholinesterase activity of erythrocytes of mice (Sabine—*Am. J. Physiol. 187,* 275). The cholinesterase activity of rat brain is unaffected by an *in vivo* dose of 60,000 r from isotope source (Sabine—*Ibid.* 280).

The liver diseases in which there is concurring abnormal distribution in one or more of the serum lipide fractions are intra and extrahepatic biliary obstruction (Furman *et al.—J. Clin. Invest. 36,* 713; Lindholm—*Acta Med. Scand. 156,* 121; Friedman *et al.—Am. J. Physiol. 188,* 337), various gallbladder diseases (Santagati—*Gazz. intern. med. e chir. 61,* 2798), ascitogenous liver cirrhosis (Mainoli *et al.—Fegato 3,* 155), fatty liver patients (Deicher & Jansen—*Klin. Wochschr. 35,* 174), and minor hepatic insufficiency (Walter *et al.—Semaine hop. Pathol. et biol. 32,* 1755). The fatty livers of choline-deficient mice contain ceroid deposits (Williams—*Circulation 16,* 952). Damaging liver with administration of carbon tetrachloride in oil decreases serum phosphatides and esterified fatty acids (Busanny-Caspari *et al.—Klin. Wochschr. 34,* 1016). The hyperthyroid rat shows an increased flow of hepatic lymph with normal lymph cholesterol concentration and the hypothyroid rat shows normal lymph flow with an increased concentration of lymph cholesterol (Friedman & Rosenman—*Am. J. Physiol. 188,* 295). In experimental nephrosis an intravascular alteration occurs in the various lipide fractions of plasma that interfere with their normal rate of egress from plasma (Friedman *et al.—Ibid. 190,* 180). Carcass-fat values in nephrotic rats do not differ from those in control animals, whereas the liver fat contents in the former group are decreased (Heyman & Hackel—*Metabolism, Clin. & Exptl. 6,* 169). In lipoid nephrosis the majority of the serum cholesterol is in the β-globin fraction (Guhl—*Klin. Wochschr. 34,* 1076). In this work the relative firmness of binding of the sterols in each of the protein fractions is measured by differential extraction. Similar data are correlated with the clinical course of the disease (Hooft *et al.—Verh. Kon. Acad. Geneesk. Belg. 16,* 33). In an electrophoretic survey of serums in various kidney diseases, total protein, albumin, and α_1-, α_2-, β- and γ-globulin are measured in acute and chronic glomerulonephritis; interstitial nephrites; iodipatic-, paranephritic-, and diabetic glomerulonephrosis; and hyperazotemic chronic glomerulonephritis (Salvini—*Arch. studio fisiopatol. e clin. ricambio 20,* 746). In a clinical study of lipoid nephrosis, the course of treatments with cortisone substances is followed through results from paper electrophoretic distribution of serum fractions (Roget—*Minerva pediat. 8,* 556).

In a clinical approach to steatorrhea it is emphasized that study should be on the stool for microscopic fat and on the oral glucose tolerance test (Spiro & Friedman—*Am. J. Dig. Dis. 2,* 680). Oral administration of oleic acid-I^{131} to patients with ulcerative colitis results in increased fecal excretion of I^{131} during the acute phase of the disease and return to control values as the patient improves clinically (Sandweiss & Levy—*Proc. Soc. Exptl. Biol. Med. 95,* 259). Patients with massive intestinal resection absorb only about half their dietary fat intake but may be improved nutritionally by more frequent feeding (Schwartz *et al.—Surg. Forum, Proc. 41st Congr. Am. Coll. Surgeons 1955,* 385).

One study on rabies in bats has provided an example of selective viral lipotropism. The brown fat of these animals serves as a depot for the storage of the virus and thereby the bats become symptomless carriers of the rabies virus (Sulkin *et al.—Proc. Soc. Exptl. Biol. Med. 96,* 461).

The presence and significance of lipides in tumors are reviewed (Lopez—*Tumori 42, 616*). A test devised for serologic cancer diagnosis is based on the ease of extracting certain serum protein fractions (Hanke *et al.—J. Lab. Clin. Med. 50,* 358). Differences in such extraction between normal and during malignant growth are due to certain lipide-protein combinations. Patients with cancer lose weight rapidly when hyperalimentation with fat emulsion is withdrawn while patients without cancer tend to maintain weight gain (Watkin & Steinfeld—*Fed. Proc. 16,* 343). Tumor mitochondria inhibits fatty acid oxidation by mouse liver mitochondria possibly because the tumors possess active adenosinetriphosphatases and diphosphopyridine nucleotidases which interfere with the normal oxidative processes (Emmelot & Bos—*Enzymologia 18,* 149, 179; *Experientia 11,* 353). Rats and mice with transplantable tumors show no appreciable increase in hepatic lipides after receiving a series of subcutaneous injections of carbon tetrachloride in olive oil (Bernardi—*Fegato, Rome, 1,* 431). The tumor-producing activity of Rous sarcoma virus preparations are inhibited by the oxidation products of Rous tumor lecithin microsome lipides and of methyl linoleate (Moloney—*J. Natl. Cancer Ind. 18,* 515). The antioxidant and pro-oxidant effect of many carcinogens is measured to gain basic information for study of biochemical mechanisms of carcinogenesis (Brown & Tappel—*Nature 179,* 105; Tedeschi & De Cicco—*Ricera sci. 26,* 1499). In a review on cholesterol in cancer, information is presented on content of cholesterol in tumors, possible transformation of cholesterol to carcinogens, errors in metabolism, etc. (Clement—*Bull. assoc. franc. etude cancer 41,* 65). No constant or characteristic relationship is evident between malignant neoplasms and disturbances in the lipoprotein ratios (Antonini & Sodi—*Bol. soc. ital. biol. sper. 32,* 685). Leukemic cells *in situ* are said to have an abnormal capacity to utilize neutral fat as an auxiliary foodstuff (Worrall—*Med. J. Australia 44, II,* 15).

Fecal lipides of bone-tuberculosis patients contain 17–51% nonsaponifiables (Putnina—*Latvijas P.S.R. Zinatnu Akad. Vestis 1956,* No. 2, 97; No. 9, 85). The serum protein-bound lipides are not altered in experimental tuberculosis of guinea pigs (Sher *et al.—Proc. Soc. Exptl. Biol. Med. 93,* 578).

Many data on serum-bound lipides and carbohydrates in diabetic patients with and without vascular lesions are recorded (Introzzi—*Arch. studio fisiopatol. e clin. ricambio 20,* 242; Galletti—*Ibid.* 201; Polosa—*Ibid.* 220; Tolomelli *et al.—Ibid.* 196). In both types of diabetic patients the β-lipoprotein content of the serum is abnormally high and the serum cholesterol content parallels the β-lipoprotein data. Other lipide work on diabetics involves mechanism of the disturbance in lipide metabolism. Diabetics show a similar response in blood amylase and plasma nonesterified fatty acid concentrations on administration of carbohydrate or orinase (Dreiling & Bierman—*Proc. Soc. Exptl. Biol. Med. 95,* 496). Such parallel defects could be associated in some common metabolic process. In the particle-free systems of alloxan-diabetic rat liver, there

is a significant depressed lipogenesis as compared to that from the normal animal (Shaw *et al.—J. Biol. Chem. 226,* 417). The well established defect in fatty acid synthesis seen in diabetes is likewise due to a lack of glucose oxidation *via* the hexosemonophosphate shunt is demonstrated (Siperstein & Fagan—*Science 126,* 1012). Here, it is also demonstrated that the primary diabetic block in fatty acid synthesis is at the site of action of reducing triphosphopyridine nucleotide, namely at the reduction of crotonyl-CoA to butyryl-CoA.

In a study of dietary fats and time in production of experimental obesity, the order of weight gain from greatest to least is directly related to the degree of saturation of the fats tested (Crisco, lard, butterfat, margarine, corn oil, coconut oil and cottonseed oil) from greatest to least saturated; with the exception of coconut oil, which though highly saturated, allowed only moderate weight gains (Barboriak—*Fed. Proc. 16,* 380). In a dissertation on treating overweight patients, the excess weight not due to disease is ascribed to excessive carbohydrate intake or a disturbance in carbohydrate metabolism (Thorpe—*J. Am. Med. Assoc. 165,* 1361). The author seems to justify the use of high-protein, high-fat, low-carbohydrate diets for successful loss of excess weight. A study of the role of protein in weight reduction, suggests that the loss of nitrogen may be a proper part of reduction, since the obese subject probably has more than a normal amount of nitrogen in his body (Dole—*Am. J. Clin. Nutr. 5,* 591). In a study of fat metabolism in obesity on mice, the obese animals show much greater rates of incorporation of labeled acetate into carcass and liver fatty acids than did normal controls (Mayer & Zighera—*Experientia 11,* 358). Mice bearing adrenocorticotropin-secreting tumors exhibit a metabolic type of obesity (Zomzely & Mayer—*Am. J. Physiol. 187,* 365). Mice strains resistant to nutritional obesity are characterized by a muscle glycogen level 4–6 times higher than those of strains which can be made obese (Lyon & Fenton—*Ibid.* 415). Obese persons are also studied with regard to hypertension and serum lipoprotein fraction distribution (Fischer & Monnier— *Schweiz. med. Wochschr. 86,* 975; Szent-Györgyi—*Am. J. Clin. Nutr. 5,* 274; Skanse—*Acta Endocrinol. 25,* 445). In general there is more incidence of hypertension among obese than among non-obese subjects.

LIPIDES IN MICROBIOLOGY AND PLANTS. *Lactobacillus delbruechii* and *L. arabinosus* fail to produce octadecenoic acids when lactobacillic acid is supplied in their media (Hoffmann *et al.—J. Biol. Chem. 228,* 349; Panos—*Univ. Microfilms, Ann Arbor, Publ. No. 18253,* 99 pp.). Here, a proposed route for lactobacillic acid biosynthesis involves the addition of a carbon fragment to the double bond of cis-vaccenic acid. The bacterial growth promoting activity of some short-chain unsaturated acids suggests that they may be intermediates in the biosynthesis of *cis*-vaccenic and lactobacillic acid in organisms (O'Leary & Hoffmann—*Fed. Proc. 16,* 228). A study of the fatty acids and respiration of *Leptospira icterohemorrhagiae* indicates that one function of serum protein in the metabolism of this organism is to furnish fatty acids in a nontoxic form (Helprin & Hiath—*J. Infectious Dis. 100,* 136). Of two mutants isolated from Mycobacterium strain 607 which are dependent for growth on fatty acids derived by solvent extraction from the parent strain, one responds to tuberculostearic acid and the other to hexacosanic acid (Karlsson—*J. Bacteriol. 72,* 813). A study of lipide synthesis by yeast deals principally with the enzymes and factors present in the cell-free extract that are required for synthesis of fat, sterols, and squalene (Corwin—*Arch. Biochem. & Biophys. 72,* 112).

Penicillium chrysogenum grows faster in presence of oleic acid than with saturated acids (Gaby *et al.—J. Biol. Chem. 227,* 853). This work contains analytical data with respect to the composition of the phospholipides elaborated when the organism is grown with saturated acids present in the medium. Actinomycete species 58B from soil grows in lecithin, cephalin, inositol lipide, sphingomelin, cerebroside, acetate, fatty acids, fat, cholesterol, etc., whereas it does not grow in mono- and triacetin, monostearate, choline, or ethylamine (Adelson *et al.—J. Bacteriol. 73,* 148). The bactericidal activity of oleic acid for *Tubercle bacilli* is characterized in regard to various substances protecting against bactericidal action, morphological response, etc. (Minami *et al.—Ibid.* 338, 345). The inhibiting effect of C_{12} to C_{20} saturated fatty acids on bacterial growth is readily reversible by oleic, linoleic, ricinoleic, vaccenic, licanic, erucic, or lactobacillic acids (Camien & Dunn—*Arch. Biochem. & Biophys. 70,* 327). Larvae of the silkworm and rice-stem-borer become highly susceptible to certain fungi when their cuticular lipides are either mechanically or chemically removed (Koizumi—*J. Insect. Physiol. 1,* 40). The component of lipopolysaccharides from gram-negative organisms which is responsible for temporary increase in resistance of mice to infection by certain bacteria has been concentrated (Howard *et al.—Nature 179,* 314).

Fatty acid esters of hydroxybenzoic acid are hydrolyzed by trypsin and chymotrypsin (Hofstee—*Biochim. et Biophys. Acta 24,* 211). The reaction can be used to investigate soybean trypsin inhibitor. Ovolecithin and other phosphoglycerides are degraded by snake-venom phospholipase A whereas inositol phosphoglycerides are not (Long & Penny—*Biochem. J. 65,* 382). The egg-yolk reaction as a test for lecithinase activity appears quantitative in *Clostridium perfringens,* but not in *Bacillus cereus* (Kushner—*J. Bacterial 73,* 297).

Particles from avocado mesocarp incorporate labeled acetate into esterified long chain fatty acids, especially into palmitic and stearic acids (Stumpf & Barber—*J. Biol. Chem. 227,* 407; *Fed. Proc. 16,* 257). The mechanism of biosynthesis of fat in maturing flax seed is studied by placing cut stems in solutions containing various labeled compounds (Vyval'ko *et al.—Ukrain. Khim. Zhur. 23,* 85). Here, sucrose, acetate, acetoacetate, and glycine all rather equally enter into the formation of fatty acids, but glycerol is built fastest from glycine and faster from sucrose than from the acetates.

In a study of fat metabolism in germinating castor beans, the utilization of bound and free fatty acids is measured with respect to respiration, conversion of fats to sugars, their *translocation,* etc. (Yamado—*Univ. Tokyo 5,* 149, 161). Higher fatty acid dehydrogenase in soybeans is characterized as to amount present in green beans, substrate utilized, activity during germination, and cofactors involved (Fukuba & Komaru—*Nippon Nogei-kagaku Kaishi 28,* 74; Fukuba—*Ibid. 31,* 67).

The properties of lipoxidases from urd beans, mung beans, wheat, and peanuts are compared as to activity, inhibitors, and mechanism of action (Siddiqi & Tappel—*J. Am. Oil Chemists' Soc. 34,* 529). The results indicate the possible occurrence of two types of lipoxidase in nature. Kinetically, the barley enzyme resembles soybean lipoxidase (Franke & Frehse—*Z. physiol. Chem. 295,* 333). In this work the appearance and disappearance of lipoxidase in leaves, roots, and seeds of various cereals is measured.

Plant lipases and those of *Aspergillus flavus* bring about more complete hydrolysis of fats than does pancreatic lipase, because of their greater ability to hydrolyze monoglycerides (Savary *et al.—Bull. soc. chim. biol. 39,* 413). The lipase content of rapeseed germinated in light increases 100-fold over that of dormant seed (Wetter—*J. Am. Oil Chemists' Soc. 34,* 66).

A glyoxylate cycle is proposed as a route for the net conversion of fat to carbohydrate in the castor beans (Kornberg & Beevers—*Biochim. et Biophys. Acta 26,* 531). Some of the characteristics in the nature of chlorophyll-protein-lipide complex in its formation from protochlorophyll is elaborated (Godnev *et al.—Doklady Akad. Nauk. S.S.S.R. 113,* 646).

Composition and Characteristics

COMPREHENSIVE AND GENERAL INFORMATION. The report of the uniform methods committee of the Am. Oil Chemists' Soc. contains recommendations for minor revisions from analytical committee chairmen on dilatometric methods, fat stability, monoglycerides, oxirane oxygen, neutral oil, lecithin, commercial fatty acids, refining methods, soap and synthetic detergents, seed and meal, and glycerol (Mehlenbacher *et al.—J. Am. Oil Chemists' Soc. 34,* 474). The report of the German fat analysis committees summarizes recent work on the following methods: moisture, storage of sample, melting, light absorption, conjugated acids, splitting, monoglycerides, peroxide value, brightness, residue value, furfurolhydrochloric acid test, physical tests, chemical tests, saponification value and glycerol (Seher—*Fette-Seifen-Anstrichmittel 59,* 451, 535).

The influences of maturity, variety and environment on composition of fats were studied. At 10 weeks after pollination the West African palm kernel oil contains 36.5–81.2% unsaturated fatty acid and only 1.4–8.5% lauric acid; at maturity the free acidity is practically gone and lauric acid comprises almost one half the fatty acids present (Crombie—*J. Exptl. Botany 7,* 181). A study of the oil and characteristics of the oil during development of a late-maturing variety of peanuts is made to determine when to harvest (Prasad—*J. Proc. Oil Technol. Assoc., India 12,* 23). Low moisture and maximum oil occurs at 65–70 days after blooming; after which time it is ready for harvest. A safflower seed containing oil of iodine value of 90–100 was produced by inbreeding the I.P. variety (Horowitz & Winter—*Nature 179,* 582). The acid value, gossypol content and oil content of the Russian cottonseed from fine-fibered plants are higher than in those of medium fiber (Podol'skaya & Gan—*Masloboino-Zhirovaya Prom. 23,* No. 2,

4). The oil content of 12 varieties of cottonseed grown in Oklahoma varied from 15.9 to 20.71% (Green *et al.—Oklahoma Agr. Mech. Coll. Expt. Sta. Circ. M-283,* 9 pp.). The data recorded in this work include percentage kernels, hulls, linters, oil in kernels, protein in whole seed and weight of seeds. Oil content of eight commercial varieties and 24 new strains of cottonseed grown in Pakistan varied from 15–27% (Khan—*Agr. Pakistan 7,* 128). Ginning results and staple length are also recorded in this work.

Both linolenic and linoleic acid contents of soybean oil produced in high environmental temperature zones are lower than those of oil produced at lower temperatures (Collins & Howel—*J. Am. Oil Chemist Soc. 34,* 491). The linolenic acid content is more closely associated with temperature than is linoleic acid. In a study of cost of production of soybean oil from various varieties, yield of beans, oil content and characteristics of the oil are included (Weber & Horner—*Agron. J. 49,* 444). Small amounts of linolenic and arachidic acids constitute the only difference between oil from *Citrullus colocynthis* of Indian origin and the same from the Sahara region (Sengupta & Chakrabarty—*Sci. & Culture 22,* 581). The oil content and composition of the oil of Argentine peanuts does not differ from that of foreign sources (Cantarelli—*Rev. fac. cienc. quim. Univ. nacl. La Plata 28,* 15). The characteristics of Borneo tallow, illipe butter, nigerseed oil, safflower oil, and sesame oils of Japan (Kato—*Tokyo Koggo Shikensko Hokoku 52,* 133) and jute seed oil of Russia (Lazur'evskii & Cherep—*Masloboino-Zhirovaya Prom. 23,* No. 1, 9) are published.

One communication contains the principal chemical and physical properties of 34 common vegetable oils (Carola—*Olii minerali, grassi e saponi, colori e vernici 33,* 432; *34,* 54). A brief review paper contains general information on glyceride composition (Bhattacharyya—*Indian Soap J. 22,* 67). Use of radioisotopes in fat chemistry is also reviewed (Hiraoka—*Abura Kagaku 6,* 127).

Many data are recorded on butterfat. The fat content and characteristics of the fat of various breeds of cattle of the Saratov province of Russia, and the seasonal variation of the data are recorded (Glukhov & Mordovina—*Sbornik Dokladov Vsesoyuz. Soveshshan. po Molochnomu Delu 1955,* 189). Seasonal variations in the physical and chemical properties are also recorded for butterfat of Alberta, Canada (Wood—*Can. J. Agr. Sci. 36,* 422) of cow and buffalo butterfat of India (Sampath & Anantakishman—*Indiana J. Dairy Sci. 9,* 135), of cow butterfat as affected by individual cow, stage of lactation, feed and plane of nutrition (Mayhead & Barnicoat—*J. Dairy Res. 23,* 238; Steen—*Beretn. Statens Forsogsmejeri* 287, 94 pp.). In some of the above references the data are discussed with regard to criterion for detection of adulteration. Analyses of milk from 63 cows in the third month of lactation show a non-significant correlation (r = + 0.156) between protein and fat content (deVuyst & Imberechts—*Rev. agr., Brussels, 8,* 206).

Seasonal fluctuations in vitamin A, carotene, tocopherol, and anthophylls of New Zealand butterfat are recorded (McGillivray—*New Zealand J. Sci. Technol. 38A,* 466). Vitamin A and carotene values are determined on the butterfat of two cows and two buffaloes throughout one lactation period (El Ridi *et al.—Proc. Pharm. Soc. Egypt, Sci. Ed. 35,* No. 7, 15). Buffalo butterfat contains vitamin A and no carotene. The color of beef and horse fat increases during grazing and fades during stall feeding, the horse fat being generally more highly colored than the beef fat (Dahl—*Z. Lebensm.-Untersuch. u. -Forsch. 105,* 180). Here, no direct relation is evident between fat color and vitamin A, but there is a general tendency thereto for a specific fat type.

Dissection and analysis of 21 fat cattle show fat tissue range from 28.3 to 96.7% fat and the iodine value from 34 to 69; the corresponding ranges of fat in muscular tissue are 1.3–14.2% and 46–73 (Callow—*J. Agr. Sci. 48,* 61).

ANALYSIS OF FAT SOURCES. Apparatus is described in which 24 samples may be extracted for the fat determination at one time (Wix & Hopton—*Chemistry & Industry 1957,* 805). The cost of analysis with the equipment is discussed. Analytical extraction of seed oil with ether solvent containing peroxides increases the refractive index and decreases the iodine value of the extracted oil (Popov—*Compt. rend. acad. bulgare sci. 9,* No. 1, 51). Correction factors are established to compensate for the errors occurring when the fat determination is based on weight of the residue after the extraction of the lipides (Ionescu & Ferando—*Rev. chim., Bucharest, 7,* 718).

Use of a supersonic device permits evaluation of back fat thickness as well as carcass grade on either the live animal or carcass (Claus—*Die Fleischwirtscaft 9,* 552). In the perchloric-acetic acid, Babcock method for determination of fat in meat products, the value obtained should be multiplied by a factor of 0.95 because the separated fat contains about 5% acetic acid (Windham—*J. Assoc. Off. Agr. Chemists 40,* 765). A method for determining fat in whale meat on board ship involves a hydrochloric acid hydrolysis, taking up fat with 1:1 mixture of ether: hexane, and measurement by saponification with standard alkali followed by back titration with standard acid (Benterud—*Norsk Hvalfangst-Tidende 45,* 511). A method for fish products involves an extraction with dry acetone, reextraction of residue with acetone containing 30% water, evaporation, and extraction of lipide residue with ether (Dambergs—*J. Fisheries Res. Board Can. 13,* 791). Extraction with straight acetone or acetone containing one percent hydrochloric acid gives high results on fish meals because nonlipide material is extracted with the fat (Montequi & Pineda—*Bol. inst. espan. oceanog. No. 78–79,* 13 pp.).

A preliminary water extraction of feeds to remove molasses before ether extraction is eliminated from a standard method because it occasionally causes erratic results (Hoffman—*J. Assoc. Off. Agr. Chemists' 40,* 358).

In fat analysis of chocolate products where the characteristics of the extracted fat are to be determined, the lecithin should be removed from the extract by extraction with boiling acetone (van Voorst—*Chem. Weekblad. 53,* 170). The treatment permits investigation for adulterant fat through determination of relation between aniline point and iodine value. A saponification method is recommended for determining fat in foods rich in starch (Fukuba *et al.—Nippon Nogei-kagaku Kaishi 28,* 59).

Sweet-cream buttermilk powder shows up to 0.4% higher fat content by the Mojonnier modification of the Roese-Gottlieb method than by the British Standard acid digestion method, which is due to the extraction of some of the phospholipides by the former method (Falkenhahn—*Australian J. Dairy Technol. 12,* 61). Fat determinations on dairy products are about 0.9% higher by the Schmid-Bondzynski-Ratzloff method than those by the Roese-Gottlieb method (Willart—*Svenska Mejeritidn. 48,* 187). A slight lack of agreement among collaborators comparing the Mojonnier, Babcock, and Sager-detergent methods for fat in milk and ice cream is ascribed to the inability of analysts to determine the same boundary of the upper meniscus (Herreid—*J. Assoc. Off. Agr. Chemists 40,* 499). In another comparison, butyrometric determinations on cream varied by 0.6%, whereas those by weight methods varied by 0.9% (Jax—*Milchwissensch. Ber. 6,* 186). In a modified Gerber method the acid is replaced by a 20:100 mixture of nonionic-anionic detergents (Godfrain—*Rev. med. vet. 106,* 370). Milk assayed by the acid Gerber method shows a fat content about 0.07–0.1% higher after acidification by acid bacteria than before treatment (Majer—*Milchwissensch. Ber. 6,* 191). Substitution of a commercial alcohol preparation for amyl alcohol in the Gerber method has no advantage (Hoffer—*Ibid.* 233). Increasing the digestion temperature from 65° to that of boiling water in the Gerber-van Gulik method for fat in cheese reduced the time required from 1.5 hour to six minutes (Walter—*Off. Orgaan. Koninkl. Ned. Zuivelbond 47,* 719). The Babcock method for cheese is similarly adjusted (Glotova—*Molochnaya Prom. 18,* No. 4, 38). The Gerber method is adjusted for the determination of fat in dried milk (Falkenhahn—*New Zealand J. Sci. Technol. 38B,* 571).

A pure, dry grade of salt is a suitable substitute for the commonly used sea sand dispersing agent for the gravimetric determination of moisture in butter (Seuss—*Z. Lebensm.-Untersuch. u.-Forsch. 105,* 89).

A micromethod for determination of serum triglycerides is based on adsorption on zeolite, extraction with chloroform, saponification, and determination of glycerol according to Lambert and Neish (van Handel *et al.—J. Lab. Clin. Med. 50,* 152). Details for fat determinations based on conversion to hydroxamic acids and colorimetric measurement after addition of ferric chloride are designed for application to samples of feces (Tompsett—*J. Clin. Pathol. 10,* 210; Merlini—*Arch. E. Maragliano patol. e clin. 12,* 1093), blood and organs (Gey & Schön—*Hoppe-Seyler's Z. physiol. Chem. 305,* 149), and serum proteins (Tompset & Tennant—*Am. J. Clin. Pathol. 26,* 1226). The test on the serum proteins involves electrophoresis of the serum so that distribution may also be determined. A micromethod for biological lipides is based on the principle that fatty acids react with formaldehyde to give a yellow to brown addition product that is measured colorimetrically (Weigel—*Fette-Seifen-Anstrichmittel 58,* 1038).

An empirical curve is developed showing the relation between oxygen consumption during autoxidation in human plasma and the total polyunsaturated fatty acids present as determined spectrophotometrically (Evans *et al.—J. Applied Physiol. 9,* 301). It serves to approximate polyunsaturated acid in plasma from the oxygen consumption of the plasma.

A method for extraction of the total lipides of animal tissue involves extraction with a 2:1 chloroform:methanol mixture and washing the extract with an appropriate salt solution (Folch-Pi *et al.—J. Biol. Chem. 226,* 497).

GRADING AND VITAMIN TESTS. Equipment and method are designed for a continuous flow process for sampling oil in tanks or tank cars during loading or unloading (Brown *et al.—J. Am. Oil Chemists' Soc. 34,* 164).

Based on trichromatic coördinates and coefficients derived with the aid of a Beckman spectrophotometer on 70 samples of various oils representing different colors and brilliancies, a simplified method of determining color of oils is designed (Sambuc & Naudet—*Rev. frac. corps gras 3,* 838). Results are good when the samples are examined at four wave lengths. The evaluation of oil color on the basis of optical density measurements at 500 mμ is proposed, because it gives a good expression of color in oils and it provides an accurate estimation of color removal during bleaching (Pohle & Tierney—*J. Am. Oil Chemists' Soc. 34,* 485). It is also proposed that color of oils be determined through their absorption at 400–700 mμ (Lyaskovskaya *et al.—Myasnaya Ind. S.S.S.R. 28,* No. 1, 45). To measure refined color on samples without determining refining loss a 100 ml. sample may be stirred with 20 ml. of 18° Bé sodium hydroxide, centrifuged, and the oil layer is filtered for color measurement (Deacon *et al.—J. Am. Oil Chemists' Soc. 34,* 367). The international recognized standards of colorimetry are said to be sufficient for the oil and fat field without special agreement on comparative samples (Zimmermann—*Fette-Seifen-Anstrichmittel 59,* 338).

The free fatty acids in the oil contained in seeds may be determined directly by milling the seeds with petroleum ether and sand, filtering and titrating the miscella (Bigoni—*Olii Minerali, grassi e saponi, colori e vernici 33,* 306). The oil content required for the calculation is detd. on another extraction. A fat acidity test is recommended as an index of grain deterioration (Baker *et al.—Cereal Chem. 34,* 226).

The laboratory refining test must be adjusted with respect to temperature, concentration of caustic, and agitation time for application to degummed cottonseed oil (Sikes—*J. Am. Oil Chemists' Soc. 34,* 72). However, the chromatographic refining test method permits 100% recovery of neutral oil. The chromatographic method of Linteris and Handschumaker for determination of neutral oil is simplified and is recommended for adoption as a tentative procedure (Tierney *et al.—J. Am. Oil Chemists' Soc. 34,* 348).

Since measurement of foots in raw linseed oil is difficult, it is proposed to determine: *(a)* sedimentation at 20° for 96 hours, *(b)* sedimentation at 40° for 96 hours, and *(c)* precipitation by acetone and acid-saturated calcium chloride (Fähnrich—*Farbe u. Lack 63,* 5, 65). Here, heat soluble substances are reported as *a* minus *b;* and *c* gives the latent sediment important for refined-oil processing. Another foots test for linseed oil is based on adding 0.7% by volume of 3:1 mixture of water and 65% nitric acid, agitating and separating the precipitate by centrifuging (de Coninck & Delacourt—*Chim. peintures 19,* 445).

A committee report on determination of vitamin A in margarine contains collaborative data on single and double column chromatographing in the method (Morgareidge—*J. Assoc. Off. Agr. Chemists' 40,* 876). The dyes yellow AB or OB may be removed from margarine, in preparation for the determination of vitamin A, by reaction with aldehydes and separation by difference in solubility or the dyes may be reduced with dithinoite (Naito & Mori—*Vitamins, Kyoto, 11,* 521, 528; *J. Vitaminol. 2,* 283, 287).

A sensitive micromethod developed for determination of tocopherols is based on reaction with phosphomolybdic acid (Rosenkrantz—*J. Biol. Chem. 224,* 165). Some oil samples contain substances which interfere with the Emmerie-Engel determination of tocopherols. Oxidized products in oils which interfere are rendered innocuous by heating to 210° under reduced pressure (Frankel *et al.—J. Am. Oil Chemists' Soc. 34,* 544). The interfering material of corn oil is removed by treatment with alkali and adsorption on diatomaceous earth (Hivon & Quackenbush—*Ibid.* 310). A method for removing pigments that interfere is based on chromatographic adsorption on siliceous earths (Blaim—*Roczniki Nauk Rolniczych Ser. A. 73,* 145).

CHEMICAL CHARACTERISTICS. The relationships of iodine numbers obtained to reaction times are plotted for the Wijs, Hubl, Hanus, and Kaufmann methods with and without mercuric acetate on castor, olive, and linseed oils, and on methyl oleate and linoleic acid (Awe & Grote—*Fette-Seifen-Anstrichmittel 59,* 733). Development of substitution reaction and practical aspects of data for design of methods are discussed. The iodine values determined on a like range of fatty materials by the Kaufmann method, at a two hour reaction period, agree with the hydrogenation values (Seher & Arends—*Mitt. Gebiete Lebensm. u. Hyg. 48,* 1). Treating fats and oils containing peroxides with methanol reduces the iodine value (Kartha—*J. Sci. Ind. Res., India, 16B,* 272). It is suggested that alcohol produces isomerization of the initial peroxides to give isomers in which the iodine absorption at some double bonds is blocked by the peroxide radicals. Commercial samples of iodine trichloride that are marketed for the preparation of iodine chloride for ioline value determination contain some hydrogen iodate and are not recommended (Bellucci & DeGori—*Ann. chim., Rome, 47,* 299). For some oils there is sufficient correlation between iodine value and refractive index so that equations can be developed for calculating the iodine value from the refractive index (de Mello & de Castro—*Agron. Lusitana 18,* 61; *Pharmazie 9,* 911).

The yields of solid bromine addition products from linoleic and linolenic acids as affected by solvent, reaction temperature and time, method of adding bromine, and concentration of the fatty acid solutions are determined and used to design a method for determining the tetra- and hexa-bromide values (Franzke & Ittrick—*Fette-Seifen-Anstrichmittel 59,* 594, 740). In the method devised, the bromine addition products are separated according to solubility in petroleum ether at 50° and values are calculated from reference curves. Hexabromide formation and precipitation are studied in grapeseed, soybean, rapeseed, olive, and wheat germ oils, olein fraction of these, and the same oils containing various amounts of linseed oil (Martinenghi & Balestrini—*Olearia 10,* 5). The data here include time of development of precipitation, character, etc. and are basic for design of hexabromide value determination and for detection of adulteration. A method for estimating linoleic acid in fatty acid mixtures is based on the tetrabromide value (Phatak & Aggarwal—*J. Sci. Ind. Res., India 16B,* 19).

The Reichert-Meissl value on fat extracted from ice cream is not adversely affected by mono- and diglyceride emulsifiers even when in extreme amounts in the ice cream (Thomas & Purko—*Proc. 37th Ann. Mtg. Western Div. Am. Dairy Sci. Assoc. 1956,* 7 pp.).

A new saponification value method is devised from technique used in the conventional and the Rieman methods and also includes determination of acid value (Mangeney—*Rev. franc. corps gras. 4,* 301). The composition of unsaponifiable material obtained from rapeseed and mustard oils by *(a)* extraction of the potassium soaps with petroleum ether, *(b)* the same extraction with ethyl ether, and *(c)* extraction of barium soaps with acetone, conversion to potassium soap and re-extraction with ether are of different composition (André & Maille—*Ann. inst. natl. recherche agron. Ser. E. 5,* 557). These data are discussed with regard to the need of accurate technique for determination of the unsaponifiable material in mustard oils.

When an ether solution of an oil is refluxed with bis (*p*-dimethylaminophenyl)amine a precipitate forms which can be filtered off and recrystallized from alcohol (Das & Niyogy—*Ann. Biochem. & Exptl. Med. India, 16,* 5). A measure of the amount of precipitate formed is proposed as a new analytical characteristic for fats and oils.

PHYSICAL CHARACTERISTICS. Methods for determining hardness of margarine and other fats are reviewed (Styazhkina—*Masloboino-Zhirovaya Prom. 23,* No. 2, 33). A consistency tester based on the resistance to a plunger being forced through a sample contained in a cylinder can be used to measure penetrometer value, resistance to pressure, and shearing strength (Grunewald—*Z. Lebensm.-Untersuch. u. Forsch. 105,* 1). In determining flow limits of chocolate in a rotational viscosimeter the results are considerably affected by roughness and composition of the container and mechanical pretreatment of the chocolate (Finke & Heinz—*Fette-Seifen-Anstrichmittel 59,* 646).

Details of a dilatometric method developed by an Am. Oil Chemists' Soc. committee are published with a summary of the collaborated work from which it evolved (Braun *et al.—J. Am. Oil Chemists' Soc. 34,* 344). In dilatometric studies, cooling cycles or heating cycles which are started from different points on the heating or cooling curves yield curves which are different from each other and from curves representing the complete heating and cooling cycles (Craig—*Ibid.* 30). Here the specific volumes at any temperature in the solid region depend on the previous history of the sample. Characteristic differential dilatometric curves are recorded for single fats, hydrogenated fats, and blended fats and are discussed with respect to the predominant glycerides present (Jasperson & McKerrigan—*J. Sci. Food Agr. 8,* 46). Dilatometric data on cream are interpreted with respect to melting point of the fat, the expansion of the liquid and solid state and calculation of the amount of solid fat (Muler & Klomp—*Neth. Milk Dairy J. 10,* 123).

Melting point diagrams of two-component systems of saturated fatty acids show: that even acids of two carbon difference have three mixed crystal phases separated by eutectics and peritectics; systems of adjacent even- and odd-numbered acids form continuous series of mixed crystals; and when acids differ by three carbon atoms, two intermediate phases may occur (Kofler—*Z. Elektrochem. 60*, 1014). Melting-refractometry; that is characterization of a solid-liquid fat mixture by the refractive index of the liquid phase, is demonstrated on several fats with regard to determining selectivity of hydrogenation, consistency, and melting behavior (Kaufman & Thieme—*Fette-Seifen-Anstrichmittel 59*, 831). In this work the relationships between melting refraction, melting point, and iodine value are plotted for cottonseed oil, palm oil, and lard of solid phases from 12.4 to 73.4%.

Thermal and x-ray diffraction data are presented for mixed symmetrical and unsymmetrical stearoyl- and palmitoyl-diacetins (Lutton—*J. Am. Chem. Soc. 79*, 5137). The symmetrical compounds occur in metastable sub α- and α'-forms, and stable β'-form. The binary mixtures prepared by random interesterification are 2/3 unsymmetrical and have very stable α-phases. The transition temperatures of C_2–C_{18} acid esters of cholesterol through smectic, cholesteric and isotopic phases are recorded with descriptions of the transitions as observed microscopically (Gray—*J. Chem. Soc. 1956*, 3733).

X-Ray diffraction data on 14 thiol esters of fatty acids show that the aryl thiol esters crystallize in tilted bimolecular layers whereas *n*-aliphatic thiol fatty acid derivatives crystallize in monomolecular layers (Witnauer *et al.*—*J. Am. Oil Chemists' Soc. 34*, 71).

When fresh surfaces of metals more electropositive than silver are "machined" under dilute solutions of fatty acid in cyclohexane, the acid is adsorbed rapidly on the fresh surface to the extent of just one mono-molecular layer (Smith & McGill—*J. Phys. Chem. 61*, 1025). The free energy involved in this mechanism suggests that a chemical reaction to form metal soap occurs. Oil-water contact angles, coefficients of friction, and electron diffraction data of films of fatty acids, cationic detergents, and anionic detergents on electropolished copper, aluminum and iron surfaces indicate that the monomolecular layers are similar to those formed on aqueous solutions (Shulman *et al.*—*Kolloid-Z. 146*, 77).

The adsorption isotherms of oleic acid on quartz pass through a maximum at a pH of about 7–8 and decrease abruptly on either side (Dem'yanova—*Tsvetnye Metal 29*, No. 4, 25). These data are pertinent to the mineral flotation processes. When stearic acid is adsorbed on iron from an 80% aqueous ethanol solution there is an electrode potential change just before 70% of monolayer-coverage is achieved (Bordeaux & Hackerman—*J. Phys. Chem. 61*, 1323). With small amounts of current the stearic acid polarizes both the cathodic and the anodic reactions, the former to a slightly greater extent.

The ω-trifluorinated stearic acid in contrast to stearic acid forms monolayer films that do not support high pressures and whole molecular areas at closest packing are too large to be accounted for by the extra bulk of the $-CF_3$ group (Fox—*Ibid.* 1058). This behavior is attributed to intermolecular repulsions of strong dipoles associated with $-CF_3$ groups attached to the hydrocarbon chain. The temperature variations of spreading pressures of cetyl alcohol and palmitic acid on aqueous surfaces are measured and molar heats, entropy, free energy and enthalpy changes accompanying monolayer formation are estimated using values for the area occupied per molecule in the equilibrium film (Boyd & Schubert—*Ibid.* 1271). Apparatus for measuring surface potentials of fatty acid films by the ionizing method and from surface pressure with a film balance are described and demonstrated in obtaining data on myristic and lauric acid as affected by pH and potassium chloride (Michel—*J. chim. phys. 54*, 206, 211, 219, 223). In the two phase system consisting of heptane and methylene blue in 0.6 *M* ammonium hydroxide, the presence of fatty acids causes the methylene blue to become enriched at the interface of the phases (Coleman & Middlebrook—*Science 126*, 163). The loss of dye from the aqueous phase is a logarithmic function of the amount of the fatty acids in the system. Thus, this phenomenon can be used for measuring unesterified fatty acids in plasma.

Unusual cataphoretic velocity—concentration curves obtained on stearic acid sol particles in butylguanidine sulfate solutions are explained by assuming that the hydrogen ions obtained from the acid dissociation form the outer part of the double layer and that hydrospheres occur around colloid particles and restrict their movement (Roy—*J. Indian Chem. Soc. 34*, 213). The properties of lipoidal membranes, such as films of fatty acids are reviewed with respect to various methods of preparing such membranes (Monnier & Monnier—*J. physiol., Paris, 49*, 316).

A method for estimating the amount of fat globules in cream as small as 1 μ and under, involves determining the portion of total fat which remains in the serum when a sample of cream, diluted to 10% fat, is centrifuged at 60° for 30 minutes at 3000 r.p.m. (Dolby—*J. Dairy Res. 24*, 68).

In the presence of organic solvents, tristearin exhibits three distinct solubility curves corresponding to three crystalline forms (Hoerr & Harwood—*J. Phys. Chem. 60*, 1265). The occurrence of a fourth crystalline form reportedly melting at 70° is not confirmed by the solubility studies. Phosphorus derivatives of fatty acids in which the phosphonate group is attached at the α-position have unusual solubility properties and ester derivatives are extremely resistant to hydrolysis (Ackerman *et al.*—*J. Am. Chem. Soc. 79*, 6524). In this work, properties of the even C_4–C_{18} fatty acid derivatives are tabulated.

The properties of lards of different composition; i.e. from back fat and leaf tissue, are alike in respect to critical solution temperatures in aqueous ethanol solutions, whereas, that of "rearranged" lard (heated with sodium methoxide) is quite different (Rao & Arnold—*J. Am. Oil Chemists' Soc. 34*, 610).

A thesis containing data on the rate of evaporation of water through fatty acid monolayers is available on microfilm (Archer—*Univ. Microfilms, Ann Arbor, Publ. No. 19261*, 86 pp.).

DETECTION OF ADULTERATION. Many efforts were made for improving and evaluating existing methods and devising new methods for detection of foreign fats in dairy products. Collaborative study of the method based on the tocopherol content show that results are variable and the standard deviations are high (Windham—*J. Assoc. Off. Agr. Chemists 40*, 522). Results based on chromatographic determination of mole percent of butyric acid are considered satisfactory (Mahon—*Ibid.* 531). With the sterol test, the addition of 10% coconut oil to butter raises the melting point of the isolated sterols 5° (Cannon—*Ibid.* 517). Limits are established for the variables in determination of Reichert-Meissl and Polenske values of Minnesota reagent-isolated-butterfat to standardize these methods for detection of foreign fats in dairy products (Klayder & Fine—*Ibid.* 509). The status of the above cited collaborative work and tests is also reviewed (Horwitz—*Ibid. 491*). The relation among the aniline point, iodine value, and Reichert-Meissl-Wollny value of butterfats is examined by the method of least squares and expressed by a formula which may be useful for detection of adulteration (van Voorst—*Chem. Weekblad. 53*, 6). A laboratory survey of seven methods shows that the method based on melting point of sterol acetates definitely detects adulteration of butterfat with 5% vegetable oil; the Wollny value is only important with certain specific adulterants; and the tocopherol method is of no value in Italy, since animal fats and coconut oil are the usual adulterants (Vitagliano & D'Ambrosio—*Latte 31*, 15). Determination of acetic and isovaleric acids in butter by the partition coefficients of the soluble volatile acids in water and carbon tetrachloride serves as a new index for detection of adulteration with dolphin oil and other foreign fats (Chioffi—*Boll. lab. chim. provinciali, Bologna, 7*, 105). Chromatographs of dolphin, whale, and mixed fish oils prepared with iso-butanol, fluoresce whereas those of butter and cacao butter do not (Cerutti—*Latte 29*, No. 12, 3). On this basis foreign fats down to 5% are detectable in butter and cacao butter. In another fluorometric study it is pointed out that natural butter fluoresces differently from margarine (Provvedi—*Olii minerali, grassi e saponi, colori e vernici 34*, 373).

A method of detection of ghee adulterated with vanaspati (hydrogenated oil) is based on the critical turbidity temperature of samples dissolved in mixture of glycerol and benzyl alcohol (Desikachar *et al.*—*J. Sci. Ind. Res., India, 16B*, 216). However, at best sensitivity at least 20% vanaspati must be present for a positive test. A test that will detect as little as 1% mineral oil in ghee or other edible oils depends on the turbidity formed on adding a saponified solution of the sample to 50% aqueous alcohol (Venkatachalam & Sundaram—*Current Sci., India, 26*, 157). The molecular refraction is recommended as a means of detecting adulteration of ghee with mustard oil (Chatterji—*Z. anal. Chem. 153*, 418).

A synthetic sesamol is prepared to serve as a tracer of commercial oils so that adulteration of olive oil, butter, and ghee can be detected by a simple test (Daghetta & Bruss—*Ann. sper. agrar., Rome, 11*, No. 4, 97). Quinine is recommended as a tracer to replace the sesame oil in India, because the sesame oil has not been entirely satisfactory (Chakravarti & Dash—*Bull. Calcutta School Trop. Med. 4*, 165).

The influence of factors such as origin, feed, method of rendering, treatment, refining and autoxidation on the absorption spectrum in the ultraviolet of lard is studied for a basis for detection of refining (Kaufman *et al.*—*Fette-Seifen-Anstrichmittel 58*, 995, 1046). Among these data, treatment with bleach-

ing earth produces a distinct triene structure which is evident by the absorption at 268 mμ. This permits detection of lard which has been bleached. The neutral red test for detection of alkali refining of lard solely indicates the change in pH (Täufel & Serzisko—*Deut. Lebensm. Rundschau 52,* 255). In a laboratory survey of methods for detection of refining of animal fats, the sensitivity of the methods based on neutral red test, aniline point-iodine value relation, and cholesterol content is recorded (Wurziger—*Fette-Seifen-Anstrichmittel 59,* 90). In another survey ultraviolet absorption and fluorescent color data are determined (Grau & Mira—*Bundesforschungsanstalt Fleischwirtschaft 1956,* 105).

About five times more isoöleic acid is isolated from hydrogenated fat than from natural beef fat (Mahadevan & Subbaran—*J. Sci. Ind. Res., India 16B,* 15).

In a laboratory survey of determination of foreign fats in cocoa products, the aniline point, cold test of Purr, refractive index of the fat, refractive index of the fatty acid, butyric acid value and spectroscopic characteristics are tabulated for cocoa fats and common adulterant fats alone and in admixture with cocoa fat (Purr—*Fette-Seifen-Anstrichmittel 59,* 615; Hettick —*Ibid.* 624).

Changes brought about in the infrared spectrum of olive oil by various amounts of cottonseed, safflower seed, soybean, coconut palm kernel and rapeseed oils are recorded as reference material for detection and identifying the adulterants (Bartlet —*Nature 180,* 1071). A proposed test for U.S.P. olive oil is a color reaction with phosphotungstic acid in a solution containing methanol, ethanol, ether and sulfuric acid (Dickhart—*Am. J. Pharm. 128,* 386). With pure olive oil there is no colored ring in the acid layer whereas 15 common vegetable oils tested produced rings of blue, green, brown, or red. A drop of "sulfur" olive oil at 180–190° added to a saturated solution of silver nitrate in acetone gives a redish color whereas with "nonsulfured" olive oils there is only a slight darkening (Christopoulos & Thomopoulos—*Rev. franc. corps gras 4,* 27). The pressed olive oil can be distinguished from "sulfur" oil on the basis of the unsaponifiable which is mainly hydrocarbon in the former and largely fatty alcohols in the latter (Tous & Martel—*Grasas y aceites, Spain, 8,* 3). "Rectified B" olive oils, i.e. the synthetic olive oil prepared by esterifying fatty acids, tend to show higher indexes of refraction than normal olive oils (Galavresi & Capella—*Olii minerali, grassi e saponi, colori e vernici 34,* 227). The presence of peanut oil in "rectified B" grade olive oil cannot be detected by the usual A.O.A.C. method or its different variations (Gazzi—*Boll. lab. chim. provinciale, Bologna 7,* 150). By a combination of column- and paper-chromatography it is possible to detect 1% or more rape oil in olive oil (Kaufmann *et al.—Fette-Seifen-Anstrichmittel 58,* 985).

Linseed and other highly unsaturated oils may be detected in mustard oils by a modified hexabromide test which is based on the turbidity after the final solution rather than gravimetric determination of the hexabromide (Dey *et al.—Current Sci., India, 25,* 227). Soybean oil when present in amounts above 10% in other edible oils may be detected through determination of δ-tocopherol content by paper chromatography (Biefer & Hadorn—*Mitt. Gebiete Lebensm. u. Hyg. 47,* 445). Oiticica oil can be detected in coating materials by the red color developed with *m*-dinitrobenzene (Esposito & Swann—*Anal. Chem. 29,* 1861).

COMPOSITION. Reviews on spectrophotometry in the analysis of oils and fats pertain to analysis of oils in the paint industry (Ahlers—*Paint Technol. 20,* 357; Moretti—*Peintures, pigments, vernis 33,* 133; Narayan & Kulkarni—*J. Proc. Oil Technol. Assoc., India, 9,* 65) and determination of linoleic, linolenic, and arachidonic acids in milk and blood (Corsini—*Clin. pediat. 38,* 403).

In the collaborated work of a spectroscopy committee it is reported that unsatisfactory agreement on determination of polyunsaturated fatty acids in the presence of conjuated constituents is attributed to isomerization of α-eleostearic acid, and work is also reported on perfection of determination of trans acids as elaidic by means of infrared absorption (O'Connor *et al.—J. Am. Oil Chemists' Soc. 34,* 600). In two communications, equipment is described for preparation of oils for spectrophotometric determinations of the polyunsaturated acids (Collins & Sedgwick—*J. Am. Oil Chemists' Soc. 34,* 360; Firestone—*J. Assoc. Off. Agr. Chemists' 40,* 487).

Common seed oils can be detected in pure olive oil on the basis of absorption at 230 mμ (D'Arrigo—*Olii minerali, grassi e saponi colori e vernici 33,* 299). This is because oils other than olive oil are generally refined, which causes a big change in absorption at that wave length.

Infrared spectra are recorded as reference information for analysis of ricinoleic acid and polymerized products of the acid (Stefanescu & Palade—*Rev. univ. C.I. Parhon, Bucurestti, 4,* No. 8, 83), and for differentiating castor oil from other oils (Vencov *et al.—Acad. rep. populare Romine, mat. fiz. 8,* 391). Band progressions of fatty acids in the 7.4–8.5 μ region can be related to the number of carbons in the chains and are useful as a basis for identification (Meiklejohn *et al.—Anal. Chem. 29,* 329). Spectra in the region of 3500–670 cm^{-1} of a series of both odd and even saturated fatty acids are also recorded and the bands are discussed with respect to structure (Corish & Chapman—*J. Chem. Soc. 1957,* 1746). Similar data and information are published on 104 branched chain and linear C_6–C_{18} acids (Wenzel *et al.—Z. Naturforsch. 12b,* 71). Pure α- and β-eleostearic acids are characterized with respect to ultraviolet absorption and the data are used to revise the spectrophotometric method for their determination (Hoffman *et al.—J. Am. Oil Chemists' Soc. 34,* 338). The infrared spectra is also used to confirm the findings of other techniques regarding the polymorphism of palmitodistearins and dipalmitostearins (Chapman—*J. Chem. Soc. 1957,* 2715).

The degree of association of fatty acids in paraffin wax and oil is determined by the degree of adsorption of their peaks at 5.66 μ and 5.832–5.812 μ (Sarkadi & De Boer—*Rec. trav. chim. 76,* 628). The wavelengths given measure monomeric and dimeric concentrations, respectively.

A simple and rapid enzymatic procedure can be used to determine total polyunsaturated acids in biological fats (MacGee & Mattson—*Fed. Proc. 16,* 391). Here, the soaps of the acids are oxidized by atmospheric oxygen in the presence of lipoxidase and the absorption of the conjugated diene hydroperoxides is measured at 234 mμ. Pancreatic lipase, because of its specificity in hydrolysis of glycerides at α-position, is used to study structure (Savary *et al.—Biochim. et Biophys. Acta 24,* 414). Except, in the case of lard, unsaturated fatty acids predominate in the 2-position. Thus, in cocoa fat all 2-positions are occupied by unsaturated fatty acid; whereas in lard, palmitic acid occurs most often in the 2-position.

Methods of determining fully saturated glycerides in fats based on acetone-permanganate oxidations and fractional crystallization are said to be subject to error because of hydrolysis of the azelaoglycerides formed (Kartha—*J. Sci. Ind. Res., India 15A,* 116, 724). A modification, developed here, involves an acetic acid-acetone-permanganate method of oxidation followed by Bertram separation of the hydrolyzed oxidation products remaining unchanged after the fission of unsaturated fat. The communication also contains simplified methods for calculation of the glyceride structure of the fats. A simple method for estimating saturated fatty acids in natural fats involves permanganate oxidation of the methyl esters in acetone, dissolving in petroleum ether and adsorbing oxidation products on an alumina column (Spickett *et al.—Chem. & Ind. 1957,* 734). The original saturated esters are recovered from the petroleum ether after the removal of the oxidized portion. A periodate-permanganate oxidation method for the same purpose has been extended by the use of media containing *tert*-butanol and pyridine (von Rudloff—*Can. J. Chem. 34,* 1413). Under the condition described unsaturated fatty acids, esters, and glycerides give nearly theoretical consumption of oxidant.

Behavior of dimethyl esters of C_3–C_{10} dicarboxylic acids in gas-liquid partition chromatography is determined and used to study the dicarboxylic acids formed on oxidation of pure C_{18} unsaturated acids and the fatty acids of soybean oil (Nowakowska *et al.—J. Am. Oil Chemists' Soc. 34,* 411).

The application of urea adduct formation to the study of fats is reviewed and demonstrated for the separation of straight chain fatty acids from those of branched structures (Moreno—*Olii minerali, grassi e saponi, colori e vernici 34,* 139): The method is said to be superior to low-temperature crystallization for analysis of the composition of the fatty acids of hydrogenated fats (Patil & Magar—*J. Sci. Ind. Res., India, 15B,* 650). Because urea forms a complex with cis isomers of natural fatty acids but not as readily with trans isomers of hydrogenated acids it may be used to detect hydrogenated fats in dairy products (Tawde & Magar—*Indian J. Dairy Sci. 10,* 43). Urea fractionation in combination with iodine value of the unsaturated fraction is proposed for estimating stability of hydrogenated fats (Pitil & Magar—*J. Sci. Ind. Res., India, 16B,* 43). This urea-complexing is also used as a basis of liquid-solid countercurrent distribution method for separating mixtures of fatty acids (Sumerwell—*J. Am. Chem. Soc. 79,* 3411). The method is effective in the separation of mixtures of fatty acids such as arachidic, stearic, palmitic, and oleic acid as well as cis and trans isomers. The films of palmitic acid on 0.1 to 1 *M* aqueous urea solution form a unimolecular layer analogous to that known in the crystal state, with a 66 sq. Å area per unit complex (Ferroni—*Ann. chim., Rome 46,* 1064).

Column chromatography methods are described for separation of nine fatty acids from milk fat (Kuramoto *et al.—J.*

Dairy Sci. 40, 314), for the determination of the fatty acid composition of the liver oil of *Hexanchus griseus* (Fenech—*Atti soc. peloritana sci. fis. mat. et nat. 1*, 27), for separation and identification of C_2 to C_6 saturated acids (Vioque—*Grasas y Aceites, Spain, 7*, 234) for determination of odd and normal C_9–C_{19} fatty acids to prove no odd acids occur in milk fat (Garton & Lough—*Biochim. & Biophys. Acta 23*, 192), to separate sterol esters, glycerides, free sterols and other lipides from the acetone soluble lipides of beef liver and baker's yeast (Hanahan & Barron—*Fed. Proc. 16*, 191), to identify the constituents of menhaden and cod-liver oils (Sorrels & Reiser—*J. Am. Oil Chemists' Soc. 34*, 131), to fractionate oil into fractions of low and high iodine value (Gupta *et al.—Sci. & Culture, India, 22*, 400), for the analysis of the serum lipides (Freeman *et al.—J. Biol. Chem. 227*, 449), and for analysis of mono-, di-, and tristearin containing mineral oil (Ravin *et al.—J. Am. Oil Chemists' Soc. 34*, 261).

Paper chromatographic methods are described for: identification of 56 vegetable oils and 64 animal oils (Bito—*Nagoya Kogyo Gakuho 8*, 144, 154, 162), separating mixtures of fatty acids, mono-, di-, and triglycerides (Holasek & Fried—*Mikrochim. Acta 1957*, 469), separating C_2 to C_6 volatile fatty acids (Roberts & Bucek—*Anal. Chem. 29*, 1447), separation of C_6 to C_{12} fatty acids (Wittenberg—*Biochem. J. 65*, 42), analysis of 16 fatty acids including saturated and unsaturated acid (Schlenk *et al.—J. Am. Oil Chemists' Soc. 34*, 377), qualitative and quantitative analysis of the C_{16} to C_{18} even fatty acids (Kaufmann & Pollerberg—*Fette-Seifen-Anstrichmittel 59*, 815), detection of individual unsaturated fatty acids (Fries *et al.—Mikrochim. Acta 1956*, 1722), separation of C_{10} to C_{18} saturated acids (Barnabas & Barnabas—*Naturwissenschaften 44*, 281), and determination of hydrostearic acid (Winsauer—*Mikrochim. Acta 1957*, 480). The literature on paper chromatography is reviewed by Kaufmann (*Olii minerali, grassi e saponi, colori e vernici 34*, 2).

Gas chromatographic procedures are described for the separation and identification of fatty acids from C_1 to C_{20} (James—*Fette-Seifen-Anstrichmittel 59*, 73) and for saturated and unsaturated acids from C_{12} to C_{20} (Beerthuis & Keppler—*Nature 179*, 731). Gas chromatography is used to identify and confirm the structure of vaccenic and arachidonic acid in human plasma by a method of oxidative fission and identification of the fission products (James & Webb—*Biochem. J. 66*, 515).

A colorimetric method for estimation of C_7–C_{18} fatty acids involves precipitation of the potassium soaps of the fatty acids with copper or cobalt nitrate at pH 9, dissolving in chloroform, and measuring the optical densities of the solution at 675 mμ for copper and 525 mμ for the cobalt soaps (Ayers—*Anal. Chim. Acta 15*, 77). The benzamide, *p*-nitrobenzamide, benzenesulfonamide, *p*-toluenesulfonamide, and acetamide derivatives of C_{12} to C_{20} saturated even fatty acids are prepared and their melting point recorded as reference data for identification of fatty acids (Sasin *et al.—J. Am. Oil Chemists' Soc. 34*, 358).

The method for determination of monoglycerides by partition to an aqueous phase from chloroform solution is modified and by collaborative investigations is demonstrated to be superior to other methods (Pohle *et al.—Ibid.* 301). The method of determination of rosin acids in mixtures with fatty acids based on difference in speed of esterification is modified with respect to technique and apparatus to gain rapidity (Linder & Persson—*Ibid.* 24).

Some data on characteristics and fatty acid composition of fats and oils that appear in communications cited in the other sections of this review are incidental to work on various aspects of fats and oil in the other sections and will not be cited again in this division. Many communications are on properties and composition of oils alone and are being listed so those readers interested in such data may have the reference. Various chemical and physical characteristics are recorded for: seed oils of *Stauntonia hexaphylla, Aralia chinensis, Kraunhia floribunda, Acorus calamus, Syringa amurensis,* and *Hibiscus manihot* (Ueno & Matsushima—*Abura Kagaku 6*, 20), Indian lauraceous fats of *Litsea chinensis, L. citrate, L. lanuginosa, L. zeylanica,* and *Antinodaphne augustifolia* (Narang & Puntambekar—*J. Indian Chem. Soc. 34*, 135), seed oil of *Aristolochia clematis* (Petrov-Spiridonov & Maslov—*Doklady, Moskov. Sel'skokhoz. Akad. im. Timiryazea 1956*, No. 22, 167), Japan seed oils of *Quamoclit angulata, Frangula crenata, Daphniphyllum glaucescens, Cocculus trilobus, Mirabilis jalapa, Polygonum perfoliatum,* and *Broussonetia papyrifera* (Koyama & Toyama—*Abura Kagaku 5*, 359), dog rose seed (Devyatnin & Zakharova—*Trudy Vsesoyuz. Nauch Issledovatel Vitamin Inst. 5*, 181), seeds of the Japanese plant species of *Viburnum erosum, Ligustrum japonicum, Hibiscus mutabilis, Ilex integra, I. macropoda, I. serrata, Pourthiaea villosa, Smilax china,* and *S. nipponica* (Koyama & Toyama—*Abura Kagaku 6*, 218), seeds of Appennine zone of Mt. Pollino, Italy from *Rosmarianu officinalis, Salvia officinalis,* and *Lavandula officinalis* (Variati—*Riv. ital. essenze profumi piante offic., oli vegetali saponi 38*, 501), fruit of the palm Mbocaya (Castellanos—*Olii minerali grassi e saponi, colori e vernici 33*, 275), and seeds of *Thevetia nereifolia* (Quilichini & Bertucat—*Bull. soc. pharm. Bordeaux 95*, 61). Both properties and fatty acid composition are recorded for the oils from: *Adhatoda vasica* seeds (Handa *et al.—J. Sci. Ind. Res., India, 15B*, 612), seeds of *Bischofia javanica* and *Antidesma diandrum* (Sarkar & Chakrabarty—*Sci. & Culture, Calcutta, 22*, 336), asparagus seed (Hopkins & Chisholm—*J. Am. Oil Chemists' Soc. 34*, 477), seed of argemone (Aceiro *et al.—Anales asoc. quim, arg. 45*, 59), seed of *Caesalpinia digyna* (Gupta & Iyenger—*Sci. & Culture, Calcutta 21*, 682), seed of Indian pulses, *Cajans cajans* (Mitra & Chakrabarty—*Indian Soap J. 21*, 143), Indian *Cinnamomum camphora* (Narang & Puntambeker—*J. Indian Chem. Soc. 34*, 143), chufa tuber (Franzke—*Fette-Seifen-Anstrichmittel 59*, 328), seed of bull nettle, *Cnidoscolus texanus* (Cushing & Cirino—*J. Am. Oil Chemists' Soc. 34*, 611), seed of coyol, *Acrocomia mexanana* (Giral & Peralta—*Ciencia, Mex., 16*, No. 1–3, 7), fruit of crabwood, *Carapa guianensis* (Pinto—*Bol. tec. inst. agron. norte, Brazil, No. 31*, 195), seed of red gourd, *Cucurbita maxima* (Tewari & Gupta—*J. Proc. Oil Technol. Assoc., India, 10*, 25), liver oil of gad fish, *Laaemonema morosum* (Komori *et al.—Abura Kagaku 5*, 284), seed of guar, *Cymmopsis psoralioides* (Mehta & Ramakrishnan—*J. Am. Oil Chemists' Soc. 34*, 459), seed of *Ipomoea palmata* (Handa *et al.—J. Sci. Ind. Res., India, 15B*, 727), seed of *Lepidium iberis* (Joshi & Tewari—*Arch. Pharm. 290*, 215), seed of Lepidium sativum (Chandra & Handa—*Ibid.* 725), body of marmots (Distler & Schönhöfer—*Arzneimittel-Forsch. 7*, 396), seed of *Momordica charantia* (Verma & Aggarwal—*J. Indian Chem. Soc. 33*, 357), seed of *Hibiscus esculentus* (Chisholm & Hopkins—*Can. J. Chem. 35*, 358), Portulaca oleracea seed (Handa *et al.—J. Sci. Ind. Res., India, 15B*, 726), seed of *Shorea robusta* (Prakash *et al.—J. Proc. Oil Technol. Assoc., India, 12*, 47), *Sisymbrium loeselii* seed (Choudhari *et al.—J. Sci. Ind. Res., India, 16B*, 45), *Swietenia macrophylla kina* tree seed (Chakrabarty & Chowdhuri—*J. Am. Oil Chemists' Soc. 34*, 489), fruit of *Sacchoglottis uchi* (Pinto—*Bol. tec. inst. agron. norte, Brazil, No. 31*, 187; *Rev. quim ind. Brazil 25*, No. 294, 12) and seed of *Vigna catjang* (Chowdhuri & Bagchi—*Naturwissenschaften 44*, 263). Fatty acid composition is recorded on oils or fats from: seed of *Cephalocroton cordofanus* (Bharucha & Gunstone—*J. Sci. Food Agr. 7*, 606), ergot (Bharucha & Gunstone—*J. Chem. Soc. 1957*, 610), body the Indian belgagra and hilsa fresh-water fishes (Pathak & Ojha—*Biochem. J. 66*, 193), liver fats of the sharks, *Carcharias limbatus* and *Pristis cuspidatus* (Pathak & Dey—*J. Am. Oil Chemists' Soc. 34*, 325), body of the fish, *Hoplostethus islandicus* (Kaufmann & Gottschalk—*Fette-Seifen-Anstrichmittel 58*, 411), the mold *Asperigillus flavus* (Singh—*J. Sci. Ind. Res., India, 16C*, 113), body of the mouse, porcupine, rabbit, flamingo and antelope (Gunstone & Russell—*J. Sci. Food Agr. 8*, 283, 287, 290), nutmeg (Patak & Ojha—*Ibid.* 537), the mold, *Penicillium flavo-cinereum* (Singh *et al.—J. Sci. Ind. Res., India, 15C*, 220), and seed of *Pongamia glabra* (Pathak & Dey—*J. Chem. Soc. 1957*, 1917). Other analyses are on one or a limited group of constituents of a fat or oil and are cited in the paragraphs that follow.

The main glyceride present in cacao butter is 2-oleopalmitostearin and not 2-palmitoöleostearin as previously suggested (Chapman *et al.—J. Chem. Soc. 1957*, 1502; Lutton—*J. Am. Oil Chemists' Soc. 34*, 521). The composition of soybean oil, as determined with a 200 tube countercurrent distribution apparatus, is in agreement with a random distribution pattern (Scholfield & Hicks—*Ibid.* 77). Fractionation of Belgian Congo palm oils indicates glyceride distribution as: trisaturated 7, disaturated 44, monosaturated 43, and triunsaturated 6% (Kellens—*Bull. agr. Congo Belge 47*, 1263). Detailed glyceride structure analysis is also recorded for Java olive seed kernel oil (Varma *et al.—J. Am. Oil Chemists' Soc. 34*, 452).

In animal fats containing little or no C_{20}–C_{22} fatty acids there is an empirical relation between iodine value and the amount of each component acid (Gunstone & Russell—*J. Sci. Food Agr. 8*, 290). This relation is expressed mathematically. The fat in mutton fatty tissue contains more stearic and trans acids but less di- and polyunsaturated acid than does the muscle fat (Hartman & Shorland—*J. Sci. Food Agr. 8*, 428). Similar comparisons are made between body and visceral fats of Indian fresh-water fish (Pathak & Ojha—*Biochem. J. 66*, 193).

In commercial palm oils with very high free fatty acidity the glyceride portion is still dominantly triglyceridic (Desnuelle *et al.—Rev. franc. corps gras 4*, 203). "Sulfur" olive oil contains some glyceride polymers (Tous *et al.—Grasas y aceites, Spain, 8*, 67).

Heptadecanoic and 14-methylhexadecanoic acid are present in hydrogenated ox perinephric fat and in mutton fat (Hansen *et al.—J. Sci. Food Agr. 8,* 331; *Biochem. J. 65,* 18; *Chemistry & Industry 1956,* 1149). Heptadecanoic acid also occurs in butter (Hansen *et al.—Nature 179,* 98) and in musk-ox fat (Chis holm & Hopkins—*Can. J. Chem. 35,* 1434). Among the C_{20} polyene acids of the glycerol phosphatides of beef liver, 5,8,11, 14,17-pentaenoic, 5,8,11,14-tetraenoic, 5,8,11-trienoic, 8,11,14-trienoic, 8,11-dienoic and 11,14-dienoic acids have been identified (Klenk & Montag—*Ann. 604,* 4). The docosahexaenoic acid of South African pilchard oil contains double bonds at the 4, 7, 10, 13, 16, and 19 carbon (Whitcutt—*Biochem. J. 67,* 60). Cod-liver oil contains 5,8,11,14,17-eicosapentaenoic acid (Klenk & Eberhagen—*Z. Physiol. Chem., Hoppe Seyler's 307,* 42). Tall oil from the wood pulp of New Zealand *Pinus radiata* contains trace quantities of 14-methylhexadecanoic acid (Hansen & Cooke—*J. Sci. Food Agr. 8,* 482). Eicosenoic, docosenoic and tetracosenoic acids occur in the seed fat of Pongamia glabra (Pathak & Dey—*J. Chem. Soc. 1957,* 1917). The saturated acids of birch and aspen include the homologous series from C_1 to C_{10} and the even-numbered acids to C_{20} (Perilä—*Ann. Acad. Sci. Fennicae Ser. A., II, No. 76,* 49 pp.). No odd carbon number acids are present in fresh butterfat but after mild oxidation, formic, propionic, valeric, and nonanoic acids may be detected (Hawke—*J. Dairy Res. 24,* 366). The phospholipides of rabbit generally contain greater proportions of C_{18} and C_{20} saturated and C_{20} and C_{22} unsaturated fatty acids than the glycerides (Futter & Shorland—*Biochem. J. 65,* 689).

Analyses of many unsaturated fatty acids that were isomerized by heating with nickel catalyst indicate that migration of the double bond occurs predominantly toward the methyl group (Blekkingh *et al.—Rec. trav. chim. 76,* 35, 49). The isoöleic acid of beef fat (vaccenic acid) is not a homogeneous substance (Subbaram & Mahadevan—*J. Sci. Ind. Res., India, 16C,* 130). Positional isomers of oleic acid are found in all fats and oils in small quantities (Narayanan & Kartha—*Ibid. 15B,* 368).

A naturally occurring 12,13-epoxyoleic acid is a cis epoxide (Bharucha & Gunstone—*J. Chem. Soc. 1956,* 1611). In this work the acid is converted to eight 9,10,12,13-tetrahydroxystearic acids. For natural sterculic acid, Brooke & Smith (*Chemistry & Industry 1957,* 1508) favor *ω-n*-octylcyclopropenyl octanic acid structure over the structure of others involving cyclopropane. The crystal data in combination with chemical evidence point to the cis D- or L-11,12-methylene-octadecanoic acid structure for lactobacillic acid (Brotherton & Jeffrey—*J. Am. Chem. Soc. 79,* 5132). The structure of mycolic acid $C_{88}H_{176}O_4$) from lipides of tubercle bacillus is also elaborated (Morgan & Polgar—*J. Chem. Soc. 1957,* 3779).

Chromatographic procedures are applied to marine animal oils (Reiser *et al.—Comm. Fisheries Rev. 19,* No. 4a, 9), lipides of green peas (Wagenknecht—*J. Am. Oil Chemists' Soc. 34,* 509), and human liver lipides (Suzuki—*Tohoku J. Exptl. Med. 64,* 39) to separate and identify various glycerides, phospholipides, vitamins, squalene, nitrogenous material, etc. The sterol fraction of the fat of many fishes has been fractionated, some of the sterols identified, and some as yet unidentified constituents are described with respect to some of their physical and chemical characteristics (Toyama *et al.—Nippon Kagaku Zasshi 75,* 1238, 1241; *76,* 236, 240, 243; *Mem. Fac. Eng. Nagoya Univ. 7,* 1, 145, 151, 156; *8,* 29, 35, 40). In many instances in this work the fatty acid composition of the fish fat is also reported. Lanosterol is isolated from the C_{30} sterol mixture of wool fat (Johnston *et al.—J. Biol. Chem. 224,* 185). In another study both lanosterol and dihydrolanosterol are isolated from the same fraction (Stokes—*Arch. Biochem. & Biophys. 67,* 272). The infrared absorption of the trans-CH=CH- group in the stigmasterol side chain differentiates this material from the sitosterols and affords the basis for an assay method (Johnson *et al.—Anal. Chem. 29,* 469). The sterols of "sulfur" olive oil are similar to those of olive oil (Tous & Martel—*Grasas y aceites, Spain, 7,* 202).

Egg phospholipide contains phosphatadylcholine 73, lysophosphatidlycholine 5.8, sphingomyelin 2.5, phosphatidylethanolamine 15, lysophosphatidyl-ethanolamine 2.1 and inositol phospholipide 0.6 mole % (Rhodes & Lea—*Biochem. J. 65,* 526). Analytical data on the phosphorus, nitrogen, choline ethanolamine and the fatty acid composition of the phosphatides of the heart of rorqual, pollacks, brain of sperm whale, eggs of pollacks, eggs of crabs, and brain of rorqual are recorded (Igarashi *et al.—Nippon Nogei-kagaku Kaishi 30,* 111, 116, 433, 435, 566, 568; *31,* 4, 8, 582). The phospholipide content of Indian peanut oil varied from 0.1 to 0.87% and of the cottonseed oil from 0.46 to 2.40% (Rao *et al.—J. Sci. Ind. Res., India, 15C,* 224).

An improved Craig countercurrent distribution system is designed for separation of phospholipides and is used to isolate phytosphingosine from corn phosphatides (Carter & Galanos—*Congr. intern. biochim. Resumes communs, Brussels, 1955,* 104). Paper chromatography with use of mixtures of ketones and acetic acid as solvents permits separation of lysolecithin, sphingomyelin, phosphatidylethanolamine, lecithin, and phosphatidic acid on unidimensional chromatograms (Witter *et al.—Arch. Biochem & Biophys. 68,* 15). 1-Fluoro-2,4-dinitrobenzene reacts in presence of triethylamine with free amino groups of phospholipides dissolved in benzene (Wheeldon & Collins—*Biochem. J. 66,* 435). This reaction serves as a basis of a method for the quantitative estimation of the free amino groups in the phospholipides. Diazomethane reacts with dinitrophenylcephalins to form corresponding methyl esters, while lecithin is unaffected (Collins & Wheeldon—*Ibid.* 441). This serves to distinguish various fractions of dinitrophenylcephalin on chromatographs. The acetone insoluble fraction of the lipides from *Bacillus alcaligenes faecalis* contains phosphatidic acids and other phosphoglycerides containing ethanolamine and polypeptides in bound forms (Saito & Akashi—*J. Biochem., Japan, 44,* 511).

Phrenosin is isolated from sphingolipides of ox spinal cord by treatment with boiling acetic acid and chromatographing on alumina (Fujino—*Nippon Nogei-kagaku Kaishi 30,* 764). The unsaponifiable constituents of the oil of *Pisum sativum,* which has a sterility effect, contains β-amyrin and β-sitosterol (Chandra *et al.—Indian Chem. Soc. 34,* 247).

A chromatographic procedure is designed for the determination of carotene, xanthophyll, and chlorophyll in the lipides of pasture plants (Worker—*J. Sci. Food. Agr. 8,* 442). A method for chlorophylls *a* and *b*, and pheophytins *a* and *b* in olive oil is based on calculations from absorption at wave lengths 6,700, 6,525, 6,775, and 6,625Å, respectively (Lorenzo—*Anales inst. nacl. invest. agron., Madrid 5,* 295).

A lipide present in yeast has properties similar to those of tocopherol (Cowlishaw & Prange—*Biochem. et Biophys. Acta 23,* 663).

No sesamin or sesamolin occurs in the vegetative parts of the sesame plant, but it appears in the seed only concurrently with oil production (Nagabhushanam *et al.—J. Sci. Ind. Res., India, 15C,* 283). Progress reported in a study on the structure of gossypol pertains to identifying some of its degradation products (Shirley *et al.—J. Org. Chem. 22,* 495; *J. Am. Chem. Soc. 79,* 1205).

A procedure for determination of higher aliphatic aldehydes in the presence of ketones and fatty acids is based on their ease of oxidation with 3% hydrogen peroxide (Metcalfe & Schmita—*Anal. Chem. 29,* 1676). The acids formed are titrated and results corrected for the amount of acid present before oxidation. This method is used for routine control of aldehydes manufactured from fatty acids.

A procedure for determining sulfur in rape oil involves converting the isothiocyanate to hydrogen sulfide with nascent hydrogen generated from hydrochloric acid and aluminum and determination of hydrogen sulfide colorimetrically (Kucera & Hejtmanek—*Prumysl potravin 8,* 199). Data are developed on the conductivity of aqueous extractions of soap from refined oil to serve for the plant control of washing soap from refined oils, (Goff & Blachly—*J. Am. Oil Chemists' Soc. 34,* 320).

The liver oils produced from fish which were contaminated with radioactive material from atomic and hydrogen bombs has no significant radioactivity (Nagasawa *et al.—Eisei Shikenjo Hokoku No. 74,* 231).

A colorimetric method for determination of zinc is adjusted for application to olive oil (Vioque & Villagrán—*Grasas y Aceites, Spain, 7,* 239). Other common analytical methods are also modified for application to oils and fats. These concern determination of the copra fumigant, ethylene oxide, in coconut oil (Benedict—*J. Am. Oil Chemists' Soc. 34,* 450) and detection of the insecticide parathion in olive oil (Biffoli—*Boll. lab. chim. provinciali 7,* 111).

Soaps and Detergents

MANUFACTURE. Manufacturing technique is developed for using the inedible oils indigenous to India for making soaps. Here, khakan, neem, undi, mahua and karanji oils are converted to satisfactory soaps (Kelkar & Nathan—*Indian Soap J. 21,* 164; *22,* 50). To make animal fat-free transparent soap in India, mahua oil replaces stearic acid or tallow, castor oil is included to give gloss, and coconut oil and sugar solutions are used in limited quantities (Das—*Ibid. 22,* 78).

Acidulated cottonseed soapstocks from five major processes of production are characterized as to content of neutral oil, oxidized acids, etc. to serve as basic data for soapmaking and for evaluation in commercial trading (Stansbury—*J. Am. Oil*

Chemists' Soc. 34, 539). In apparatus designed to destroy gossypol in cottonseed oil soapstock, the material is treated at temperatures of 212–215° and pressures of 290–300 lbs. per sq. in. (Pominski & Pack—*Ibid.* 299). Fatty acids obtained by the acid hydrolysis of peanut oil soapstock are conditioned for soapmaking by treating with bleaching earth and hydrogenating at 180° and 25 lbs. per sq. in. pressure (Sreenivasan *et al.—Oils & Oilseeds J., India, 9,* No. 2, 5). Chlorite bleached soapstock is given a hypochlorite treatment to induce resistance to deterioration (Hurt—*Brit. 762,687–8*; *U. S. 2,802,848, 2,810,735*).

A patented soft soap is made from mixture of palm oil, tallow, peanut oil, fish fat, and rosin and is saponified with potassium carbonate and hydroxide (Soc. Sanitor, S.a.r.l.—*Fr. 999,532*). Lower molecular weight acids are added to high molecular weight soapstock to increase firmness of bars and granulated soaps made therefrom (Stegemeyer—*U. S. 2,792,347*). A transparent soft soap of synthetic acids contains definite mixtures of fractions of C_9–C_{11} and C_{12}–C_{20} acids and has a 38-40% fatty acid content (Manneck & Heinz—*Ger. 838,183, Cl. 23e*). Another synthetic soap is made from C_{16}–C_{18} hydrocarbons by chlorination, dechlorination, adding carbon monoxide and hydrogen catalytically, and fusion with alkali (Büchner—*Ger. 838,351, Cl. 23e*). Dicarboxylic acids are added to soap formulation to achieve hardness and inhibit adherence of soap flakes (Aylesworth—*U. S. 2,792,348*).

Some new soapmaking techniques are described. A cylinder of a continuous carbonate saponification system contains alternating stationary and moving vanes and the saponifying mixture flows through the gaps between them (Zarembo *et al.—U.S.S.R. 104,989*). In another reaction chamber of a continuous system, the saponifying reagent is fed at the top, soapstock is fed from below and the liquids are rotated in the chamber (Habicht—*U. S. 2,776,305*). An automatic soft soap boiler has heating and timing arrangement whereby ingredients are added and soap is discharged after a measured cycle (Morrison—*U. S. 2,800,398*). A regulator devised to control supply of components to the soapmaking chamber is dependent on viscosity (Palmqvist—*U. S. 2,803,635*). In a rapid saponification method, warmed concentrated alkali is added to heated fat with violent stirring (Berlitzer—*Fr. 993,927*). Saturated fatty acid soaps are made from unsaturated fatty acids by treatment with excess caustic in the presence of water at 300–450° under pressure of 100 kg. per sq. in. (Stein & Hartmann—*U. S. 2,806,869*). Here one mole of hydrogen and one mole of acetic acid is eleased per double bond and resulting fatty acid radical is two carbons shorter than the present unsaturated acid. In a plant built in Kharkov for saponification with sodium carbonate, an edible grade carbon dioxide is recovered and is used also in the manufacture of synthetic fatty acids (Bespyatov *et al.—Masloboino-Zhirovaya Prom. 22,* No. 6, 24; *23,* No. 4, 28).

A study of factors that affect completion of the saponification process indicates that excess caustic is a very important factor (Bespyatov *et al.—Ibid. 23,* No. 7, 31). Thus, at 100° and 0.6–0.4% excess caustic, saponification is complete in 40 minutes and at 0.2% excess 60 minutes is required. A patented process to speed saponification is based on adding alcohol after most of the saponification has taken place (Thai —*Fr. 993,254*). The alcohol hastens completion of the reaction. A process for converting pine gum to soap by saponification in thin heated layers permits recovery of turpentine by azeotropic distillation with the moisture present (Vitex S. A.—*Fr. 1,008,146*).

In a patented apparatus for drying soap, the water is removed from the liquid soap under vacuum (Mentasti—*Ital. 501,448*). Conductivity data of soaps at concentrations of 78 to 83% are recorded to serve for the control of soap dryers (Okholm—*J. Am. Oil Chemists' Soc. 34,* 17). Soap passsing through a new plodder is cooled with refrigerated brine, dried in air, and then pressed into soap bars (Schulerud—*U. S. 2,776,544*). A 20% moisture soap bar is hardened by extruding at temperatures below 35° and is finished by heating at 40° or more but below the point where the bar no longer retains its form (Coetzer & Wainwright—*U. S. 2,802,793*). A newly patented soap bar is shaped for efficient handling, storage, and wear (Vier & Kohn—*U. S. 2,792,349*).

Phase diagrams of three peanut-oil base soaps are recorded to serve as reference data for using the oil for commercial soapmaking (Prevot—*Rev. franc. corps gras 4,* 263). Studies on darkening of soaps indicate that soaps made from lard or tallow develop dark spots from iron contamination, whereas soap from 75% hydrogenated stock does not (Moldavskaya *et al.—Masloboino-Zhirovaya Prom. 23,* No. 3, 22). Addition of 0.1% water glass to soap after the graining operation inhibits oxidative deterioration and prevents spotting during storage. In a study of development of moisture on soap, a distinction is made between hydroscopicity and sweating (Defromont *et al.—Rev. franc. corps gras 4,* 416). Sweating is explained as caused by migration of ions to the surface to result in an osmotic disequilibrium. It is inhibited by reduction of salts and free alkali to a minimum.

Several communications and patents pertain mainly to the builders or fillers added to soaps. Studies show that hydrolysis of tripolyphosphates in storage and during spraying of detergent slurries is catalyzed by presence of large amounts of alkali sulfate, carbonate and silicate; it is higher in countercurrent spray drying than in the parallel steam process; and is less in coarse products than in fine end products (Ansätzen—*Fette-Seifen-Anstrichmittel 58,* 1029). In another study a variety of sodium and potassium phosphates are incorporated into various liquid detergent formulations and half-lives of the polyphosphates are determined for storage at 70°F. and 120°F., respectively (Bennett & Liss—*Soap Chem. Specialties 33,* No. 1, 44). The data are useful for design of soap and detergent formulation and for storage. Data on the effect of spray nozzle, temperature, aging, working, and presence of other builder on the hydrolysis of sodium tripolyphosphate in arylalkyl sulfonate detergent compositions are recorded to serve as reference for design of drying procedures (Pfrengle—*Rev. franc. corps gras 4,* 5). An anhydrous phosphate product useful as a soap builder or water softener is made by fusion of a solution of sodium carbonate and phosphoric acid (Bowman & Ramsey—*U. S. 2,751,357*). The balling tendencies of soap particles is lessened by applying a soap-silicate complex to the surface of the soap particles (Eaton—*U. S. 2,776,943*). A soap composition that is resistant to shrinkage, cracking, or crystallization, contained 20% sodium silicates and small amounts of flour, starch, and sodium glycolate (Hashimoto—*Japan 2984–'56*). Other filling materials prepared for addition to soap and detergent products are: a ligneous resin extracted from sulfite waste liquors (Bieler—*Fr. 1,005,787*), a product of the treatment of α-cellulose with sodium chloroacetic acid (Chaufan & Maretto—*Span. 227,395*), and mineral salt-alginic acid gels (Brunel—*Fr. 1,007,767*). A shampoo, which is said to induce curling of hair, is mainly soap containing minor amounts of starch, carboxymethylcellulose and sodium dodecyl sulfate (Pardo *et al.—Span. 219,882*).

Many new optical brightening agents, which may be used as soap additives, are described (Leavitt—*U. S. 2,793,192*, Eden—*Swiss 320,745*; Ackermann—*U. S. 2,805,999*; Eder—*U. S. 2,806,054*; Craig—*U. S. 2,785,133*; Häusermann—*U. S. 2,762,802*; J. R. Geigy A.-G.—*Swiss 308,268*; de Saint-Aunay & Lefebvre—*U. S. 2,813,864*). Skin tolerance tests on four commercial optical bleaching chemicals demonstrates that these compounds are innocuous even in concentrations 100 times higher than those used in practice (Schulz & Wulf—*Arzneimittel-Forsch. 7,* 402).

Various compounds are added to soap and detergents to induce special characteristics. Addition of sodium salts of salicylic acid-halogenated anilide compounds to soap used for laundering cotton protect the laundered cotton against deterioration through cellulose-degrading fungi (Ciba Ltd.—*Swiss 300,565*). Dodecylbis (2-hydroxyethyl) benzylammonium chloride serves as a germicidal additive in various cleaning compounds (Ciba Ltd.—*Swiss 306,796*). In the preparation of the nonionic surfactant-iodine complexes that serve as germicidal cleaners, part of the iodine is lost owing to iodination of the surfactant and formation of hydrogen iodide (Bartlett & Schmidt—*Applied Microbiol. 5,* 355). The newly patented germicidal additives for toilet soaps are certain halogenated trisphenol derivatives (Beaver *et al.—U. S. 2,798,046*; Chiddix—*U. S. 2,782,279*), salts or esters of β-aryloylacrylic acids (Shumard—*U. S. 2,795,554*), β-nitroethylene-substituted aromatic compounds (Shumard—*U. S. 2,795,555*), 2-hydroxy-3-methyl-5-chlorophenol sulfide (Wenneis *et al.—U. S. 2,814,597*), halogenated diphenylcarbanilides (Monsanto Chem. Co.—*Brit. 769,273*), and thiuram disulfide derivatives (Vinson—*Dutch 81,358*). Small amounts of fatty acid amides are added to toilet soaps to confer anti-irritant properties (Furuta & Nagayama—*Japan 2632–'55*). Clothes laundered with soap containing DDT are said to have delousing properties for up to six months (Galinski—*Prace Inst. Badawczyck Przemyslu Rolnego i Spozywczego 6,* 109; Bojanowska—*Ibid.* 125). Soap is stabilized in respect to color and odor development with azine compounds such as benzalazine (Fusco & Harshman—*U. S. 2,813,112*). Addition of acyl dicyandiamide to detergents containing phosphates inhibits tarnish of copper and nickel (Scott—*U. S. 2,813,831*). The erosion of glass by alkaline cleaners is prevented by adding a small amount of calcium chloride plus starch or hydroxy acid to the washing agents (Uno & Kouchi—*Japan 6682–4 – '55*).

A "dry" skin cleansing agent consists of latex and ammonium hydroxide plus small amounts of wool fat and paraffin oil (Francois—*Fr. 1,009,598*). A hand cleaning paste consists of oleic acid, paraffin oil, gasoline, triethanolamine and water (Menk—*Swiss 285,778*). A cleanser powder contains soap, alkaline cleaning salts, mineral abrasives and sawdust (Vives—*Span. 219,579*). Attapulgite rock milled to very fine mesh is recommended as an abrasive or filler for tooth paste, cleaners, and polishing waxes (Bensmann—*Olii minerali, grassi e saponi, colori e vernici 34,* 273). Cleansing preparations are also made of mixtures of inorganic salts with little or no soap (Soc. products peroxydes—*Fr. 1,000,847*; Malzac—*Fr. 1,008,615*; Rettani—*Ital. 499,040*; Perlman—*U. S. 2,801,978*; Reich —*Ital. 505,643*). One such preparation is formulated for removing "milkstone" deposits from dairy equipment (Merget—*U. S. 2,788,328*).

Preparation and properties of synthetic detergents made from animal fats are described by investigators at the Eastern Regional Laboratory. For ethenoxylated fatty acid of animal fats or the fatty alcohols made from animal fat optimum wetting properties appears in compounds with 14-18 ethenoxy groups per molecule (Wrigley—*J. Am. Oil Chemists' Soc. 34,* 39). Among sulfated ethenoxylated tallow alcohols, two ethenoxy groups appear optimum; more ethenoxy groups improve solubility but reduce detergency (Bistline *et al.—Ibid.* 516). Among many salts of α-sulfostearic acid tested, the lithium, triethanolaminonium and magnesium salts are the best detergents (Weil *et al.—J. Am. Oil Chemists' Soc. 34,* 100). Solubility, foaming capacity, emulsifying, and other properties of the compounds are recorded in the above communications. Bar form synthetic detergents made in this series of work are salts of α-sulfonated saturated tallow acids (Weil *et al.—Soap Chem. Specialties 33,* No. 12, 49). Representative detergent bars with good characteristics are monosodium, sodium ammonium, and sodium triethanolammonium salts in ratio 72:20:8 mole percent, and monoammonium and ammonium triethanolammonium salts in the ratio 85:15 mole percent.

The polyoxyethylation of fatty alcohols is described in respect to effect of catalyst, different alcohols, reaction temperature and reaction pressure (Satkowski & Hsu—*Ind. Eng. Chem. 49,* 1875). The data presented here are of practical use for the manufacture and use of the detergents.

The chemical mechanism in the making of lauric acid-diethanolamine condensed detergents is explained as formation of the amide, thermal rearrangement of the amide to the lauroyl ester of diethanolamine, which in turn is converted into the dilauroyl amido ester of diethanolamine (Kroll & Nadeau—*J. Am. Oil Chemists' Soc. 34,* 323).

Other literature on synthetic detergents describes patents on products or manufacturing techniques. For convenience of presentation these are cited under the name of assignee or the patentee:

Aktiebolaget Separator
Mixtures of syndets compounded to yield specific viscosity curves *(U. S. 2,803,635; Brit. 756,395).*

Am. Cyanamid Co.
Sodium dialkyl sulfosuccinates *(U. S. 2,788,329; 2,813,078, Brit. 760,121).*
Copolymers of arylamide or methacrylamide and acrylic or methacrylic fatty alcohols *(U. S. 2,816,882, Brit. 764,409).*

D'Angelo, L.
Carob seed meal-syndet bar *(Ital. 509,588).*

Anselmi, L.
Neutral triethanolamine soap *(Ital. 509,001).*

Armour & Co.
Monoacyl derivatives of alkylenediamines *(U. S. 2,750,366).*

Arnold, Hoffman & Co.
Amido condensation products of carbamoyl derivatives with condensation products of polyamines and fatty acids *(U. S. 2,764,601).* Reaction products of paraformaldehyde and unsaturated fatty acids *(U. S. 2,764,604).*

Atlas Powder Co.
Hydroxypolyoxyethylene salts of alkylaryl sulfonic acids *(U. S. 2,778,814).* Condensation products of *sec.*hexitylamines, formaldehyde and phenols *(U. S. 2,802,820).* Sulfates of hydroxy ethers *(Brit. 766,706).* Polyoxyalkylene ethers of heterocyclic amides *(Brit. 767,024).*

Badische Anilin- & Soda Fabrik A. -G.
Sulfated esters of butylene glycol and high boiling alcohols *(Ger. 854,509, Cl. 12o).*

Böhme Fettechemie G.m.b.H.
Substituted alkylsulfonic acids *(Brit. 764,340, 764,613).* Anion syndet-salt mixtures *(Brit. 757,987).*

Bray Oil Co.
Refining mahogany sulfonic acids *(U. S. 2,809,209).*

Brit. Petroleum Co. Ltd.
Solid nonionic syndet-urea complexes *(U. S. 2,814,611).* Separating nonionic syndets by precipitation from alcohol solutions *(U. S. 2,814,613).* Fractionation of nonionic syndets from hydrocarbon solution *(Brit. 756,334).*

Brizon, J. M. A.
Sulfonated syndet-methylcellulose mixtures. *(Fr. 1,007,039).*

Brunel, H.
Solid mineral oil sulfate sodium silicate mixtures *(Fr. 1,005,669).* Sulfonated syndets-salt mixtures *(Fr. 1,007,944).*

California Research Corp.
Salts of acylaryl sulfonates *(U. S. 2,787,638–9, 2,772,239, 2,813,832).* Polyoxypropylene glycol disulfate detergent *(U. S. 2,802,789).*

Carpena, M. C.
Mixtures of sulfates and sulfonates of fatty alcohols and castor oil *(Span. 228,919).*

Centro Invest. Emp. Nat'l. Calvo Sotelo.
High purity dodecylbenzene sulfonate *(Span. 231,091).*

Ciba Ltd.
Certain quaternary ammonium salts *(U. S. 2,794,808; Swiss 290,858, 314,321).*

Colgate-Palmolive Co.
Drying synthetic detergent mixtures *(U. S. 2,770,600, 2,812,018).* Syndet shampoo *(U. S. 2,773,835).* Bleaching sulfonated detergents *(U. S. 2,804,466).* Chlorinated alkylaryl sulfoamide compounds *(U. S. 2,809,937).*

Continental Oil Co.
Alkylaryl sulfonates free from inorganic salts *(Brit. 773,423).* Alkylaryl sulfonates *(U. S. 2,806,055, 2,806,875, 2,807,590, 2,813,917).*

Diffley, W. J.
Dry syndet-inorganic mixtures *(U. S. 2,791,562).*

Dow Chem. Co.
Polyalkylolpolyalklenepolyamine compounds *(Brit. 767,596).*

E. I. du Pont de Nemours & Co.
Stabilized alkyl sulfate detergents *(U. S. 2,765,280).*

Durand & Huguenin
Alkylaryl sulfonic acid-phosphate compound *(U. S. 2,794,004).*

Eastman Kodak Co.
Anionic detergent-copolymers of *N*-methylacrylamide and vinyl alcohol mixture *(U. S. 2,798,047).*

Esso Research & Eng. Co.
Separating sulfonates from hydrocarbon solutions *(U. S. 2,786,868).*

Etab. Fournier-Ferrier
Condensation products ethylene oxide with fatty amides and aromatic hydroxy-containing amines *(Fr. 1,007,215).*

Ethyl Corp.
Sulfonated alcohols made from oiticica oil *(U. S. 2,800,516).*

Farbwerke Hoechst A.–G. M. Lucius
Sulfonated nonaromatic hydrocarbons *(Ger. 916,409, Cl. 12o).*

Furuta, T. & Nagayama, S.
Solid sulfonated coconut oil-stearic amide mixture *(Japan 2037-'55).*

Gaggianesi, P.
Soap-syndet-builder mixture *(Ital. 512,084).*

General Aniline & Film Corp.
Synthetic detergent bar *(U. S. 2,781,320–1).*

General Mills, Inc.
Sulfonated products of reaction fatty urea compounds with aldose sugars *(U. S. 2,808,404).* Sodium salts of fatty acid β-aminopropionates *(U. S. 2,810,752).* Fatty β-alanine detergents *(U. S. 2,811,549).* Condensation products of fatty amines with an alkylarylate ester *(U. S. 2,814,643).* Zwitterions of detergent amino acids *(U. S. 2,816,920).*

Gershenovich, A. I. & Balakirev, E. S.
Preparation of alkyl sulfonates. *(U. S. S. R. 101,532).*

Goldschmidt, A.–G.
Reaction products of fatty amines, formaldehyde and phenols *(Brit. 771,635).*

Gulf Research & Development Co.
Sulfonated petroleum oil detergent *(U. S. 2,807,589).*

Henkel & Cie, G.m.b.H.
Sulfonated fatty nitriles *(U. S. 2,785,193).* Substituted β-aminobutyric acid esters and salts *(Brit. 776,121).*

Imhausen & Co., G.m.b.H.
Sulfonation with sulfonyl chlorides *(Ger. 950,635, Cl. 12o)*.
International Minerals & Chem. Corp.
α-Guanidino substituted fatty acids *(Brit. 747,668)*.
Kadimah Chem. Corp.
Fatty acid sulfates and sulfonates *(Brit. 750,609)*.
Lobitos Oilfields Ltd.
Petroleum sulfonic acids *(Brit. 771,581)*.
Luntz, H. E. & Popovac, D. O.
Sulfonation of alkylaryl hydrocarbons *(U. S. 2,768,199)*.
Mannheimer, H. S.
Cycloimidine derivatives *(U. S. 2,781,349–58)*. Sulfated salts of certain amino acids *(U. S. 2,781,370–92)*.
Miura, H.
Apparatus for continuous sulfonation *(Japan 1741-'55)*.
Monsanto Chem. Co.
(Alkylthio)alkanosulfonic acids *(U. S. 2,799,702)*. Aryl sulfonates *(U. S. 2,781,402)*. Sulfonation with sulfur trioxide *(U. S. 2,782,230, Brit. 761,095)*. Sulfated condensed products ethylene oxide and branched chain alcohols *(Brit. 757,937)*. Alkylaryl sulfonates *(Brit. 763,031)*.
National Drug Co.
Phosphates and sulfates of polyhydroxylated flavones and flavanones *(U. S. 2,764,596)*.
N. V. Bataafsche Petrol. Maatschappij
Alkyl sulfates *(Dutch 81,602, 81,935)*.
Pagani & Co.
Detergent-builder bar *(Ital. 493,567)*.
Procter & Gamble Co.
Monoglyceride-sulfonated alcohol (dental detergent) *(U. S. 2,812,284)*.
Pure Oil Co.
Purification of sulfonates *(U. S. 2,800,503)*. Apparatus for petroleum sulfonate manufacture *(U. S. 2,802,026)*.
Refined Products Corp.
Alkali metal salt of polycarboxylic amino acid *(U. S. 2,808,435)*.
Ringeissen, M. E. G.
Detergent-builder mixtures *(Fr. 1,001,324–5)*.
Rohm & Haas Co.
Surface-active polycarbamates *(U. S. 2,765,324)*. Surface-active polyamides *(U. S. 2,765,325, 2,776,951)*. Alkoxypentenyl sulfonates *(U. S. 2,789,133, Brit. 772,860)*. Ethers of alkylphenoxypolymethanols *(Brit. 770,073)*. Alkyl-*N*-sorbitylalkanamides *(Brit. 771,423)*.
Rudolf & Co., Chem. Fabrik G.m.b.H.
Bright salts of alkylaromatic sulfonic acids *(Ger. 902,255, Cl. 12o)*.
Ruhrchemie, A.-G.
Neutralizing sulfonic acids *(U. S. 2,766,276)*.
Sandoz Ltd.
Sulfonated epoxidized alkyl compounds *(Swiss 315,882)*.
Sanyo Fats & Oils Co.
Aliphatic ketone reacted with an amine *(Japan 3216-'55)*.
Scottish Oils Ltd.
Alkyl sulfate-mineral oil-alcohol cleaner *(U. S. 2,787,596)*.
Shell Development Co.
Alkylaryl sulfonates *(U. S. 2,796,429)*.
Sinclair Refining Co.
Sulfonation of petroleum oils *(U. S. 2,783,273)*.
Soc. anon. Chimiotechnic
Sulfonated hydroxyethylamides of fatty acids *(Fr. 1,004,350)*. Sulfonated rosin *(Fr. 1,003,450)*.
Soc. anon. d'innovations chim.: Sinnova ou Sadic.
Derivatives of chloroformic acid and complex amino acids *(Fr. 1,017,280)*.
Soc. civile d'etudes brevets Hycar
Partial glyceride esters *(Fr. 1,000,568)*.
Soc. franc. produits menagers et hyg. generale.
Mixed sulfonated detergents *(Fr. 1,002,869)*.
Soc. lab. recherches applications inds.
Sulfonation of condensation products of fatty acids esters with alkoxyamines *(Fr. 999,911)*.
Soc. franc. recherches techniques.
Sulfonated petroleum and tar oil fractions *(Fr. 1,006,247)*.
L. Sonneborn Sons, Inc.
Sulfonated polyalkylated aromatic residues *(U. S. 2,802,866)*.
Standard franc. petroles.
Sulfonated products of condensates of aromatic and chlorinated paraffinic hydrocarbons *(Fr. 1,006,591–2)*. Liquid cleaner of aliphatic amine-hydrocarbon-alcohol mixture *(Fr. 1,007,765)*.
F. Steinfels A.-G. Seifenfabrik.
Quaternary ammonium compounds *(Swiss 301,409, 301,511–14)*.
Sun Oil Co.
Decolorizing mineral oil sulfonates *(U. S. 2,808,430)*. Desalting mahogany sulfonic acids *(U. S. 2,810,745, 2,813,897)*.
Unilever, N. V.
Arylacyl diguanides *(Dutch 79,189)*. Acylaryl amide-builder—another syndet *(Dutch 80,096, 81,356)*. Mixed ionic and nonionic detergents *(Dutch 81,051)*. Syndet-builder dishwashing detergent *(Dutch 81,069)*.
Union Oil Co.
Dialkyl sulfoxides *(U. S. 2,787,595)*.
U. S. Dept. Agr.
Alkylaryl sulfonate-polyethyleneglycol mixture *(U. S. 2,806,001)*. Esters of hydroxyalkanesulfonates with α-sulfonate fatty acids *(U. S. 2,806,044)*.
Universal Oil Products Co.
Secondary alkylaryl hydrocarbons *(U. S. 2,771,496)*.
Vitogen Products
Purifying laurylpyridinium detergent *(U. S. 2,776,291)*.
Wyandotte Chem. Corp.
Products of condensing polyoxypropylene polymers with a nitrogen base compound *(Brit. 776,661)*.

There are communications on soaps and detergents which are reviews or contain general information on history, economy, known manufacturing procedures, or description of commercial products. For convenience of presentation, these are classified and cited under the subject treated:

Historical:

History of modern detergents (Harwood—*J. Roy. Soc. Arts 105*, 407). Heavy duty liquid detergents (*Soap Chem. Specialties 33*, No. 8, 43). Oldest literature reference to soap (Levey—*Ibid.* No. 12, 53). Detergent research abroad (Wells—*Ibid.* No. 5, 57).

Soap Manufacture:

Flow diagrams (Hardy—*Ind. Eng. Chem. 49*, No. 1, 95A). Soap and detergent pilot plant (Heald—*Ibid. 49*, 338). "Meccaniche" continuous saponification (Algranati—*Rev. franc. corps gras 4*, 597). Continuous manufacture (Kupchinskii *et al.*—*Masloboino-Zhirovaya Prom. 23*, No. 7, 19). Continuous soap washing and finishing (Podbielniak *et al.*—*J. Am. Oil Chemists' Soc. 34*, 103). Centrifuges in soap plants (Weber—*Seifen-öle-Fette-Wachse 82*, 211). Avoiding manufacturing troubles (Vosganiantz & Harlan—*Riechstoffe u. Aromen 7*, 49). Making hollow sphere washing powders (Zilske—*Seifen-öle-Fette-Wachse 82*, 177, 218, 263). Spray drying (Manneck—*Ibid.* 220; Baker *et al.*—*Chem. Eng. Prog. 53*, 593; Hauschild—Soap *Perfumery and Cosmetics 29*, 1235).

Soapstock:

Wool fat in soap and cosmetics (Dmitrievskaya & Moldavskaya—*Masloboino-Zhirovaya Prom. 22*, No. 8, 27). Substitutes for coconut oil (Khan—*Indian Soap J. 21*, 109).

Builders and Fillers:

Sodium carbonate as a builder (Lefaure—*Congr. mondial detergence, Paris, 2*, Sect. 5–11, 630). Sodium carboxymethyl cellulose (Pollok—*Ibid.* 689). Starch esters (Paliot *Ibid 1*, 352). Per salts (Merlo *et al.*—*Ibid.* 363). Sodium silicates (Blanchard—*Ibid.* 316; Bedat—*Ibid.* 348). Bentonite (Bagchi & Murherji—*Indian Soap J. 21*, 105).

Soap and detergent additives:

Iodophores (Cantor *et al.*—*J. Soc. Cosmetic Chemists 7*, 419). Polyvinyl alcohol (Smith—*Am. Perfumer Aromat. 68*, No. 5, 36). Optical dyes (Siegrist—*Congr. mondial detergence, Paris 2*, Sect. 5–11, 512). Ethylenediaminetetraacetic acid (Hette—*Ibid.* 636).

Synthetic detergents:

Reviews (Smith—*Mfg. Chemist 28*, 281; Raphael—*Ibid.* 562; Morrisroe—*Soap Chem. Specialties 33*, No. 5, 47; Richter—*Chem. Tech. 9*, 153; Gershenovich—*Khim. Nauka i Prom. 1*, 298; Kane—*Indian Soap J. 22*, 138). Surface-active agents in Japan (Yoshimura & Isoda—*Congr. mondial detergence, Paris 2*, Sect. 5–11, 537). British synthetic detergents (Bruce—*Chem. Products 20*, 53; Schon—*Soap Chem. Specialties 33*, No. 2, 43). Possibilities of manufacturing syndets in India (Bhattacharyya—*Indian Soap J. 22*, 123; Achaya & Saletore—*Ibid. 21*, 145). Classification of surface-active substances (Stas & Ver-

heggen—*Ind. chim. belge 22,* 683). Composition and properties (Calvo—*Rev. cienc. apl. Spain 11,* 123). Metals for the detergent manufacturing plant (Delvaque—*Congr. mondial detergence Paris 1,* 334). Supplying alkylate (Kirk & Baker—*Soap Chem. Specialties 33,* No. 2, 51). Sulfonation (Gilbert & Jones—*Ind. Eng. Chem. 49,* 1553; Etienne—*Congr. mondial detergence, Paris 1,* 215; Kooijman *et al.*—*Ibid.* 379). Cationic (Brow & Linfield—*Soap Chem. Specialties 33,* No. 4, 89; Lincoln—*J. Soc. Cosmetic Chemists' 8,* 222). Dodecyl ether sulfates (Egan *et al.*—*Chem. Specialties Mfrs. Assoc. Mtg. 1956,* 174). Alkylaryl sulfonates (Hopfinger—*Chemik 10,* 73; Profic —*Olii minerali, grassi e saponi, colori e vernici 34,* 230; Payne & Preston—*Mfg. Chemist 27,* 500). Detergents from petroleum (Maretic—*Nafta 7,* 206). Alkyl sulfates (Rabinovich & Skripchenko—*Masloboino-Zhirovaya Prom. 22,* No. 6, 19). Teepol (Dosso—*Congr. mondial detergence, Paris 1,* 373). Sulfated "oxo" alcohols (Wemelle & Bolle—*Ibid.* 93). Sulfonated grape pit oil (Herra—*Quim & ind., Spain, No. 14,* 10). Sulfonated dolphin oil (Alexa *et al.*—*Bul. inst. politek Isai 1,* No. 1–2, 137). Sulfonated olive cake oil (Herrera—*Congr. mondial detergence, Paris 1,* 339). Nonionics (Gadaskina *et al.*—*Zhur. Priklad Khim. 30,* 148; Stanton—*Soap Chem. Specialties 33,* No. 6, 47; Satkowski & Bennet—*Ibid.* No. 7, 37; Cloney & Mayhew—*Ibid.* No. 8, 52; Fine—*Ibid.* No. 9, 50; Tschakert—*Rev. franc. corps gras 4,* 587; Corbiere—*Congr. mondial detergence, Paris 2,* Sect. 5–11, 487; Schoeller—*Ibid. 2,* 503, 826; Aftalion—*Ibid. 1,* 358; Kehren & Rösch —*Fette-Seifen-Anstrichmittel 59,* 1; Melliand—*Textilber 37,* 1194). Fatty acyl alkylamides (Dutton & Reinisch—*Mfg. Chemist 28,* 124, 176; Hembrough—*Chem. Prod. 20,* 331; Pugh—*Mfg. Chemist 28,* 557). Sugar ester detergents (Osipow & Snell—*Chem. Prod. 20,* 101; Whalley—*Ibid.* 105). Synergy and detergents (Hittner—*Congr. mondial detergence, Paris 2,* 709).

Physical Chemistry and theories of detergency:

Physical chemistry of washing (Smola—*Österr. Chem.-Ztg. 50,* 11; Hopfinger—*Chemik 9,* 137; Raphael—*Mfg. Chemist 28,* 240; Noad—*Congr. mondial detergence, Paris 1,* 414; Wijga—*Ibid.* 19). Theory of foam formation (Nakagaki—*J. Phys. Chem. 61,* 1266). Micelles (Sasaki—*Bull. Chem. Soc. Japan 30,* 326). The phase rule in the soap industry (Finizia—*Riv. ital. essenze, profumi, piante offic. olii vegetali, saponi 38,* 412).

Detergent analytical methods:

Bibl. 1888–1956 (Harris & Bernstein—*A.S.T.M. Bull. No. 150A*). General methods (Cruz—*Grasas y Aceites, Spain 7,* 243; Paquot—*Congr. mondial detergence, Paris 1,* 171; Sisley *et al.*—*Ibid.* 189). Analysis by infrared spectrometry (Delsemme—*Ibid.* 192). Analysis of sodium lauryl sulfate (Fayaud & Rivera—*Ibid.* 223). Determination of nonionics in dilute solutions (Evans—*Ibid.* 202). Analysis of fatty alkylamides (Giuseppe—*Ibid.* 206). Determination of concentration of ionic detergents (Preston & Epton—*Ibid.* 310). Determination of alkyl sulfates by quaternary ammonium compounds (Bert—*Ibid.* 185).

Practical testing:

Consumers properties of soap (Klyuchevich—*Masloboino-Zhirovaya Prom. 23,* No. 2, 25). Practical performance (Mukherjee—*Indian Soap J. 22,* 126; Berbe—*Congr. mondial detergence, Paris 2,* Sect. 5–11, 677). Evaluation tests (Schwen—*Ibid. 1,* 239; Pugh & Epton—*Ibid.* 252; Wetzel—*Krankenhaus—Apotheker 1957,* 10; Grifo & Woodward—*Chem. Specialties Mfg. Mtg. 1956,* 179). The scope of a launderometer test (Kortland *et al.*—*Congr. mondial detergence, Paris 1,* 260). Effectiveness of nonionic detergents for washing wool (Stas-Sariban—*Ibid. 2,* Sect. 5–11, 433). Detergency screening tests (Ferris & Leenerts—*Chem. Specialties Mfrs. Mtg. 1956,* 154). Radioactive tracer techniques in washing studies (Manos—*Ibid.* 94; Sasaki—*Abura Kagaku 6,* 67). Tests for grease removal from metals (Riedinger—*Congr. mondial detergence, Paris 2,* 847). Service evaluation of bars (Manneck—*Seifen-Öle-Fette-Wachse 82,* 151, 179). Determination of whiteness of washed test fabric (Gruel—*Cong. mondial detergence, Paris 2,* Sect. 5–11, 616). Bacterial power of detergents (Vallee—*Ibid.* 810).

Detergents in use:

Liquid detergents in automatic laundering process (Edis-Bates & Tarring—*Congr. mondial detergence, Paris, 2,* Sect. 5–11, 646). Synthetic detergent washing powders Galinski—*Prace Inst. Lab. Badawczych Przemyslu Rolnego i Spozywczego 5,* No. 3, 23). Modern detergents in household uses (Zuppiroli—*Congr. mondial detergence, Paris, 2,* Sect. 5–11, 686). Detergency and sterilization (Resuggan —*J. Soc. Dairy Technol. 10,* 84). Germicide based detergents (Moore & Hardwick—*Mfg. Chemist 27,* 305). Removal of blood and chocolate stains with detergents (Nieuwenhuis & Tan—*Wasindustrie 6,* No. 4, 8). Waterless hand cleaners (Beach—*Soap Chem. Specialties 33,* No. 10, 52). Cleaners for building maintenance (Barron & Burner —*Ibid. No. 12,* 55). Synthetics in finishing fabrics containing wool (Cheetham & Whewell—*Congr. mondial detergence, Paris, 2,* Sect. 5–11, 438). Sheepskin detergents (Edis-Bates & Tarring—*Ibid.* 562). Leather dyeing assistants (Tuck—*Ibid.* 564). Nonionics in metallurgy (Gire—*Ibid.* 872). Detergent research related to water and sewage (Coughlin—*Public Works 87,* No. 3, 180; Moss —*Soap Chem Specialties 33,* No. 4, 43).

Glycerol:

Economic and use information (Pattison—*Paint Ind. Mag. 71,* No. 11, 8; *Soap Chem. Specialties 33,* No. 3, 43). Distillation (Fainberg—*Masoboino-Zhirovaya Prom. 22,* No. 6, 18). Purification by ion exchange (Vekhotko & Moiseev—*Zhur. Priklad. Khim. 29,* 1203; Meeberg—*Indian Soap J. 22,* 143). Processing glycerol waters from autoclave splitting (Spinov *et al.*—*Masloboino-Zhirovaya Prom. 23,* No. 1, 36).

CHEMICAL ANALYSIS. There is only a very small amount of new literature on analytical methods for the soap laboratory. A new method of evaluating tallow for soapmaking is based on the color of a saponified sample dissolved in glycerol (Loury —*Rev. franc. corps gras 4,* 206; Loury & Prevot—*Ibid.* 442). The color is compared with standard iodine solutions or measured spectrometrically as a means of predicting the color of soap made from the tallow. The introduction of an "alkali value" is proposed for characterizing soaps (Presting & Kaiser —*Chem. Tech. 8,* 386). It expresses the fatty acid equivalent in the soap in milligrams of potassium hydroxide. It is an indirect expression of the average molecular weight of the fatty acids of the soap.

Some analytical methods pertain to builders and additives. A method for determination of pyrophosphate in commercial triphosphate involves chromatographic adsorption on ion exchange resin elution of ortho-, pyro-, and triphosphates separately with definite eluants and analysis of these extracts (Weiser—*J. Am. Oil Chemists' Soc. 34,* 124). The refractive indices of aqueous solutions of condensed sodium phosphates are recorded as analytical reference data for concentration and average chain length of the phosphates (Griffity—*J. Am. Chem. Soc. 79,* 509).

Results of 16 European and 14 American collaborators on the analysis of glycerol samples by the Am. Oil Chemists' Soc. and the British analysts modification of the sodium periodate methods show that within laboratory agreement of the latter is better; whereas among laboratories, variability is less with the former (Pohle *et al.*—*J. Am. Oil Chemists' Soc. 34,* 591). In a survey of tests for detecting crude glycerols which will cause difficulty in refining or yield poor products, the determination of pH, nitrogen, color of distillate, and distillate color stability when heated are considered most useful (Segur *et al.*—*Ibid.* 363).

The literature shows that there is greater interest in the analysis of synthetic detergents than for the analysis of soaps. In the determination of active ingredients in synthetics on the basis of extraction, substitution of a 1:1 acetone:ether solution for alcohol obviates errors due to solubility of the sodium carbonate or the sodium perborate which may be present (Ross & Blank—*Ibid.* 70). Novel reagents are described for indicating the presence of fatty acids, sulfated and sulfonated anionic surface-active agents, quaternary ammonium and pyridinum salts, and cationic-active amines when present as single substances (Holness & Stone—*Analyst 82,* 166). The electrical conductance of many cationic-hydrochloride surfactants when titrated with silver dodecyl sulfate shows a distinct minimum which may be utilized as a means of quantitative analysis (Yoda *et al.*—*Nippon Kagaku Zasshi 77,* 1087; Dolezil & Bulandr—*Chem. Listy. 51,* 255; Kuyper & Vader—*Congr. mondial detergence, Paris, 1,* 382; Musha *et al.*—*Bunseki Kagaku 5,* 476). The above procedures can be used inversely, i.e., alkyl sulfates may be determined by titration with cationic surfactants. Cationic surfactants are determined colorimetrically, using as reagents cobalt chloride-ammonium thiocyanate solution (Aoki *et al.*—*Yakuzaigaku 16,* No. 1, 11) or tin chloride in dilute hydrochloric acid (Yoshimura & Morita—*Eisei Shikenjo Hokoku No. 74,* 77). Some cationics are determined

gravimetrically by precipitation with phosphotungstic acid *(Ibid.)*. A volumetric method for quaternary ammonium compounds is based on precipitation with silver perchlorate and back titration with silver nitrate and potassium bromate (Neu —*Fette-Seifen-Anstrichmittel 59,* 503). From the halogen content, one may also calculate the molecular weight of the surfactant.

Two procedures are described for determination of alkyl sulfates by precipitation with nickel salts and titrating excess nickel reagent (Renault & Gautier—*Bull. Soc. chim. France 1957,* 208; *Chim. anal. 39,* 189).

A method for determination of sodium laurate in sodium *N*-lauroylsarcosinate is based on chromatographic separation of the lauric acid and titration with sodium hydroxide (Cullum —*Analyst* 82, 120).

A qualitative test for alkylaryl sulfonate involves conversion to an azo dye by reaction with a diazonium salt (Rosen & Goldfinger—*Anal. Chem. 28,* 1979). Naphthalene derivatives give purple color; benzene derivatives give red colors; and yellow-amber colors are negative. Alkyl benzene sulfonate detergents are detected in water and sewage by extraction with 0.1% solutions of 1-methylheptylamine in chlorform or hexane and determination by the methylene blue method (Fairing & Short—*Anal. Chem. 28,* 1827).

In the analysis of polyethylene nonionic surfactants, free polyethylene glycol may be separated by adsorption on silica gel (Nakagawa & Muneyuki—*Ann. Rept. Shionogi Res. Lab. 7,* 209). Nonionic surface-active agents may be isolated from mixtures with ionic compounds by use of appropriate ion exchange resins to remove the latter compounds (Rosen—*Anal. Chem. 29,* 1675; Weeks *et al.—Soap Chem. Specialties 33,* No. 8, 47). A method for analysis of polyethylene glycol esters is based on saponification, extraction of the free polyethylene glycol with hot salt solution and calculating composition of the mixture from saponification and hydroxyl numbers (Malkemus & Swan—*J. Am. Oil Chemists' Soc. 34,* 342). Procedures are also described for determination by precipitation with phosphotungstic acid (Etienne—*Parfums, cosmet., savons No. 137,* 33), and with sodium tetraphenyloborate (Neu— *Fette-Seifen-Anstrichmittel 59,* 823). Determination of nonionic surface-active agents in orange juice by chromatographic isolation and reaction with iodine, phosphomolybdic acid, and barium chloride solutions, respectively, as reagents show recoveries of 92.5–102% (Kawashiro & Takeuchi—*Eisei Shikenjo Hokoku 74,* 233). The commercial nonionic, Triton X-100, can be determined in detergent samples through its 278 mμ absorption peak, assuming the absence of other substances absorbing in this region (Griffith—*Chemistry & Industry 1957,* 1041).

PHYSICAL PROPERTIES OF SOAPS AND DETERGENTS. Structures present in the liquid-crystal phases of soap are interpreted from x-ray diagrams (Luzzati *et al.—Nature 180,* 600). Middle soap consists of long, identical, parallel rods in regular hexagonal array and is nematic. Neat soap comprises parallel, equidistant sheets and is smectic. Phase diagrams as prepared for soaps are now extended to synthetic detergents by records on the systems sodium lauryl sulfate-water, sodium monoglyceride sulfate-water and ternary system of these with salt (Bergeron—*Congr. mondial detergence, Paris, 1,* 24).

The viscosities, cloud points, surface tensions, and interfacial tensions against olive oils are recorded for various fatty alcohol and phenol condensates with ethylene oxide having various length polyoxyethylene chains (Raphael—*Ibid.* 52). Surface tension data on various dialkyl sodium sulfosuccinates are interpreted to indicate that micelle formation and surface hydrolysis occur below the critcal micelle concentration (Williams *et al.—J. Colloidal Sci. 12,* 452). Surface tension measurements and critical micelles values of aqueous solutions of alkylbenzenesulfonates with and without methyl branches in the alkyl chain show that such side branches lower the values (Gershman—*J. Phys. Chem. 61,* 581). Surface tension curves as determined by the tensiometer of Thibaud are registered for several detergents and are said to indicate the detergency of the compounds (Vallee & Guillaumin—*Rev. franc. corps gras 4,* 309; Vallee—*Ibid. 3,* 764). A comparison of surface tension-concentration curves of detergent solutions with similar curves for the solution containing salt are interpreted to confirm the presence of "factor two" in the denominator of the Gibbs equation when applied to surface-active electrolytes (Lange—*Kolloid-Z. 153,* 155). Similar data on the interfacial tension of petroleum ether-water interfaces are also interpreted in regard to explanation of the Gibbs adsorption isotherm applicable to surface-active electrolytes in water (Haydon & Phillips—*Nature 178,* 813). The observation that surface tension of soap solution increases on addition of butanol up to 50% and above 50% it decreases, is interpreted to indicate that up to to 50% butanol hydrophilic oleomicelles exist and above 50% lipophilic hydromicelles are formed (Bose and Mehrotra—*Kolloid-Z. 150,* 151).

Observations that cation soaps precipitate arsenic sulfide, iron oxide, and other sols over a certain range of concentration, but peptize the coagulum at higher concentration; and a coagulum produced by soap of one charge is peptized by soap of opposite charge or by a nonionic soap are interpreted to indicate that colloidal particles are first covered by soap molecules with polar groups inward and later with a second layer with polar groups outward (Tamanushi—*Kolloid-Z. 150,* 44). In similar work in which surfactants of different chain length are compared; concentrations required for flocculation decreased with increasing chain length of the surfactant with charges opposite to that of the particle and at higher concentration of surfactant the inorganic systems are restabilized owing to recharge of the colloid particle (Hazel & Strange—*J. Colloid Sci. 12,* 529). In continuation of work on the system, the concentration of the surfactant required to decrease the mobility of the particles to zero, called the isoelectric concentration is determined and represented by curves and equations (Strange & Hazel—*J. Phys. Chem. 61,* 1281).

The adsorption of water vapor by gelatin-dodecyl sulfate ion and by gelatin-dodecyl ammonium is less than by pure gelatin (Tamaki & Tamamushi—*Bull. Chem. Soc. Japan 29,* 731).

Viscosities of surface layers of soap solutions are greater than those of the foam films, thus suggesting that the compositions of the free films are not identical with those of surface layers (Trapeznikov—*Kolloid. Zhur. 19,* 252). A novel method of studying surface films is based on using tritium labeled surfactant and also tritium labeling compounds whose influence on the films is studied (Nilsson—*J. Phys. Chem. 61,* 1135). This technique is used: to demonstrate that micelles are formed below the critical micelle concentration; to determine the ratio of surfactant and alcohol in films of surfactant-alcohol-water systems; and to show the behavior of alcohol in such films as affected by changing concentration. The temperature of transition of soap solution surface from plastic to nonplastic increases with increasing chain length and is also a function of soap concentration (Burcik & Newman—*J. Colloid Sci. 12,* 10). The soap concentration at maximum transition temperature is in every case well below the critical concentration for micelle formation. The tear in soap membranes occurs when the surface layer soap concentration falls below the critical value of 0.6×10^{-9} mole per sq. cm. and is independent of membrane thickness (Sheludko & Polikarova—*Godishnik Sofiiskiya Univ. Fiz. Mat. Fak. 49,* 15).

A cellophane membrane as used in equilibrium dialysis with ionic surfactants, can become ion-selective in such a manner as to tend to prevent the passage of surface-active ions or their micelles through the membrane (Kushner & Parker— *J. Phys. Chem. 61,* 822). Presumably this lack of transmission is due to adsorption of surfactant ions or their micelles into the membrane.

The surfactants, Brij-35 and Tween 80, activate the hydrolysis of olive oil in low concentrations but inhibit the reaction at high concentrations; whereas Span-80 and -85 show these phenomena in reverse (Matsumura *et al.—J. Pharm. Soc. Japan, 6,* 1355). This is explained on the basis that agents with large hydrophile-lipophile balances activate enzymes in lower concentrations and inhibit in higher concentrations, while the reverse is true of those with small such balances.

Among polyethylene glycol monoalcoholic ethers, the maximum water solubility derived from a fatty alcohol by introduction of oxyethylene groups corresponds to the molecular weight of alcohol divided by 44.05 (Chakhovskoy—*Congr. mondial detergence, Paris, 1,* 43). Anionic agents added to such compounds raise their critical solution temperatures (*Ibid.* 47). When a polyoxyethylene ether is added to an anionic surfactant, the critical micelle concentrate of the latter, as observed by conductance disappears with increasing addition of the nonionic (Yoda *et al.—Nippon Kagaku Zasshi 77,* 905).

The effects of solubilized hydrocarbon on aqueous solutions of polysoaps as observed by conductance and viscosity measurement is explained on the basis of changes in the molecular dimensions of the polysoap molecules (Strauss & Slowata— *J. Phys. Chem. 61,* 411). The solubilization capacity of soap solutions for normal C_3–C_6 alcohols decreases with increase of the length of the acid chain in the soap (Bose & Mehrotra— *Z physik. Chem., Leipzig, 206,* 339).

A general theory for micellar detergent solutions is developed with the aid of statistical mechanics (Hoeve & Benson— *J. Phys. Chem. 61,* 1149). Here, possible distribution of micel-

lar size with a fair sharp maximum are derived on the basis of a liquid-like structure for the interior of nonionic micelles. Equations for calculating energy changes of highly charged spherical micelles as applied to sodium dodecyl sulfate are interpreted for the pure solutions and as affected by salt and transfer to nonpolar media (Overbeek & Stigter—*Rec. trav. chim. 75,* 1263). The equilibrium concentrations of sodium ions, lauryl sulfate ions and micelles are calculated for sodium lauryl sulfate from light scattering, electrophoresis and conductivity data (Hoyer—*J. Phys. Chem. 61,* 1283). Here, the standard free energy changes per molecule associated with micelle formation are linear functions of the ionic strength of the solution. The critical micelle concentrations of alkali salts of alcohol esters of dodecyl sulfate are in the order: lithium >sodium>potassium (Meguro *et al.—Nippon Kagahu Zasshi 77,* 1236).

The effect of additions of salt up to 0.3*M* to three cationic detergents is determined by measurements of refractive index, turbidity, and viscosity and interpreted with respect to micellar weights and critical micelle concentrations (Kushner *et al.—J. Res. Natl. Bur. Standards 59,* 113). Additions of salt beyond 0.05*M* results in rapid growth of the micelles; this is probably the first step in the "salting-out" process.

The critical concentration of micelle formation is recorded for three sulfo-type soaps as determined by light scattering and dye solubilization (Kucher & Kovbuz—*Kolloid Zhur. 18,* 193), for polyoxyethylene monodecyl ether as measured by surface tension, dye solubilization, and polarography (Nakagawa *et al. —Nippon Kagaku Zasshi 77,* 1563, 1684), and for several fatty amines determined through conductivity measurements (Hoyer & Greenfield—*J. Phys. 61,* 818). The electrophoretic mobilities of the fatty amine micelles depend on the ionic strength of the solution more than on the nature of fatty amine (*Ibid.* 735). The electrical conductivity of a cationic soap solution decreases with increasing velocity gradient to a boundary value; the effect is greatest in concentrated solutions at low temperatures, decreases on dilution and heating, and disappears in a relatively narrow temperature-concentration range (Heckmann—*Z. physik. Chem., Frankfurt, 9,* 318). This behavior seems to indicate the existence of a boundary line that separates the range of unoriented micelles from that of globular ones.

In solutions of nonionic surface-active agents of increasing concentrations, the dye, cyanine 5R, changes color just below the critical micelles concentration (Nemto—*Nagoya-shi Kogyo Kenkyujo Kenkyu Hokoku No. 13,* 33). A study of micelles of many surfactants as measured by changes in absorption of added azobenzene dye at 320–355 mμ is interpreted to indicate that micellar concentration is constant at surfactant concentrations of 5–20% and only micellar size changes with surfactant concentration (Sasaki *et al.—Bull. Chem. Soc. Japan, 30,* 186). When increasing amounts of ionic surfactants are added to solutions of fluorescent dyes, fluorescence begins at a weak level and increases with increasing surfactant until a constant value is attained, which is about two times that of the original aqueous solutions of the dyes (Kondo *et al.—Nippon Kagaku Zasshi 77,* 1281). With neutral congo red solutions, addition of cationic surfactant causes, successively, a precipitation and dispersion; but in acidic solution, there is in addition a color change from blue to orange (Kondo *et al.—Ibid.* 1240).

In a comprehensive study of micelles of sodium alkyl sulfate, the data on effect of alkyl chain length, dust, salt, impurities, and polyvinyl acetate are interpreted with regard to dissociation, micellar charge, and the micellar weight (Prins & Hermans—*Koninkl. Ned. Akad. Wetenschap., Proc., Ser. B59,* 298). Light scattering observations on poly-soap solutions in pure water indicate a molecular weight of 0.2–0.5 of the actual values, but in presence of electrolyte values fairly close to the actual molecular weights are obtained (Sinha *et al.—J. Am. Chem. Soc. 79,* 281). Turbidity of water soluble distilled fractions of Triton X-100 as measured by light defraction is a changing function of concentration below concentrations of 0.3–0.4 g. per decaliter (Kushner *et al.— J. Phys. Chem. 61,* 371).

The micelle behavior of various surfactant solutions as affected by polar and nonpolar organic compounds and by compounds of different structures are interpreted, in general, in regard to the size and structure of the micelle. The critical micelle concentration of sodium dodecyl sulfate in water passes through a minimum as the temperature is raised, but in ethanol-water mixtures above 20° the critical micelle concentration increases with temperature, the temperature coefficient becoming increasingly greater as the alcohol concentration rises (Flockhart—*J. Colloid Sci. 12,* 557). The observations are discussed in relation to theories on micellar structure. A thinning of soap solutions by nonpolar liquids is explained on the basis of the liquids solubilizing the micelles and the thickening or gelling by polar liquids is caused by bridging of the micelles by the polar molecules (Markina & Rebinder—*Doklady Akad. Nauk S.S.S.R. 109,* 1156). Soap gels in various organic solvents are also described in regard to time and temperature of setting and influence of the concentration of soap (Deshpande & Buch—*J. Indian Chem. Soc. 33,* 321). The critical concentration for micelle formation of dodecylammonium salts of fatty acid in several nonpolar solvents, obtained by measuring the amount of water solubilized as a function of the surfactants and the slope of this line, is expressed as the solubilizing capacity (Kitahara—*J. Colloid Sci. 12,* 342). This work is also extended to several dodecylammonium fatty salts and to various temperatures (Kitahara —*Bull. Chem. Soc. Japan, 29,* 15). The solubility of benzene in aqueous solutions of dodecylbenzene sodium sulfate of various concentrations is also measured by viscosity, refractive index, surface tension and turbidimetric methods (Kuroiwa *et al.—Res. Repts. Fac. Textile & Sericult Shinshu Univ. 5,* 128). In a study of the states of aggregation of dinonylnaphthalene sulfonates of 10 cations (lithium, sodium, ammonium, calcium, etc.) in benzene indicates that micelles contain 9–14 acid residues each (Kaufmann & Singleterry— *J. Colloid Sci. 12,* 465). Their aggregation number is usually independent of concentration and almost independent of the water content of the system. Viscous solutions produced similarly by alkali metal phenylstearates are also studied with respect to effect of the alkali metal, size of cation, and addition of other materials to the system (Honig & Singleterry—*J. Phys. Chem. 60,* 1108, 1114). The viscosity and fluorescence polarization data are interpreted with respect to structures such as aggregation, elastic-viscous systems, linear polymers, and shape and size of micelles. In a solubilization of *n*-hydrocarbon by poly (2-vinylpyridine) partially quaternized with dodecyl bromide the conductance change is small; however, benzene and octanol produce large conductance depressions (Strauss & Slowata—*Ibid. 61,* 411). These changes are not related to those that produce viscosity maxima. Observations of absorption of naphthols by cationic micelles in dilute aqueous solutions indicate that the aromatic compounds with polar groups are externally adsorbed on the cationic micelles and impose a cylindrical symmetry on the micelles (Nash—*J. Applied Chem. 6,* 539). This results in long cationic filaments, thus explaining the mechanical properties of the solutions. The character of the solubility curve of chloroxylenol in aqueous solutions of polyethylene 1000 monohexadecyl ether is explained as solubility of the former in micelles at the mole rate of 1.9 to one of surfactants (Mulley & Metcalf—*J. Pharm. & Pharmacol. 8,* 774).

PERFORMANCE AND USE TESTING. A new method of determining foam capacity and foam stability is based on measuring rate of foam buildup during 15 minutes stirring and foam breakdown for 30 minutes after the stirring is stopped (Kaertkemeyer—*Parfums, cosmet. savons No. 138, 31*). The Schlachter-Dierkes foam test is modified to improve reproducibility (Machemer & Heinz—*Congr. mondial detergence, Paris, 1,* 278). Foam values by different methods do not agree satisfactorily, although reproducibility is usually good with the same method (Mauri—*Grasas y aceites, Spain, 8,* 78). A foam test for toilet soap bars is based on abrading the bar with a cellulose sponge which is constantly wetted and rinsed in water (Becher & Compa—*J. Am. Oil Chemists' Soc. 34,* 53). The end-point is defined as the number of strokes of the sponge required to form a uniform layer of foam on the surface of water in a test vessel into which the sponge dips.

The foaming ability of dilute aqueous cetyltrimethylammonium salts is retained in the presence of equimolar amounts of naphthol, whereas the rate of drainage of the foam under gravity is greatly reduced (Nash—*J. Applied Chem. 7,* 392). The mechanism of the improvment of foam stability of nonionic surfactants by addition of anionic surfactants is explained on the basis of the additive being solubilized into the interior of the micelles (Schick & Fowkes— —*J. Phys. Chem. 61,* 1062). Another explanation based on conductivity studies suggests that the stabilizer increases micellization (Ross & Bramfitt—*Ibid.* 1261). Here, inhibitors are explained on the basis of decreasing micellization. Lauric diethanolamide is superior to several other amide surfactants for stabilizing suds of sulfate and sulfonate type shampoos (Kritchevsky & Sanders—*Congr. mondial detergence, Paris, 1,* 133).

Among foam fractions successively separated from a solution of alkyl sulfates, those produced initially are inferior in foam performance to those produced at a later stage

(Evans & Epton—*Ibid.* 114). With sodium dodecyl sulfate the critical micelle concentration obtained from the plot of foaming power *vevrsus* concentration agrees with the values obtained by other conventional methods (Kashiwagi—*Bull. Chem. Soc. Japan, 30,* 193). Bivalent metal salts of dodecyl sulfate foam better than the univalent metal salts (Boido *et al.—Congr. mondial detergence, Paris, 1,* 155). In generating foams from sodium dodecyl sulfate solutions adsorption of the surfactant in the foam increases with solution concentration until the critical concentration for micelle formation is reached and thereafter it remains constant (Wilson *et al.—J. Colloid Sci. 12,* 345). In this work the presence of dodecyl alcohol in the system causes no sharp change in the amount of surfactant adsorbed in the foam. The foam performances of many "built" alkylbenzene sulfonates are recorded to show the relation between structure and foaming power (Kooijman *et al.—Congr. mondial detergence, Paris, 1,* 130). Maximum foaming of soap solutions occurs at pH of 9.5–10.9, and a double maximum in foaming power occurs as the concentration is increased (Dervichian—*Ibid.* 125). During the foaming of sodium oleate solutions, the composition of the material adsorbed in the foam is a 2:1 ratio of sodium oleate and oleic acid (Raison—*Ibid.* 105).

In a theoretical investigation of foam drainage an equation is presented correlating the drainage rate with liquid viscosity, based on a model wherein drainage is considered as liquid flowing between two plates (Jacobi *et al.—Ind. Eng. Chem. 48,* 2046).

Measurement of wetting capacity of detergents with a new apparatus is based on penetration of a solution of the sample through a standard felt disk (Desalme—*Rev. franc. corps gras 4,* 545). Among monoglyceride products of the common vegetable oils, those made from coconut oil have the highest wetting power (Varma—*Indian Soap J. 22,* 191).

The pH, surface tension, foaming ability, foam stability, and cleaning properties of mixtures of soap and alkylbenzenesulfonate in hard and soft waters are recorded for use as reference material for formulation (Nevolin *et al.—Maslobo-ino-Zhirovaya Prom. 23,* No. 1, 27). Similar data are recorded for alkylbenzenesulfonates made from alkyl benzene fractions of various boiling range derived from distillation of polymers from petroleum gas (*Ibid. No. 7,* 33). The detergencies of tetra- and penta-polypropylene benzene sulfonates are said to be better than that of ordinary soap (Nevolin—*Ibid.* 24). The detergencies of alkyl sulfates derived from alcohols of the "oxo" process are best at carbon chain lengths of 12–17 (Bolle & Wemelle—*Congr. mondial detergence, Paris, 1,* 149). Detergency of built alkylpolyethylene oxides is optimum at C_{12} chain length with 3 ethoxy groups in alkaline medium, and at C_{12}–C_{16} chain length with 7 ethoxy groups for neutral or acid medium (Kehren & Rösch—*Melliand Textilber. 37,* 1308).

Textiles treated with resins, to induce resistance to iron staining, improve ironing and improve drying, "gray" less when laundered with soap than when synthetic detergents are used (Uhl—*Fette-Seifen-Anstrichmittel 59,* 137). Some such fabrics gray considerably in laundering.

In laundering with built alkylsulfonate solutions containing increasing amounts of carboxymethylcellulose (CMC), the washing effect as represented by a curve relating concentration of CMC to whiteness shows unexplainable maximums and minimums (Stawitz & Höpfner—*Seifen-öle-Fette-Wachse 82,* 261). A concentration of 0.25 g. per liter of CMC gives the best results. In another report, whiteness of the wash test cloth is said to increase with increasing amounts of CMC (Keene & Airs—*Congr. mondial detergence, Paris, 1,* 241). The action of CMC as a suspending agent is attributed to its adsorption by the textile material (Stüpel—*J. Polymer Sci. 19,* 459).

The increase in detergent capacity as measured by the removal of an artificial soil from cotton is recorded for a sodium alkylaryl sulfonate with five different builders (Boido—*Congr. mondial. detergence, Paris, 1,* 144). All the builders tested, except sodium bicarbonate, improved detergency. In similar work on cleaning soiled linen, the pH of optimum effectiveness is also determined (Colas—*Ibid. 2,* Sect. 5–11, 622). Like data are recorded for built soap solutions (Corin—*Ibid.* 478). In a study of the mechanism of builder action, their effect on sorption of sodium myristyl sulfate on cotton and on carbon is measured (Perry *et al.—J. Am. Oil Chemists' Soc. 34,* 493). There is no consistent correlation between the amount of surfactant sorbed and either pH or the anionic charge of the builder. The presence of phosphates in rinses is recommended even when phosphate-built surfactants or soaps are used for washing (Schuster—*Seifen-öle-Fette-Wachse 83,* 451).

The effects of various alkaline and oxidizing agents commonly used with soaps on the synthetic fabrics, Orlon, Acrilon, Dynel, Vinyon, Terylene, Nylon and Grilon, are evaluated by x-ray examinations, measurements of the breaking strength and weight, and on viscosity of solutions in dimethylformamide (Dyrenfurth—*Eidgenöss. Materialprüfunge u. Versuchsanstalt Ind. Bauw. u. Gewerbe No. 166,* 39 pp.). Data are also recorded on removal of vaseline, lanolin, waxes, salves, and ointment bases from various synthetic fabrics during laundering (Schmitz—*Fette-Seifen-Anstrichmittel 58,* 1041). Cotton and staple viscose rayon colored with copper-, chromium- and cobalt-containing dyes undergo considerable damage when washed with detergents containing oxidizing bleaches (Schönberger—*Congr. mondial detergence, Paris, 2,* Sect. 5–11, 462). However, copper base phthalocyanine dyes are satisfactory.

The literature on evaluation of efficiency of fluorescent whitening detergent additives is on the use of fluorimeter for the purpose and deal mainly with corrections to be made on the readings (Allen—*Soap Chem. Specialties 33,* No. 7, 40; *J. Optical Soc. Am. 47,* 933).

The new tests described for evaluating dishwashing detergents are based on removal of fats, eggs, and soils commonly involved in dishwashing; and foaming of the products is also evaluated (Leenerts & Myers—*J. Am. Oil Chemists' Soc. 34,* 361; Fineman & Greenwald—*Congr. mondial detergence, Paris, 2, Sect. 5–11,* 665). Dishwashing detergents are also evaluated for their action on the overglaze decorations of the wares (Otrhalek & Bacon—*Am. Ceram. Soc. Bull. 35,* 438). The standard test apparatus for resistance of porcelain enamels to abrasion of the Porcelain Institute is adapted for testing abrasiveness of household cleansers (Gerardi—*Soap Chem. Specialties 33,* No. 2, 47). Sequestrants used in bottle washing are evaluated on the basis of the amount of scale deposited on a stainless-steel screen from caustic solutions containing the additive when hard water is added (Colaric *et al.—Ibid.* No. 9, 47). A method for evaluating dairy cleaning detergents involves cleaning steel planchets soiled with milk containing calcium-45 and determining the amount of the radioactive calcium removed (Firsching & Everson—*J. Am. Oil Chemist's Soc. 34,* 547).

Details of results from bacteriology investigations on detergent material are too extensive for inclusion in this survey. Here, in most cases, the scope of the work is cited and the reader should consult the individual reference for details. The bactericidal efficiencies of various built detergents containing several quaternary ammonium additives against *Escherichia coli* are recorded (Cousins & Clegg—*J. Appl. Bacteriol. 19,* 250). The germicidal potentials of three quaternary ammonium compounds are determined against *Bacillus subtilis, Mycobacterium tuberculosis, Escherichia coli,* and *Staphylococcus aureus* (Marazzi—*Studi Urbinati Fac. farm. 28,* 136, 143, 148). Presence of lecithin usually increases the resistance of the spores against the compounds. Common commercial detergents are classified from tests with *Escherichia coli* according to: *(a)* having a hidden lytic action, weakly bactericidal, and noncoagulating, *(b)* those having mixed effect, strongly bactericidal, coagulating and lytic, and *(c)* indifferent detergents, weakly bactericidal, noncoagulating, and nonlytic (Bolle—*Pharm. Acta Helv. 32,* 1). Several ionic detergents are evaluated for lytic effect with *Micrococcus lysodeikticus* (Gilby & Few—*Nature 179,* 422). The inhibitory effect of dilute sodium dodecyl sulfate on the production of carbon dioxide by yeast suspension containing various concentrations of sodium chloride can be related to the total concentration of the sodium ion present (Armstrong—*Ibid.* 780). Sodium dodecyl sulfate is effective in 1:100,000 dilution for preventing algal infestations (Andrey & Mirimanoff—*Pharm. Acta Helv. 32,* 162). The bactericidal activity of 5-chloro-2-hydroxydiphenylmethane in soap solution decreases with increasing soap concentration probably because of decreasing solubility (Berry & Briggs—*J. Pharm. & Pharmacol. 8,* 1143). An evaluation of the inhibitory effects of detergents on enzymes show that: anionics are more inhibitive than cationics: β-amylase is more sensitive than α-amylase; and heat liability of enzymes is increased by presence of detergents (Katagiri & Ikemiya—*Koso Kagaku Shinpojiumu 12,* 5).

Many bacteria will grow in pharmaceutical dispersions made with nonionic detergents. Addition of 1:1000 concentration of sodium benzoate to nutrient containing 1% nonionic does not inhibit growth of many cultures (DeNavarre—*Congr. mondial. detergence, Paris, 2,* 741). More than 50 preservatives and combinations are evaluated for inhibiting many microorganisms in dispersions of the nonionic surfactants (Barr & Tice—*J. Am. Pharm. Assoc. 46,* 442, 445).

In this work the most satisfactory preservative is sorbic acid at 0.2% by weight.

The detergents, dioctyl sodium sulfosuccinate and sodium lauryl sulfate, when added to suspensions of *Shigella dysenteriae, S. paradysenteriae, S. ambigua* or *Salmonella typhosa* consistantly enhance the pathogenicity in mice inoculated intraperitoneally (Christovao—*Proc. Soc. Exptl. Biol. Med. 94,* 724).

A comprehensive review on toxicity from anionic, cationic and nonionic surfactants deals with possible hazards in the household, industrial and medical fields, and also covers accidental and criminal intoxications (Gaultier & Fournier—*Congr. mondial. detergence, Paris 2,* 793). Another review on toxicity of surfactants deals principally with their safety in foods (Darby *et al.—Natl. Acad. Sci. Natl. Res. Council Publ. 463,* 10 pp.).

The cutaneous effect or toxicity of detergent solution is the text of three reviews (Suskind—*J. Am. Med. Assoc. 163,* 943; Bidaux—*Congr. mondial detergence, Paris, 2,* 699; Herzberg—*Fette-Seifen-Anstrichmittel 59,* 747). Three communications contain test methods for skin compatibility of washing agents (Gotte & Kling—*Fette-Seifen-Anstrichmittel 59,* 820; Koehler—*Ibid.* 351; Reumuth—*Riechstoffe u Aromen 6,* 317).

Surfactants are used in the study of structure and characteristics of proteins. The observation that 10–14 molecules of sodium decyl sulfate are bound by a serum albumin molecule is discussed in reference to the secondary and tertiary structures of the serum albumin (Markus & Karush—*J. Am. Chem. Soc. 79,* 3264). In a study on the same interaction, S^{35}-labeled dodecyl sulfate is used and the complexes formed are separated for study by electrophoresis (Jerchel *et al.—Z. Naturforsch. 11b,* 681). The amount of sodium dodecyl sulfate bound by egg albumin at pH 4.2 to 2.3 is constant thus indicating that the number of positive charges on the albumin is constant in this pH region (Aoki *et al.—Bull. Chem. Soc., Japan, 29,* 758). This permits determination of the albumin by titration with the surfactant. At pH of 6.8 the egg albumin-sodium dodecyl sulfonate interaction involves different heats of reactions with different ratios of reactants, thus indicating different complexes are formed (*Ibid. 30,* 53). Soaps greatly accelerate heat denaturation of albumin, although they retard the subsequent aggregation (Loseva & Tsiperovich—*Kolloid Zhur. 19,* 222). This is explained on the basis that fatty acid anions are incorporated in protein particles and thus lower their stability, but they impart a high negative charge to the resulting molecule which hinders the aggregation. Synthetic detergents rapidly produce hemolysis of human erythrocytes by action on free phospholipide in the cell wall and slowly by a process in several stages apparently involving a breakdown of a lipoprotein in the cell wall (Rideal & Taylor—*Proc. Roy. Soc., London, B146,* 225). Films of bovine plasma albumin formed under a variety of conditions on barium soap are characterized as to thickness, refractive index and mass per unit area (Bateman & Adams—*J. Phys. Chem. 61,* 1039). When rat liver microsome pellets are suspended in solutions of the nonionic detergent, Lubrol W, in 0.25*M* sucrose, and the resultant separated by centrifugation, the residual detergent pellets contain virtually all the ribonucleic acid (Cohn & Butler—*Biochim. & Biophys. Acta 25,* 222).

Many other nondetergent uses of surfactants and soaps are studied. One communication contains solubility data of nicotine in solutions of soap and cationic detergents, and includes phase diagrams for the ternary systems of detergents-nicotine-water (Langbridge *et al.—J. Colloid Sci. 11,* 585). In kaolinite water systems, anionic agents increase deformability and decrease sedimentation volumes and filterability; cationic agents decrease deformability and increase sedimentation volumes and filterability; and nonionic agents show either little effect or small decreases in deformability (Ormsby *et al.—Natl. Acad. Sci.-Natl. Res. Council Publ. No. 456,* 251). Surfactants greatly increase the cathode and anode overvoltage in electrolytic processes with zinc and cadmium amalgams; this effect is further intensified on addition of magnesium sulfate (Losev—*Doklady Akad. Nauk S.S.S.R. 111,* 626). Organic compounds with significant solubility can be purified by a simple crystallization from water containing small amounts of detergent to yield products of greater purity than derived from a single aqueous crystallization (Sugihara & Newman—*J. Org. Chem. 21,* 1445). Two procedures are described for the determination of the fibrinogen content of plasma by means of titration with cationic detergents (Graf—*Hoppe-Seylers' Z. physiol. Chem. 304,* 273). In a modified potassium palmitate titration method for determining hardness of water, Eriochrome Black T is used as the indicator (MacMillan & Mitra—*Indian Chem. Soc., Ind. & News Ed. 19,* 182).

Addition of 2.5–5% sodium lauryl sulfate to glucose solutions increases absorption of the glucose from the intestines of the rat and the rabbit (Kozlik & Mosinger—*Pharmazie 11,* 22, 539). Addition of this detergent to chick rations tends to reduce their growth rate (Bonsembiante—*Ann. sper. agrar, Rome 11,* 629).

In adding surfactants to fertilizers, the anionics are more readily adsorbed on acidic surfaces, while cationics are more readily adsorbed on basic material (Fox & Jackson—*J. Agr. Food Chem. 5,* 578). Here acidic surfaces are made hydrophilic by anionic surfactants and hydrophobic by cationic surfactants. The addition of the surfactant, sodium dodecylbenzene sulfonate, to acid prior to the acidulation of rock phosphate is patented (Jaquier—*U. S. 2,802,728*). Data are recorded on the efficiency of 24 surfactants for coagulation and laying industrial dust (Avy—*Congr. mondial detergence, Paris, 3,* 940).

Research related to detergents in sewage and water treatment has continued. The work done by the British Institute of Sewage Purification on this problem is reviewed (Degens—*Congr. mondial detergence, Paris, 3,* 1054). In another review on the subject, it is concluded that concentrations now found in sewage do not affect efficiency of the sewage treatment plants, but there is a problem of frothing (Moss—*Sewage & Ind. Wastes 29,* 1107). Another reviewer regards frothing of sewage as a symbol of surfactants being present, but points out that the following effects are also possible: lowering of biological oxygen demand (B.O.D.), change in microorganisms, particularly destruction of protozoa, lowering gas yield, and a decrease in suspended solids (McKinney—*Ibid.* 654). Synthetic sewage with up to 375 p.p.m. of soap and up to 350 p.p.m. of fat show little tendency to froth; however, 37.5 p.p.m. of sodium lauryl sulfate and 30 p.p.m. of "Fab" cause frothing (Munro & Yatabe—*Ibid.* 883). This frothing is dependent on pH. Activated sludge studies show that the anionic, Nacconol N.R., decreases oxygen utilization to the greatest extent at pH 5, whereas the greatest inhibiting effect of cationic detergents is at pH 9 (Manganelli—*Proc. Ind. Waste Conf. 11th Conf. 1956,* 611). The effect of various surfactants and builders on biological oxidation is evaluated in terms of B.O.D.-chemical oxygen demand ratio (Sheets & Malaney—*Ibid.* 185). Such data should be considered in evaluating sewage plant performance. The effects of common detergent builders in concentrations of 0–100 p.p.m. on the B.O.D. test is recorded for possible use in study of biological sewage treatment processes (Malaney & Sheets—*Sewage & Ind. Waste 29,* 263). The reduced efficiency of the primary sedimentation processes, due to the presence of surfactants in the sewage, can be controlled by assisting sedimentation with aluminum sulfate (Beaver—*Congr. mondial detergence, Paris, 3,* 1059).

Resistance to biochemical oxidation of synthetic detergents affected primarily by branching of alkyl chains in the molecule and by the length of alkyl or polyethoxy chain in the molecules (Bogan & Sawyer—*Proc. Ind. Waste Conf. 1955,* 231). Tetrapropylenebenzene sulfonate and polyethoxy esters with more than five ethoxy groups are resistant. Where detergents enter water supplies, problems only arise with polypropylenebenzene sulfonates as a result of resistance to biological oxidation and with complex phosphates which increase coagulant requirements (Sawyer & Ryckman—*J. Am. Water Works Assoc. 49,* 480). Detergents which pass through a sewage treatment process that includes a percolating filter do not seem to affect effluent quality (Mann & Herbert—*Water & Sanit. Engr. 6,* 206).