Promotion of Research Discussed in Technical Program

SEVENTY-NINE papers were presented at the three general and eight specialized sessions of the 27th annual fall meeting of the American Oil Chemists' Society, November 2-4, 1953, at Chicago's Sherman hotel.

Promotion of Research

The opening sessions involved a series of papers on the importance of private and government agencies in the promotion of research and their relationship to the fat and oil industry. R. H. Ewell of the National Science Foundation gave a well-documented paper on the program of the Foundation, an independent government agency instituted by Congress in the fall of 1950. Dr. Ewell said that the director, Alan T. Waterman, reports directly to the president. The National Science Board of 24 members acts in an advisory capacity to the director and staff of the Foundation.

The Foundation is charged with supporting basic research and education in the sciences, with developing a national science policy, and with other duties. In the present fiscal year the Foundation will make grants in support of basic research totaling about $2,000,000 in the mathematical, physical, and engineering sciences and $2,000,000 in the biological and medical sciences. Also in this fiscal year the Foundation will award post-graduate and post-doctorate fellowships in the sciences totaling about $1,730,000.

Another important function of the Foundation is to collect data and make studies to provide a basis for a sound national policy with respect to science. Therefore the Foundation is now beginning the most comprehensive survey of scientific research which has ever been made. This survey will cover all fields of science and all types of organizations doing research. Particular emphasis will be placed on a quantitative appraisal of the economic and social effects of science.

The modest sums of money now available to the Foundation cannot support more than a small fraction of the basic fundamental research in colleges and universities which have been receiving some support from the armed forces, the Office of Naval Research, and other governmental agencies. The support of fundamental research by the Foundation will no doubt be of significance to fat and oil chemistry. Its support by the Congress, with increased appropriations, will be important to the future growth of the fat and oil industry.

Other papers on the opening session were given on the National Soybean Processors Association and the soybean industry by R. G. Houghtlin, the activities of the American Meat Institute as they relate to fats and oils by G. M. Lewis, and the outlook for the baking industry by William Bradley. A paper by R. C. Liebenow on the activities of the Chicago Board of Trade as related to the oils and fat industry was also given at the opening session.

Future Chemists

The student session which ran concurrently with the opening session was well attended by college students from the Chicago area as well as by members of the Society. The session began with a paper by H. A. Schuette on the historical development of lipid chemistry. J. C. Cowan continued this trend with a paper on the present research in edible fats.

The biochemistry of the lipids was explained by H. J. Deuel Jr., dean of the Graduate School at the University of Southern California. Dr. Deuel classified the lipids into simple, compound, and derived lipids and then indicated how each group was important in nutrition or metabolism. He pointed out how the classical statement "fat burns in the flame of the carbohydrate" has been shown to be true by today's biochemists.

The economic aspects of the oils and fats and their industrial application were presented by C. E. Morris and D. H. Wheeler. The latter pointed out with an illustrated set of slides the familiar every-day products in which fats and oils are necessary components. In spite of the many uses to which fats and oils are put however C. E. Morris presented enough data to indicate that new markets must continually be found through intensified research. Dr. Baldwin, in a paper on the literature and its use, showed how the work which has already been done helps a research chemist plan new research and helps to prevent unnecessary duplication of effort.

The importance of chemistry in the drying oil industry was told by Wouter Bosch. A list of the colleges and universities which provided special training in fat chemistry was provided in a survey by F. A. Kummerow. The latter found that five universities offered formal course work or seminars and research training in fat and oil technology. These five universities were Ohio State, Purdue, Illinois, Minnesota, and Wisconsin.

Characteristics of Rearranged Lard

One of the most interesting papers of the general session was one by C. W. Hoerr and D. F. Waugh on some physical characteristics of rearranged lard. It was pointed out that rearrangement of the structure of triglyceride molecules by

Program Personalities

1. OPENING SESSION—Speakers Monday morning are shown above: R. C. Liebenow, Chicago Board of Trade; R. G. Houghtlin, National Soybean Processors Association, Chicago; Procter Thomson, president of the American Oil Chemists' Society; R. H. Ewell, National Science Foundation, Washington, D. C.; W. B. Bradley, American Institute of Baking, Chicago; and G. M. Lewis, American Meat Institute, Chicago.

2. STUDENT SESSION—Speakers in front row are A. R. Baldwin, editor, *Journal of the American Oil Chemists' Society*; J. C. Cowan, Northern Regional Research Laboratory, Peoria, Ill.; and D. H. Wheeler, General Mills Inc., Minneapolis; in back row, F. A. Kummerow, University of Illinois, Urbana; H. A. Schuette, University of Wisconsin, Madison; K. F. Mattil, chairman; and H. J. Deuel Jr., University of Southern California, Los Angeles.

3. ANIMAL FEEDS—Watching a demonstration are these speakers: H. R. Kraybill, chairman; John Matshushima, University of Nebraska, Lincoln; L. R. Dugan Jr., American Meat Institute Foundation, Chicago; M. L. Sunde, University of Wisconsin, Madison; E. E. Rice, Swift and Company, Chicago; and B. S. Schweigert, American Meat Institute Foundation.

4. DETERGENTS—Seated *(left to right)* are D. O. Popovac, Continental Oil Company, Ponca City, Okla.; Frank Schlachter, Armour and Company, Chicago; A. J. Stirton, Eastern Regional Research Laboratory, Philadelphia; and C. O. Hebenstreit, Armour and Company, Chicago; standing, L. E. Weeks, Monsanto Chemical Company, Dayton, O.; W. D. Pohle, Swift and Company, Chicago; E. L. Boley, chairman; and Howard Paitchel, Colgate-Palmolive-Peet Company, Jersey City, N. J.

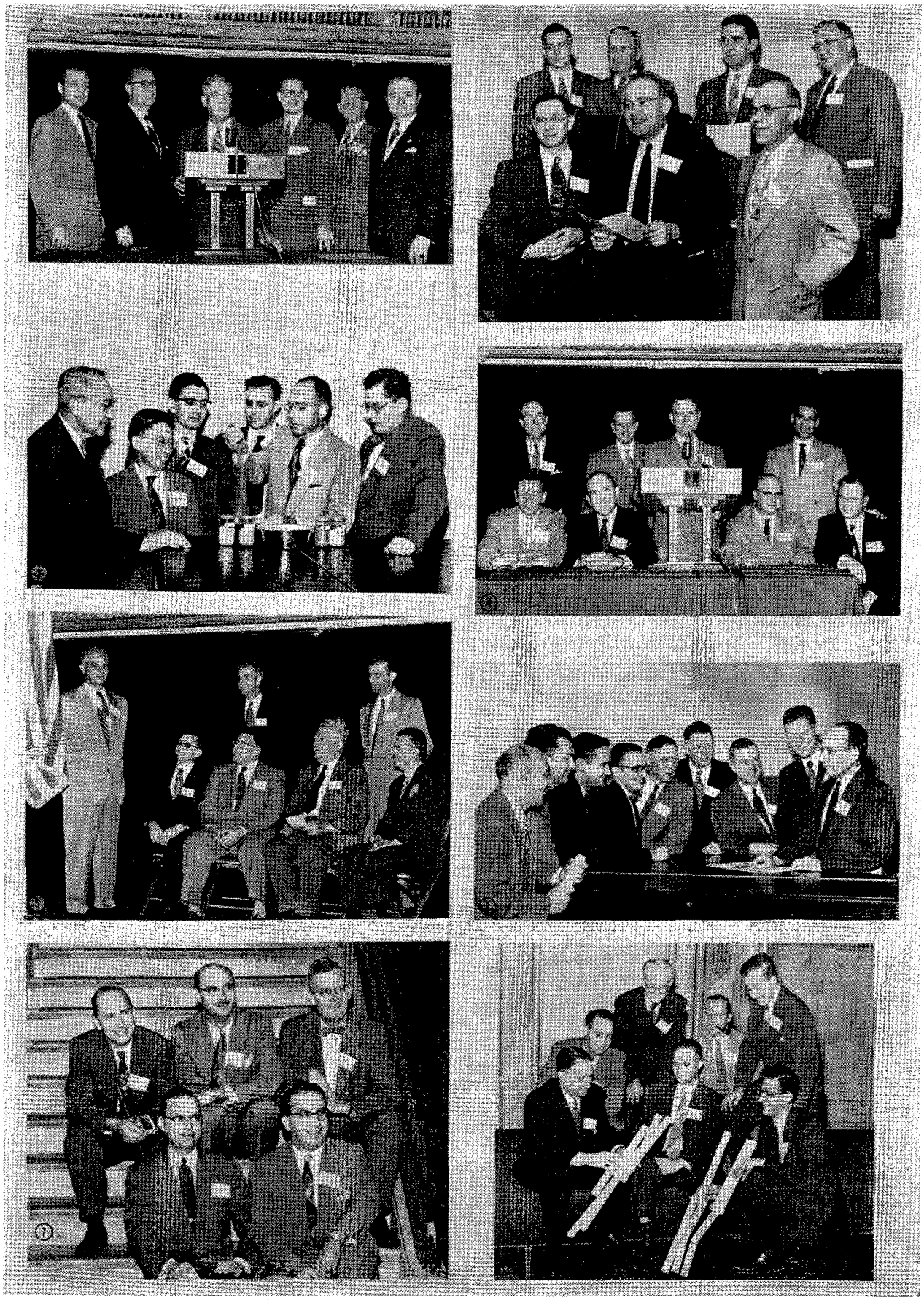
5. SOLVENT EXTRACTION—G. J. Stockmann, chairman, stands at left; seated are J. Pominski, Southern Regional Research Laboratory, New Orleans; Frank Lerman, Armour Research Foundation, Chicago; E. A. Gastrock, SRRL; Paul A. Belter, Northern Regional Research Laboratory, Peoria, Ill.; standing are J. W. Dunning, V. D. Anderson Company, Cleveland; and E. L. D'Aquin, SRRL.

6. FATTY ACID DERIVATIVES—From left to right these speakers are F. J. Licata, Metasap Chemical Company, Harrison, N. J.; R. E. Baarson, Armour and Company, Chicago; Glenn R. Wilson, Ethyl Corporation, Detroit; John G. Wallace, Du Pont Company, Niagara Falls, N. Y.; W. C. Ault, Eastern Regional Research Laboratory, Philadelphia; G. H. Goodyear, Glyco Products Company, Chicago; H. G. Bryce, Minnesota Mining and Manufacturing Company, Minneapolis; H. B. Knight, ERRL; and H. J. Harwood, chairman.

7. MARGARINE—At the foot of the stairs are S. F. Riepma *(left)*, National Association of Margarine Manufacturers, Washington, D. C., and S. J. Rini, chairman; behind them are Max Wolf, Food and Container Institute, Quartermaster Corps, Chicago; C. H. Struble, Miami Margarine Company, Cincinnati; and L. F. Conway, Osceola Foods Inc., Osceola, Ark.

8. GENERAL SESSION—Models are of interest to this group: *(seated)* G. A. Crapple, chairman; R. O. Feuge, Southern Regional Research Laboratory, New Orleans; and C. W. Hoerr, Armour and Company, Chicago; *(standing)* K. E. Holt, Archer-Daniels-Midland Company, Minneapolis; Rozier D. Oilar, consultant on Latin-America, West Lafayette, Ind.; D. R. Merker, Swift and Company, Chicago; and J. W. Shigley, Pennsylvania State College.

Program Personalities



treatment with an interesterification catalyst produces marked changes in the chemical and physical characteristics of the fat. The samples used in this investigation were obtained by heating prime steam lard at temperatures slightly above its melting point for periods up to about an hour in the presence of very small amounts of sodium methoxide. The catalyst was removed by water washing, and the products were deodorized by conventional methods.

One important consequence of alteration of the properties of lard is the tremendously enhanced shortening value in cake baking. Photomicrographic examination demonstrates that the rearrangement process results in replacement of the large, coarse crystal clusters, which are deleterious in cake shortening, with a desirable lacy network of delicate needles. X-ray measurements of the cross-sectional (short) spacings of these crystals demonstrated that both ordinary lard and rearranged lard existed in the β-type configuration. The appreciable increase in the longitudinal (long) spacings of rearranged lard was interpreted in terms of a structural change which limits the nearness of approach and prevents perfection of packing of the triglyceride molecules. Differences in the cooling and heating curves of the various lard samples were correlated on the basis of solubility considerations with alterations in the relative proportions of di- and trisaturated triglyceride components.

Another paper on triglyceride structure was given by B. F. Daubert and D. R. Merker. Dr. Daubert stated that the limiting cross-sectional area per molecule obtained for a condensed monolayer of tristearin on water was 59.7 $Å^2$, which is equivalent to 19.9 $Å^2$ per hydrocarbon chain. This area is in excellent agreement with the cross-sectional area, 19.9 $Å^2$, calculated for the three-dimensional alpha form, thus supporting the conception that the molecular structure within the monolayer is related to the orientation that the molecules assume in three dimensions.

The limiting areas for a series of unsymmetrical saturated triglycerides of shorter average chain length than tristearin were slightly higher but approached the value obtained for tristearin as the temperature was lowered or the chain length increased. Therefore the orientation in the condensed state is independent of chain symmetry and depends only on the orientation of the polar grouping at the water surface.

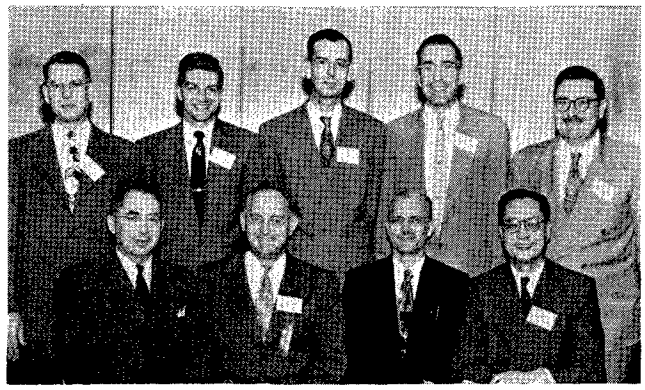
All of the monolayers in the condensed state were solid, and the temperatures of each film expansion compared favorably with the melting points of the three-dimensional alpha forms. Polymorphism, analogous to that occurring in three dimensions, was not found to exist in the monolayers.

The significance of these results is twofold. First, the statement of Dervichian, that "the vitreous form of the triglycerides, while unstable under ordinary conditions, is the stable state in monolayers," has been verified for a series of unsymmetrical saturated triglycerides. Secondly, the stable beta form, characteristic of triglycerides in three dimensions, apparently does not exist in monolayers. A logical interpretation for the absence of the higher melting beta form is that it requires a tuning fork structure, which is not capable of existing in the two-dimensional state. Accordingly the alpha form in two as well as three dimensions should have the hydrocarbon chains aligned side by side rather than in a tuning fork arrangement.

The Isolation of a Highly Unsaturated Fatty Acid

E. G. Hammond and W. O. Lundberg prepared methyl docosahexaenoate from hog brain phosphatides and established its purity and ultraviolet absorption spectra. From its physical and chemical characteristics as well as other considerations, the double bonds, all of which were in the *cis* configuration, have been tentatively assigned to positions 4, 7, 10, 13, 16, and 19 in the carbon chain.

The importance of highly unsaturated fatty acids in nutrition was pointed out by H. J. Deuel Jr., who stated that methyl linoleate was shown to exert a protective effect against injury due to x-irradiation; the daily optimum protective dose was shown to exceed 100 mg. per rat. Another function of unsaturated fatty acids involves the removal of cholesterol from the liver. It was found that the liver cholesterol level was abnormally high and that of plasma cholesterol lower than the normal, in the case of rats receiving fat-free diets, as contrasted with the values for animals on diets containing 15% of fat. A quantitative evaluation of the essential fatty acid requirement for pregnancy and lactation was given. The optimum requirement for female rats was found to be 50 to 100 mg. daily, based upon such indices as litters cast, total number of rats at 3 days, average 3-day weight, number surviving for 21 days, and average 21-day weight.



FAT STABILITY—Speakers in this session are pictured together with the program chairman, H. T. Spannuth: *(seated)* W. F. Geddes, University of Minnesota, St. Paul; Mr. Spannuth, Wilson and Company, Chicago; W. G. Bickford, Southern Regional Research Laboratory, New Orleans; and S. S. Chang, University of Illinois, Urbana; *(standing)* C. D. Evans, Northern Regional Research Laboratory, Peoria, Ill.; Clarence Sidwell and J. H. Mitchell Jr., Food and Container Institute, Quartermaster Corps, Chicago; R. J. Sims, Swift and Company, Chicago; and A. S. Henick, Food and Container Institute.

Use of Fats in Animal Feeds

Of the technical sessions the new one on the use of fats in animal feeds was received with much interest. E. E. Rice stated that fats are readibly-digestible energy sources for animals. In many cases they improve texture and color and decrease the dustiness of mixed feeds. Under certain conditions they improve the efficiency of utilization of other feedstuffs and thus have value over and above that of their energy content. Each of these factors contributes to the value of the product as a feedstuff. By calculation it can be shown that the minimal value of fat should be 2½ times that of corn. Experiments with pigs, chickens, ducks, and turkeys prove it to be worth more in many cases.

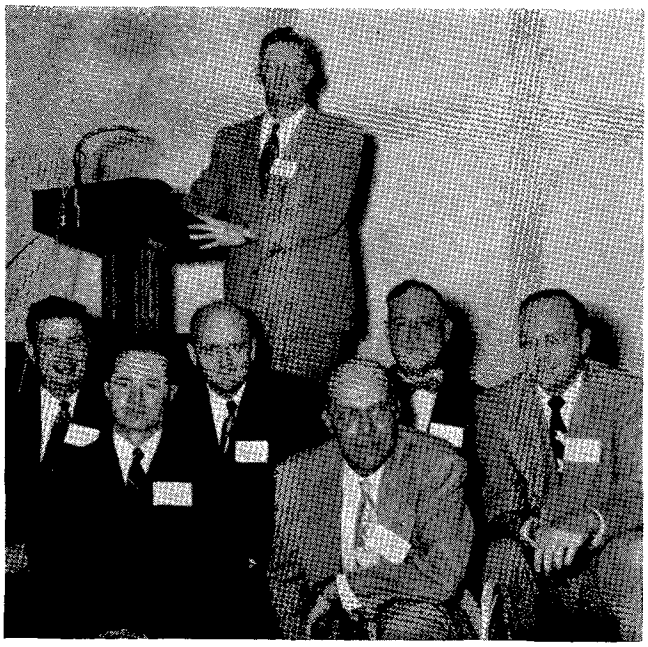
Lack of familiarity with fats as feedstuffs and the need for slightly revised manufacturing techniques for the incorporation of fats in feeds have delayed acceptance of fats by the feed industry. More and more feed manufacturers are experimenting with fats and are preparing to use feeds with fats if cost factors are favorable.

Fat Stability

Eight papers, three of them on methods for measuring the extent of fat oxidation, were given at the fat stability session. Other papers included changes in the lipids and breadmaking value of wheat meal streams, the effects of high temperature storage upon lard as a raw material for shortening manufacture, the antioxidant and antipolymerization properties of gossypol derivatives, and soybean lecithin as metal inactivating agents.

A study of the oxidative polymers of soybean oil by S. S. Chang and F. A. Kummerow indicated that a relationship existed between polymers and flavor reversion. The polymers formed during the autoxidation of soybean oil at 60°C. were isolated by a solvent extraction method using diethyl ether and pentanehexane as solvents. The more polar polymer fraction was further oxidized by air at 30°C., and the volatile material obtained was fractionated and characterized. The same carbonyl compounds which have been isolated from reverted soybean oil or reverted hydrogenated soybean oil, *i.e.*, acetaldehyde, propionaldehyde, n-hexanal, 2-pentenal, and 2-heptenal were identified as their 2,4-dinitrophenylhydrazones.

The more polar polymer fraction contained 21.04% of oxygen and degraded to volatile carbonyl compounds under vacuum as well as oxygen-free nitrogen. Depolymerization and ethanolysis of these polymers were carried out in ethyl alcohol which had been adjusted to a normality of 3.5 with anhydrous hydrogen chloride. The depolymerized product contained hydroxy-keto-derivatives of ethyl oleate. Scrapings of a polymeric substance formed on the filter press of a soybean oil refinery could, for example, also be depolymerized to similar derivatives. It is therefore evident that oxidative polymers could be unintentionally introduced into soybean oil and serve as a precursor of reversion compounds.



DRYING OILS—Speakers at this session are posed informally by the photographer: *(front row)* R. P. A. Sims, National Research Council, Ottawa; and D. H. Wheeler, General Mills, Minneapolis; *(second row)* E. G. Bobalek, Case Institute of Technology, Cleveland; R. M. Brice, Archer-Daniels-Midland Company, Minneapolis; L. L. Carrick, University of Michigan, Ann Arbor; and J. N. Shaw, Archer-Daniels-Midland, Minneapolis; *(standing)* W. O. Lundberg, Hormel Institute, Austin, Minn., presiding instead of C. G. Moore, Nubian Paint Division, Glidden Company, Chicago.

Margarine and Related Products

Eight papers, six of them directly related to margarine, were given at this session. W. C. Brown pointed out the rapid growth in the use of vegetable fat for frozen desserts. During 1952 approximately 11,000,000 gallons of vegetable fat ice cream were sold in four states. Today such a product is legal in nine states and is increasing in popularity. Much of the vegetable ice cream was initially made from imported coconut oil. Today domestic oils have been developed which are commercially equivalent to the imported oils. A quality product can be made if reasonable care is combined with technical know-how and quality raw materials.

Drying Oils

Two of the six papers on the drying oils session dealt with the theoretical aspects of polymerization. R. F. Paschke and D. H. Wheeler found that dimerization between two polyene acid groups in the same triglyceride ester (intrapolymerization) produces no increase in molecular weight. Dimerization between two polyene acid groups in different molecules produces increased molecular weight. The extent of intrapolymerization in bodying of oils has been a matter of some controversy.

In the present study linseed oil was bodied at 300°C. to H, U, and Z-3 Gardner viscosity. Monomeric triglycerides were separated from polymeric triglycerides by a centrifugal molecular still. The monomeric and the polymeric triglycerides were converted to methyl esters which were analyzed for monomer, dimer, and trimer.

The monomeric triglycerides afforded small amounts of dimeric and trimeric methyl ester (1.5 to 6%), showing little intrapolymerization in the monomeric triglyceride.

The polymeric triglycerides afforded increasing amounts of dimeric and trimeric methyl esters, with dimer/trimer ratios following the pattern found in polymerizing pure methyl esters.

The above method would not directly diagnose dimerization between polyene acid groups in the same or different triglycerides of the polymeric triglycerides. Estimation of molecular weights of the polymeric triglycerides were made from their viscosities and were compared with that calculated from the composition of the derived mono-, di, and trimeric methyl esters. The molecular weight estimated from viscosity was lower than that calculated from monomer, dimer, trimer ratio. This may indicate intrapolymerization in the polymeric triglycerides.

R. P. A. Sims measured the specific refraction and the ratio of polymeric acyl groups to polymeric glycerides and showed that molecular changes during the early stages of thermal polymerization were inversely proportional to glyceride concentration. The presence of diluent during polymerization enhances intraglyceride reactions while reducing the amount of interpolymer formed.

Using viscosity as an index of extent of reaction, various additives were classified as catalysts and inhibitors of thermal polymerization. On the basis of the accepted mode of action of the additives, the contribution of the Diels-Alder ionic and radical mechanisms to thermal polymerization was estimated.

Solvent Extraction

It was pointed out by Frank Lerman that emphasis on solvent extraction developments is turning from soybean to cottonseed and other oilseeds. New continuous processes have been evolved, particularly for cottonseed with its fines-producing difficulties. Existing soybean processes are being modified to handle higher oil-content materials either by full solvent extraction or with screw-pressing prior to extraction.

An important trend in equipment design is the change from high, vertical percolation extractors with gravity liquid flow to lower or horizontal extractors with an increased number of pumping steps. Other improvements in vegetable oil extraction were discussed.

Some progress has been made in solvent extraction of fats from animal materials. The major innovation has been the introduction of azeotropic extraction.

Although an increasing number of solvents is being considered and tried, the hexane fractions still remain the popular solvent for vegetable oil recovery and heptane fractions for animal fats.

Much fundamental extraction design information has appeared in the literature. However theory still lags appreciably behind practical applications because of lack of experimental values, of changes in type of oilseed and its pretreatment for extraction, and of the different methods for extraction in the new processes.

A combination of 15 papers was presented at the detergent and fatty acid derivative sections. The detergent session dealt almost exclusively with methods of evaluating detergents and the fatty acid derivative session with the application of fatty derivatives. Perfluoroalkyl esters, according to A. H. Ahlbrecht, G. B. Blake, H. G. Bryce, and V. E. Welschinger, should find some interesting uses. Perfluoro acids can be reduced to yield alcohols of the type R_fCH_2OH where R_f is a perfluoroalkyl radical, *i.e.*, C_3F_7, C_7F_{15}, etc. Such alcohols can be esterified with both hydrocarbon acids and perfluoro acids. A series of esters each containing 10 carbon atoms has been prepared. These range in fluorine content from 44 to 67%.

F. A. KUMMEROW.

NBS Continues Instrumentation Program

A program of research and development in basic instrumentation is now in its fourth year at the National Bureau of Standards. Under the general direction of W. A. Wildhack, chief of the NBS office of basic instrumentation, new applications of physical principles are being evaluated and applied to problems in measurement and control. Theoretical analyses are also conducted in various phases of instrumentation, and critical surveys are made of available instruments and techniques for types of measurement that are becoming increasingly important.

The NBS office of basic instrumentation was established in 1950 to serve as a research, reference, and consultation center on problems of instrumentation for the laboratories of government and industry. Its program is sponsored by the Office of Naval Research, the Air Research and Development Command, the Atomic Energy Commission, and the National Bureau of Standards. While this program constitutes only a relatively small part of NBS activities, it represents an effort to utilize the Bureau's facilities and experience in the field of physical measurements to advance those techniques of measurement and control that are fundamental to progress in science and industrial technology.