In 1943 there were created in Paris the institutions which still have the task of studying fats. The activity of the I.R.H.O. (Institut de Recherches sur les Huiles et Oleagineux) is directed to the study of problems concerning the exploitation of oil products in Africa and the production of oils. The agronomic problems of the oil palm, coconut, peanut, and castor plant have been closely studied, not only in Paris but more particularly in test centers at Dahomey, Cameroun, etc. In the case of the oil palm tree, the result has shown significant success; the hectare output has increased tremendously. The extraction of oil has been greatly improved also by replacing part of the small oil mills by modern ones. Concurrently various laboratory studies were carried out in Paris by the I.R.H.O., such as the extraction of carotene from palm oil, the refining of shea butter, and studies on carotenes.

At about the same time members of domestic industries founded the I.T.E.R.G. (Institut Technique d'Etudes et de Recherches des Corps Gras), a professional institution financed by a self-imposed tax on production. It created a research laboratory in Paris and financed the Laboratoire National des Matieres Grasses in Marseilles. In 1950 the I.T.E.R.G. was designated the Institut des Corps Gras and became a part of the Centres Techniques Industriels (Industrial Technical Centers).

The activity of the I.T.E.R.G. is determined by its structure; its task is to be useful to domestic industries in the field of fats. In addition to an active library, the I.T.E.R.G. carries out laboratory research that is principally aimed at applied research problems.

The Laboratoire National des Matieres Grasses has studied questions related to oil refining (nature of foots, neutralizing, bleaching), to halogenated and hydroxylated by-products of fats (hydroxyacids and oxidized acids) emulsions, hydrolysis, and interesterification.

In that same year, 1943, the C.N.R.S. (Centre National de la Recherche Scientifique), the governmental institution that forms a part of the National Board of Education, founded in the group of laboratories of Bellevue (in suburban Paris) the Laboratoire des Corps Gras. Emile Andre was its director until 1945, and since then I have served. The task of this laboratory is to study the scientific aspects of problems pertaining to fats, especially those which may find application in various branches of industry. This laboratory has gradually grown in importance until today it has a staff of 25 persons. It recently increased its scope and was renamed as the Laboratoire de Lipochimie in order to stress its increased activities. Studies carried out by the Laboratoire de Lipochimie deal with the different branches of the field of fats. More than 200 articles have been published since its founding. Besides studies of secondary importance, there are today three principal fields of study: the phenomena of autoxidation and the antioxidants, the higher aliphatic peracids, and the saturated aliphatic dibasic acids.

In the field of education the I.T.E.R.G. founded in 1943 the Cycle de Preparation aux Techniques des Corps Gras; in 1952 it was reorganized into the Ecole Superieure d'Application des Corps Gras, which schedules classes and laboratory work for one year. It is open to French or foreign engineers.

The scientific and technical achievements in the field of fats are published in France chiefly in two series of reviews. The first is the Bulletin des Matieres Grasses from the Institut Colonial de Marseille. The first issue dates from 1917; it was replaced in 1946 by the review "Oleagineux," published by the I.R.H.O. The second series published by the I.T.E.R.G. successively has been constituted by the following: Corps Gras, Savons (1943–1944), Industries des Corps Gras (1945–1947), Bulletin d'Information de l'I.T.E.R.G. (1947–1954), and, finally since 1954, the Revue Francaise des Corps Gras. For 15 years engineers and chemists engaged in fat work have had a society, the Groupement Technique des Corps Gras. It participates in the Societe Internationale pour l'Etude des Corps Gras (I.S.F.).

Conclusion

From this survey of the development of industry and scientific research in the field of fats in France during the last 50 years one can conclude that very significant progress has been achieved. The position of France in this field is certainly one of stature and of honor.

Fifty Years of Fat Research in Germany

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THE PROGRESS of research in fats during the past 50 years in Germany is a long period and an extensive subject. Research is not limited literally to the glycerides but includes the other lipids, such as phosphatides, sterols, lipovitamins, and lipochromes. Innumerable industrial products from fats and their substitutes, like detergents and surface-coating materials, should be included. Contemporary German literature contains thousands of papers published in this field. This very general perspective should, in no case, claim completeness, especially so in biology and nutrition physiology as well as apparatus and process technology. Where the literary references are devoid of interesting events, I shall include some personal experiences.

It has been 50 years since I was a student of chemistry at the University of Heidelberg. Eminent chemists were occupying the chairs of learning in the German universities at that time. Emil Fischer, W. Nernst, and E. Abderhalden in Berlin, A. von Baeyer (succeeded by R. Willstätter in 1915), H. Wieland and Hans Fischer in Munich, A. Hantzsch and W. Ostwald in Leipzig, A. Windaus in Freiburg, J. Thiele in Strassburg, Ludwig Knorr in Jena, C. Harries in Kiel, A. Ladenburg in Breslau, and F. Haber in Karlsruhe are only a few of the world-famous names. At the University of Heidelberg, along with T. Curtius, there was another chemist, F. Krafft, less known and of ripe age, who had however contributed a lot to the research in fat chemistry. He was the first fat chemist I came to know. In a rather modest laboratory he accomplished valuable work on the chemical constitution of fatty acids through the degradation of the higher to the lower homologues, with alkyl methyl ketones as the intermediate. He also synthesized the first pure monoglyceride from monochlorhydrin and the potassium salt of fatty acids.

Subsequently I was attracted by Fischer in Berlin, who had already won the 1902 Nobel Prize in chemistry for his contributions to the basic research in carbohydrates and proteins. He had started his researches in fats, the third largest group of foodstuffs, as well. Fischer died in 1919, and a commemoration ceremony was held in Berlin for him. Knorr, in tribute to his teacher and friend, said, "During the last days before his death Fischer has developed a remarkable method for the preparation of glycerides with the help of acetone glycerol and has established the migration of the acyl residues. These experiments indicate that Fischer had planned to begin with a systematic experimental study of fats. It is a pity that he could not carry out his intentions."

The same feelings of regret must be expressed even today because it is evident that few of the leading German chemists devoted themselves to the study of oils in subsequent years. While carbohydrates and proteins received special attention, research in fats remained neglected until very recent times. The main difficulty in the investigation of these compounds was that they are, on the whole, rather difficult to crystallize, are very easily affected by autoxidation and polymerization, and display innumerable possibilities of isomerization. There are many natural fats even today whose composition is unknown.

I shall divide my review into the following five sections:

I. 1909 until the first World War;
II. 1914–1923, the period of the first World War and the great fat scarcity in Germany;
III. 1923–1933, after the currency reform, a period of oil surplus;
IV. 1933–1945, National Socialist regime's endeavors to attain self-sufficiency and the second World War; and
V. the period after the second World War.

A close relationship will be noted between political events and fat research in Germany. Unfortunately basic research is dependent upon politics. It influences the economic situation, thereby making available the financial means so very necessary for research. Applied research in a country has also to be adjusted to its needs.

I. 1909-1914

Fifty years ago research could be carried out without interference—a period in which one could achieve important results in chemical research with relatively modest means.

In the field of fundamental research A. Bömer is the fat chemist belonging to this period above all. I knew him for many years and took over the chair in chemistry of foodstuffs at the University of Münster after his death. His Phytosterol Method for the differentiation between technical and vegetable oils and the Melting-Point-Difference Method for detection of tallow in lard are in use still. Bömer was one of the pioneer chemists who studied the chemical constitution of mixed glycerides, their synthesis, their isolation from natural oils, and their purification through fractional crystallization or high-vacuum distillation. A. Grün started in the same field in 1910. The preliminary work of Windaus on the constitution of cholesterol falls into this period. He discovered the digitonin precipitation method, which is still used. O. Diels was another worker. Harries discovered ozonolysis for the determination of the constitution of unsaturated fatty acids. This technique was used on oleic acid for the first time and became of significant importance. The constitution of linolenic acid was established by E. Erdmann in 1909. E. Vongerichten found petroselinic acid in the oil of *Petroselinum latifolium* seeds and C. Paal hydrogenated oils and fats with a palladium catalyst, inspired by the discovery of Wilhelm Normann. Abderhalden prepared optically-active glycerides.

The oil analysis of those days was based on the determination of characteristic values and the names of Austrian chemists (Hübl, Hanus, Reichert, Meissl, and Hazura) are intimately connected with it. Great pains were taken to characterize various oils through these values. Next were the color reactions, which have however lost their importance entirely. Among the methods, discovered in Germany in this era, may be mentioned the Kreis Reaction, which was used to detect the rancidity in fats. D. Holde, W. Herbig, Erdmann, E. Glimm, W. Fahrion, W. Vaubel, J. Davidsohn, and H. Wolff were some of the chemists busy with fat analysis. Willstätter described a quantitative method for the estimation of glycerol content in the oils. Normann employed acetic anhydride for the determination of acetyl value, and Engler used the viscometer named after him for the determination of viscosity of oils. The determination of Buchner value in wax analysis dates back to this period.

In chemical technology there were many significant developments. Catalytic hydrogenation of oils is the foremost among them all, discovered by the Westphalian chemist Normann. He was a friend for many years, and shortly before his death in 1939, informed him of his election to the honorary membership of our society and of the decision of Münster University to confer an honorary doctorate on him. Although he had obtained his basic patent in 1902, the technical utilization of his great discovery in Germany had to wait until the years preceding the first World War. Twenty years ago the Deutsche Gesellschaft für Fettwissenschaft established a medal in his memory, which is granted annually for fat research. Two American scientists have been honored: A. R. Baldwin (1951) and W. O. Lundberg (1957). Professor Toyama, recipient last year, emphasized that Normann's discovery was of great significance to the Japanese people, making possible the use of fish oil as edible fat in hundreds of thousands of tons. Among further German technical achievements were the splitting of oils in autoclaves (pure-water cleavage), the manufacture of stand oils by exclusion of air, the bleaching with benzoylperoxide and persulphates, the deodorization of oils through treatment with superheated steam in vacuum, the application of fatty acid amides as emulsifiers, and the enzymatic oil-splitting (Connstein). Clay discovered near Munich was converted to bleaching earth. Alkyl- and arylesters of phthalic acid were introduced into the surface-coating industry; the first natural resin and shellac substitutes were manufactured from phenols and the "fats-dissolving soaps" and turkey red oils were studied.

II. 1914-1923

Now came the war, which was marked by an acute shortage of oils. As a result of industrialization the supply had become a very difficult problem. Although all possible means were tried to solve it through the increased cultivation of oil seeds in the former German colonies in Africa, the yearly import of oil seeds required still about one billion gold marks. In 1913 there were imported about 1.7 million tons of oil-bearing fruit and oil seeds including the oil cakes. The emphasis in internal production was upon animal fats. Of the total annual consumption about 500,000 tons came from internal production. For the extraction of technically important linseed oil 560,000 tons of seeds, costing about 130 million marks, were required every year. The blockade of the country created conditions of extraordinary scarcity. Towards the end of the war people had to be satisfied with only 7 g. of fat per week per person. The fatless diet of those years, which resulted in disease and death for hundreds of thousands of women, children, and old people, has been described as "Experiment on Living Beings" by A. Grün.

Thus it became very urgent for research workers to develop new sources of fats. All types of seeds, never used earlier, were employed for oil extraction. *e.g.,* the seeds of lime and beech and the kernels of the stone fruits, etc. The waste water from the slaughterhouses and hospitals was used for the extraction of fats, which were put to technical use subsequently. The edible oils disappeared altogether from the industrial field because their application by the soap and surface-coating industry was prohibited by the war committee for vegetable and animal oils and fats. The urgency to find substitutes however gave rise to the discovery of processes which were of lasting importance. The soap was loaded more and more; the percentage of clay in the KA-soap rose constantly. The nonedible fish oils were deodorized through polymerization and were used in the soap industry and Stiepel and Harries tried to oxidize the hydrocarbons, ingredients of the tar oil obtained during the coking of lignite, to fatty acids. Water-glass and colloidal calcium silicate were put into the washing agents.

To incorporate the lathering and wetting characteristics synthetic products were discovered which may be considered to be the beginning of the modern detergents. The alkylarylsulfonates were developed through the alkylation of naphthalene and the subsequent sulfonation for the first time by Nekale. The surface-coating industry used the resin and seed oil from the coniferous trees. Tall oil, the by-product of the cellulose industry, found its first application. Synthetic resins as varnish media, especially the phenol formaldehyde resins, replaced the drying oils, and the polymerized acrylic esters were used for the first time for this purpose by O. Röhm. Glycerol was manufactured through fermentation of sugar by Connstein and Lüdecke or replaced through glycols, concentrated solutions of lactates, and the slime from plants The continuous process for the oil extraction by H. Bollmann and Hildebrandt was another important technical development of this era.

Fundamental research had to take a secondary place in war-time. However a considerable number of important papers were published in this period. The basic work of Emil Fischer and his co-workers, especially M. Bergmann, has already been mentioned. Windaus and A. Grün continued their successful experiments. The increasing importance of hydrogenation, with the amount of hydrogenated fat rising to half or even in some cases to two-thirds of the total fat consumed during the war days in Germany, gave an impetus to the study of the reaction-mechanism by Normann, W. Meigen, and Erdmann. The number of publications in analytical chemistry was equally large.

The end of hostilities did not at first improve the supply of fats and oils to the German people or to industry. The progressive depreciation of the mark made it impossible to import seeds and oils. Thus the endeavors to increase the cultivation of oilseeds, which in fact rose to about 140,000 ha., and to explore substitutes were strengthened still further. Experience had proved that to neglect the research work in fats had been a big error. German fat chemists had already in 1919 demanded the establishment of an institute for research in fats. The War Committee had established a Scientific Department, which was placed in charge of the professor of pharmacy and foodstuffs at the University of Berlin, H. Thoms. On the abolition of this department in 1920 the Central Station for Oils and Fat Research was founded and placed under Holde at the Technical University of Berlin. Eminent personalities were commissioned to work for its program (nutrition, M. Rubner; fatty acid synthesis, Harries; synthetic edible oils, W. Kerp; surface coatings, T. Marcusson; and soaps, A. Welter). The means available for research were rather meager. Research activity increased however in spite of the inflation, and there were a large number of publications in fat chemistry in the years immediately after the war.

Grün and R. Limpächer succeeded in synthesizing lecithin for the first time. The experiments in re-esterification and re-acidification of fats by Fischer and Normann once again gained importance. Bömer and A. Heiduschka discovered that margaric acid was only a mixture of palmitic and stearic acids. Harries brought forward valuable evidence for the chemical structure of the shellac acids. Numerous papers appeared on the glycerides, natural fats and their characteristic values and catalytic hydrogenation (K. H. Bauer, G. Amberger, Herbig, Thoms, Holde, C. Grimme, Grün, Wolff, Bömer, etc.). The mechanism of catalytic hydrogenation was investigated by Erdmann, Normann, Meigen, and Bauer; and nickel catalyst was prepared from nickel formate by K. H. Wimmer.

On the technical side the line of attack was the same as that during the war. Paraffin oxidation was further tackled by E. Schaal, Harries, Fischer, H. C. Kelber, Grün, L. Ubbelohde, A. Eisenstein, and H. H. Franck. Synthetic resins alone as well as in combination with natural resins were extensively used. In the case of soaps the "Self-Acting Detergents," *i.e.,* those replaced by per salts, gained increased importance. Progress was also made in the difficult subject of naphthenic acids (I. Davidsohn). The activity in vitamin research aroused interest in the vitamin-content of oils and fats. The splitting of fats by enzymes was studied extensively by Willstätter and co-workers. After the turkey red oil manufacturers' association had published the standardized methods of analysis, a commission met in 1925 and decided to bring out uniform testing methods for the fat industry.

The first experiments in fats which were carried out in my laboratory dealt with the study of keto-enol desmotropy, on which I had worked as a co-worker with my teacher, Knorr, before the first World War. In August 1914 I had to exchange my peaceful laboratory work with the front service and could return to research only after I had been seriously injured in 1918. During the study of isomerization of diacetosuccinic ester I found that there were enolic forms which could not be analyzed by the method of K. H. Meyer as the bromine did not add to them. In order to have a stable bromine solution which could be used for titration, one day I prepared a solution of bromine in methanol which had been saturated with sodium bromide previously. However different behavior of bromine with respect to the enolic double bonds suggested the urgency of carrying out experiments with other types of unsaturated compounds. And thus I became interested in fat chemistry which offered many unsaturated fatty acids with various types of double bonds. The variations in the bromine addition could be studied equally well, *e.g.*, the comparative addition in the case of oleic and elaidic acids. As the addition in the first case was comparatively easy, with an analogy to the maleic and fumaric acids, I concluded that the *cis*-form was suited to oleic acid. For polyethenoid fatty acids a selectivity in the addition was observed only under special conditions so that the bromine solution could be employed for the determination of iodine value. This method, which was published in 1922, is included in the official methods of oil testing in Germany and other countries, *e.g.*, in Soviet Union, as I incidentally came to know during my visit to Moscow and Leningrad last year.

Söderbäck had prepared free thiocyanogen in those days. Its similarity to the halogens inspired me to study its addition to the polyunsaturated organic compounds, thus the desired selective or partial addition to the polyunsaturated acids was discovered. A special analytical method, thiocyanometry, was developed, which proved useful in other spheres too, *e.g.*, in the analysis of unsaturated hydrocarbons and essential oils. This led to the beginning of the systematic analysis of fats and oils. Till then considered to be only research methods, this type of oil characterization could now be applied to general analysis. The preparative isolation of bromine adducts of unsaturated fatty acids for the analytical work were cumbersome and yielded unreliable results. Now with the help of thiocyanometry a large number of fats and oils could be titrimetrically analyzed for their fatty acid composition.

III. 1923-1933

The preceding era of war and inflation ended with the currency reform. The stabilization of the mark led to increased imports in a very short time. During the inflation most Germans had lost their fortunes; many of the manufacturing concerns had been taken over by foreign interests because of the relatively high purchasing power of the foreign currencies. Thus everything had to be started afresh. The Renten-Mark (new German currency) permitted the import of oil seeds and fats at the cheapest possible prices. Toward the end of the '20's cost of one kilogram of soya oil from Manchuria was about 20 pennies, and the price of linseed oil could in no way be considered high. But fat research could hardly be said to have gained any advantage from the revival of German economy. Research is important and supported only when the accumulated difficulties have to be cleared away. In spite of all that, until the beginning of the National-Socialist regime, a lot of work, indeed with success, was carried out.

R. Kuhn synthesized the colored polyunsaturated acids. The constitution of cholesterol was finally established (Windaus, Wieland and Diels). Grün used iso-oleic acid as a means of detecting the hydrogenated fats. In collaboration with Franz Wittka he worked over the oxidative fission of unsaturated fatty acids. In dilatometry Normann found a valuable method for examining the hydrogenated fats. E. Lederer contributed important studies of the physical properties of fats. H. Schmalfuss discovered that diacetyl was responsible for the characteristic smell of butter. Drying oils, which were once again made available to the scientist, attracted a new field of research. From the Eibner laboratory in Munich a series of papers came out, dealing with the autoxidation, film formation, mechanism of drying agents, the oxyne, and the influence of pigments over the drying phenomenon, etc. The preparative bromination of unsaturated fatty acids was applied to the determination of fatty acid composition of natural oils. Bauer took up the study of tung oil and elaeostearic acid, which along with abietic acid and its esters also attracted the attention of E. Fonrobert and F. Pallauf. Wilborn discovered the presence of licanic acid in oiticica oil. J. Scheiber and Wolff took up the study of the mechanism of polymerization. J. d' Ans worked on paint technology. In food stuffs chemistry Bömer and Heiduschka prepared numerous fats. J. Grossfeld improved upon the fat analysis, and G. Greitemann separated the glycerides of hydrogenated whale oils through preparative methods. K. Täufel and H. Schmalfuss started a series of valuable experiments on the rancidity of fats.

In my laboratory the thiocyanometry was further improved upon; emission spectrography was used for detecting the presence of nickel in hydrogenated fats; ultraviolet spectrography and interferometry were applied in the field of fats; iodomeric acid value was worked out; and the simultaneous hydrogenation and splitting of oils were studied. While Stadlinger was specially engaged in oils, Davidsohn and Herbig investigated detergents. W. Schrauth studied the splitting of fats. The significance of such detergents as would be effective in hard water or an acidic medium was recognized. The igepones and lamepones were put to technical use, and the sulfates of fatty alcohols (H. Bertsch) achieved immense technical application. The fatty alcohols used in these detergents were obtained from fatty acids through high pressure hydrogenation (Normann, W. Schrauth, and Schmidt, 1930–31). Mono- and diglycerides were introduced as emulsifiers (Goldschmidt A. G.). The de-acidification through distillation was developed as a continuous process (Wecker, Lurgi).

IV. 1933-1945

As soon as the German economy had shown signs of recovery brought about by the Renten-Mark, the familiar results of over-production were clearly visible during the last years of the period just discussed. The crisis in sales and production took ever-threatening form; unemployment increased; dissatisfaction developed among the people and prepared the ground for extremist political elements. Such were the years between 1933 and the end of the second World War. In the first years of the National-Socialist regime the demand for fat could still be met through the imports of oil seeds, or of fats and oils. But the political situation led to the steadily growing economic isolation of Germany, and with that came the motto: "Nahrungsfreiheit des deutschen Volkes" and the efforts for self-sufficiency.

All the experience gained during the first World War and subsequent inflation were recollected and under the impact of the "four-year plan" of the authoritarian regime was put on a modern footing. The agriculture, centralized under an United organization, yielded an increased output of milk and butter as well as that of other animal fats. The cultivation of oilseeds benefited from the intensive cultivation research programs, and the fat output increased remarkably. The rapeseed production rose to about 400,000 tons. The oilseeds thus far never exploited in Germany were studied, and up to a certain extent, even cultivated, as safflower, earth almond, rocketoil, beechnut, nuts, fruit kernel, gourd seed, grape seed, tobacco seed, etc. Oil was extracted from chestnuts, and even from the coffee grounds until the coffee seeds could still be imported.

A special consequence of the scarcity in oil was the renewal of whale hunting. In the earlier centuries Germany had been quite active in whaling. Now many technical and scientific problems of whaling were solved. On the ships being used for whale hunting, floating factories were put up which processed the whales systematically. In addition to the oil and meat, the bones and internal organs were completely utilized. All the edible fats for nutrition became once again the motto of the industries concerned. Thus paraffin oxidation was more and more taken up on an industrial scale (I. G. Farbenindustrie Oppau, A. Imhausen, und Fettsäure-Werke Witten), and nearly 100,000 tons of fatty acids were annually manufactured by this industry. A small amount of this production was esterified with glycerol and tried as edible fats. The synthetic fatty acids, however, were chiefly given to the soap industry.

The too-low and too-high boiling fractions of the fatty acid distillation process found other technical applications. The surface-coating industry took more and more of the products of organic synthesis. Synthetic rubber was converted into the chlorinated rubber. Phthalic acid went into the production of oil-saving alkyd resins; numerous vinyl compounds and styrol, etc., were processed into the basic products for this industry. Products resulting from nitration and acetylation of cellulose and synthetic copals, etc., were put into the market. An "Einheitsfirnis" (standard varnish), which contained only about 20% of stand oil, was offered to the trade.

Fundamental research assisted industrial development in Germany by tackling the relevant problems. In the field of plant breeding valuable work was done on lupines (W. Rudorf), soybeans (Sessous), and flax (Schilling). Research in fat stability was intensified (Täufel, Schmalfuss, Thaler, etc.). Colloid chemistry was applied to the study of soaps (Thiessen, Lottermoser, K. Hess, K. Lindner, etc.). In my institute new methods were developed in the field of analysis, *e.g.*, Dien-Value, applicable in the case of conjugated unsaturated fatty acids, was used in the analysis of numerous natural oils. Adsorption chromatography was applied for the first time to the separation of fatty substances (1937). The oil-sulphurization, the thermodynamics of the fat-splitting, the polymerization of drying oils, the molecular-distillation, and the refining of fats were also studied in this period.

V. 1945 Until Today

The collapse of the National-Socialist regime struck German scientific research heavily. It had already suffered very much during the war, and the difficulties facing it now were in no way less. According to the Morgenthau Plan, Germany was to be converted into an agricultural country. Various scientific associations were dissolved under the order of the occupying powers. The Deutsche Gesellschaft für Fettforschung met the same fate although it was the only society, which, in spite of the strong discriminatory actions of the National-Socialist regime had not switched over to their program; in other words, it had maintained its independence during those difficult days. The Reichsinstitut für Fettforschung was closed, and the publication of its scientific organ, Fette und Seifen, was banned. Most of the factories and research laboratories had been destroyed, or at least had been rendered entirely unfit for any type of work. The majority of the German scientists were dismissed and had to undergo the "denazification processes" in subsequent years.

It was only in 1948 that the initial steps for the reorganization of the Deutsche Gesellschaft für Fettforschung could be undertaken. Because of the necessity of obtaining the consent of all the occupation powers, we did not have much success in the beginning. All research was under strong control, and the name of our society was changed to the Deutsche Gesellschaft für Fettwissenschaft. For the first post-war conference of the DGF in October 1949 the research journal once again was published. Research activities were also gradually resumed. The fat institute, which had been started again with DGF initiative, was taken over by the federal government in 1953 and has been housed in a former private residential building since 1950. E.R.P. funds contributed to its equipment, and the Marshall plan began to operate benevolently. Thus most of the post-war publications of German fat research have originated from this institute. They can be summarized in the following paragraphs.

One of the most important research developments has been the systematic application of paper chromatography to fat analysis since 1949. Thus it has been possible to analyze on paper fatty acid mixtures, including those containing acids with the same Rf values by the use of suitable solvent systems. Numerous reactions of fat analysis have been carried out on paper, *e.g.*, the formation of characteristic metallic soaps, the addition of halogens and mercury acetate, the catalytic reduction, the saponification of glycerides as well as the determination of the Dien Value, the Iodine Value, using radio-active isotope iodine 131, and the Acid Value with the help of cobalt 60. Photometric and electrometric methods have been employed for the quantitative evaluation of the paper chromatograms. Thus it is now possible to carry out the qualitative and quantitative analysis of the fatty acid components of most of the oils and fats even when the amount of the sample to be analyzed is extremely small, *e.g.*, a single soy bean or a single kernel of sunflower seed. The separation glycerides and recently the surface chromatography have been tackled very satisfactorily, also the paper-chromatographic analysis of detergents with the help of the "Transparency Method." With the help of allyl-ester and urethane methods it has been possible to analyze the long-chain wax alcohols and wax acids so that a method for the exact analysis of wax has been developed for the first time. Among the optical methods infrared spectography has been taken up and will be investigated and developed through the systematic study of polyunsaturated acids.

On the preparative side, numerous compounds have been synthesized, namely, fatty aldehydes, the chlorides, and amides of polyunsaturated acids, alkine acids as well as new glycerides, *e.g.*, conjugated fatty acid glycerides and mixed glycerides of amino acids. The synthesis of long-chain fatty acids and their derivatives has been carried out through the addition of olefines to the fatty acid chlorides with the formation of halogen-alkyl ketones as the intermediates.

In the field of detergents increased attention has been paid to the study of their physico-chemical properties. The study of autoxidation and polymerization has been carried forward, especially under the influence of new types of catalysts. The adducts which are formed during the copolymerization of drying oils and cyclopentadiene have been isolated in the pure form.

In the sphere of biology of fats, conjugated oils and especially the glycerides of parinaric acid were sucesfully examined in the study of fat absorption. It has been established that the fat administered through the rectum is also absorbed.

From the technical point of view the interesterification, which had been already exploited during the war and catalytic hydrogenation were studied. A new process has been developed, through which the hydrogenation is carried out economically in a continuous way and so that no iso-oleic acids are formed. In surface coatings the Chemische Werke Bayer, Leverkusen, have brought a new type of basic material, the Desmodur-Desmophen-finish into the market. It is a product of condensation of iso-cyanates with polyalcohols to form polyurethanes and is an example of successful industrial research, results of which have been often kept secret for obvious reasons.

The second edition of the "Deutsche Einheitsmethoden zur Analyse von Fetten und Fettprodukten" (standard German methods for the analysis of fats and fat products) was published in the form of a looseleaf book. The journal "Fette-Seifen-Anstrichmittel" has appeared in a substantially more extensive form. Beyond the analysis of fats and fat products a new work, "Analyse der Fette und Fettprodukte" (Springer-Verlag, Berlin) was published last year.

Fat research in Germany, in spite of all the difficulties, has endeavored to make up for the deficiencies caused by the war and its consequences. It has been desired to establish contacts with research workers in foreign countries through participating in various international conferences, *e.g.*, the Union Chimique Pure et Appliqué ("Jupak"), Association Internationale de la Chimie Industrielle, the Commité International de la Detergence," and the "International Society of Fat Research." We are especially happy over our friendly relations with the American Oil Chemists' Society, and I would like to offer you, once again, our congratulations on the Golden Jubilee Celebration of your society and best wishes for further successful work.

An Historical Survey of Fats and Oils Research in Canada

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ORGANIZED fats and oils research in Canada began at the Fisheries Experimental Station at Prince Rupert, B.C., in the late 1920's under the guidance of H. N. Brocklesby, now a consulting chemist in the United States. A year or so later the Ontario Research Foundation opened a fats and oils laboratory under the direction of A. D. Barbour, now deceased. Laboratories in other organizations were started during and since World War II.

Fats and oils research in Canada is influenced by our dependency on imports for most of our edible vegetable oil requirements. This caused a serious situation during World War II when many sources of supply were cut off. Greater self-sufficiency in fats and oils production has been an important objective for some years.

Our huge wheat surpluses also influence research. It has been realized for years that an alternative crop to wheat is desirable. Edible oil seeds are the obvious answer as they would provide much-needed oil while relieving the wheat situation. But it is not easy to make a change. Wheat is comparatively easy to grow as it matures in about 100 days. Soybean, sunflower, and safflower crops in the past have required 120–130 growing days, and, if they are to provide satisfactory alternative crops to wheat, earlier maturing varieties must be developed.

Much progress has been made by the plant breeders.