

A REPORT OF THE CONVERSAZIONE, HELD
DEC. 17, 1886.

SUBJECT: BUTTER AND ITS FALSIFICATIONS.

Prof. A. R. Leeds in the chair.

TOPICS OF DISCUSSION.

1. American methods and improvements in manufacture.
2. Statistics of present home production and of export.
3. Existing State and Federal legislation to control and regulate.
4. Sanitary considerations :
 - A. Relating to the fat of infected animals and decomposed fats.
 - B. Relating to accompanying organisms, animal tissue, etc.
 - C. Relating to foreign mineral substances, dyestuffs, etc.
5. Detection of imitations and falsifications of butter.
 - A. Determination of melting and solidifying points.
 - B. Determination of specific gravity,
Critique of König's method.
 - C. Use of the microscope,
Critique of Taylor's method.
 - D. Methods of Hehner, Kættstorfer, Reichert, Meissl.

The notes taken during the discussion were submitted to and carefully revised by each speaker. The editors are not responsible for the statements and opinions contained in this report.

After some introductory remarks, the Chair invited Dr. Chas. A. Doremus to begin the discussion by relating the history of the beginning of the manufacture of imitation butter in the United States.

I.

AMERICAN METHODS AND IMPROVEMENTS IN
MANUFACTURE.

DR. C. A. DOREMUS: In the Winter of 1872-3 Prof. R. Ogden Doremus was requested by Mr. Alfred Paraf to examine his patented process for making butter from beef suet, and to give an opinion on the chemical principles involved. Experiments had been made in the laboratory of the School of Mines, Columbia College, and Paraf was able to produce an excellent artificial butter. Efforts were next made to organize a company to exploit the process, and to that end Paraf took an office in the city and many gentlemen were shown the manufacture on a small scale, and thereby induced to take a monetary interest in the Oleomargarine Company.

In the Spring of 1873, in company with my brother, Mr. T. C. Doremus, I met M. Mége Mouries in Paris, and we negotiated for the right to manufacture butter under his patent in America. After contracts were signed we were permitted to visit the Paris factories. Butter was not manufactured on a very large scale. Most of the product was sold as cooking grease, "graisse de ménage," a substitute for lard, though it had the appearance of butter. Much was also put up in the form of pats and sold as artificial butter. M. Mége had many certificates from high authorities concerning the healthfulness of the product, and the invention was considered of great importance, furnishing as it did a cheap wholesome article of food.

The process, as carried on in Paris, consisted in separating the fat from the membrane at a low temperature. The melted fat was allowed to crystallize by slow cooling. The mass was then subjected to pressure, the oleo oil being thus separated from the stearine which remained in the cloths.

The oil was churned either with water or milk. Mége deemed the use of mammary pepsin, obtained by the use of the udder of the cow, advantageous. The butter was worked by being repeatedly passed between grooved wooden rollers. The first pair of these had large, the second fine longitudinal grooves.

A sample of artificial butter from New York was better than that manufactured in Paris. Butter color was used to impart a yellow hue, both in Paris and New York.

M. Mége had sold the right to use his patent in Austria, and was making other negotiations. My impression is, however, that the European rights have never yielded him a large income, and that no factories have been built of the size of those afterwards erected in this country. Factories now exist in Germany, but I have no statistics concerning them.

On our return to New York the troublous times of 1873, and the discovery that Mr. Paraf was not an inventor, but that he had filched his knowledge of making artificial butter from descriptions of Mége's process, and possibly from the publications of the British Patent Office, led to the reorganization of the Oleomargarine Company under the title of the United States Dairy Company, and the purchase by the latter of the Mége patent.

The manufacture of butter was continued by this company under the presidency of H. A. Mott, Esq., at a small inconvenient factory in Brooklyn. Dr. H. A. Mott, Jr., was for a time chemist of the company and I succeeded him. The factory was conducted mainly for the purpose of exhibiting the process to parties negotiating for State rights or local licenses. It was too small to be run profitably and too inconvenient. The rooms were not capable of being maintained at proper temperatures, and the machinery was not of the best description. As a consequence, while most of the butter made was sold at a good price, other lots were of poor quality and brought little. I know of several persons who purchased from the factory for home consumption. About this time infringers began to treat large quantities of fat, and to manufacture oleo oil and butter. I was informed at that time that large orders were filled to supply oil to manufacturers of cheese. The factory in Brooklyn was at length discontinued, and subsequently the manufacture in New York was conducted by the Commercial Manufacturing Company under license from the United States Dairy Company. From that time I have only had an indirect interest in the manufacture.

DR. H. A. MOTT.—Respecting the Paraf patent, I would state that M. Paraf read a description of the Mége process for the manufacture of artificial butter in the *Moniteur Scientifique*, and after ex-

claiming in the presence of some friends that the process was of great value he immediately drafted specifications for an American patent for the manufacture of oleomargarine; Paraf being the first to name the product oleomargarine, on the assumed basis that the product contained a fat called margarine. After securing a patent, a company was immediately organized. Paraf never produced any butter which was free from grain or crystallization, and consequently thirty or forty thousand pounds of his product remained on his hands and was finally sold for soap fat.

I met Paraf in Dr. Chandler's laboratory one afternoon and spoke to him about preventing crystallization. He said, That is just what we are working at and it is the most important factor undiscovered. I procured some of his product, and after melting it allowed it to run out on broken ice which was kept in agitation; the result was a product possessing the velvet smoothness of butter and free from grain or crystallization. I then produced 40 tubs of oleomargarine butter free from grain by using snow instead of ice. This was a discovery, simple as it was, that made oleomargarine butter a commercial success. My process was afterwards adopted by all manufacturers.

Dr. Wm. K. NEWTON.—Very little of the original oleomargarine is now made. That was a combination of beef fat, a little milk and salt.

The material now made, in nearly all cases, is a mixture of beef fat, lard, cottonseed oil or sesame oil, milk, coloring matter and salt. Different manufacturers vary the proportions of these ingredients. The Western makers also mix butter with the oleomargarine; some contains as high as 30% of butter and commands a very high price, from 20 cents to 25 cents a pound at wholesale.

The great tendency now is to use as much lard as possible.

The Eastern makers buy the materials at second or third hands, while most of the Western factories are connected with large stock yards, abattoirs, slaughter houses and packing establishments.

II.

STATISTICS OF PRESENT HOME PRODUCTION AND OF EXPORT.

W. K. NEWTON.—Probably 75%, and certainly 60%, of all the “oleo oil” or clarified beef fat is exported; by far the greater quantity goes to Holland where it is made into artificial butter. There are 160 factories in Holland alone where artificial butter is made.

Very little imitation butter is now exported from this country.

The reports just received from the U. S. Treasury Department show that between the 1st and 30th November, 1886, over five millions of pounds of oleomargarine were in stock at the factories and retail stores in the country.

There were on December 1st, 1886, 34 manufacturers, 204 wholesale dealers and 2,400 retail dealers who had paid license fees. It is probable that the latter will be doubled in a month.

H. A. MOTT.—The Commercial Manufacturing Company was compelled to stop manufacturing some two years ago, on account of the slaughterers of cattle using the fat themselves in the manufacture of oleomargarine. The Commercial Company, however, during the last year of their business, manufactured 50,000 lbs. of oleomargarine butter a day besides producing tons of oleomargarine for export.

To produce the 50,000 lbs. of butter, 122,000 lbs. of fat was utilized and from which was obtained

Butter.....	50,258.5 lbs.
Stearine.....	12,200 “
Tallow.....	34,160 “
Scrap (for fertilizer).....	30,093 “
Total Value.....	\$10,840 82
Cost of Production.....	10,575 00
Profit.....	265 82 per day.

The number of cattle slaughtered in New York city at that time was 624,000 per annum, yielding 69,888,000 lbs. of fat; the conversion of this fat into oleomargarine instead of into tallow would have yielded a profit to the commerce of New York of \$3,377,391.

The possible production of oleomargarine oil at that time in the United States was 297,537,000 lbs., which, if converted into butter, would yield 357,044,400 lbs.

If this fat were converted into tallow its value would be \$37,705,821.91.

If converted into oleomargarine \$78,884,399.06.

This industry would then compare favorably with

The Cotton Crop.....	\$233,000,000 00
“ Hay “	280,000,000 00
“ Wheat “	300,000,000 00
“ Corn “	420,000,000 00
“ Value of Beeves (slaughtered).....	659,206,480 00

I made the first complete analysis of oleomargarine butter, which I give below:

Water.....	11.203
Butter solids.....	88.797
	<hr/>
	100.000

Insol. Fats	{	Oleic	}	—24.893
		Palmitine		
		Stearine		
		Arachin		
		Myristine		
Sol. Fats	{	Butyrine	}	— 1.823
		Caprine		
		Caproine		
		Capryline		
Caseine.....	0.621			
Salt	5.162			
Coloring matter ..	Trace			
		<hr/>		88.797

III.

EXISTENT STATE AND FEDERAL LEGISLATION TO
CONTROL AND REGULATE.

W. K. NEWTON.—The testimony received and published by the New York Senate Committee in 1883 and by the Committee on Agriculture of the United States House of Representatives, is all biased and in favor of prohibition, and many of the statements made in these reports, by advocates of prohibition, are unscientific, untruthful and unfounded. The tendency of these reports has been to disgust the people with artificial butters, and to give such a bad name to the substance that few people will knowingly purchase it.

Effect of this evidence upon the public and the farmer: The farmer is persuaded that the making of oleomargarine is injuring the butter manufacture.

In "Bradstreet's," June 19, 1886, a table is published giving the price of average butter before and after the manufacture of oleomargarine. These figures show that its manufacture has not influenced the price of ordinary butter.

New York was the first to pass a law. (See *Table*.)

New Jersey, second. A prohibition law was first passed, which was never enforced.

The article should be put under the ban of the law. Not on the ground of its wholesomeness, but on account of its interferences with the dairy interest. Moreover, it is never sold under its true name. The inspectors have examined 673 stores in New Jersey. In only three was the oleomargarine sold for what it is. The only people who ask for it are the keepers of boarding houses, cheap restaurants and hotels. People never go into a store and ask for oleomargarine and butterine as such.

In New Jersey since the law has been enforced the sale has been reduced 60 per cent.

The record of licenses shows that out of 900 grocery stores in New Jersey, only 150 have obtained licenses. All the cases have been brought under the clause in the State laws, which provide that the seller should inform the buyer what it is, and give him a

printed card to that effect. We think it a vital point to limit and control the sale of oleomargarine. If sold, it should be sold for what it is. The color is added to sell it for something which it is not. The argument of the dealer is that annatto and carrot are added to natural butter in the autumn to give it a pleasing color, but this is not necessary to give flavor or to make it sell.

STATE LAWS.

I give below a summary of the laws of the several States.

Alabama has no law.

Arkansas has no law.

California. A restrictive law. Compels dealers to sell oleomargarine for what it is ; tubs to be marked ; dealers to have a sign: "Oleomargarine sold here."

Colorado. Requires a State license.

Connecticut. Requires tubs to be branded and a sign ("Oleomargarine sold, or used, here") to be hung up in stores, also in inns, hotel or boarding houses where it is used.

Delaware. Restrictive.

Florida. Misdemeanor to sell oleomargarine as butter.

Georgia. No law.

Illinois. Restrictive law.

Indiana. Restrictive law.

Iowa. Restrictive law.

Kansas. No law.

Kentucky. No law.

Louisiana. No law.

Maryland. Restrictive law.

Mississippi. No law.

Maine. Prohibitory law.

Massachusetts. Requires licenses in cities and towns. Must be sold for what it is.

Michigan. Restrictive law.

Minnesota. Restrictive law.

Missouri. Prohibitory law.

Nebraska. No law.

Nevada. No law.

New Hampshire. Imitation or artificial butter cannot be sold unless colored pink.

New Jersey. Restrictive, but cannot be sold if colored, or if in imitation of or semblance of butter.

New York. Same in effect as New Jersey.

North Carolina. No law.

Ohio. Prohibitory, unless the oleomargarine is made only of beef fat and milk.

Oregon. Restrictive. Sign must be hung in hotels and eating houses wherever used.

Pennsylvania. Prohibitory.

Rhode Island. Restrictive.

South Carolina. No law.

Tennessee. Restrictive.

Texas. No law.

Vermont. Restrictive.

Virginia. No law.

West Virginia. Restrictive.

Wisconsin. Prohibitory.

Arizona. Restrictive.

Dakota. Restrictive.

No other territory has any law.

R. W. MOORE.—Several investigations were held by committees from the Legislature of the State of New York in regard to the manufacture and sale of oleomargarine. The most important of these was made by the Committee on Public Health of the State Senate, in the Spring of 1884. This committee held its meetings in New York city, and received a large amount of evidence which was subsequently printed. The evidence is necessarily of a varied character but the drift of the whole mass of testimony was plainly in one direction—against the manufacture and sale of oleomargarine—though those who favored the article were at liberty to appear before the committee and state their side of the question as fully as necessary. The subsequent action of the committee was in accordance with the state of public opinion at the time as well as the spirit of the press.

The report of the committee was followed by the passage of the law establishing the Dairy Commission of the State and prohibi-

ing the manufacture and sale of all butter substitutes. The first case tried was made under Section 6, Chap. 202, Laws of 1884, which absolutely prohibits the manufacture and sale of all articles designed to take the place of butter. This section was held to be unconstitutional by the Court of Appeals, in the well known case of *The People vs. Marx*. The whole of the law was by no means included in this decision. Section 7 of the same act declares that the coloring of oleomargarine a yellow hue constitutes an imitation, and prosecutions have repeatedly been made under this section. The case of the *People vs. Arensberg* has been carried to the Court of Appeals, and a new trial was ordered on technical grounds. The first of the re-trials in the Court of Sessions was decided in favor of the people. The selling of oleomargarine for butter is also prohibited by law in the State of New York, and numerous convictions have been obtained for this offense.

The federal law is different in character from the New York State law, but does not in any way supersede or conflict with it. It simply imposes a tax on the manufacture of oleomargarine, and punishes the evasion of the tax or failure to pay the license fee on the part of the manufacturer or dealer in the same manner as is pursued in excise cases. The working of this law is yet to be seen.

IV.

SANITARY CONSIDERATIONS.

C. A. DOREMUS.—During the period referred to in my previous remarks, and at several times since, I have had occasion to visit both the establishments manufacturing under the Mège patent and others, so-called infringers, and have witnessed both the preparation of oil and the manufacture of butter from it. In all these experiences, however, I have never seen any fat other than pure, fresh beef fat used in the manufacture of artificial butter, with the exception of a small quantity of pure butter added to give flavor. Generally milk or buttermilk was employed in churning and a

flavor thus imparted. Butter color was used, even in Paris, to heighten the slight, natural yellow tint of churned oleomargarine. I am creditably informed that recently a specially prepared lard is sometimes added to impart smoothness and counteract the tendency of the artificial butter to become "grainy."

Not only were pure materials used in the manufacture, but the greatest cleanliness was always observed, and the fat was repeatedly washed before use and all utensils kept scrupulously clean and free from odor.

While it is possible that infringers have been led to admix other fats or oils to oleomargarine in the manufacture of butter, I doubt very much if impure materials can be used successfully, since very little rancid fat or oil would depreciate the value of a large quantity of good fat if mixed with it in making butter. I am aware of large quantities of fat purporting to be low grade of butter, the produce of the dairy, being sold in this city after being reworked and cleansed and the rancidity removed.

I have seen many samples of poor oleomargarine butter and dairy butter. The worst that could be said of the former was that it was tallowy or possessed a "grain," while the dairy butter was rancid, full of streaks of different color, not infrequently containing vermin from the cattle, and that of the very lowest grades was altogether most wretched.

It is exceptional for artificial butter to become rancid. This has been my experience after using much of it in the household for cooking purposes, and many friends have had a similar experience after giving the article a thorough trial.

During the past Summer I had occasion to visit the laboratories of the Imperial Board of Health at Berlin. In conversation with Prof. Sell, I was surprised to hear of the effect produced in Germany by the newspaper articles written in this country and giving most extraordinary statements concerning several of the most important American industries, especially those where the products serve as food. I took occasion to suggest that too great credence should not be given to newspaper articles, as the information they conveyed was not always reliable. It seems to me that the American press is to blame for much of the disrepute into which certain of our commodities have fallen abroad.

In regard to the coloring of oleomargarine, it may be said that the American mind is prejudiced in favor of a yellow color either in butter or any substitute for it. It has become a second nature to regard any white fat as lard. I am firmly of the belief that a sample of oleomargarine, though sold as such, would bring a better price if colored than the same article uncolored, while the reverse would hold of colored lard. Most of our dairy butter is of higher color than that used in Europe, and, to meet the taste of our people, the dairyman either feeds his cows carrots or colors the butter. If butter is melted at the same temperature as that used to extract oleomargarine and then churned its color becomes lighter. Melted butter and oleo oil are very nearly the same color.

R. W. MOORE.—Statements have frequently been made by persons and newspapers, that the ordinary butter of commerce was, to a large extent, adulterated by proprietors of the dairy and creamery, by the admixture of oleomargarine oil, cotton seed oil and other foreign fats. At one time during 1886 these statements were very widely and persistently circulated, to such an extent, in fact, that the dairy commissioner instituted a thorough inspection of all the creameries in Orange and Sullivan counties with a view of ascertaining the truth or falsity of these statements. A number of creameries were inspected, the inspection covering but three days, and the samples taken, thirty-four in number, were submitted to me for analysis. In no case were results obtained which would justify even a suspicion that the samples in question were not pure butter. The soluble fatty acids varied from 5 to 8 per cent.

Up to this time no positively noxious ingredients have been detected in artificial butter, and the statements regarding the use of mineral substances, dyestuffs or metallic admixtures must be regarded as unproven. The coloring matters used are vegetable in origin and harmless in character. The base of most colors for oleomargarine is annatto, which can be detected by Martin's test which is founded on the fact that annatto is freely soluble in a dilute solution of caustic alkali. The fat is dissolved in bisulphide of carbon and an aqueous solution of caustic alkali is added in a very dilute form. The color will be extracted from the fat and will appear in the aqueous layer, whence it can be drawn off and

further examined. Owing to the fact that caustic alkalis produce a yellow coloration with bisulphide of carbon, the use of chloroform as a solvent is preferable. If bisulphide of carbon is used it must previously be purified by agitation with caustic alkali and redistillation. It is also advisable to carry the test to the end by evaporating the aqueous solution nearly to dryness and testing with sulphuric acid for a blue color showing annatto. The liability to error, with the use of carbon bisulphide in practiced hands, is extremely small, and results are obtained much more rapidly in this way.

H. A. MOTT.—Michel and the Chicago microscopist obtained all sorts of distorted bodies by pressing the cover so hard upon the fat globules; they condemned the crystals of fat, which are certainly as pure as crystals of water.

The Chicago observer allowed the butter to melt and examined the water from it after it had stood for several days and naturally obtained the same organisms as would be obtained by allowing water to remain exposed to the air before examining the same. His results were manufactured, false and of no scientific value.

The oleomargarine manufacturers melt the fat of hogs at 100° to 103°F. and obtain an oleomargarine lard so to speak which is as different from ordinary lard as oleomargarine is from tallow. It therefore should not be called lard, as ordinary lard could not be used from the fact that it possesses an odor derived from the scorching of the membrane.

Cotton-seed oil is used by some manufacturers, but if ordinary butter is added also the artificial butter produced will become rancid in 24 to 48 hours.

J. H. STEBBINS, JR.—Mr. Martin's test for coloring matter consists in dissolving a certain amount of butter fat in CS₂, and then treating the CS₂ with a very dilute aqueous solution of KOH. I have tried it on natural butters and found that it gave the same color reactions as with highly colored butters or butter substitutes. The test was repeated several times with always the same results. I also made a blank test with CS₂ and KOH alone and obtained the same test. According to Pinner (Org. Chem., 1876. p. 35,) fixed caustic alkalis dissolve CS₂, the reaction being

$$\text{CS}_2 + 2 \text{KOH} = \text{H}_2\text{O} + \text{K}_2\text{CS}_2\text{O} \text{ or } \text{CS} \begin{matrix} \text{SK.} \\ \text{OK.} \end{matrix} \text{ This explains the}$$

formation of the coloring matter, whether any coloring matter has been used or not. At first I used a 1 per cent. solution; afterwards I used a much weaker solution; now only two drops of $\frac{1}{4}$ KOH dissolved in 25 c.c. of water, and shaking it up with five grams of butter in 20 c.c. of CS_2 . But even in natural butters the color appears in an hour more or less. As to the natural appearance of oleo fats, it has been testified to by dairymen that the natural color of the oleo is white. But at Eastman's factory I saw the whole process, and the oleo oil is as yellow as a good many samples of ordinary butter which I have seen, and this, too, without the addition of any artificial coloring matters.

The color of oleo oil, it has been stated, after being churned with milk, is creamy and much lighter in color. But a new preparation of oleo oil is put upon the market, which, after being churned, gives the same color as natural butter. The manufacture of this product is a trade secret as yet.

W. K. NEWTON.—Makers of artificial butter intend to sell the article and as any bad taste or smell would stop the sale, the manufacturers are anxious to make it without using any spoiled fat, etc. Decomposed fats of course cannot be used.

Dr. Eugene Sell's pamphlet upon artificial butter, especially that portion relating to its manufacture in the United States, and its history is copied from American trade journals and is unreliable. The chemical part of the paper is good.

As to the color, some makers use a great deal of coloring matter to produce the color of June or July butter.

The makers of oleomargarine use double the quantity of salt which is used by the dairy people; the reason being to get rid of the lardy taste. The object of the makers is to make an article as cheaply as possible. Sometimes they use poor fat and know nothing of the process. In one factory rich milk is used, but after the oleomargarine is thrown on the ice the other constituents of the milk drain away, leaving only the fat.

As to the price, a large dealer will buy several tubs of the same article and mark it 15c., 20c., 25c. and 30c., all of which have cost the dealer from 9 to 20 cents.

C. W. STILLWELL.—In relation to Martin's test with carbon bisulphide, it is necessary to purify every sample of CS_2 , by shak-

ing it up with a solution of caustic soda or potash, drawing off the CS_2 , and distilling at a low temperature. Thus purified, it will give a very faint color with his test when left over night; but the test as used on oils takes but a few minutes. The color of the melted fats is a very good indication as to the presence of artificial coloring. I judge largely by that as well as by other indications. Martin's test is reliable when properly done; but it is well to carry the test to the end and get the reaction for annatto with sulphuric acid. Out of over 300 samples tested by me during the last two years, as received from the inspectors, hardly more than 10 turned out to be butter.

V.

Detection of imitations and falsifications of butter. A.—Determination of melting and solidifying points.

R. W. MOORE.—The best method for determining melting points was found to be that of Wimmel (Pogg. Ann. 133, 121) where this fat is drawn part way into a capillary tube, solidified and allowed to remain solid for several days. The tubes are then immersed in a beaker of water in such a manner that the level of the solid fat is beneath the surface of the water. The water is then gradually heated and the temperature noted at which the fat rises to the surface of the water. This temperature is taken as the melting point.

J. S. STEBBINS, JR.—I find great difficulty, owing to the variation of usage among chemists, as to the point taken for the beginning of melting and solidifying, one taking it when the fat becomes transparent, while another determines the melting point when it softens. As it is very hard to say at what temperature the fat becomes transparent, and as it is probable that each observer uses his own judgment on this point, it will be found impossible to obtain uniformity of results by this method. I therefore consider it worthless. Another by

placing a small weight upon the surface of the solidified fat, and noting the temperature at which it sinks to the bottom of the beaker. Another by floats; this method consists in observing the temperature at which a glass float, held in position at the bottom of a beaker by the solid fat, rises to the surface. It is just the reverse of the previous method. I do not think much of either of them. This gives a variation from 19° up to 40° . These methods give results varying from 19° to 40° C. It will therefore be seen that they are very unsatisfactory, especially since the melting point of butter substitutes can be adjusted so as to correspond with that of butters.

C. W. STILLWELL.—The melting point of butter is so difficult to determine with any degree of precision that I make no attempt to use any of the processes given for the purpose. They all are of little value. The crystallizing point of the insoluble fatty acids, called by the French the "titre," is a valuable aid at times to the analyst. This process has been in use for years in the grading of tallow for shipment especially to France, Germany and Russia. It admits of great accuracy, duplicates needing not to differ more than one tenth of a degree Cent.

The clear fat is saponified, dissolved in water, decomposed by acid and the acid solution drawn off. The cooled cake of fat is melted with fresh water and cooled and the fat put into a test tube and the crystallizing point taken.

Pure butter has a titre of 36.5° to 37.5° C. The oleomargarine of commerce generally tests about $40.^{\circ}$ C. unless in the case of mixed samples where the titre is lowered on account of the butter present; oleomargarine oil should not test over 40° C. If it goes to 41° to 41.5° it is too tallowy and cannot be used for the finer grades, unless by a liberal admixture of refined lard, and even then the product is not of the best.

In connection with this subject, the following table may be of interest. It is taken from the analysis of several hundred samples of tallow made in our laboratory, and shows the great change in the quality of the tallow made after the use of the best portions of the fat for oleo oil was well established.

Year.	Titre average.	Limits.
1872.....	44.17° C.	42.00—45.25
1873.....	44.15 “	41.00—46.50
1874.....	44.42 “	41.00—46.80
1878.....	42.27 “	40.17—46.60
1879.....	42.57 “	40.35—41.95
1880.....	42.80 “	40.10—45.87
1881.....	42.72 “	40.00—45.40
Oleo oil.....	40.65 “	38.40—41.90

V.

USE OF THE MICROSCOPE.

R. W. MOORE.—The microscope has a limited use in the examination of butter. The globules of fat in the case of butter are spherical while in the case of oleomargarine pear shaped bodies are seen in their place. A mixture of butter and oleomargarine however shows results from which no safe conclusions can be drawn. As regards the St. Andrew's cross which it is claimed can be seen in butter when examined by polarized light and cannot be seen in oleomargarine, the second annual report of the New York State Dairy Commissioner shows photographs from the microscope of the St. Andrew's cross obtained in the examination of both butter and oleomargarine. The presence of crystals in butter has been known for some time and the cross is probably due to them.

MORTON LIEBSCHUTZ.—The melting point can be determined by heating and arranging to view with polarized light. The apparatus has been devised by M. Leon Loviton, chemist to the Minister of Commerce in Paris, and described in the *Bulletin de la Société Chimique*. The heating is produced by means of circulation of hot water the temperature of which is regulated by the operator. The heating apparatus contains the preparation whose melting point is to be studied under the microscope.

The author states that by the use of polarized light, the colored

phenomena presented by the substance passing from the solid to the liquid state are striking, and that the concordance of different observations is remarkable.

C. A. DOREMUS.—If butter is melted and reproduced by churning, many of the difficulties met with in the manufacture of artificial butter will be encountered. The butter will be grainy, tallowy and of light color. Small crystals will also form.

In a celebrated lard case Dr. Belfield of Chicago made elaborate microscopical examinations on the formation of crystals of stearine and lard. These were reported and illustrations were given.

D.—*Methods of Hehner, Köttstorfer, Reichert, etc.*

The discussion of this topic was opened by the reading of the following letter :

PRINCETON, Dec. 14th, 1886.

PROF. A. R. LEEDS.

Dear Sir: I am a strong advocate of the use of Reichert's test, to the exclusion of all others, for the detection of foreign fats in butter, for the following reasons :

1. It is more *convenient* than any except Koettstorffer's.
2. It is as thoroughly *quantitative* as any other. I can mix a genuine butter with any of the fats ordinarily used to imitate butter, and Reichert's test and formula will enable me to state the proportion of foreign fat just as accurately as any other process.
3. It is as *exact* as any other method. With due care as to the alcohol and potash used, and with due regard to the conditions of distillation (very easy to secure), my duplicates do not vary more than 0.2 c.c. of $\frac{N}{10}$ alkali ; nor do those obtained in my laboratory by different persons.
4. I know of no cheap fat or oil which can be mixed with fats other than butter fat so as to escape detection by Reichert's process. On the other hand, cocoanut oil can be so mixed and escape detection by either Koettstorfer's or the original Hehner's process. I have also in my laboratory a mixture of 60 per cent. of genuine

butter fat with cocoanut oil and mutton suet, which has successfully passed both Koettstorfer's test and a modification of the Hehner method—Dupré's (with determination of both insoluble and soluble fatty acids). Its specific gravity is not below the lowest limit for fresh genuine butter. It has, even when melted, successfully passed an ordeal under the nose of an expert in cocoanut oil, and I myself can detect neither the smell nor the taste of that oil in it. I have submitted it to one who has made a special study of fats with the microscope, and from all I can learn he has failed to recognize the cocoanut oil. Its melting point is about 1.5° C. above that of butter, but I took mutton suet because it was at hand. Had I used beef fat the melting point would have been correct, and the mixture would have passed every standard test, except that of Reichert, as pure butter. It was not made from a selected butter, high in glycerides of soluble acids, or my mixture could have been made with much less pure butter fat; but it was made from an average butter. By Reichert's test the mixture consumed 9.6 c.c. $\frac{N}{10}$ alkali; by Dupré's it gave 88.21 insoluble, and 5.01 soluble fatty acids; total 93.22. That is somewhat low, but Bell gives one representative genuine butter with 89 insoluble and 4.5 soluble acids; total 93.5; and Blyth gives another with 87.68 insoluble and 5.37 soluble; total 93.05. Blyth also states (apparently quoting Muter) that "if a butter shows anything less than 89.5 insoluble acids with 5 soluble, it may be passed as genuine." Following these authorities my mixture must pass for pure butter fat. Of course a mixture could be made to pass Reichert also, but it would have to be within very much narrower limits. To pass Reichert's test and still have a correct melting point and specific gravity I do not think it could contain more than 20 per cent. of foreign fats; taking average butter. I say then that (disregarding the question of actual use of cocoanut oil in commercial imitations of butter) Reichert's method is the one that will best secure the analyst from being imposed upon by some designing mixer of fats; whereby the expert analyst might be placed in an unpleasant position in the witness chair. Of course I leave out of consideration sundry strong-smelling fish oils, calculated to defeat any chemical analysis, but scarcely likely to elude the chemist's nose.

5. Reichert's test can be just as clearly presented to a jury as any

test which includes the estimation of the soluble and insoluble fatty acids, because both methods require the use of a standard alkali solution. Hehner's original method does not require such a solution ; but I think no chemist would now rely on the determination of the insoluble fatty acids alone, because if he did he would have to pass as genuine a very large proportion of the mixed or adulterated butters now in the market ; unless he adopted a standard untenable in court.

6. I am opposed to using Reichert's test in connection with, or as an adjunct to some other test (except in some cases), because there will often arise cases where the Hehner original method will fail to condemn a sample that Reichert's will condemn ; and there is at once a conflict of results. So, too, with Dupré's method. It is not so sharp as Reichert's, and I know of a case where Dupré's method left the analyst in some doubt, while the Reichert, showing a consumption of only 9.7 c.c. $\frac{N}{10}$ alkali, conclusively condemned the sample. Koettstorfer's test I would leave out for the reason already stated.

In my opinion it would be a great step forward if our analysts would adopt Reichert's test to the exclusion of others—perhaps reserving Koettstorfer's as a preliminary in cases of emergency, where many samples were to be handled.

I am certain I can make two tests (and I think more) by Reichert's method while I am making one by any method for both soluble and insoluble fatty acids ; and the Reichert test will give, after all, a more certain result.

Yours very truly,

H. B. CORNWALL.

R. W. MOORE.—The method of Hehner estimates the insoluble fatty acids in a fat and neglects the soluble acids. It is, however, incomplete by itself and laborious of execution ; as modified and amplified by Dupré (*Analyst*, 1, 87) more complete data are obtained, but the process is at best cumbersome and is also open to other objections which will be given later on.

The method of Koettstorfer is easy, rapid and elegant, and has moreover a very wide range of usefulness in the analysis of fats other than butter. The fact, however, that there are oils and fats which gives much higher figures than butter, renders possible a

large number of ingenious mixtures which would invalidate the process.

The Reichert process presents many advantages, both as regards ease of manipulation and reliability of results. The same can be said of the method of Meissl, which is simply the Reichert method with double quantities of substance and reagents. A large number of analyses by various chemists confirm the reliability of the method. Only one chemist (*Fres. Zeit.* 21, 394) gives results lower than those found by Reichert, and his figures were not obtained by the method as laid down by Reichert. Moreover, his figures have not been confirmed by any other chemists, and though frequently attacked the author has not attempted to justify his results.

The method which on all accounts I have found most satisfactory, has been a modification or rather a continuation of Reichert's process suggested by Dr. Waller. The Reichert process is followed out strictly and the figure for the first distillate is obtained; then 50 c.c. of water is added to the flask and the distillation repeated. This is continued until the distillate is practically neutral—requiring less than 1-10 c.c. of $\frac{N}{10}$ NaOH for neutralization. The insoluble fatty acids are washed, and whatever solid acid is retained in the condenser is rinsed out with hot alcohol; the solid acid remaining on the filter is also dissolved in alcohol and the whole dried and weighed in the original flask. The data furnished are : 1. The Reichert figure; 2. The total soluble acids and the insoluble acids. This will give all necessary information in regard to the quality of the sample.

The rate of distillation is also instructive, about 80% of the total volatile acids coming over in the first distillate. In regard to chemicals used, but one standard solution is required, $\frac{N}{10}$ NaOH, whereas several are required by the Dupré process. The use of standard alcoholic potash obviated, which is a great advantage, as it is liable to daily and even hourly change.

Some difficulty is experienced in obtaining satisfactory alcohol and potash. These should be of such purity that a blank test should give a distillate requiring not more than 5 c.c. $\frac{N}{10}$ NaOH. The alcohol and potash varies in this respect from 2-1.7, and this should always be taken into account in calculating the results.

On the whole the method has shown itself to be easy, rapid and reliable, and gives the greatest amount of information in the shortest space of time.

C. W. STILLWELL.—I saponify 5 to 6 grms. of the dry fat in a closed flask, evaporate the alcohol, dissolve in water and connect the flask with a condenser. Decompose by a slight excess of dilute sulphuric acid, and pass a rapid current of steam through the solution. The volatile acids are rapidly driven over. With oleomargarines the distillation is usually done in 20 to 30 minutes; with butters about three-quarters of the total amount present is distilled in the same time, and the balance is rapidly obtained by a still further treatment. The distillation is carried so far that but a mere trace of volatile acid is left. The use of a current of steam not only works more rapidly and perfectly in the estimation of the volatile acids, but it leaves the insoluble acids in such a condition that they are very easily washed—rarely needing more than two washings of about 200 c.c. water each.

The presence of cocoanut will be detected by the slower rate of distillation of the volatile acids, as compared with butter.

In forming a judgment upon the character of the sample analyzed, if we have a mixture of butter and oleo oils, it is generally necessary to use both the sol. and insol. fatty acids. The sp. gr. is not of much use in this case. But in the case of an oleomargarine, pure and simple, either the sol. fatty acids, the insol. fatty acids, or the sp. gr. is sufficient to determine its character. Some samples of oleos containing lard have a very high sp. gr., and the sp. gr. of cottonseed stearine sometimes used is nearly that of butter.