XX.—Detection of Oleomargarine.

By P. Casamajor.

In the *Moniteur Scientifique* for April, 1881, is an article on Butter Analysis, in which are given the processes used at the Municipal Laboratory, attached to the Prefecture of Police in Paris, for the detection of foreign fats in butter. This is followed by an account of an areometric method used for the same purpose, and based on the difference of density between butter and the fats with low melting point, extracted from tallow, which are made to resemble genuine butter, and which are known under the commercial name of *oleomargarine.*

The sale of oleomargarine has become so extensive in this country, that a purchaser of butter is never sure whether he is getting true butter or its imitation. In view of this fact, I have thought it useful to give a process, based on the difference of specific gravity between butter and oleomargarine, of such simplicity that it can be easily applied by any person having rudimentary ideas of manipulation.

Processes of this character are those which can be used with greatest efficiency to check adulterations. I have, in previous communications, given such processes for the detection of starch sugar mixed with cane sugar, and for the detection of starch sugar syrup, mixed with sugar-house syrup.

Although my concern is principally with the difference of density between butter and oleomargarine, I propose to very briefly call at-attention to the processes used at the Municipal Laboratory of the Prefecture of Police, as these show important differences in chemical composition between true butter and its adulterant, which confirm the difference in the specific gravity. Such an important character as the specific gravity would not differ to any marked extent, without a corresponding diversity in the composition of the two substances.

One process used at the Municipal Laboratory is the following: The sample of butter to be tested is melted, so as to separate water, salt, etc., which is deposited, and a certain amount of scum, which comes to the surface. Of the clear melted fat, under the scum, about 3 or 4 grms. are taken and saponified by 1 or 2 grms. of potassic hydrate. The fat and potassa should be mixed with 50 c.c. of alcohol. In about 5 minutes the saponification is complete, and the cautious addition of water should not produce any turbidity. If any takes place, the operation must be begun anew. The soap formed is afterwards decomposed with weak sulphuric acid, and the insoluble fat acids are collected and weighed. The result of a great number of experiments is, that in butter the percentage of fat acids thus obtained is usually 86.5 to 87.5 per cent., and that sometimes it is as high as 88 per cent. In animal fats from tallow the percentage of insoluble fat acids is $95\frac{1}{2}$. The difference, $95\frac{1}{2} - 87\frac{1}{2} = 8$ per cent., is attributed to the absence in tallow of volatile and soluble fat acids which exist in butter

Another process is given in which the result is obtained volumetrically, by estimating the quantity of potassa used in saponifying the fat. 1 grm. of butter requires 225 to 232.4 c.c. of potassa solution, while 1 grm. of tallow, or other animal fat of the same nature, requires from 195 to 197 grms. of the same potassa solution.

Mr. Charles Girard, director of the Municipal Laboratory, considers as adulterated any butter requiring, for saponification, less than 221.5 c.c. of the potassa solution. In some unfavorable cases this volume may represent nearly 30 per cent. of foreign fat.

The method for detecting the difference between butter and oleomargarine by the difference of specific gravity, is one proposed by Messrs. Leune and Harburet.

The butter to be tested is first melted, so as to separate the pure fat from water, salt, etc. The clear melted fat is placed in a cylinder, heated by the vapor escaping from a water bath, kept boiling, but no part of the cylinder is to be in the boiling water. I understand that by heating in this way, the temperature of the melted fat remains at about 93° C. To determine the density of this fat an areometer is placed in it. This areometer is graduated in such a way that, in butter, it will sink to the lowest mark of the scale, while oleomargarine corresponds to the highest point in the graduation. The intervening space is divided into ten equal parts, each one of which corresponds to $\frac{1}{10}$ of oleomargarine, mixed with butter. More than 600 experiments made by Messrs. Leune and Harburet, with artificial mixtures, show that, within an approximation of ten per cent., the instrument gives correct results.

Soon after this areometric method was published, it was announced that the difference of the specific gravities of butter and of oleomargarine, was too slight to distinguish the one from the other. As Messrs. Leune and Harburet had not stated what the specific gravity of each was, it was impossible to judge of the truth of this statement, and it became interesting to ascertain the facts of the case. The following process is the result of my attempts to determine the specific gravities of butter and of oleomargarine : I chose, in the first place, to ascertain the specific gravity of each at 15° C., which is the usual temperature for such determinations. The process consisted in finding for each a liquid in which, at 15° C., a portion of butter or of oleomargarine, freed from impurities by previous melting, and containing no air bubbles, would remain in equilibrium in any portion of the liquid, without any tendency to rise to the top or sink to the bottom. The readiest liquid for this purpose was a mixture of alcohol and water, as this is easily prepared and it has no dissolving action on the fats to be tested. As the density of the liquid in which a body remains in equilibrium is the density of the body itself, the problem was narrowed down to finding the difference of density between two mixtures of alcohol and water of different strengths. It was found that pure butter, at 15° C., would remain in equilibrium in alcohol of 53.7 per cent. This corresponds to specific gravity 0.926. This butter was obtained from a gentleman at whose country place the butter was made. I obtained oleomargarine from melted warm beef suet by pressure. At a temperature of 25° C., this expressed fat had the consistency of butter. The alcohol, which at 15° C. would hold it in equilibrium, had a strength of 59.2 per cent., which corresponds to a specific gravity of 0.915.

The question of the possibility of distinguishing butter from oleomargarine becomes equivalent to the possibility of distinguishing alcohol of 53.7 per cent. from alcohol of 59.2 per cent. As this difference is 5.5 degrees of Gay Lussac's alcohometer, it is very evident that the specific gravity is a sufficient character for distinguishing butter from oleomargarine. This difference may appear more clearly to persons not familiar with alcohometry, by stating that it is the difference between 0.926 specific gravity and 0.915.

By means of the tables of Gay Lussac and of Tralles,* it is a very easy matter to prepare alcohol of the required strength at any temperature, to be kept in bottles for future use.

As the expansion of fats is different from that of alcohol, it is advisable to bring the alcohol to 15° C. when making an observation, which can be easily done by any one provided with a thermometer.

To deliver the sample of fat on the alcohol, I have found that the best plan is to melt the fat and let a large drop of it fall into the liquid. The fat should be melted in a little spoon or a little scoop, and the drop should be delivered by bringing the spoon or scoop close to the surface of the alcohol. It requires a little practice to do this neatly, so

* See the excellent tables of Prof. McCulloh.

as not to get an air bubble in the ball of melted fat. When an air bubble becomes imprisoned in the fat, I have had no difficulty in removing it with a strip of paper, while it lies on top of the alcohol. Sometimes the globule of fat only partially sinks in the alcohol ; the top of it becomes flat and remains exposed above the liquid. A slight tap on the side of the glass is then generally sufficient to form a wave and sink the globule.

If we take alcohol of 56½ per cent., which represents equal volumes of alcohol of 53.7 per cent. and of 59.2 per cent., and if we deliver on the surface of this alcohol a globule of melted butter and one of oleomargarine, the butter will sink to the bottom and the oleomargarine will remain at the top, while the two globules are still warm and liquid. Afterwards, if the alcohol has a temperature of about 30° C., the butter will become solid, while the oleomargarine may still remain liquid. Then the butter will rise to the top of the alcohol, which is due to the expansion of butter on solidifying. If the alcohol be then kept for a few minutes at 15° C., the oleomargarine will become opaque and remain at the top, while the solid globule of butter will sink to the bottom.

If instead of taking alcohol of 56 per cent., we use alcohol of 59.2 per cent., oleomargarine will remain on top, and butter will sink to the bottom at all temperatures above 15° C. At 15° C., oleomargarine will remain in equilibrium in any portion of the liquid in which it may be placed.

If oleomargarine was always sold pure, the foregoing indications would be sufficient to distinguish it from butter, but the oleomargarine found in the market is always more or less mixed with true butter, to improve its taste and appearance. This being the case, alcohol of 59 per cent. is not the proper liquid to detect oleomargarine. We should use alcohol of 55 per cent., and consider as oleomargarine any so-called butter which will not sink to the bottom in alcohol of this strength at 15° C. This is founded on the fact that not more than one-third of butter is ever mixed with oleomargarine to improve its taste and appearance.

Bearing in mind the experiments of Messrs. Leune and Harburet, already cited, the proportion of butter and of oleomargarine in a mixture could be easily detected by finding what strength of alcohol will hold in equilibrium at 15° C., a globule of fat under examination. As the difference of 59.2 and 53.7 is 5.5, the proportion of oleomargarine is the difference between the strength of the alcohol and 53.7, divided by 5.5, or more conveniently multiplied by 0.18. If the alcohol required to hold a globule of fat in equilibrium at 15° C., has a strength of 57 per cent., then: (57 — 53.7) × 0.18 = 3.3 × 0.18 = 5.95, or say $\frac{6}{10}$ of oleomargarine. If the alcohol had a strength of 58, then (58 — 53.7) × 0.18 = 4.3 × 0.18 = 7.72, or about $\frac{8}{10}$ of oleomargarine.

The proportions of butter and oleomargarine in a mixture may be also determined without the aid of an alcohometer, by using the two solutions of 53.7 per cent. and of 59.2 per cent. These may be placed in graduated glasses and poured cautiously into a third glass, until an alcohol of sufficient strength is obtained to keep in equilibrium a globule of the fat under examination, at 15° C.

The relative volumes of the two solutions used in making the mixture, give the proportions of butter and oleomargarine.

XXI.—Detection of Starch Sugar Syrup Mixed with Sugar-House Molasses.

By P. Casamajor.

In previous communications I have given processes for detecting the adulteration of cane sugar by starch sugar. The adulteration of sugar-house syrups by starch glucose is still more extensively practised than that of sugar, and a great portion of the syrups sold by retailers in this market is mixed with starch glucose.

This form of adulteration may be very easily detected by the use of strong methylic alcohol, in which the alcohometer of Tralles, or of Gay Lussac, will indicate about 93½°.

A straight sugar-house syrup, when mixed with three times its volume of this strong methylic alcohol, will dissolve by stirring, giving a very slight turbidity, which remains suspended, while yrups c ontaining the usual admixture of starch sugar give a very turbid liquid, which separates, when left at rest, into two layers, the lower being a thick viscous deposit containing the glucose syrup.

Considerable quantities are sold of a thin syrup, of about 32° Beaumé, in which the proportion of sugar to the impurities is greater than in common sugar-house molasses. When a syrup of this kind is stirred with three times its volume of methylic alcohol, a marked turbidity and deposition will take place, which consists of pure sugar. The crystals are hard and gritty; they adhere to the sides of the glass, and are deposited on the bottom. There is no resemblance between this precipitate and that due to starch sugar syrup.

It may not be useless to mention, that if a straight sugar-house