was used, it will be seen that 36.4 per cent. of this silver oxide completely escaped decomposition.

The above results, in connection with others along a similar line, have induced me to believe that attention has not heretofore been directed to the ease with which silver may be oxidized by lead oxide, and particularly by substances which give up a part of their oxygen upon gentle ignition, such as manganese dioxide and barium dioxide. Is it not then reasonable to assume that certain losses, or irregularities in the treatment of silver and its compounds, may be due to this cause?

UNIVERSITY OF TENNESSEE.

THE DETERMINATION OF THE SOLID FAT IN ARTIFICIAL MIXTURES OF VEGETABLE AND ANIMAL FATS AND OILS.

BY J. H. WAINWRIGHT.

Received February 1, 1896.

IT will readily be conceded by most analysts that there is no subject in analytical chemistry presenting more difficulties than the examination and analysis of the fixed oils and fats. This is especially true in the case of mixtures of oils of different origin, and there is probably no problem more difficult to solve in most cases than the analysis of such a mixture when even approximately correct quantitative results are required.

It is only within a comparatively recent period that the investigations of the chemist have been especially directed to this branch of research as formerly the character and identity of a sample of unknown origin was chiefly, but very doubtfully, established by means of obscure color reactions and one or two simple determinations, such as specific gravity, melting point, etc.

At present, however, the investigations of many learned chemists have shown that determinations of the chemical and physical properties of a sample, such for example as the combining weight of fatty acids, the percentage of iodine the sample will absorb, the percentage of volatile fatty acids, etc., will yield results by which may be established, in most cases with reasonable accuracy, the fact as to whether it is a simple oil or fat, such as olive, linseed, lard, butter, etc., and if so its identity and quality; or, if adulterated, to determine with a fair degree of accuracy the character and probable extent of adulteration. This is especially the case when a mixture consists of but two oils or fats, one of which is known, in which case a few quantitative determinations will usually enable the analyst to readily ascertain its approximate composition.

If a sample, however, consists of a mixture of *more* than two oils or fats, any statement of its composition calculated from the results of such determinations as above mentioned would be of extremely doubtful accuracy in any case, even if one of the constituents were known, and even then it would be at best but a broad approximation owing to the variations in chemical and physical properties exhibited in different specimens of the same kind of oil.

Some years ago samples of compound lard for export were submitted to the United States Laboratory for analysis with a view to determining the relative proportions of its constituents in order that the claim of the exporter for "drawback" of duties paid on one of its constituents might be verified.

This "compound lard" or "lard compound" has in recent years become an important article of commerce and consists essentially of cotton-seed oil and oleostearin made from beef fat mixed in different proportions; and sometimes containing a small percentage of genuine lard. Its composition is variable according to the brand and particular formula by which compounded, but is generally about as follows:

	Per cent.
Olestearin	20 to 30
Cottonseed oil	70 to 80

or

Oleostearin	18 to 30
Lard	10 to 20
Cottonseed oil	65 to 75

In the first case determinations of the properties of the sample would disclose its composition with reasonable accuracy, but in the second case considerable time was spent, I might almost say wasted, in making a long series of these determinations, both on the samples themselves and on mixtures made in the laboratory in accordance with the formula for comparison, without arriving at any satisfactory conclusions, until finally a very simple method for the analysis or rather assay of these "lard compounds" was devised, which up to the present time seems to yield fairly satisfactory results.

About 150 grams of the sample is placed in a beaker and heated in a boiling water bath until entirely melted. The water is kept boiling for at least one hour and is then allowed to cool gradually without removing the beaker from the bath until the temperature is reduced to about 75°–80° F. It is then allowed to stand for at least twelve hours in a moderately warm place.

In practice the beaker immersed in the warm water of the bath is left standing in the laboratory over night at the ordinary room temperature which is usually all that is necessary excepting in very warm weather when the temperature should be reduced by artificial cooling.

This process causes the solid fat to crystallize, which being accomplished, fifty grams of the sample is weighed from the beaker after its contents have been thoroughly mixed by means of a glass rod or spatula, and is carefully wrapped in a double thickness of Canton flannel in which it is subjected to pressure in a small screw press.

The pressure should be applied very gradually, especially at first, and should be continued until the screw has been forced down as tightly as possible. After standing a few minutes to permit the oil to drain off, the contents of the press are removed and the cake of solid fat, consisting essentially of stearin, is easily separated from the cloth in which it is wrapped and can then be weighed.

The press used is called "Osborne's Patent Beef Press," and can be obtained in almost any hardware store, and is used for domestic purposes, such as the preparation of "beef tea," etc.

The length of time required is usually at least one hour, and the temperature seems to be a matter of comparative indifference provided, of course, extremes are avoided.

No great accuracy is claimed for this method, and that it is based on any thing like *strictly* scientific principles remains to be proved, but the following results will, I think, show that it is what it is claimed to be, *i. e.*, a useful, if rough method for the assay of these manufactured compounds, and it is especially valuable as a preliminary operation in the more extended process of analysis.

Mixtures of the various ingredients, *i. e.*, oleostearin, lard and refined cottonseed oil were made in the laboratory, of which the following, as well as many others, are typical examples :

NO. 1.

	Grams.
Oleostearin	20
Lard	10
Cottonseed oil	70

NO. 2.

Oleostearin	25
Lard	10
Cottonseed oil	65

NO. 3.

Oleastearin	25
Cottonseed oil	75

NO. 4.

Oleostearin	24
Lard	10
Cottonseed oil	66

which, when assayed by the above described method, yielded respectively :

Number.	Per cent.
1	19.6
2	25.2
3	25.8
4	25.2

The following are the results obtained with samples of different formulas submitted for analysis :

SAMPLE A.

	Per cent.
Oleostearin	30
Cottonseed oil	70

SAMPLE B.

Oleostearin	25
Lard	10
Cottonseed oil	65

SAMPLE C.

Oleostearin	25
Cottonseed oil	75

SAMPLE D.

Oleostearin	25
Lard	10
Cottonseed oil	75

SAMPLE E.

Oleostearin	25
Cottonseed oil	75

SAMPLE F.

Oleostearin	23
Lard	10
Cottonseed oil	67

SAMPLE G.

Oleostearin	23
Lard	10
Cottonseed oil	67

SAMPLE H.

Oleostearin	24
Lard	10
Cottonseed oil	68

SAMPLE I.

Oleostearin	25
Cottonseed oil	75

which, upon assay as above, gave the following percentages, respectively :

	Per cent.
A	29.2
B	26.4
C	24.4
D	26.2
E	25.2
F	24.6
G	23.9
H	24.4
I	24.5

All of the above assays would seem to show that the results yielded are correct to within about one and a half per cent., and in my opinion it would be perfectly safe to consider that as a reasonable margin of error.

In consideration, however, of the character of the process of assay as well as the character of the mixture and of the samples analyzed, I do not believe the analyst would be justified in reporting any *exact* amount of oleostearin found and have therefore adopted the form of reporting that the sample submitted contained "not less than —— per cent., nor more than —— per cent.," the margin of the error being as stated.

UNITED STATES LABORATORY.

THE MEASUREMENT OF THE COLORS OF NATURAL WATERS.

BY ALLEN HAZEN.

Received January 30, 1896.

THE diffusion of more accurate information and more rational theories as to the causation of diseases during the past few years has resulted in simplifying and changing many of the problems presented in connection with the chemical analysis of public water supplies. The healthfulness of a water for such use is determined to a much greater extent than formerly, by critical inspections of the sources of supply, particularly in the case of surface waters; and information as to the size of the water shed, flow at different seasons, amount of storage and character of the storage reservoirs, together with full information in regard to the population on the water shed and the way it disposes of its sewage, are more important and frequently adequate in themselves to determine the wholesomeness or unwholesomeness of a water; and the use of chemical analysis in connection with the investigation of such problems is rather in serving as an index of the varying amounts of contamination at different times, than in showing the presence or absence of substances which are in themselves injurious to health. Bacterial examinations also, which have become so frequent and necessary in connection with analyses of this character, play also their part in measuring such fluctations.

There are, however, several determinations which indicate in themselves substances desirable or undesirable in a public water supply, and among these perhaps the most important are the hardness, the color, and in the case of ground water supplies, the iron; and although the color is determined mainly for its own