and the alcohol distilled off, the distillate always contains small quantities of compounds having the characteristic odor of formaldehyde and the power of reducing silver nitrate, but that these compounds are unsaturated bodies of unknown nature.

Other aldehydes can be removed by digestion with resorcin and sulphuric acid, or with aniline and phosphoric acid. Their presence is indicated by the usual aldehyde reactions or by the resorcin test.

Phenols and bases will combine with any formaldehyde that may be made in the course of a test. They must therefore be removed—by distillation from sodium or potassium hydroxide in the case of phenols (this treatment also removes acids)—by distillation from dilute sulphuric acid in the case of bases.

Various compounds such as coloring-matters, etc., can be removed by simple or fractional distillation, by filtration through bone-black with or without previous treatment by lime, or by extracting the alcohol with water and testing the aqueous extract after distillation.

It is best to test only solutions wholly soluble in 2 to 3 parts of water, that will distil between 50° and 100°.[1]

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THE ESTIMATION OF FAT IN INFANT AND INVALID FOODS.

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IN THE year 1889 there was published in the *Journal of Analytical Chemistry*, page 381, a new process for determining the percentage of fat in milk, cream and skimmed milk. Since that time I have found this process capable of giving very satisfactory results in the determination of fat in condensed milks, infant foods, confections, etc., to which substances the usual methods of fat extraction with ether, or low-boiling gasoline in a Soxhlet apparatus, seem to be inapplicable.

The difficulty of extracting the fat from the dry residue of a diluted, sweetened, condensed milk by the usual fat solvents has been fully appreciated for many years, and other methods have been devised for making this determination.

[1] Mulliken, Scudder: *Am. Chem. J.*, **24**, 447. The question is here treated entirely from the standpoint of the resorcin test, but the general principles remain the same.

At the present time probably the most widely used method of estimating fat in condensed milk is the modification of the Babcock process devised by Prof. A. E. Leach[1]. As is well known, the Babcock volumetric process fails when applied to sweetened condensed milks, on account of the charring action of strong sulphuric acid on sugar. Leach overcomes this difficulty by removing the sugar in solution while he retains the fat in the precipitated curd. By Leach's device, the Babcock process is made applicable to condensed milks because of the fact that the sugar and fat can be largely separated through the agency of the curd of the milk. In cases where the fat cannot thus be separated from sugar, or other objectionable substances, which might produce a precipitate of carbon under the influence of strong sulphuric acid, Leach's modification is of no service. In infant foods where the percentage of sugars and dextrin is high, neither Leach's method nor the usual gravimetric methods seem applicable, and it is in samples of this character that my process, although among the oldest of the rapid volumetric processes for estimation of fat in milk and cream, may still be useful.

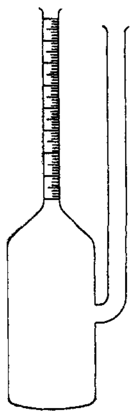
The following results of experiments made by my assistant, Mr. H. M. Loomis, show very clearly the difficulty encountered in attempting to extract the fat in infant foods by the usual method. A sample of Horlick's malted milk gave 1.91 per cent. of fat by extraction with petroleum ether for forty-eight hours in a Soxhlet apparatus, while 8.7 per cent. was obtained by the volumetric process. Borden's malted milk gave, by the method first mentioned, 0.83 per cent. fat; by the second, 6.30 per cent. Professor McGill, by extraction with petroleum ether, found 1.41 per cent. of fat in a sample of Horlick's malted milk[2].

In several samples of infant foods, the residue from forty-eight hours' extraction with petroleum ether, was subjected to the volumetric process, and an additional quantity of fat was obtained. To more carefully test the accuracy of the process, a mixture of powdered casein, sugar, dextrin, and fat of known proportions was made in the laboratory and submitted to analysis. Unfortunately the results of this experiment are not to be found, but I can state that the results obtained by the test were in close accord with the amount of fat actually used in preparing the mixture.

[1] This Journal, 22, 589.

[2] See "Food Inspection and Analysis," by A. E. Leach, p. 271.

The following is a description of the process as applied to milk:



5 cc. of the milk to be tested are delivered through the side tube into a flask of the construction shown in the figure. To this is added 2.5 cc. of 80 per cent. acetic acid, and an equal volume of concentrated sulphuric acid. After mixing the milk and acids, the flask is set in hot water until the contents turn a coffee color. It is then removed and cooled; 4 cc. of ether are added, and mixed thoroughly with the liquid. The flask is again placed in hot water and the ether allowed to boil off. A layer of supernatant fat will then be found floating on the surface of the liquid. By pouring hot water down the side tube, the melted fat is raised into the narrow graduated tube at the top of the flask where its volume can be read. The flask is graduated for 5 cc. of milk to read in tenths of per cent.

In case of infant foods, introduce through the side tube 1.72 grams of the powder, then add 5 cc. of water and bring the powder as far as possible into solution. Now proceed in the same manner as with milk. Multiply the result by 3 (1.72 grams is one-third of the weight of 5 cc. of milk).

To determine fat in sweetened condensed milk, to 1 part by weight of the milk, add 4 parts, by weight of water and mix thoroughly. Proceed with this sample the same as with milk. Multiply result by five.

The style of flask used is a matter of no importance provided there is sufficient means of escape for the ether vapor and a sufficiently delicate means of reading the fat column. In case the larger tube is made to enter at the top of the flask, it should reach only a short distance into the bowl so that it will allow free escape of the ether vapor through it. In the flasks used by me, the bowls have about the same volume as the bowls of the Babcock milk flasks.

The process above described will, I believe, give reliable results in cases where a process, like the Babcock, requiring the use of large quantities of sulphuric acid would fail. The charring action of the mixture of strong acetic and sulphuric acids is less than that of the sulphuric acid alone. Furthermore, in this process, the dissolving as well as the charring action of the mixed acids depends largely upon the application of heat which is under control and can be stopped at any desired point. As a matter of fact, the success of the process will depend largely on the judgment used in regulating the first heating. I have found it better to avoid charring even though solution is not obtained. At this stage a clear liquid must not be expected. After the emulsified fat has been dissolved in the ether and finally raised by the addition of hot water the fluid in the flask will appear clear or nearly so.

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NOTE.

Changes of Color Caused by the Action of Certain Rays on Glass.— While working on this subject two articles have appeared which render a detailed account of my experiments unnecessary.

Sir William Crookes[1] has noticed that glass from South America containing manganese becomes violet on exposure to the sun's rays and Franz Fisher[2] has observed the same phenomena with ultraviolet rays from a mercury vapor lamp. There are a few suggestions quoted from the papers of Sir William that I may note:

"It would be interesting to hear if travellers in other tropical countries have observed any such change of color of glass."

My samples came from New Mexico and were intensely colored.

"It is hardly conceivable that there can be a special radioactivity of the soil in certain parts of Chili and Bolivia sufficiently powerful to produce the effect."

The sand from New Mexico was not radioactive. A bottle partly buried showed the greatest change of color where most exposed to the sun's rays. Different samples that have been exposed to the sun's ray, presumably for several years, show a depth of color approximately proportional to the manganese present.

"Sunlight and radium both produce similar effects in these respects. Their modes of action are known to be, in the main, very different, but it has been clearly shown that, in general, variation in time being disregarded, what radium is capable of doing in the way of inducing chemical change, ionizing gases, producing phosphorescence, and impressing a photographic plate, sunlight will also effect."

1 *Chem. News*, Feb. 17, 1905, p. 73.

2 *Ber. chem. Ges.*, S. 946, 1905.