shows that the acid is too strong, and it should be diluted to a specific gravity of 1.82 before using, or a little less of the acid could be used for the test.

It sometimes happens in testing buttermilk, that is quite sour, that the addition of water to bring the fat into the neck of the bottle where it can be measured, causes a precipitate of casein or other matter which mingles with the fat and prevents an accurate reading. This difficulty has also occurred a few times with milk that had stood a considerable time before testing; it may be entirely avoided by filling the bottles with a hot mixture of equal parts of sulphuric acid and water instead of water alone.

The greatest source of error is in the graduation of the tubes, and no one should purchase tubes except from reliable parties who will guarantee their accuracy.

The above is an accurate method of determining the amount of fat in milk, and promises to be of great use to the dairyman. It is used in the laboratory to select those milks which, containing a low per cent. of fat, are to be subject to further analysis.

*Analysis of Milk.*—The adulteration of milk is determined by a more or less complete analysis of the sample. Except in special cases the analysis is confined to a determination of the three constituents, viz.: Total solids, fat, and solids not fat. To understand the significance of a milk analysis a knowledge of the methods employed is necessary. There are many methods in use, differing slightly in material used or manner of manipulation. Each analyst selects the one most adapted to the conditions under which he works and the apparatus at his disposal. The method employed in the State laboratory is as follows: A nickle-plated perforated copper tube is filled with washed and ignited asbestos, and carefully dried at 100° C. The tube and contents are weighed and about 2 c. c. of the well-mixed milk are dropped on the asbestos, and the tube again weighed. The difference in the two weights gives the weight of the milk taken. The tube is then placed in a drying oven, heated by gas and containing a thermometer by which the oven is kept at a temperature of 100° C.
(212° F.) Here the tube and its contents are kept till all the water is expelled; this generally takes three hours. It is then removed, allowed to cool in a desiccator and weighed. The final weight is the weight of the tube plus the total solids of the milk. The loss in weight from the combined weight of the tube and milk is the weight of the water in the milk taken. The fat is now determined by placing the dried tube in a fat extractor and subjecting it to the action of dry ether. The ether dissolves the fat from the milk solids, but has no effect on the solids not fat. The solution of fat in ether is received in a weighed glass flask, the ether is distilled off, leaving the fat behind. The flask and fat are now placed in the drying oven, allowed to remain till the last traces of ether have been driven off, removed, cooled and weighed. The increase of weight in the flask represents the amount of fat present in the milk. From these figures a simple calculation will give us the percentage composition of the milk. The figures obtained from an analysis like the above will enable the chemist to judge of the quality of the sample in hand, so far as the removal of cream or the addition of water is concerned. Adulteration by skimming is shown by the low per cent. of fat. This may be as in cases found in Milwaukee as low as one per cent. In determining if a sample of milk has been watered, advantage is taken of the fact that the solids not fat of herd milk rarely falls below nine per cent. Taking, then, nine per cent. as the standard for solids not fat, the amount of water added may be calculated. The following analysis of a sample of milk delivered at a cheese factory shows the effect of watering: Total solids, 8.58; fat, 2.33; solids not fat, 6.25. The amount of water added is determined by the following proportion: 

$$8 : 100 :: 6.25 : x; \ x = 69.45.$$ 

The milk, therefore, contained, if the standard was fixed at 9 per cent. solids not fat, 69.45 parts of standard milk, and 30.55 parts of added water.

It is estimated that about 90 per cent. of the adulteration of milk is in skimming and watering. The adulteration of the other 10 per cent. consists in the addition of material to
preserve the milk, to increase the specific gravity, or to improve the appearance of the milk. The following substances have been used as adulterants: cane sugar, glucose, flour, starch, dextrine, solution of starchy substances; gum arabic, gum tragacanth, yolk of egg, white of egg, caramel, brown sugar, gelatine, isinglass, licorice juice, brown extract of chicory, extract of marigold, carrots, annotto. The following cases are also on record: the addition of glycerine, emulsions of oleaginous seeds, also the addition of old milk, buttermilk and condensed milk to conceal watering. Preservatives are also added: bicarbonates of soda, boracic acid and borates, salicylic acid, common salt and glycerine have been found.

The great majority of cases consists in the removal of cream or the addition of water. The addition of water is not only a direct fraud on the consumer, but recent investigations would indicate that this addition of water may bring about the spread of contagious diseases. Chas. Girard (Rapport sur les Travaux du Laboratoire Municipal 1885), makes the following statement: "It is well known that water is a vehicle for contagious diseases; wells, cisterns, receptacles of every description that serve for the storage of water, may become charged with organic matters injurious to health. Thus it is that milk which by itself is very liable to fermentation, becomes dangerous when mixed with contaminated water. A great number of ferment germs may be introduced into the milk and there developed with great rapidity. Milk dealers in Paris have been known to add to their cans water taken from the gutter. Such water, infected with germs and putrid matter, constitutes a veritable poison. Diarrheal diseases, vomiting and colics are the invariable sequences of the ingestion of milk adulterated with such matter."

The frequent tracing of the source of typhoid and scarlet fever to a contaminated milk supply, shows that this fear is not by any means an idle one. The presence of nitrates and nitrites is direct proof of the use of contaminated water. These salts are not found in normal milk, even if the salts have been fed to the cows.
Cane sugar is added to conceal watering; its use, however, must be limited, as any large amount will give a decided sweet taste. Glucose, flour and other starch containing substances, dextrine and gums are added for the same purpose as cane sugar, to give a body to watered milk. Gum tragacanth has been used, not for increasing the specific gravity, but to cause the milk to froth. Coloring matter as annatto and carrots are very liable to be found in watered milk. Skimmed milk having too blue a tint, the coloring matter is added to bring back the yellow tint which to the public eye is a guarantee of purity. A simple method for testing for annatto is as follows: one hundred c. c. of the suspected milk are rendered alkaline by the addition of 5 c. c. of a solution of carbonate of soda, and are poured into a jar five inches high. A strip of filter or blotting paper five inches long by one-half wide is then placed in the jar and allowed to stand in the dark for twelve hours. This strip is removed, carefully washed, when if annatto is present, it will be of a pale salmon color, and if dipped into a solution of stannous chloride will show a pink color. The addition of coloring matter to milk is usually in the form of an alkaline solution. Sometimes, however, a mixture devised especially for the purpose is used. A mixture of this kind largely used in San Francisco, had the following composition; common salt, saltpetre, traces of caustic soda, and a large quantity of sugar. The color is due to caramel. The above compound is dissolved in water and the solution used for adulterating milk.

Decomposition of Milk.—Milk when left to itself at a temperature of above 90° F. undergoes rapid decomposition. The first sign of this breaking up is the evolution of carbonic acid gas. The fermentation is arrested at this point by means of heat or antiseptics, the decomposition is arrested and the milk remains sweet. If the fermentation is allowed to continue, the next step is coagulation of the casein, owing to the formation of lactic acid. The formation of lactic acid from the milk sugar gives its name to this species of ferment. As has been shown by Pasteur, the lactic ferment is due to the presence and growth of one of the lower