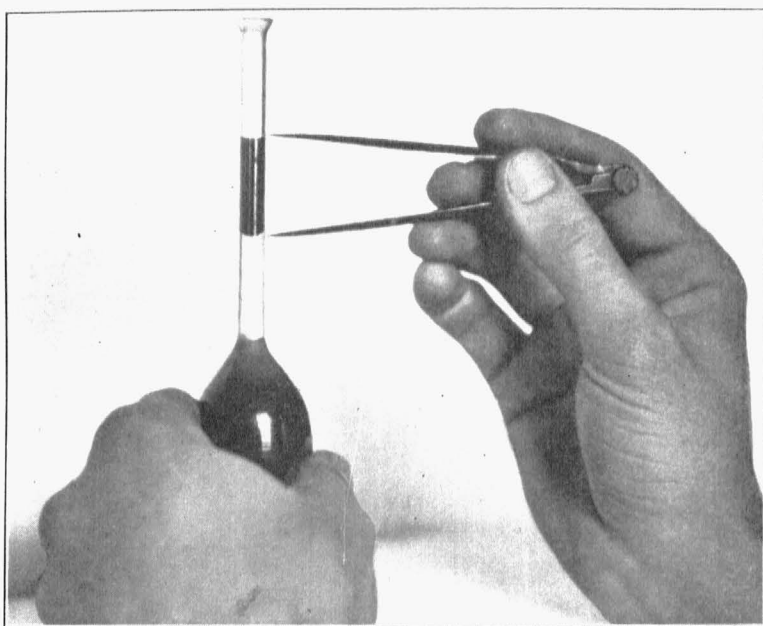


Testing Milk and Cream

W. P. HAYS



The Babcock test for butterfat, named for its inventor, Dr. S. M. Babcock of the Wisconsin Agricultural Experiment Station, is a rapid, accurate, inexpensive and simple method of testing milk and milk products for the percentage of butterfat. It is based upon the action of sulphuric acid and the use of centrifugal force.

The sulphuric acid dissolves all the milk solids except the fat and as a result allows the fat to rise more rapidly. The chemical action resulting from the addition of the acid generates heat which melts the fat globules and causes the fat to rise more rapidly. The separation of the fat is further

aided by the increase in specific gravity of the serum caused by the heavy sulphuric acid.

The centrifugal force throws the heavy parts violently outward and the fat is gradually forced to the center (the top of the mixture).

TESTING WHOLE MILK

The steps to be followed in the operation of the Babcock test are:

1. Secure a representative sample of milk.
2. Measure out 17.6 c.c. of this milk with a pipette.
3. Transfer the milk from the pipette to the test bottle.
4. Add 17.5 c.c. of sulphuric acid to the milk in the test bottle.
5. Thoroughly mix the milk and acid by shaking with a rotary motion.
6. Place the bottles in the centrifuge, (Babcock tester), cover, and whirl at the proper speed for 5 minutes.
7. Add hot water until the contents rise to the neck of the bottle and whirl again for 2 minutes. Next add enough more hot water to bring the fat column entirely within the graduated portion of the neck of the bottle and whirl again for 1 minute.
8. Read the test at a temperature of about 135° Fahrenheit.

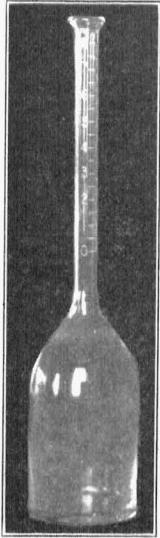


Fig. 2. — A whole milk test bottle.



Fig. 3.— Pipette holding 17.6 c. c. of milk.

Securing a Representative Sample.—Butterfat in milk exists in minute globules in suspension. These, being lighter than the rest of the milk, tend to rise, carrying with them small amounts of the other solids resulting in the familiar creaming of milk. Before the test is made, care must be taken that the sample represents a fair average of the milk to be tested. The milk should be thoroughly mixed by pouring back and forth from one vessel to another several times, or by thorough stirring. For best results the milk should be brought to a temperature of about 70° F.

Measuring the Milk.—The milk is measured with a 17.6-c.c. pipette. After the milk is thoroughly mixed, the tip of the pipette is immediately inserted

and the milk sucked up with the mouth until it rises well above the graduation mark on the stem. The dry forefinger is then quickly placed over the mouth of the pipette. Holding the pipette vertically with the mark on a level with the eye, gently relax the pressure of the finger and allow the milk to flow slowly out until the top of the column of milk is level with the mark on the pipette. The pipette then holds just enough milk to deliver the correct amount for the test.



Fig. 4.—Correct way to transfer the milk from the pipette to the test bottle.

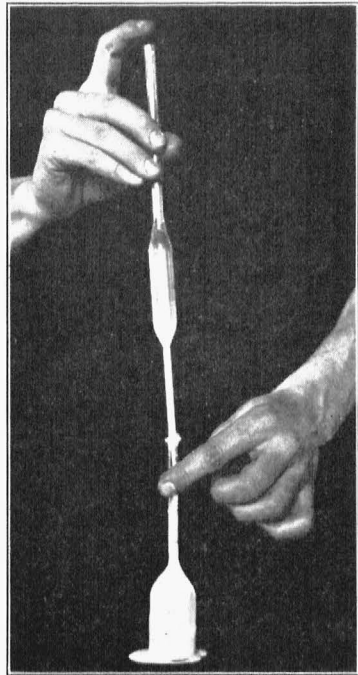


Fig. 5.—The wrong way of transferring the milk to the test bottle.

Bottle should be tilted so that the milk runs down the side of the neck.

Filling the Test Bottle.—Place the tip of the pipette in the neck of the test bottle. Hold both the test bottle and the pipette in a slightly oblique position and let the milk run slowly into the bottle. The object of inclining the test bottle and pipette is to allow the milk to run down the side of the neck of the test bottle thus allowing an exit for the air in the bottle. If this precaution is not observed the neck of the bottle may clog up and some of the milk run over the top. When nearly all of the milk has run out of the pipette, the last drop may be forced out by blowing into the upper end of the pipette. In this manner 17.5 cubic centimeters of milk, (18 grams) are delivered into the test

bottle, the extra one-tenth of a cubic centimeter held by the pipette is the amount which ordinarily remains clinging to its wall.

Adding the Acid.—After the milk has been measured into the test bottle, the acid, also at a temperature of about 70° F., should be added. The acid is added by means of a measuring cylinder. To get the correct amount fill the measure up to the mark (17.5 c.c.). Hold the test bottle in an inclined position and slowly pour in the acid. The bottle should be rotated slowly at the same time so that all milk adhering to the neck will be washed down. The milk and acid should now be in two distinct layers in the bottle. Never drop the acid directly through the body of the milk for charred, black particles may be produced which will obstruct the reading later.

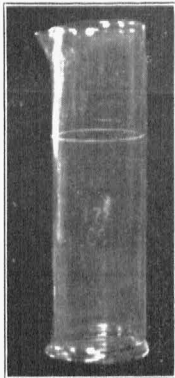


Fig. 6. — Acid measure.

The acid used is commercial sulphuric, specific gravity 1.82 to 1.84. It is very corrosive and destructive to skin, clothing, wood, and most metals. If any is accidentally spilled, it should be washed off quickly and washing soda, ammonia water, or some other alkali applied to neutralize it.

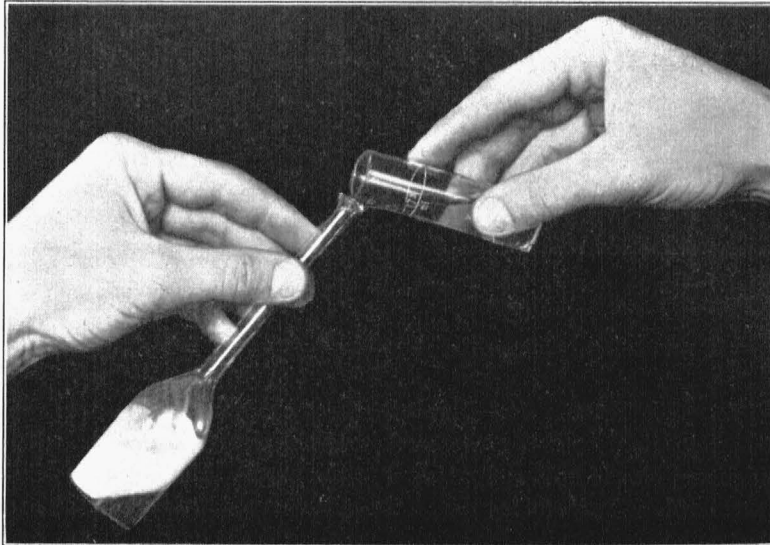


Fig. 7.—Adding the acid to the milk in the test bottle. Note two distinct layers in the bottle.

Mixing the Milk and Acid.—The acid and milk should be thoroughly mixed immediately by shaking the bottle carefully with a gentle rotary motion.

Point the neck of the bottle away from the face because if, in shaking, any of the mixture gets into the neck, it may be thrown out violently. When once begun the mixing must not be interrupted until the solution is complete.

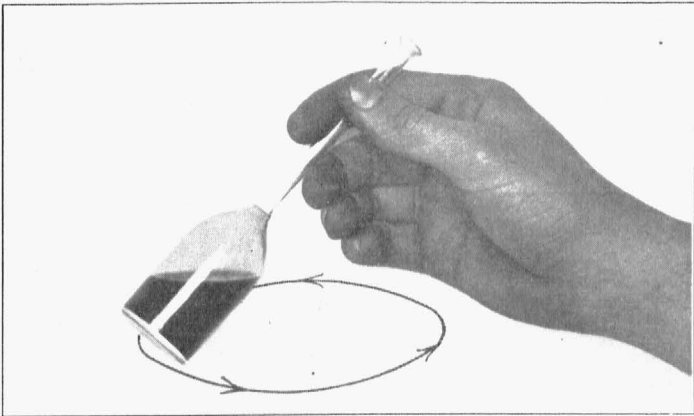


Fig. 8.—Mixing the milk and the acid. A gentle rotary motion gives most complete and safest mixing.

The effect of the acid on the milk is first to curdle it, and then to dissolve the curd. As the mixing progresses, the contents are gradually changed to a dark brown color. A common error with beginners is to fail to continue the shaking until all particles or clots of curd are entirely dissolved.

Whirling the Bottles.—The test bottles with the milk and acid properly mixed are now placed in the sockets of the tester or centrifugal machine. They should be arranged in pairs on opposite sides of the center so that they will balance when rotating. If an odd number of tests is to be made, a test bottle filled with water may be used to balance the machine. It is better to put the bottles in the tester directly after mixing the milk and acid while the

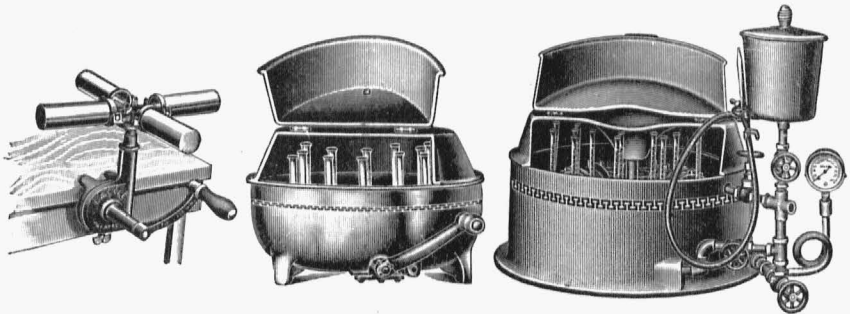


Fig. 9.—Various types of Babcock centrifuges, reading from left to right they are: the 4-bottle hand tester, the 12-bottle hand tester, and the 12-bottle steam tester.

bottles are hot. When the bottles are in place, the tester is covered to keep them from getting cold and to protect the operator from flying glass, if any of them break while whirling. Whirl for 5 minutes at proper speed. This will be sufficient to bring practically all of the fat to the surface.

Adding the Water.—With a pipette, hot soft water is added to the bottles until the contents come nearly to the lower part of the neck. The cover is then replaced and the whirling repeated for 2 minutes. Hot water is again added until the entire fat column is brought within the graduated portion of the neck.

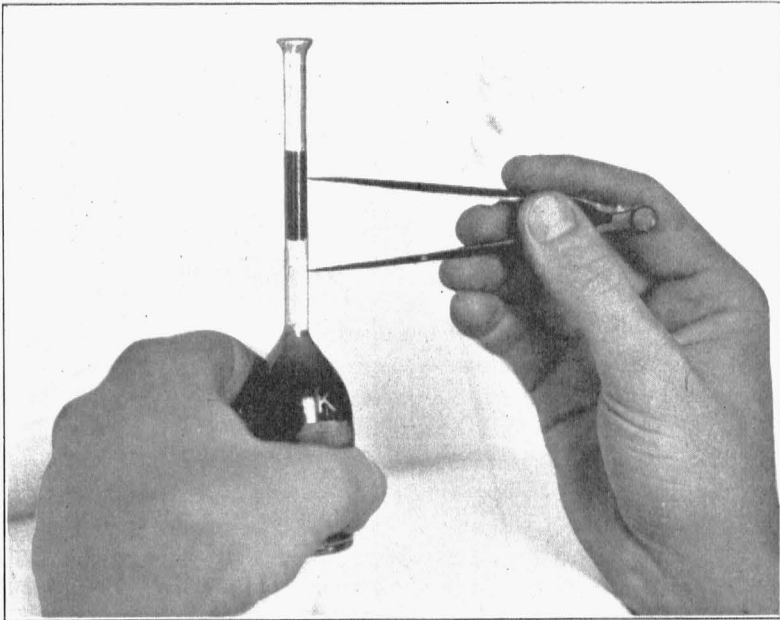


Fig. 10.—Reading the wholemilk test. After measuring the length of the fat column, as shown on the cover page, the dividers are lowered till one point falls on the zero mark. The upper point then indicates the percentage of fat in the sample.

It must never reach beyond the top mark or some of the fat may be lost. Whirling is then repeated for another minute.

Reading the Test.—If the test is successfully conducted the fat will be in a clear, golden-yellow column sharply separated from the clear and nearly colorless acid solution immediately below it and there will be no foam at the top. The bottles must be kept warm either in the tester or preferably in a water bath until read. The reading should always be made at a temperature of between 130° and 140° F. The fat at this temperature will have a well-defined meniscus or curved surface at both the top and the bottom. The reading can

be made best with an ordinary pair of dividers, measuring from the extreme bottom of the lower meniscus to the extreme top of the upper meniscus. The points are placed at the upper and lower limits of the fat column and the dividers are then lowered without changing the "spread" until one point is at the zero mark. The other point will indicate the percentage butterfat in the sample tested. The test bottle used for whole milk is graduated by tenths to either 8 or 10 per cent.

Imperfect Tests.—If the foregoing directions are followed strictly, a perfect test should result. It is not to be expected, however, that the beginner will always meet with success. An imperfect test may result from one or more of the following causes:

1. *Foam or gas bubbles on the fat column obscuring the upper meniscus.* This defect is caused by using hard water. The carbonates of the water are decomposed by the acid and liberate carbon dioxide which forms the foam and gas bubbles. The water used should, preferably, be soft water, but hard water may be used if a few drops of sulphuric acid are added.

2. *A dark-colored fat column containing black particles and with black particles obscuring the lower meniscus.* This trouble results from any one or a combination of the following causes: (a) acid too strong; (b) too much acid; (c) acid at too high temperature when added to milk; (d) milk too warm when acid was added; (e) allowing the acid to drop directly into the milk; (f) an interruption in the mixing of the acid and milk before the solution is complete; (g) allowing the acid and milk to stand too long in the test bottle before being mixed.

3. *A light-colored fat column containing white curdy material obscuring the lower meniscus.* This results from one or more of the following causes: (a) acid too weak; (b) too little acid; (c) acid too cold when added to milk; (d) milk too cold when acid was added; (e) mixing was not continued long enough to dissolve all of the milk solids.

TESTING CREAM

In general, the operation of the cream test is the same as the milk test, but there are some modifications. The most important of these is that the cream sample must be weighed into the bottle instead of being measured.

The Babcock test is based upon the use of 18 grams of milk or cream. When testing milk it is possible to measure out this amount with a pipette accurately enough for all practical purposes, but with cream, conditions are different. Depending upon its fat content and thickness, cream may adhere to a pipette or measure, so that all of it will not run into the test bottle. Furthermore, the specific gravity will vary with the richness and also with the amount of air which the cream may contain. It is, therefore, impossible to obtain a measure which will deliver the correct weight of cream under all conditions, and consequently the cream must be weighed.

Cream test bottles are made for both 18-gram and 9-gram samples. The smaller 9-gram bottle is more widely used because it is more convenient to handle and more accurate to read. Small torsion balances prove very satisfactory for weighing the cream, and may be purchased specially made for cream testing.

Preparing Cream for Test.—A point never to be lost sight of in the testing of cream and milk is that the small quantities taken for the test must be truly representative. The preparation of cream for testing does not differ materially from that of milk. The fat must be evenly distributed and if there are no lumps in the cream this can usually be accomplished by pouring from one bottle to another. If lumps are present it is advisable to first pass the cream through a very fine sieve rubbing the lumps through with the finger and then to mix in the usual manner. If the cream has stood some time in the sample jar, the top may have become hard, leathery, and difficult to mix. In this case the jar should be set in warm water until its contents are warmed to a temperature of about 110° F. when the cream will be softened sufficiently to be easily mixed.

Weighing the Sample.—The weight of the sample depends upon the size of the bottle used. A 9-gram bottle is recommended. The ordinary pipette is most

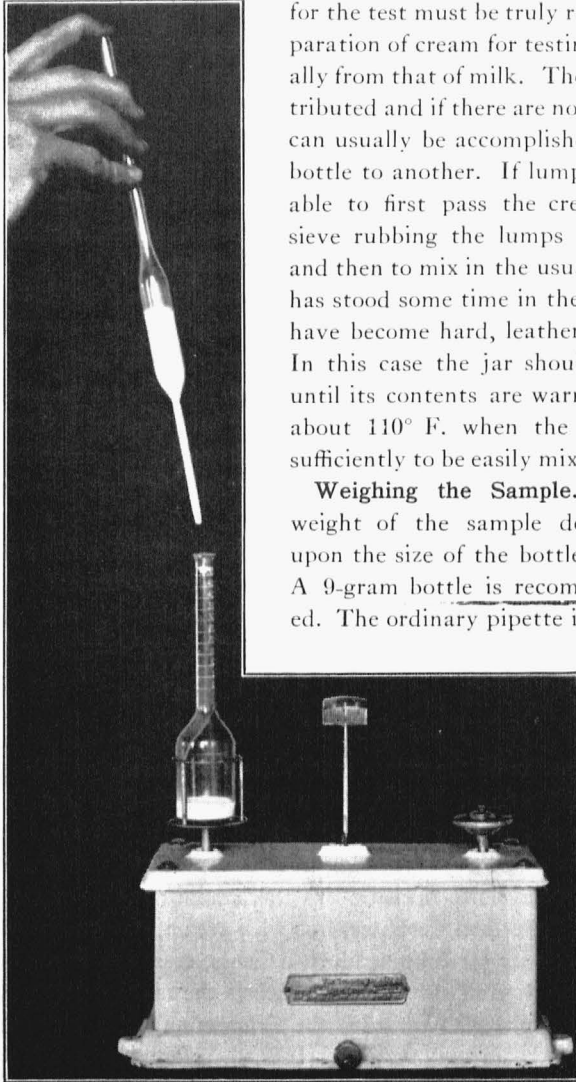


Fig. 11.—Weighing the cream into the test bottle. Add the cream drop by drop until it balances.

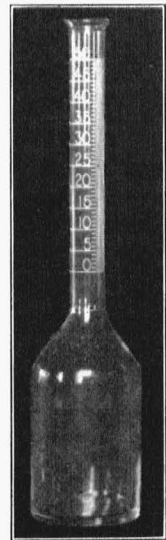


Fig. 12. — A standard 9-gram 50 per cent cream test bottle

convenient for putting cream into the test bottle because the flow can be easily checked when the correct quantity has been run in. The weight must be exact. While beginners often experience some difficulty, practice will bring about proficiency in this operation.

Completing the Test.—Acid is added in the same manner as when testing whole milk except that the quantity of acid required is somewhat less. Usually the best plan is to add the acid until the mixture becomes the color of coffee.

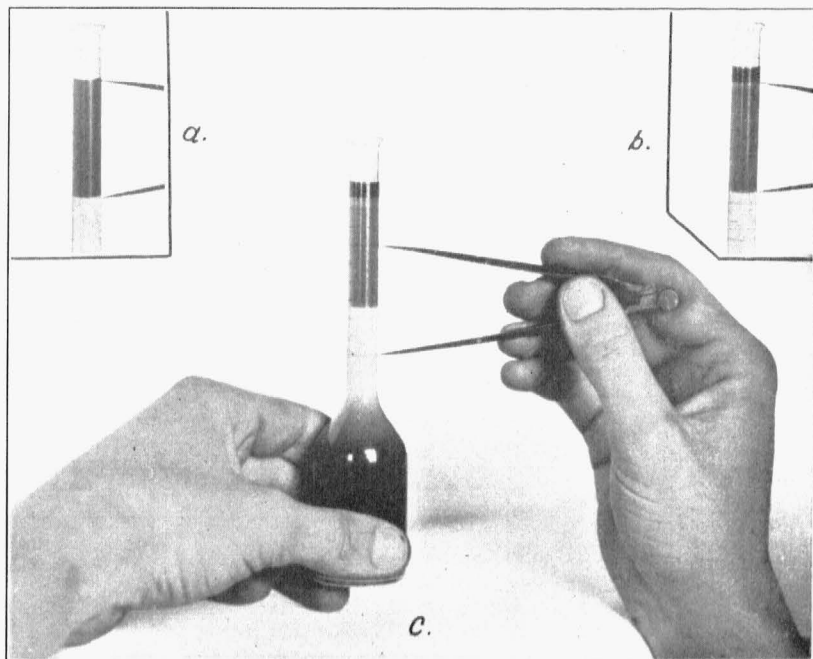


Fig. 13.—Reading the cream test. (a) Measuring the fat column when glymol is not used. (b) Showing how the use of glymol results in more accurate measurement. (c) Reading the percentage of fat.

After the acid is added to the cream proceed, up to the time of reading the test, in exactly the same manner as with milk. The important difference between reading the cream test and the milk test is that in the cream test the fat column included is from the bottom of the lower meniscus to the bottom—not the top—of the upper meniscus. A more accurate reading can be made by adding a few drops of a colored oil (glymol) to the top of the fat column. The glymol levels the top meniscus and the reading is then taken from the bottom of the lower meniscus to the union of the fat and glymol. The test bottle ordinarily used for cream is graduated by five tenths to fifty per cent,

TESTING SKIMMILK AND BUTTERMILK

Skimmilk and buttermilk are tested in the same manner as wholemilk, but since the amount of fat is very small, it is necessary to use a special bottle. A double-necked bottle is used, the larger of the two necks being used for the introduction of the milk and acid, and the smaller neck for the reading of the test. A little more care in mixing the milk and acid should be used to prevent the fluid rising in the smaller neck, also, the bottle should be run in the centrifuge a little longer than for whole milk testing. About 5 to 7 minutes is sufficient for the first whirling, the usual 2 minutes for the second, and 1 minute for the third. The test bottle for skimmilk and buttermilk is graduated by hundredths to one-half of one per cent.

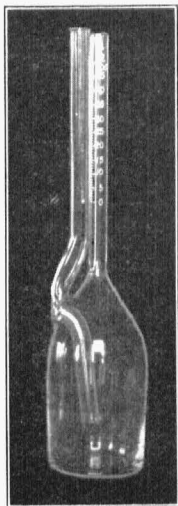


Fig. 14. — A standard skimmilk test bottle.

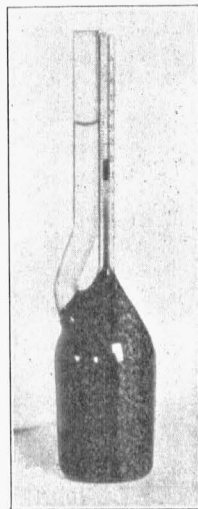


Fig. 15. — A completed test; reading .06 per cent

CLEANING THE GLASSWARE

As soon as all samples are read the bottles should be emptied immediately. An earthen jar with a perforated cover is a safe, convenient receptacle for the waste. The bottles should be given an occasional shake while emptying to loosen the sediment in the bottom. The bottles and other glassware can be easily cleaned with hot water and a good washing powder. A brush should be used as an aid in cleaning. Rinse with clear hot water.

MATERIALS AND APPARATUS

It is very important that the glassware be calibrated accurately. Test bottles and pipettes may be obtained which conform to the requirements of the United States Bureau of Standards, and it is advisable to use them.

Any of the makes of centrifugal machines should prove satisfactory so long as they are run at the speed recommended by the maker.

All glassware, scales, and the commercial sulphuric acid used in the Babcock test are regularly sold and may be secured from practically all dairy supply companies.

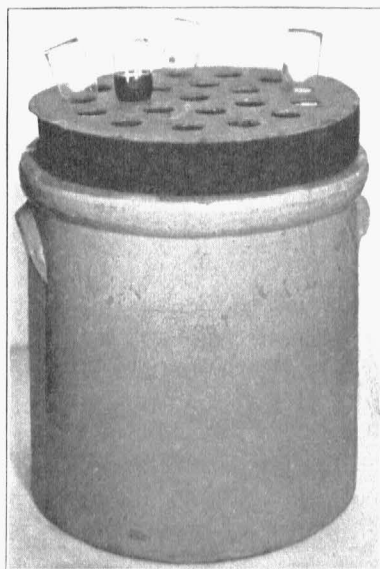


Fig. 16.—Earthen jar for waste acid with a convenient cover for draining the bottles.