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The Babcock Test  
Michigan State University Extension Service  
P.S. Lucas  
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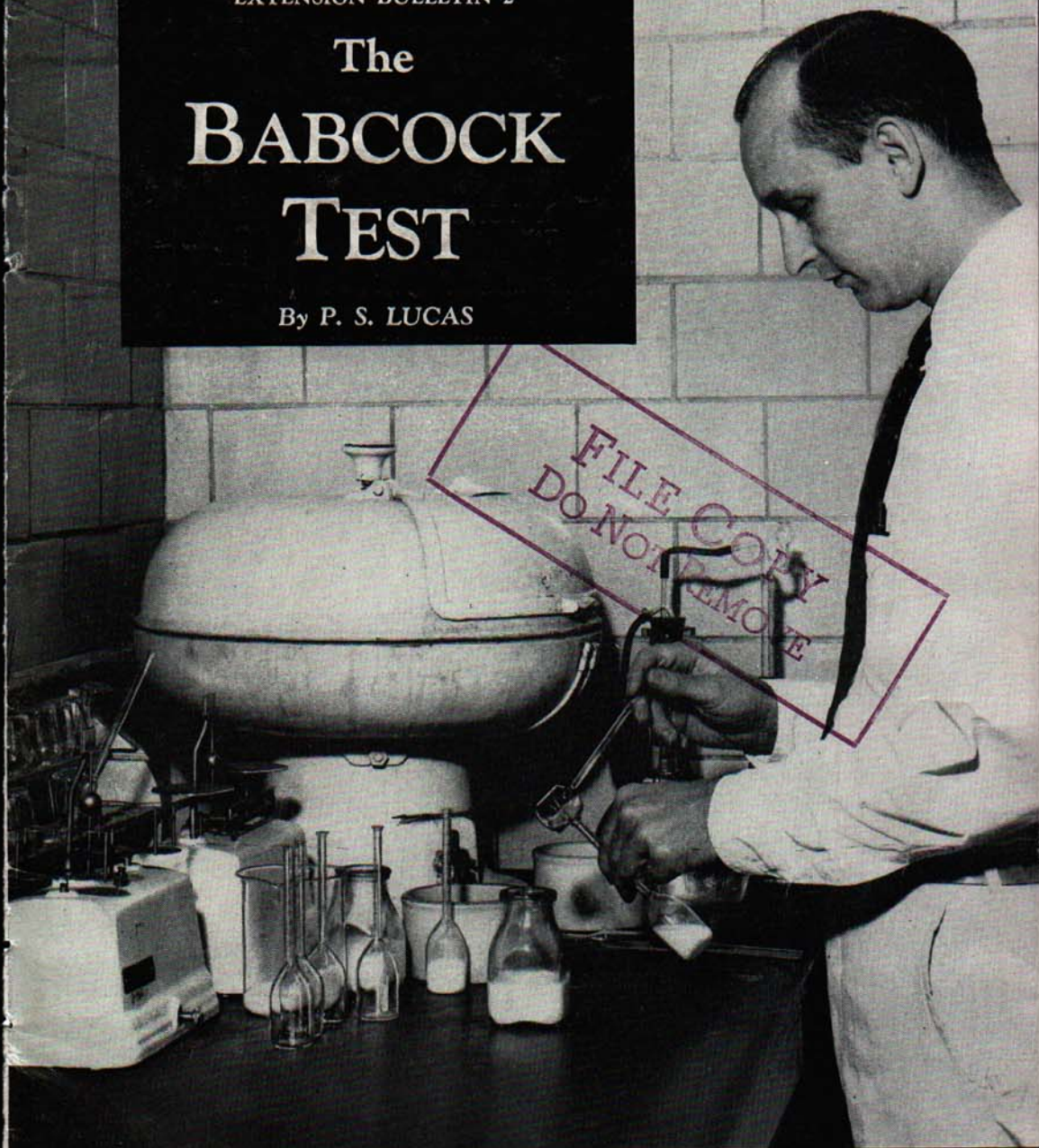
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EXTENSION BULLETIN 2

# The BABCOCK TEST

By P. S. LUCAS



MICHIGAN STATE COLLEGE : : : EXTENSION SERVICE  
EAST LANSING

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# The Babcock Test

By P. S. LUCAS

In Michigan the Babcock test is the legally recognized factory method for the determination of the percent butterfat in cream and milk. By slight changes in apparatus or procedure, or both, the test may be used for the determination of butterfat in condensed milk, buttermilk, skimmilk, whey, ice cream, cheese, and butter. This bulletin is intended as a manual of instruction for the testing of milk and

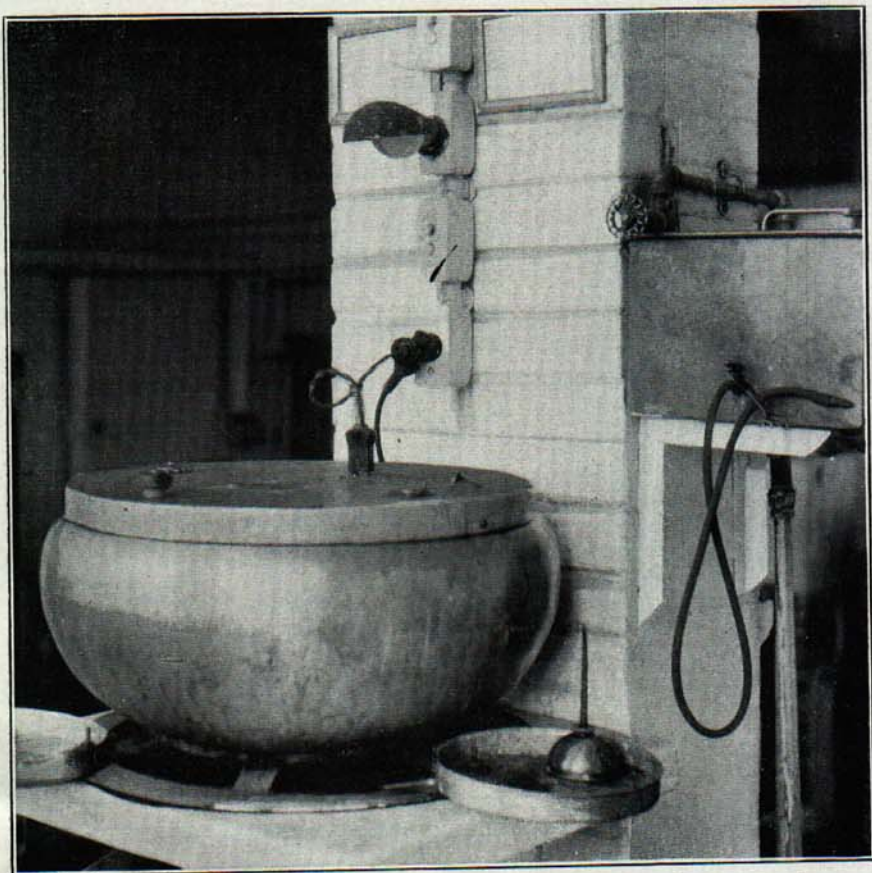


Fig. 1. Babcock tester and water bath in the creamery. Water and steam are piped to the bath, and a hose connected with the bath makes filling of the bottles convenient.

cream, skimmilk, buttermilk, and whey. It is designed particularly for applicants for state testers' license, for plant testers, and for dairymen wishing to test their own herds.

### SAMPLING

Probably more incorrect results in testing are obtained from the faulty sampling of milk and cream than from inaccurate testing. Butterfat globules tend to rise in milk and must be uniformly distributed

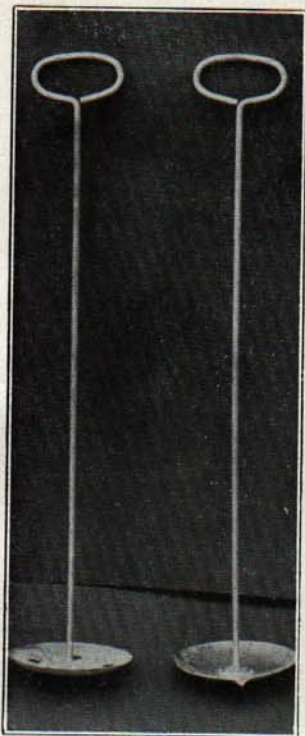


Fig. 2. On the left a milk or cream stirrer; right, combined stirrer and sampler.

through the milk if the sample from which a test is to be made is to supply a correct determination. Proper sampling is accomplished by turning the milk over in the can some 10-12 times, using a stirring rod or sampler, as picture, or by pouring the milk or cream from one container to another some four to six times. More thorough mixing is required for cream than for milk. Usually a 2- to 4-ounce sample is taken from the thoroughly mixed milk or cream. If samples are to be held any length of time before testing they should be stored in air-tight jars in a cool place away from direct exposure to sunlight. Screw-top jars or rubber-stoppered jars are the more popular types of sample jars. The latter are preferable. If the jar is not air-tight, evaporation takes place causing the sample to test higher than it should.

Proper sampling may be difficult, if not impossible, under certain conditions. Cans of frozen milk or cream must be completely melted at a temperature not exceeding 110° F. before a sample may be properly taken. Rapid melting or melting at too high a temperature may cause a portion of the fat to become oily. Once this occurs it is impractical to attempt a remedy. Partially churned cream should be handled in the same manner as frozen cream. Lumpy, heavy cream may be sampled by slowly warming and stirring until the body of the cream becomes smooth.



Fig. 3. Three-ounce screw-top sample jars are best for cream samples; rubber-stoppered jars for milk composites.

In testing individual animals in the farm herd difficulties also arise. A sample for any one cow must be taken from the complete milking of that animal. The fore milk and strippings vary greatly in fat content; the entire milking must be sampled if the test is to be correct. Second, the sample should be allowed to stand an hour before being tested to permit any air or gases to escape.

In case the samples are to be held for some time at the farm before testing or if they are to be sent to some distant point for analysis, they should be preserved by the addition of corrosive sublimate (mercuric chloride), potassium bichromate, or formalin, to prevent the milk from souring. Corrosive sublimate is the most commonly used of the three and is obtained in tablet form. It is poisonous, and the tablets should contain a coloring material, which colors the sample pink or green as a means of warning. One tablet of corrosive sublimate is sufficient for the preservation of a comparatively large sample for two weeks if the sample is kept cool. These colored preservative tablets may be purchased from any of the dairy supply houses.

Potassium bichromate is a yellow powder and is also available in tablet form to be used as a milk preservative. It is fairly efficient for

keeping milk for one to two weeks. Formalin is a liquid, and about 1 cc. (20 drops) should keep a pint sample of milk for two weeks. Both potassium bichromate and formalin are poisonous if taken internally.

It is customary practice for milk plants and cheese factories to take a small amount of milk each day from each patron's milk and add these portions to each other in a tightly stoppered bottle bearing the patron's name or number. These daily amounts taken, to be correct, must be in proportion to the weight of the milk the patrons deliver each day, and when mixed together, they make up what is known as a composite sample. Thus 1 cubic centimeter per pound of milk delivered may be the unit amount taken. Composite samples while legal for milk, are illegal for cream for several reasons.

The composite mixture of the daily milk samples is prevented from souring by the addition of one of the previously mentioned preservatives, usually corrosive sublimate, and is tested two, three, or four times a month. Each addition of the daily portions to the composite jar should be properly mixed in and the jars stored in a cool place, away from sunlight, from one day to the next. Composites should be held no longer than two weeks and preferably should be tested in a week or 10 days. They should be warmed and mixed carefully and thoroughly just before testing. Neither the preservative added to the samples nor the development of acid has any effect in lowering or raising the fat test of the sample.

#### TREATMENT OF SAMPLES

Fig. 4. Milk pipette 17.6 cc.; cream pipette 9 cc.

After the sample is taken, with the exception of the composite it is best tested as soon as possible. Before the sample is to be measured into the test bottle, it should be brought within the temperature range of 55° F. to 70° F. The sample is then mixed thoroughly by pouring from one jar to another several times, and the proper amount pipetted at once into the test bottle. It is bad practice in mixing to shake the sample in the jar because of the incorporation of air bubbles and the great danger of churning the butterfat.

When samples in sample jars are kept too long and under improper conditions the cream layer may become leathery. In such instances it is best to warm the sample to 100° F., mix thoroughly, and pipette at once. Churned samples are treated in the same manner but in this case, as with soured milk, the test obtained is approximate only. To liquefy a sample that has curdled, one-eighth teaspoonful of lye may be added to neutralize the lactic acid and the sample allowed to stand until the curd has broken down. The sample is then mixed and pipetted into the test bottle. Where an alkali is added to samples, the acid must be added very carefully because of the violent chemical action that takes place between acid and alkali. If the acid is added rapidly, part of the contents of the bottle may be thrown out, injuring the operator.

### APPARATUS REQUIRED FOR TESTING

The following apparatus and supplies are required for the Babcock test:

1. Test bottles
2. Centrifuge or testing machine
3. Commercial sulfuric acid
4. Pipettes
5. Acid measure or dipper
6. Dividers
7. Water bath and thermometer
8. Cream balance
9. 9-gram weight

**Sulfuric Acid**—Ordinary commercial sulfuric acid of 1.82 to 1.83 specific gravity (90-92 percent pure) is used for the test. The approximate cost is 5 cents a pound. Chemically pure sulfuric acid is much more expensive and is not required for the test.

**Milk Test Bottles**—The Michigan state law requires the use of specific types of test bottles for both milk and cream, and these bottles are



Fig. 5. Testing acid for strength by means of the acidometer.



tested for accuracy by the Bureau of Dairying, State Department of Agriculture. Legal milk test bottles for Michigan are required to read accurately and directly for an 18-gram sample of milk, to have a total graduated face reading to 8 percent, with the smallest unit of calibration being 0.1 percent, and to be accurate within one-tenth of 1 percent. Milk bottles that have passed state inspection are etched with the letters "S.G.M.," meaning "Standard Glassware of Michigan." Accepted milk pipettes are similarly marked.

**Cream Test Bottles**—Two types of cream test bottles are legal for testing in Michigan: (a) 9-gram charge, 50 percent, 6-inch bottle graduated into 0.5 percent, and (b) 9-gram charge, 50 percent, 9-inch bottle, also graduated into 0.5 percent. The error permitted in these

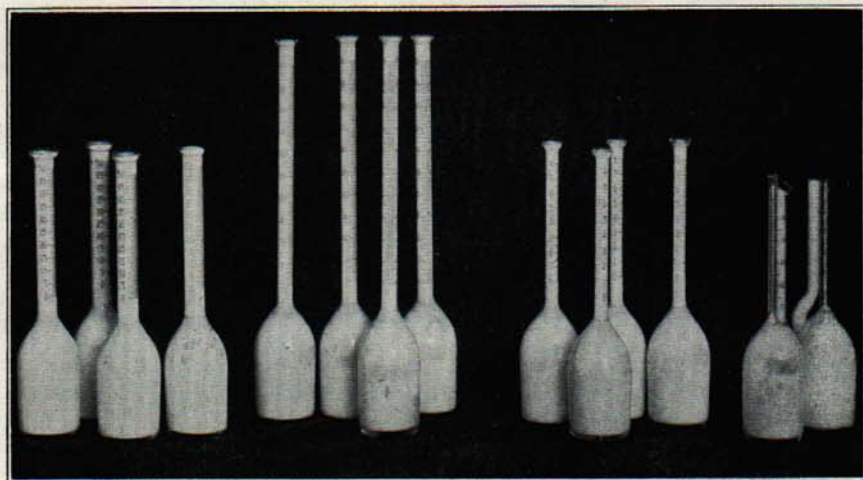


Fig. 6. Cream, milk, and skimmilk test bottles legal for use in Michigan.

bottles is not more than the smallest unit of calibration or five-tenths of 1 percent. Breakage is considerably greater with the 9-inch bottle, and a larger tester is required. Consequently, the 6-inch bottle is used almost exclusively. Cream test bottles are marked "S.G.M." if they meet the requirements for accuracy.

**Pipettes**—The milk pipette is so graduated that when filled to an etched line on its stem, it holds 17.6 cc. of milk, and delivers 18 grams or 17.5 cc. of milk. For transferring cream to the test bottle a nine cc. pipette having a large bore stem is usually used, but inasmuch as cream must be weighed rather than measured the size pipette used is immaterial, except as a matter of convenience.

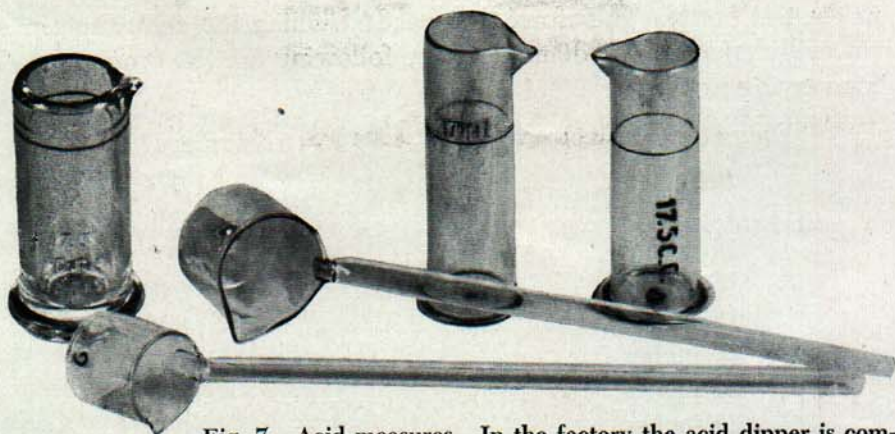


Fig. 7. Acid measures. In the factory the acid dipper is commonly used because of greater convenience.

**Acid Measure**—If the acid is of proper strength, 17.5 cc. are the proper amount to use for milk, and the acid measure is so graduated. Because of its greater convenience the acid dipper is used usually in plants. Automatic measuring devices attached to acid bottles are used in many large plants.

**Centrifuge**—Testing machines are available in varying sizes ranging from 2-bottle to 48-bottle capacity. The hand power tester in either the open or closed style is commonly used for farm testing, while either steam or electrically driven machines are used in factories.

The centrifuging of the test bottles should be carried out in a room at ordinary room temperature. If this is done, heated testers are unnecessary. If the room is cold, however, the tester should be warmed electrically, or by pouring hot water around the base of the centrifuge. Steam-driven testers are normally sufficiently heated due to the steam itself. Unenclosed testers cannot be properly warmed.

It has been found that almost 31 pounds of centrifugal force are necessary for the separation of the butterfat from the other materials



Fig. 8. Acid bottle which automatically measures 17.5 cc. of acid.

in the test bottle. Therefore, the speed at which the centrifuge must run will depend on its diameter. The following are the proper speeds for varying size testers:

Diameter of wheel	Number R.P.M.
10 inches .....	1,074
12 inches .....	980
14 inches .....	909
16 inches .....	848
18 inches .....	800
20 inches .....	759
22 inches .....	724
24 inches .....	693

In filling the pockets of the centrifuge with test bottles, the operator must use care to make certain that the tester is properly balanced. The test bottles should be spaced around the centrifuge, if it is not

completely filled, so that two bottles on one side will be exactly balanced by two on the opposite side. In testers having double rows of pockets, no less than four bottles should be run at a time. In this manner the tester is kept in balance. Unbalanced testers become unsteady and cause considerable bottle breakage, besides injuring the bearings of the tester.



Fig. 9. Common types of calipers used for measuring fat columns.

**Dividers**—Many types of dividers are on the market and are satisfactory, depending on individual preferences. Most readers, however, prefer those having two sharp points.

**Water Bath**—The water bath consists of a tank of water heated to 135°-140° F. and is used to temper the fat in the test bottle neck to the reading temperature required by law. The bath is usually a tank

made of galvanized iron or copper, connected with steam and water, is 8 inches high and of any desired width and length. The copper bath is much more durable and almost as economical as the galvanized iron bath.

**Cream Balances**—Cream scales for weighing cream tests may be purchased in different sizes varying in capacity from 1 to 12 bottles. Usually the balance capable of weighing but one bottle at a time is preferred because ordinarily, though not necessarily so, it is of greater accuracy. In practice, a two- to four-bottle balance is commonly used. When a cream balance is loaded to its full capacity and is in perfect balance it should be of sufficient sensitivity that the pointer will oscillate one division on either side of center on the standard by the addition of .03 gram of weight. This is spoken of as the scale's "sensibility reciprocal". Cream scales to be acceptable legally must have a sensibility reciprocal of no greater than .03 gram (3 centigrams).

### THE TESTING OF MILK

**Measuring the Milk**—Usually a two- to four-ounce sample of milk is taken for testing. Before pipetting the proper amount of this into the test bottle, the fat is uniformly distributed throughout the milk serum by pouring from one sample jar to another four to six times or more if necessary (as when the cream line becomes leathery). Immediately after mixing, the small end of a 17.6-cc. pipette is inserted below the surface of the milk and a sample drawn into the pipette to above the etched mark on its stem. This level of the milk is held by quickly placing the end of the index finger over the end of the pipette, and then slowly lowering the level of the milk to the 17.6 cc. etched ring about the pipette by partially releasing the pressure of the index finger. The pipette stem is then placed as far as it will go into the milk test bottle neck, the milk allowed to run out, and the small portion in the end of the pipette blown out. A small amount (about 0.1 cc.) clings to the side of the pipette. This is accounted for in the regulation of the size of



Fig. 10. Showing proper method of pipetting milk into a milk test bottle.

the pipette, it being so designed as to deliver 18 grams of milk, which is about 17.5 cc.

A ground surface will be found on the bulb of the bottle. This is to provide a means of marking on the test bottle the name or number of the patron whose milk is being tested, or for otherwise identifying the sample.

**Addition of Acid**—The acid being of proper strength (1.82-1.83 specific gravity which corresponds to 90-92 percent purity) and acid and milk being within the temperature range of 55°-70° F., the proper amount of acid to use is 17.5 cc. Weaker or stronger acid may be used, however, by increasing or decreasing the amounts or by varying the temperatures of milk or acid, or both. Warmth hastens the action of

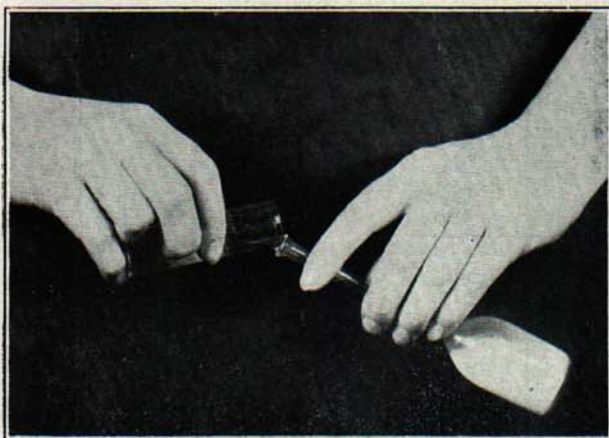


Fig. 11. Addition of acid to a milk test bottle.

acid. Under other than standardized conditions, enough acid should be added so that the mixture immediately after mixing assumes a red mahogany, or deep cherry red color. This may be determined by trial with the first sample, and the amount of acid thus measured, used in subsequent tests.

Such procedure is usually followed in the commercial plant. Amounts of acid may be regulated also by the color of the resulting fat column. For both milk and cream tests, the fat column should be a straw-yellow color. The acid jobber often sends out acid that tests 1.84 specific gravity, and it is common, though poor practice, for the tester to weaken this strength acid by allowing through carelessness or otherwise, the acid in the container to stand exposed to the air. The acid, as a result, absorbs water and becomes weakened. The accompanying table will illustrate how percent purity of sulfuric acid varies with specific gravity.

**Specific Gravity and Percent Purity Equivalents**

1.841 - 97	1.839 - 95	1.834 - 93	1.825 - 91	1.815 - 89
1.840 - 96	1.837 - 94	1.830 - 92	1.820 - 90	1.808 - 88

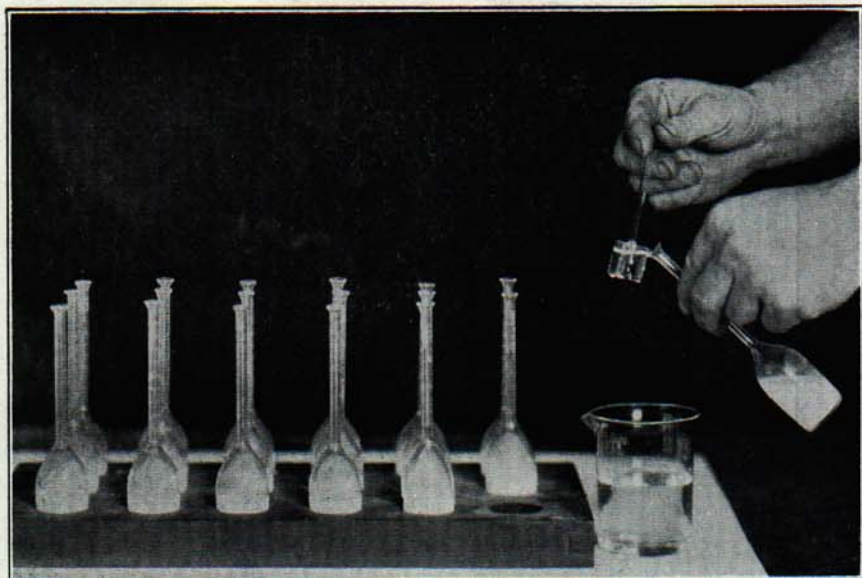


Fig. 12. In the milk plant from 12 to 24 tests are usually made at a time.

It is well to add acid to the milk slowly, to prevent charring of the curd. It is better still to add the total amount in three portions, mixing the milk and acid in the test bottle after each addition by rotating the bottle gently in one plane rather than by shaking the mixture. In adding acid, it should be poured down the side of the bottle neck to prevent choking the neck and to wash down any milk adhering to the side of the neck.

The tests should be whirled first for 5 minutes, after which hot water at a temperature of 140° to 160° F. is added and in quantity sufficient to raise the mixture to the base of the neck of the bottle. The bottles are then whirled 2 minutes, water at the same temperature as that above added so as to raise the fat column into the graduated portion of the bottle neck. The bottles are whirled again for 1 minute. The tests may then be removed from the centrifuge and placed in a hot water bath for tempering before reading. The water in the bath should be at a temperature of 135°-140° F. and in sufficient quantity to be higher than the top of the fat column of each test. The tests should be left in the bath for 5 minutes before removing and reading.

The water used for filling the test bottles should be boiled water, soft water, or distilled water so that bubbles of carbon dioxide will

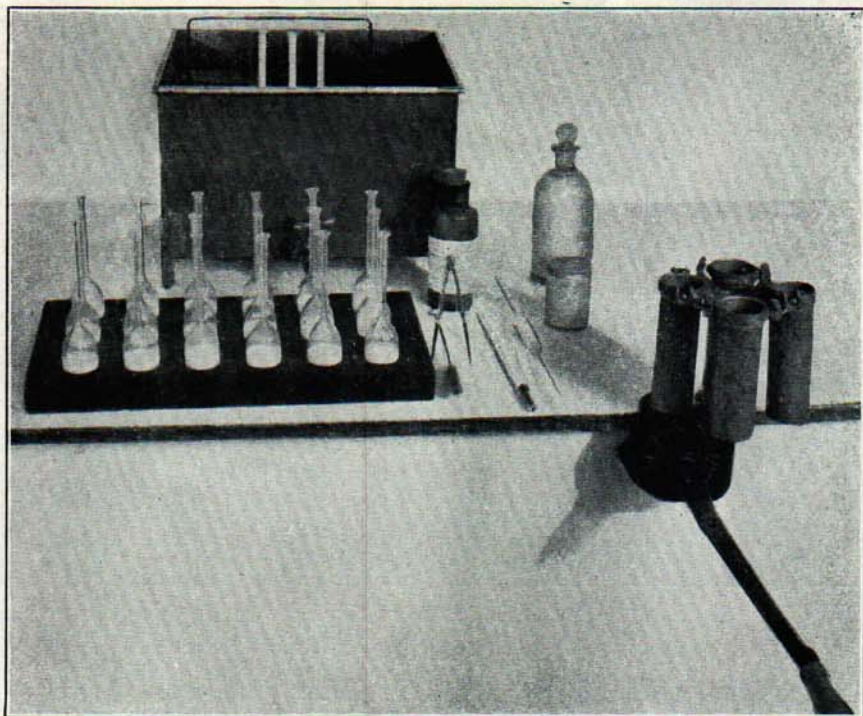


Fig. 13. The apparatus pictured is adapted to farm Babcock testing of milk.

not be released by the action of the acid on the carbonates present in most tap water. These might collect in the fat column, causing foaminess and a consequent inaccurate reading. A few drops of sulfuric acid added to each gallon of water used will cause it to act about the same as soft water, but it quickly corrodes the metal container used as the water bath—especially if the bath is made of galvanized iron. The water is conveniently added to the test bottle from a pipette, but it is common practice in the dairy plant to suspend a tank, provided with an outlet, above the water bath. This tank should be connected with water and steam (for heating the water). The outlet usually has connected to it a small rubber tube closed by means of a pinchcock and long enough to reach each test bottle in the tester. Hot water may be added to the tests by this means.

**Reading the Tests**—After the tests have remained in the water bath for the required 5 minutes, they are ready to be read. Since the test bottles have been calibrated to read accurately at a temperature of 135°-140° F., it is necessary that the fat column be measured

immediately after the bottles are taken from the bath, and before any temperature changes occur. If the tests are read at too low a temperature the results will be low, while if the temperature at reading is above 140° F. the results will be too high.

The top of the fat column has a distinct concave curvature, while the bottom of the column usually, but not always, has a less distinct convex curvature. Either of these curved surfaces of the fat column is called a meniscus, and the proper method of reading the milk test is to measure from the top of the upper meniscus to the base of the lower. In the Babcock test some very small fat globules, composing the so-called residual fat, are not thrown into the graduated neck of the bottle during the centrifuging, but remain in the acid-skimmilk mixture in the bulb of the bottle. This fat usually amounts to about 0.1 to 0.2 percent. Therefore, in order to compensate for this loss of fat, the two menisci are included in the reading. By making the reading in this manner, the Babcock test gives results almost identical with the official chemical determination.

To read a milk test, one point of a pair of calipers is placed at the bottom of the lower meniscus and the other point at the top of the upper. This distance or length is carefully laid off on the graduated portion of the neck, the bottom point of the dividers being placed at the zero marking and the marking observed at which the top point of the caliper rests.

### THE TESTING OF CREAM

Cream, to be sold legally as cream, must test at least 18 percent butterfat. Ordinarily the test ranges from 18 to 50 percent. The fat being lighter than the skimmilk portion, it is obvious that the richer the cream the less it will weigh per unit volume. For this reason it is necessary that the cream be weighed, since a measured amount may vary considerably in weight. Either freshly separated, or sour, fermenting cream may contain bubbles of air or gas that might cause a variation in weight in a volumetrically measured sample. Lastly, the weight of cream delivered into the test bottle would vary, if measured, because it

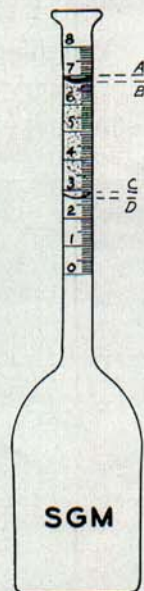


Fig. 14. Milk tests are read from the base of the lower meniscus to and including the upper meniscus, or from A to B as shown in the diagram.



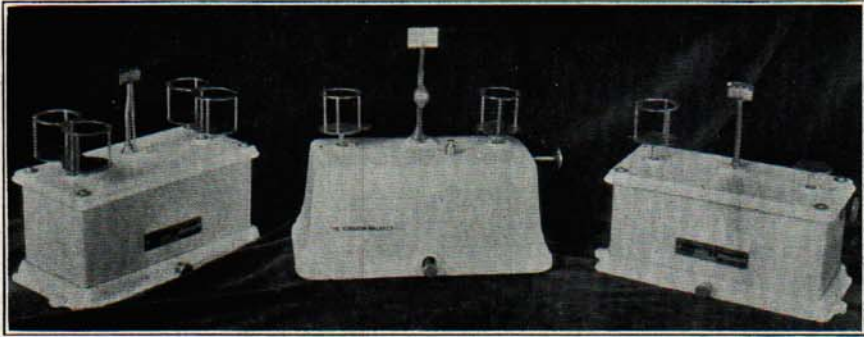


Fig. 15. Types of cream balances.

would be impossible to deliver an entire pipetteful of cream on account of its sticking to the walls of the pipette. For these three reasons cream must be weighed rather than measured.

**Weighing Cream**—Because of the large amount of fat in cream it is necessary to use a test bottle with a larger neck than for milk. A 9-gram pipette is usually used to transfer to the test bottle a 9-gram sample of cream.

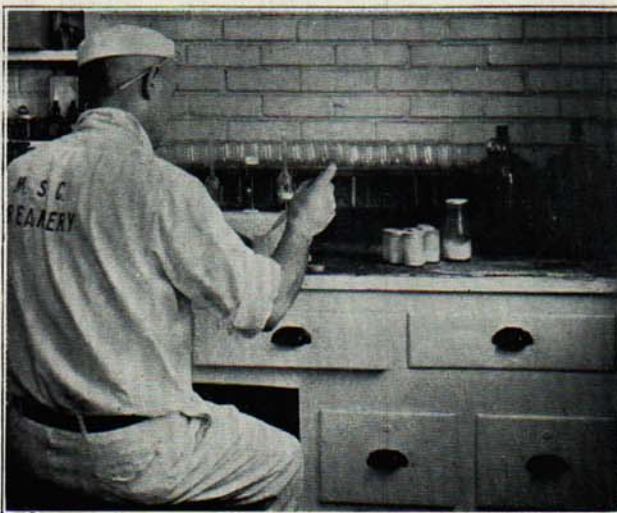


Fig. 16. Weighing cream samples in the butter plant.

The cream balance used for weighing tests must be placed in a position free from drafts and must be level. The bottles are placed on the pans of the scale and the scale balanced so that the pointer oscillates an equal number of spaces on either side of center. A 9-gram weight is placed on the pan

of the balance opposite the cream bottle. Nine grams of the cream sample is weighed into the cream bottle, the weight removed, and if the balance is of greater capacity than one bottle, an equal amount is

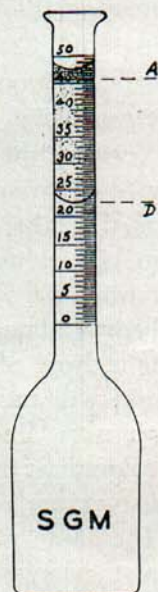
weighed into the bottle on the pan where the weight had been placed. This process is repeated until all the tests have been weighed out.

**Adding Acid to the Cream Sample**—Cream samples usually are only half as heavy as milk and do not possess as much milk solids as the same volume of milk. Much less acid is required, therefore, to digest the milk solids. Three methods are used in adding acid. By the first method, which is the one commonly accepted, the sulfuric acid is added slowly until the color of the mixture is that of coffee to which a liberal portion of cream has been added. About 8-12 cc. are usually sufficient. The bottle is whirled in the tester for 5 minutes at the proper speed, filled to the base of the neck with water at 140°-150° F., whirled for 2 minutes, enough water at the same temperature added to lift the butterfat column into the graduated portion of the neck, and centrifuged again for 1 minute. The bottle is then set in a water bath at 130°-140° F. for 5 minutes before reading.

Another method of adding the water and acid to cream is to add 9 cc. of water to the 9-gram sample of cream, and then add 17.5 cc. of acid of the proper strength. The test is centrifuged as in the method outlined above.

A third method, like the second, is one that is designed as a short cut to the first. Since the third method also gives a clear fat column, has no effect on accuracy, and requires less care and skill in manipulation, it has become widely accepted in both plant and laboratory work. This method consists of adding about 8-12 cc. of acid to the 9-gram cream sample, or to add acid until the mixture of acid and cream, after being shaken, turns chocolate-brown in color. After thorough mixing of the cream and acid a small amount of soft, hot water is added (about 8-15 cc.), and mixed with the acid-cream mixture. The bottles are whirled for 5 minutes, and sufficient hot water (140°-150° F.) added to bring the fat well up into the graduated scale. The bottles are whirled for 1 minute and placed in the water bath for 5 minutes for tempering.

Fig. 17. Cream sample showing how glymol will break the top meniscus. The sample is properly read from the base of the lower meniscus to the line formed by the glymol and butterfat, that is, from "A" to "D".



In reading a cream test, the lower point of the caliper is placed at the lower line of the lower meniscus, and the upper point placed so as to include one-third of the depth of the upper meniscus as pictured. This measured depth of fat column is then laid off on the graduated portion of the test bottle neck, the lower point being placed at zero. In reading any test, care should be taken to hold the bottle in a horizontal position with the upper meniscus level with the eye.

Much inaccuracy has arisen from time to time in the reading of the cream tests due to the upper meniscus. A simpler method of reading the cream test is to add to the surface of the fat column a material that will flatten the meniscus. Colored paraffin oil, also called mineral oil, as well as glymol, is usually used. This oil may be inexpensively colored by using a fat soluble red aniline dye, such as Newport oil red No. 13044. This dye is dissolved in the oil at the rate of 1 ounce for each 25 gallons of oil. Alkanet root may also be used as the coloring material, but it has the disadvantages of being more expensive, requiring a much longer time for solution, and of fading to a yellow color on prolonged exposure to sunlight. A medium heavy refined grade of oil should be used for cream tests. Three or four drops of the brightly colored material will break the fat meniscus and will provide sufficient contrast to the color of the fat to make plain the line of demarcation between the fat and oil. This material colored or uncolored may be purchased commercially under such names as "red reader," glymol, paraffin oil, white mineral oil, etc. The cream test is then read by placing the lower point of the caliper at the lower line of the lower meniscus and the upper point placed so as to strike just at the point of contact between the fat column and the meniscus-leveling material. This measured depth of fat column is then laid off on the graduated portion of the test bottle neck, the lower point of the caliper being placed at zero. In reading any test care should be taken to hold the bottle in a horizontal position with the upper meniscus level with the eye.

### TESTING SKIMMILK FOR BUTTERFAT

The Babcock testing of skimmilk requires the use of a special test bottle having a small graduated neck to accommodate very small quantities of fat. The test bottle has a second neck of a size sufficient for the introduction of milk and acid. The test for fat in skimmilk by the Babcock method is somewhat inaccurate because the fat globules left

in skimmilk are for the most part so small that it is difficult to exert sufficient centrifugal force in the test to throw them to the surface without breaking the bottles. The test results are valuable for comparing with similar tests but are not strictly accurate.

In making the test, a 17.6-cc. pipetteful of the well-mixed sample of skimmilk is placed in the test bottle and is mixed slowly and thoroughly with 20 cc. of sulfuric acid. When the bottles are placed in the centrifuge, the filling tubes should be towards the center. This forces the fat into the calibrated portion of the neck during centrifuging. Tests are whirled in the tester, first for 8 minutes, enough hot water at 140° F. or above is added to bring the mixture to the shoulder of the bottle, tests are whirled again for 2 minutes, hot water added to raise the fat column into the graduated portion of the bottle neck, and whirled again for 1 minute. Unless carefully manipulated and held at the right temperature, the fat column may recede in part to the bulb of the test bottle. By pressing the fore finger of the left hand firmly over the mouth of the filling tube the fat column may be raised or lowered considerably to facilitate reading. The average skimmilk bottle reads in hundredths of 1 percent and may read in total to .25 or 0.5 of 1 percent. It is calibrated to read direct for an 18-gram sample.

**The Normal Butyl Alcohol Test for Skimmilk**—This test is designed to increase the accuracy of the Babcock method of testing skimmilk. Whereas the unmodified Babcock method for skimmilk gives results approximately half as great, or less than, those obtained by the ether extraction methods, the normal butyl alcohol method is nearer the chemical method. In this test 2 cc. of normal butyl alcohol are added to the skimmilk bottle. Nine cubic centimeters of skimmilk is then added, mixed, and is followed by 7 to 9 cc. of sulfuric acid. The test is then completed as for the unmodified method except the whirling periods are 6, 2, and 2 minutes, respectively. Because one-half charge (9 grams), is used, the fat reading must be multiplied by two.

### TESTING BUTTERMILK AND WHEY

The procedure for testing buttermilk is identical to that for testing skimmilk. In testing whey the method is the same except that only 10 cc. of acid are used. The normal butyl alcohol method may be used also for buttermilk and whey.

### DEFECTIVE TESTS

*Charred Fat Columns* are caused by the use of too strong acid, too much acid, too high temperatures of acid, milk, or of both, allowing the test to stand too long before whirling, interrupted and incomplete mixing, and use of soured milk samples, especially if these are warm.

*Curdy Fat Columns* are the result of the use of too weak acid, too little acid, too low temperatures of milk, acid, or both, incomplete mixing, and running the tester too slowly.

*Foamy Fat Columns* are characterized by bubbles of gas in the fat column. If hard water is added to the test, the acid may act on the carbonates, if present in sufficient quantity, releasing small amounts of carbon dioxide gas. The use of soft water, boiled water, or acidulated water, as previously described, will remove the difficulty.

Uneven fat columns are caused by too low temperatures in the testing room, in the tester, or allowing the tests to chill before they are run.

### CLEANING BABCOCK GLASSWARE

Test bottles should be emptied as soon as read. A perforated cover fitted over a large stone jar on a sheet lead tray makes a convenient container for the discarded acid. The emptied bottles may then be rinsed well in hot water containing an alkaline washing powder, followed by a rinse of warm clear water. Bottles that have accumulations of scum may be cleaned by pouring small lead shot into them and shaking until the walls are scoured clean by the shot, or by soaking in a solution of sulfuric acid containing potassium dichromate crystals. Also, test bottles containing deposit may be cleaned by pouring into the bottle a small amount of water and then a small amount of sulfuric acid. The intense heat of the acid-water mixture plus the cleansing action of the sulfuric acid will quickly remove the deposit. The bottles should finally be rinsed with clean warm water. In the large plants a two-compartment sink is desirable for washing test bottles. In the first compartment hot water is placed containing at least 2 percent of alkaline dairy cleanser and in the other warm clear water. By this method 24 bottles in a rack may be washed at a time. If the alkaline hot water is kept very hot no brushing is necessary to keep test bottles in perfect condition.

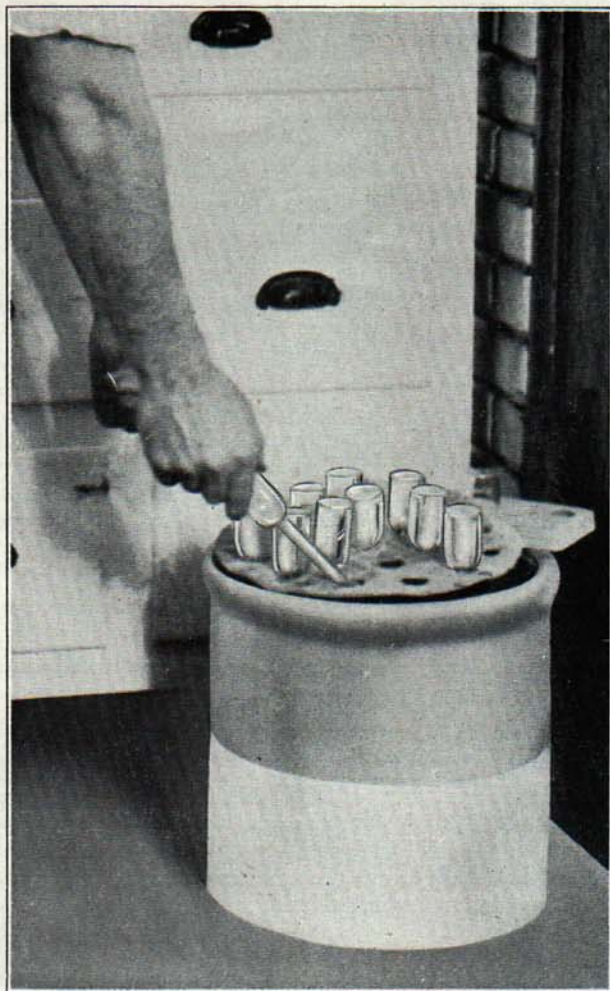


Fig. 18. Used acid, being corrosive, may be emptied into earthenware or lead-lined containers.

LAWS AND REGULATIONS GOVERNING THE LICENSING OF "BABCOCK" TEST OPERATORS, SAMPLING AND TESTING OF MILK AND CREAM AND USE OF THE "BABCOCK" TEST.

*The People of the State of Michigan enact:*

SECTION 1, ACT No. 212, PUBLIC ACTS 1935.

Every person who shall test milk or cream in this state by the Babcock method or otherwise for the purpose of determining the percentage of butterfat or milk fat contained therein, where such milk or cream is bought and paid for on the basis of the amount of butterfat contained therein, shall first obtain a license from the commissioner of agriculture.

Any person applying for such license or renewal of license shall make written and signed application on blanks to be furnished by the commissioner of agriculture for a license to test milk or cream where such milk or cream is bought and paid for on the basis of the amount or percentage of butterfat or milk fat contained therein. The granting of a license shall be conditioned upon the passing by the applicant of an examination, to be conducted by or under the direction of the commissioner of agriculture.

All licenses so issued or renewed shall run for a period of one year from the date of issue unless sooner revoked, as provided in section three of this act.

A license fee of two dollars for each license so granted or renewed shall be paid to the commissioner of agriculture by the applicant before any license is granted.

SECTION 2, ACT No. 212, PUBLIC ACTS 1935.

The commissioner of agriculture shall establish and promulgate rules and regulations not inconsistent with this act that shall govern the granting of licenses under this act and shall establish and promulgate rules and regulations not inconsistent with this act that shall govern the manner of testing, including, but not in limitation thereof, the taking of samples, location where the testing of said samples shall be made and the length of time samples of milk or cream shall be held after testing.

SECTION 3, ACT No. 212, PUBLIC ACTS 1935.

The commissioner of agriculture shall have power to revoke any license granted under the provisions of this act, upon good and sufficient evidence that the provisions of this act, or the rules and regulations of the commissioner of agriculture are not being complied with: *Provided*, That before any license shall be revoked, an opportunity shall be granted the licensee, upon being confronted with the evidence, to show cause why such license should not be revoked.

SECTION 4, ACT No. 212, PUBLIC ACTS 1935.

Any licensee who feels aggrieved at the decision of the commissioner of agriculture may appeal from said decision within ten days by writ of certiorari, to the circuit court of the county of Ingham, and an issue shall be framed in said court, and a trial had, and its decision shall be final unless an appeal is taken to the supreme court.

## SECTION 5, ACT No. 212, PUBLIC ACTS 1935.

In taking samples of milk or cream from any milk can, cream can or any container of milk or cream, the contents of such milk can, cream can, or container of milk and cream shall first be thoroughly mixed either by stirring or otherwise, and the sample shall be taken immediately after mixing, or by any other method which gives a representative average sample of the contents, and it is hereby made a misdemeanor to take samples by any method which does not give a representative average sample where milk or cream is bought or sold and where the value of said milk or cream is determined by the butterfat contained therein.

## EXTRACT FROM SECTION 6, ACT No. 212, PUBLIC ACTS 1935.

Every person, firm, company, association, corporation or agent thereof buying and paying for milk or cream on the basis of the amount of butterfat contained therein as determined by the Babcock test shall use standard Babcock test bottles, pipettes, weights and scales as defined in this act, and it shall be unlawful for any such person, firm, company, association, corporation or agent thereof to falsely manipulate, under-read or over-read the Babcock test or any other contrivance used for determining the quality or value of milk or cream where the value of said milk or cream is determined by the percentage of butterfat contained in the same or to make a false determination by the Babcock test or otherwise, or to falsify the record of such test or to read the test at any temperature except the correct temperature which shall be between one hundred thirty-five degrees and one hundred forty degrees Fahrenheit, or to pay on the basis of any test, measurement or weight except the true test, measurement or weight.

## EXTRACT FROM SECTION 7, ACT No. 212, PUBLIC ACTS 1935.

No person, firm, company, association, corporation or agent thereof, buying and paying for milk or cream on the basis of the amount of butterfat contained therein as determined by the Babcock test or otherwise shall use the "standard Babcock testing glassware" unless each piece of such glassware shall bear the certificate of the commissioner of agriculture thereon.

## SECTION 9, ACT No. 212, PUBLIC ACTS 1935.

Any person violating any of the provisions of this act shall be deemed guilty of a misdemeanor and upon conviction thereof shall be punished by a fine of not more than one hundred dollars and the cost of prosecution, or by imprisonment in the county jail for a period of not more than two months, or both such fine and imprisonment in the discretion of the court. All acts or parts of acts contravening the provisions of this act are hereby repealed.

By virtue of the provisions of Act No. 212, Public Acts 1935, the Commissioner of Agriculture hereby makes and promulgates the following rules and regulations:

1. Applicants for licenses, as provided in Section 1 shall present themselves for examination at such points and on such dates, as the Director of the Bureau of Dairying, or other authorized examiner may designate.

2. The granting of licenses, as provided in Section 2, shall be governed by compliance with Act No. 212, P. A. 1935 and the receiving, by applicant upon examination, of at least 70 points of a possible 100 based on the following credits:

- (a) subjects, written examination—75%
- (b) practical demonstration —25%



3. For the purpose of Section 6, the true measurement or weight shall be 17.6 cubic centimeters for milk and 9 grams for cream and in all tests the cream shall be weighed into the test bottles. To bring the test to the proper temperature for reading, bottles shall be left in water bath at a temperature between 135 and 140 degrees Fahrenheit, for at least three minutes.

4. Glymol: In reading cream tests, the upper meniscus shall be removed by the addition of a few drops of glymol when the test bottles are taken from the water bath. In the case of milk tests, no glymol shall be used, and the meniscus shall be included in the reading.

5. Saving Samples: Samples of milk and cream that are tested for the purpose of determining the percentage of butterfat contained therein and which tests are used as a basis for payment for such milk and cream, shall be saved until 4 o'clock p. m. of the business day following the day on which samples were tested. Such samples of milk and cream so tested and preserved shall be appropriately dated and identified by test number or patron's name and shall be properly covered and sealed to prevent any changes in composition or deterioration of the samples. A sufficient number of such samples shall be tested on each and every visit of authorized inspectors or agents of the Commissioner of Agriculture to determine the accuracy of the testing being done. Complete results of samples tested shall be shown on each inspector's report and a copy shall be forwarded to the creamery receiving the milk or cream.

6. For the purpose of Section 7, the certificate of the Commissioner of Agriculture designating "standard Babcock testing glassware" shall be in the form of the letters S G M which letters shall be blown or marked on the side of each piece of such glassware.

SEAL

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the official seal of the Department of Agriculture, in the City of Lansing, State of Michigan, this 9th day of August, A. D. 1935.

JAMES F. THOMSON,  
Commissioner of Agriculture.