Ohio Agricultural Experiment Station

CIRCULAR No. 122

WOOSTER, OHIO, APRIL 1, 1912

TESTING THE DAIRY COW

OHIO AGRICULTURAL EXPERIMENT STATION

DAIRY HERD

Record of Individual Cows. Pounds of Milk per Day

March 1912		No 1 Bess		No 2 Twin		No 3 Boss		No 4 Lady		No 5 Rose		No 6 May	
1	AM	26	8			15	2	19	7			11	8
	PM	18				11	3	15	9			11	6
2	AM	28	1			14	7	18	4			13	
	PM	16	5			12	7	15	9			13	4
3	AM	27	1			13	9	19	8			13	5
	PM	16	8			12	6	16	3			11	4
4	AM	27	2			15		18	2			13	4
	PM	16	6			12	5	15	8			11	
5	AM	28				15	2	19	8			13	4
	PM	18	6			11	4	16	9			11	
6	AM	26	6			13	5	19	2			13	
	PM	17	3			11	3	16	2			11	6
7	AM	25	7			13	8	20				13	6
	PM	17	5			11	3	16	4			11	6
8	AM	26	2			15		19	4	10	5	13	6
	PM	16	4			11	5	16	2	7	4	12	
9	AM	27	3			14	4	19	4	11	4	13	8
	PM	15				11	2	15	3	7		11	6
10	AM	27				15	1	19		12		13	2
	PM	16	2			12	6	15	5	7	8	11	6
11	AM	26	5	17	4	13	9	19	4	12		13	8
	PM	15	7	12	8	10	5	15	6	7	6	10	8
12	AM	25	5	15	4	14	6	19	9	12		14	
	PM	16	8	12	4	11	2	16	6	8		11	
13	AM	26	8	18		14	4	18	3	11	8	14	
	PM	15	5	12		11	5	16	2	8		10	
14	AM	27	3	20		14	7	18	6	12	8	13	4
	PM	16	5	12		12	4	16		8		12	
15	AM	25	4	20		14	2	19	4	12		13	9
	PM	17	9	12	6	12		16	4	8	4	12	4
16	AM	26	1	20		14	4	17	4	12	8	13	8
	PM	16	6	14		11	7	16	7	8		12	2
17	AM	26		20		14	3	18	6	12	6	13	6
	PM	17		14	9	11	3	16	4	8	8	12	4
18	AM	26	1	19	8	13	4	20	2	13		13	4
	PM	17	3	15		11	3	15	4	8	6	11	
19	AM	24	0	19		14		19	7	13	1	14	2
	PM	18	8	14	6	12	4	16	2	8	5	9	5
20	AM	26	3	19		12	6	19		12	8	10	5
	PM	17	1	14	6	11	5	15	6	8	8	10	5
21	AM	28	6	18		13	2	18	6	12	8	10	4
	PM	16		14	6	10	3	13	6	8	8	10	
22	AM	26	9	18		14		18		12	2	11	
	PM	20		11		10	1	15	6	8	8	10	2
23	AM	25		17		13	6	17	5	12		11	
	PM	15		14		11	6	15	9	8	8	10	
24	AM	24	1	18	4	13	3	17	8	12	6	10	
	PM	15	5	14		10	7	16	2	8		10	8
25	AM	24	2	18		14		19	2	13		11	
	PM	14	6	14		11	3	15	8	8	6	10	6
26	AM	22		17		13		16	9	13	4	13	
	PM	14	9	15		11	8	16	2	8		10	4
27	AM	21	7	17	6	13	6	18	8	13	2	12	4
	PM	14	4	14		10	7	15	8	8	4	10	6
28	AM	22	5	17	5	13	9	17	6	12	4	12	
	PM	13	4	12	5	10	4	16	6	8	6	11	6
29	AM	22	5	16	4	14	4	20		12	6	12	4
	PM	12	5	13	6	9	9	16	2	8		11	4
30	AM	22	4	17		13	4	19	4	12		13	4
	PM	13	6	13	6	11		16	6	8	4	11	4
31	AM	23	1	17	5	12	1	20	4	12	2	13	
	PM	14	2	13	5	12	2	16		9		11	9
Total		1292.7		664.6		790.0		1085.8		495.5		743 0	

Fig. 1. A convenient form of milk sheet. The weight of each milking may be recorded daily and summarized at the end of each month.

TESTING THE DAIRY COW

BY T. R. MIDDAUGH

INTRODUCTION

Many farmers of Ohio are realizing the importance and possibilities of keeping accurate records of the performance of their dairy cows. In this way they are enabled to discriminate intelligently between the profitable and unprofitable individuals which comprise their herds. Because of the growth of interest in dairying, there is constantly a demand for information regarding the methods of determining the composition of milk relative to its fat content.

Two important guides are availabe for determining the amount of milk and butterfat produced; these are the milk scales and the Babcock test. They afford the only satisfactory method of ascertaining the productivity of the dairy cow.

The writer desires to aid, as far as is practicable, all who are interested in learning how to manipulate the Babcock test, and to answer, through the medium of this circular, the many inquiries that come to this department for information along this particular line.

KEEPING RECORDS

In connection with a description of the Babcock test, a few suggestions are offered in regard to keeping records of the production of the dairy cow. Investigations show conclusively that many cows are being maintained at a very small profit to their owners; while a goodly number do not pay for the feed they consume and the labor involved in caring for them. A knowledge of the productive capacity of every cow is essential, if it is desired to receive a profit sufficiently great to justify engaging in the dairy business.

Milk scales and the Babcock test make it possible for the dairyman to ascertain the relative production of a dairy cow at a comparatively small cost. A number of farmers are availing themselves of this opportunity, and are securing some very astonishing results.

In order to be able to decide intelligently which cows are yielding a profit and which are not, it is necessary to know the amount of milk and butterfat produced, and also the amount of feed

each cow consumes. It may not be consistent in all cases, however, to dispose of a cow that does not produce a certain fixed quantity of butterfat in a year. The value of her product should be compared with the cost of the feed consumed in order to form an accurate opinion of her value. Perhaps, not all cows receive the proper amount of feed necessary to yield maximum results; and, no doubt, a great number do not receive more than a maintenance ration, or one which furnishes nutrients in a quantity sufficient only to maintain the animal without gain or loss in body weight. It is true that the same cow might yield different results with different owners. Many causes may contribute to the variation in quantity and quality of the production of the dairy cow.

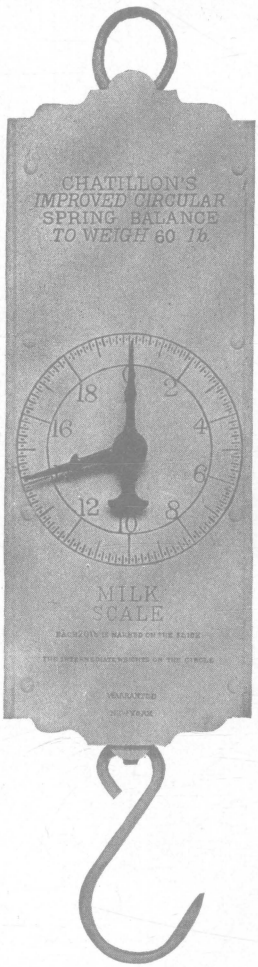

Fig. 2. A spring balance for weighing the milk. Scales weighing by pounds and tenths of pounds are perhaps the most preferable for a dairyman's purpose.

To carry out such a plan the milk from each cow should be weighed daily and tested for butterfat at regular intervals. A pair of scales (Fig. 2) should be hung at a place convenient for the milkers, and a milk sheet (Fig. 1) placed near, so that the weight of each cow's milk may be conveniently recorded. When daily milk records are kept a sample of milk, taken morning and evening, for a period covering from 4 to 5 consecutive days of each month, is sufficient for the butterfat test. This mixed or composite sample is tested for butterfat and the result is taken as an average for the month. The total amount of butterfat contained in the milk for a month is ascertained by multiplying the amount of milk by the percentage of fat, and dividing the product by 100.

The following examples are records of a month's production in milk together with the percentage of fat in each (See Fig. 1):

1,292.7	lbs.	of	milk	testing	3.2	percent	is	equal	to	41.3	lbs.	butterfat
664.6	"	"	"	"	4.2	"	"	"	"	27.9	"	"
790.0	"	"	"	"	5.2	"	"	"	"	41.0	"	"
1,085.8	"	"	"	"	3.0	"	"	"	"	32.5	"	"
495.5	"	"	"	"	5.6	"	"	"	"	27.7	"	"
743.0	"	"	"	"	4.8	"	"	"	"	35.6	"	"

Daily records are not only of value to ascertain the relative value of a dairy cow, but the various factors which affect her daily performance may be observed; and by noting the variation of her daily production, the owner is able more wisely and economically to adjust the feed to the needs of the individual.

It may appear to a farmer or dairyman that too much time is required in carrying out the plan of keeping daily records. It is true that special attention must be given, and regularity and accuracy are quite essential in conducting such work, if one expects to secure definite results; it has been found, however, that the good results obtained have always been more than sufficient to warrant all additional labor, and expense, if any, involved. The reader is referred to previous publications issued by this Station which show results of maintaining accurate records of dairy cows, Circulars 67 and 99.

Where it is found necessary to eliminate weighing of the milk daily in order to economize time, it is recommended that the milk be weighed and tested for butterfat at intervals of one month. This method consists in weighing the milk from each cow for a period of from 2 to 3 consecutive days of each month. Samples of the milk, morning and evening, are taken during the same time the milk is weighed. This mixed or composite sample is tested for butterfat and the result is taken as an average for the percentage of butterfat for the month. The average weight of milk for the number of days the milk is weighed will furnish a basis from which the total month's milk production may be found. This method will only approximate the actual production, but will be close enough to provide a means by which the unprofitable cow in the herd may be discovered.

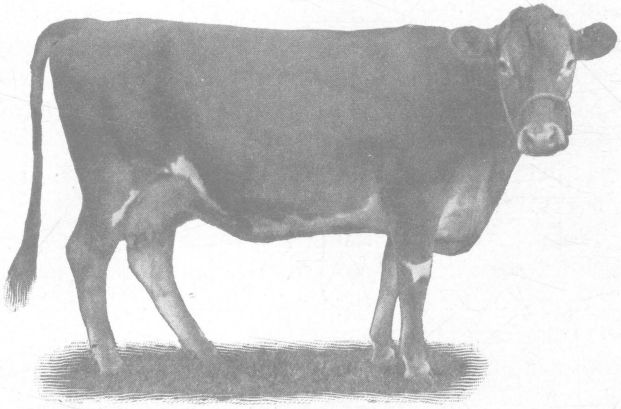

Fig. 3. This cow produced 6,183.4 lbs. of milk and 308.6 lbs. of butterfat in 322 days. Average percent fat, 5; vaule of butterfat at 25 cts. per pound, $77.15.

Figures 3 and 4 represent two cows belonging to a certain dairy herd. The production of each cow was found by keeping daily milk records; butterfat determinations were made at the end of each week. With respect to age and lactation period they were much the same. Both received the same care and attention. The production in either case does not approach by any means the extreme which may be found in many Ohio herds. A great many dairymen, no doubt, think they are keeping profitable cows; while if it were truly known, they are feeding high priced feeds to cows that may be called "star-boarders." It should be no longer a matter of feeding the dairy cow in order to dispose of farm crops; but rather to utilize all available material to the very best advantage.

Fig. 4. This cow produced 2,730.5 lbs. of milk and 143.6 lbs. of butterfat in 291 days. Average percent fat, 5.25; value of butterfat at 25 cts. per pound, $35.90.

Several of the fundamental uses of the Babcock test may be mentioned, as follows:

1. By testing the different cows, the herd may be improved in a relatively short time by eliminating the animals that are found inferior.

2. It is well to test milk or cream when sold on a butterfat basis, to determine whether the proper test is received.

3. It may be well to test skimmilk occasionally to guard against any possible loss that might result from improper separation; buttermilk may also be tested to see how much fat is lost in the process of churning.

The following material is necessary for maintaining records and testing milk, viz: Milk sheets, milk scales, sampling jars, preservative, milk pipette, milk test bottles, acid measure, sulphuric acid, dividers, and centrifuge or tester. In addition, cream bottles and cream scales are necessary for testing cream.

SAMPLING THE MILK

Before taking the sample, the entire quantity of each cow's milk should be poured from one vessel to another a few times or stirred well with a dipper. This is done to distribute the fat uniformly throughout the milk. Then with a small dipper or cup, about an ounce of the milk is taken for the sample. The same quantity of milk should be taken at each milking. Samples which are taken from day to day are known collectively as "composite" samples. If they are taken for three days, the jar at the end of that time will contain a mixture of the samples of six milkings, or a three days' composite sample; likewise, if the sampling is continued for a week, the mixture will contain a week's composite sample.

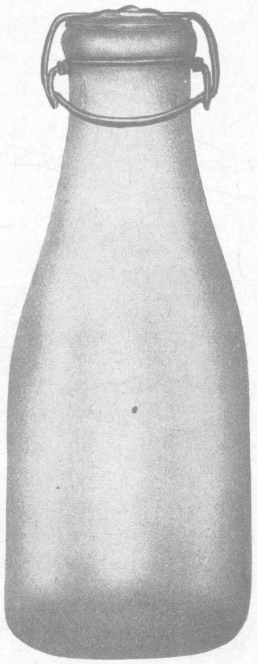

Fig. 5. A glass jar in which samples of milk may be kept.

Fig. 6. A device for sampling milk.

Samples of the milk from each cow should be placed in glass jars bearing the name or number of the particular cow from which the sample is obtained; otherwise, the jars may be exchanged. A number may be painted on the jars, or stickers may be procured on which the name or number of each cow can be written. Mason fruit jars make very satisfactory containers for keeping the samples. The samples should be kept in as cool a place as possible; they should also be well stoppered to prevent evaporation of the milk.

The sampling may be done by means of a sampling tube, (Fig. 6) which may be obtained from any dairy supply house. They are made from brass or copper, from one-half to one inch in diameter, open at both ends, and are equipped with a hood which fits neatly over one end; these hoods are provided with small openings which admit the

milk into the tube. The tube is then lowered into the pail of milk with the hood set so that the openings in the hood are left open; as soon as the milk in the tube is level with the milk in the pail, the hood is forced over the end of the tube by pushing it down against the bottom of the pail. The milk thus enclosed is the desired sample, which may be transferred to the glass jar.

PRESERVATIVES

Where milk samples are kept at a warm temperature, some preservative should be added to keep them sweet. The amount of preservative will depend upon the quantity of milk to be preserved, and also upon the temperature at which it is kept. Corrosive sublimate, potassium bichromate, and formalin are preservativas which are often used for this purpose. These substances are very poisonous and should be used with the utmost care. About one-half cubic centimeter of formalin, or from 10 to 15 drops, are sufficient to keep milk samples sweet for about 5 or 6 days, or longer, depending upon the temperature. About 7 or 8 grains of potassium bichromate will serve equally well for preserving the samples. Corrosive sublimate tablets are convenient to use; they are ready prepared, put up in boxes containing from 500 to 1,000, and may be obtained from any dairy supply house.

Fig. 7.

Fig. 8.

MEASURING THE SAMPLE

Unless care is taken in measuring out the sample to be tested results are obtained that are unreliable, and the entire procedure is worthless. The sample from which a test is to be made must first be thoroughly mixed before a sample is taken with the pipette. It is best to heat the composite sample by setting it into another vessel containing water heated to about 100 to 110 degrees Fahr. The milk should then be poured back and forth from the container to

another vessel until a complete mixture is assured. Any cream that adheres to the sides of the jar containing the composite sample should be removed. A small brush may be used for this purpose.

After the sample is thoroughly mixed, draw out with the 17.6 c. c. pipette (Fig. 9) the required amount of milk and deliver it to the test bottle. Pipettes have a mark on the stem which indicates the necessary amount to be taken for each test. In sucking the milk into the pipette it is best to have the milk rise a little above the mark on the stem; then by gently releasing the finger, the quantity required may be checked at the desired place. Care should be taken that no milk be lost in transferring it from the pipette to the test bottle. (Fig. 10.)

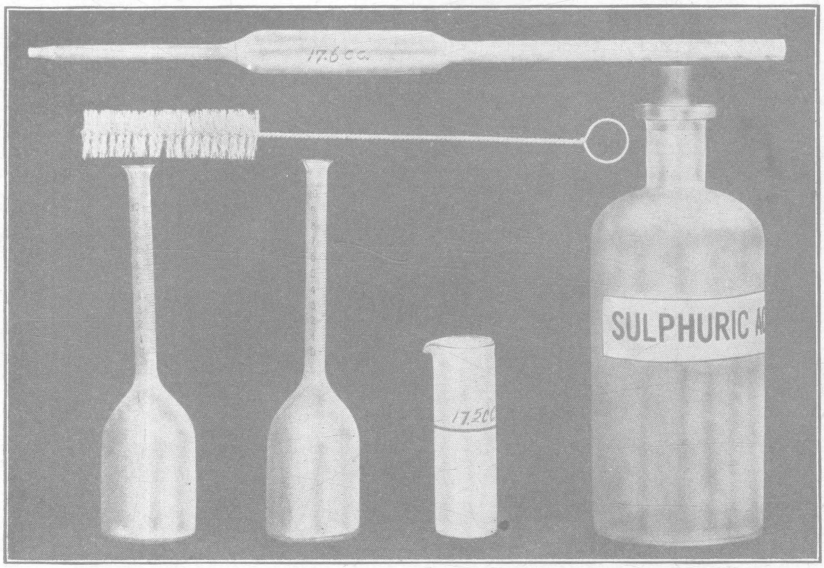

Fig. 9. Milk test bottles, acid measure, sulphuric acid bottle, 17.6 c. c. milk pipette and a brush for cleansing the test bottles are shown in this group.

ADDING THE ACID

Sulphuric acid having a specific gravity of 1.82 to 1.83 is recommended for use in testing. The quantity of acid required for each sample is 17.5 c. c. Acid measures are marked so as to contain the proper amount to use under ordinary conditions. In handling acid, care should be taken that none be spilled on the hands or clothing. In case of accident plenty of cold water should be applied at once.

The temperature of the milk and acid should be as near 60 degrees Fahr. as possible. If the temperature of the milk and acid

is much above 60 degrees there is danger that the casein and sugar in the milk will be burned or charred by the action of the acid; these charred particles will rise in the neck of the test bottle and mix with the fat column. If the temperature of the milk and acid is much below 60 degrees the casein in the milk may not all be dissolved; both of the above conditions will affect the accuracy of the reading of the percentage of fat.

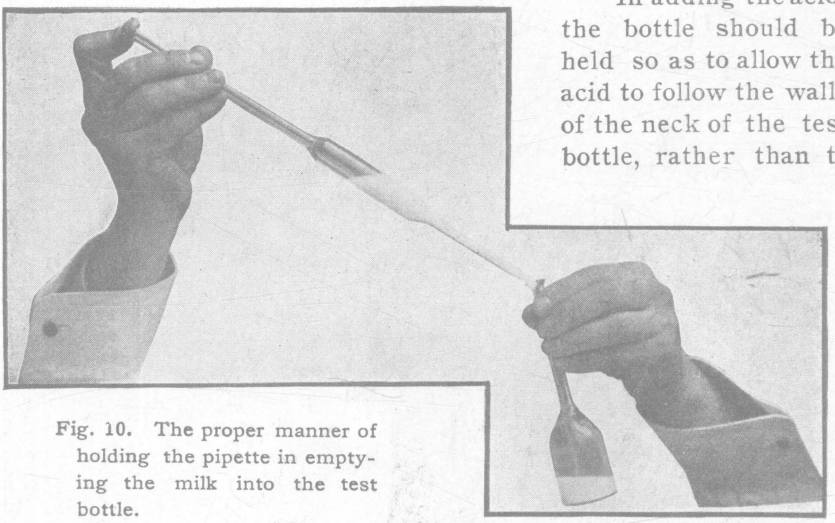

Fig. 10. The proper manner of holding the pipette in emptying the milk into the test bottle.

In adding the acid, the bottle should be held so as to allow the acid to follow the walls of the neck of the test bottle, rather than to have the acid run in the center of the milk. After the acid has been added, the milk in the bottles should be carefully but thoroughly mixed by giving them a rotary motion; this is done to dissolve the solids-not-fat in the milk. The mixture becomes very hot, caused by the chemical action of the acid upon the water in the milk. The color of the mixture becomes very dark. The samples should not be allowed to cool before being placed in the centrifuge. In case they are allowed to stand and become cold, they should be heated by placing the bottles in another vessel containing hot water.

READY FOR THE CENTRIFUGE

Immediately after the milk and acid are mixed in the test bottles, they should be placed in the centrifuge or tester, (Fig. 11) and whirled at full speed for 5 or 6 minutes; this is done to separate the fat in the milk, and bring it to the surface. Sometimes there may be some casein remaining in the milk that is not entirely dissolved; to guard against this possible condition, it is well to shake the

samples again at the end of the first run; otherwise, these undissolved portions of curd will remain in the fat, and will affect the reading.

After the first run, hot water, preferably soft, should be added to each bottle until the contents are raised to the neck of the test bottle. The bottles are again whirled at full speed for 2 or 3 minutes. Hot water is again added to each bottle until the fat reaches to the 8 or 9 percent mark on the graduated neck of the test bottle. The addition of hot water in two portions greatly assists in securing a better separation of fat. After the last addition of water, the bottles are given a final whirling at full speed for at least one minute, after which time the separation is complete.

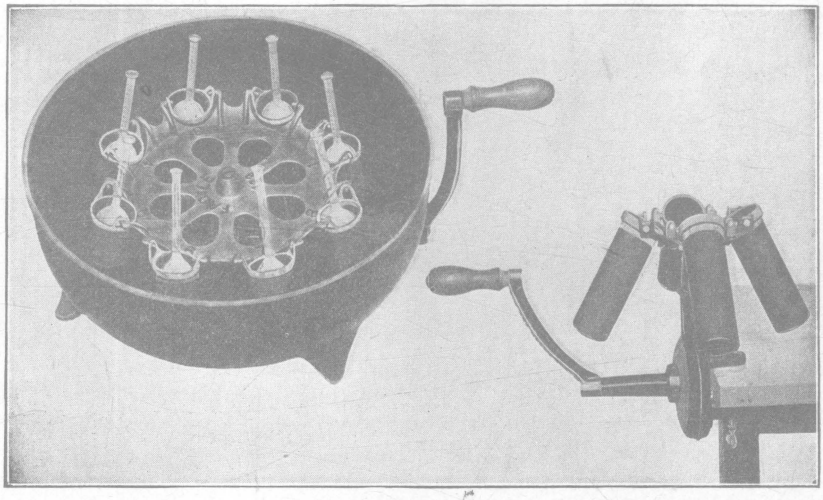

Fig. 11. Different styles of hand testers. To get accurate results, the tester should run smoothly, and be given the proper number of revolutions per minute. The lid must be kept on while in motion. The capacity of tester will depend upon the size of the dairy

READING THE TEST

The fat in the neck of the test bottle after it is separated should have a clear, yellowish or straw color. The line of separation between the water and the fat column is always distinct, provided the operation is carried out in a proper manner. There should be no black or white particles in or below the fat column of a finished sample. The reading should be taken before the fat is allowed to cool; it should be read at a temperature of about 125 to 140 degrees Fahr. In case the samples fall much below this temperature, they should be heated by placing the test bottles containing the finished sample in hot water.

The upper line of the fat column is always curved, caused by the capillary attraction of the fat to the glass. In reading the percent of fat, the spaces between the lower line of fat and the extreme upper part of the curve or meniscus are counted. This is best done by means of a pair of dividers (Fig. 12). The points of the dividers are placed at the extreme ends of the fat column; then without changing the angle of the dividers, one point is placed on the zero mark, while the other point extends up along the sides of the neck of the test bottle; this point of the dividers indicates the percentage of fat.

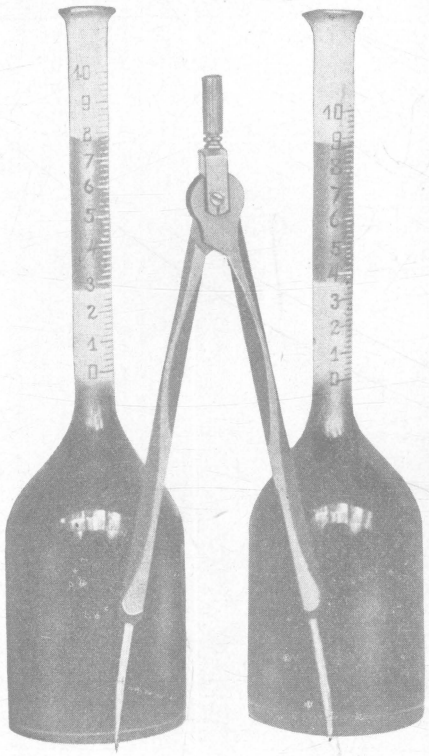

Fig 12. Two finished samples and a pair of dividers. Note that the samples have duplicate reading. In testing milk or cream, it is recommended that tests be made in duplicates. If the reading is the same in both cases, the results are entirely trustworthy. The finished samples must be kept warm until after the reading is made.

Milk test bottles are usually graduated into ten large divisions, each division representing one percent; these are again divided into five spaces, each space representing one-fifth or two-tenths of one percent. Test bottles have a small spot of ground glass on the body of the bottle on which a number can be written with a lead pencil. The number on the test bottle should correspond with the number on the jar containing the composite sample.

In testing milk, two samples of each cow's milk should be measured out in separate test bottles in case one or the other might be accidentally broken; also to make duplicate tests. If the reading is not the same in both cases, some error must have been made during the operation of the test. In case results differ more than one small space, or two-tenths percent, another sample of the same milk should be taken and tested in a more careful manner.

TESTING SKIMMILK

Skimmilk should be tested occasionally for butterfat to make sure that the milk and cream are completely separated. A different type of test bottle is required for testing skimmilk, since the fat contained in the skimmilk is usually not sufficient in amount to fill one division on the whole-milk bottle. Skimmilk bottles are arranged with double necks. The milk, acid and water are added through the larger tube, the smaller tube being intended for the fat column.

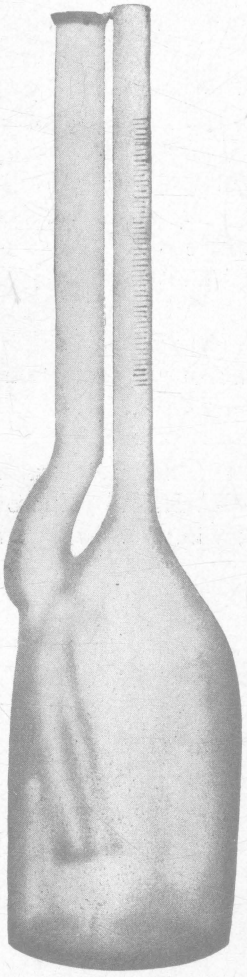

Fig. 13. Skimmilk bottle.

The same quantity of skimmilk is taken for testing as of whole-milk, but slightly more acid is required. The amount of acid should be about 20 c. c. In adding the acid to the skimmilk it is best to add the acid in two or three different quantities, each quantity being mixed separately with the milk. After the milk and acid are mixed, the skimmilk bottle should be placed in the centrifuge and whirled at full speed for 7 or 8 minutes; hot water is then added, and again whirled at full speed for 3 or 4 minutes. The sample should be read before being allowed to cool. Each division of the scale on the skimmilk bottle usually represents five-hundredths of one percent; these large divisions are again divided into five spaces, each space representing one-hundredth of one percent. Skimmilk testing five-hundredths percent fat would contain five-tenths pound, or one-half pound, of butterfat per 1,000 pounds.

In conclusion we may say that the milk scales and the Babcock test are the most efficient means of determining the value of the dairy cow. The simplicity of the test is such that the ordinary boy or girl with a little instruction can easily operate it. Selection of type and dairy form may offer some assistance in judging a good cow; but the Babcock test, which is no respecter of age or breed, may be called into service to be the impartial and infallible judge in our endeavor to cull the herd of its rightly called "spongers."

SUMMARY

Following are the various steps necessary in testing milk:

1. Secure a representative sample.
2. Measure out the required amount of milk with the 17.6 c. c. pipette and deliver it to the test bottle.
3. Add 17.5 c. c. sulphuric acid for whole-milk, 20 c. c. for skimmilk; mix gently, but thoroughly.
4. Place in centrifuge and whirl at full speed for 5 or 6 minutes for whole-milk, 7 or 8 minutes for skimmilk.
5. Add hot water to bring the fat up to the neck of the bottle.
6. Whirl again at full speed for 2 or 3 minutes for whole-milk, 3 or 4 minutes for skimmilk.
7. Add hot water again to bring the fat up in the neck of the bottle to the 8 or 9 percent mark.
8. Give final whirling at full speed for at least one minute.
9. Read the test at 125 to 140 degrees Fahr.
10. Record the test and empty the bottles immediately; cleanse thoroughly by shaking to remove sediment.

ACKNOWLEDGEMENT

The photographs and illustrations accompanying this circular were made by the Station Photographer, Mr. Wm. P. Beeching, Jr., to whom due credit is given.

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