The Dairy.

Testing Milk and Cream.

[A Lecture delivered by W. A. Macdonald before the Dominion Farmers' Council.]

No. IV.

III.—THE CREAM GAUGE.

The cream gauge, or cremometer, is simply a glass tube about eight inches deep and one and-a-half inches in diameter, open at one end and setting upon a glass stand. The milk, when placed therein, is allowed to stand for twenty-four hours, and the instrument is so graduated that the volume percentage of cream can be seen through the glass at a glance. It was formerly supposed that the milk which cast the greatest bulk of cream was the richest in butter or butter fat. This, however, has been proved to be a great fallacy, and the volume or measure standard has fallen into disuse, it being superceded by the weight percentage of butter or fat. The bulk of cream depends upon many circumstances which we cannot control. Temperature plays a significant part. Raised in the cold, the cream has greater bulk than when raised in a warm surrounding, the other conditions being alike, although the percentage of fat raised may be equal or less. Another important factor is the condition of the casein of the milk, which substance is not in a state of solution like the albumin, the milk, sugar, and the mineral constituents; but the nearer the casein approaches the soluble condition the more easily the fat globules rise to the surface, while, on the other hand, the more viscid the casein, the greater is the resistance offered to the rising of the globules. This condition also operates upon the percentage of casein in the cream, so that two samples of cream which analyze the same percentage of fat may vary materially in volume. Besides, some samples of milk build less bulk of cream in proportion to the percentage of fat than others, and here, again, we get different volumes. In short, it has been found that the bulk has varied in extreme cases from four to forty percent without showing any material variation in the percentage of butter fat, and yet many creameries still adhere to this standard: that is, paying the same price for equal volumes of cream. Let me here present the results of a few actual tests. The following table shows the differences that have occurred, one examination being made by Dr. Kirchner, Professor of Agriculture, University in Halle, Germany, and the other by Prof. James Long, England:

TABLE SHOWING THE DIFFERENCES IN THE PERCENTAGES OF FAT AND CREAM.

Examined by Dr. Kirchner.			Examined by Prof. Long.					
Total Solids.	Percentage of Fat.	Percentage of Cream.	Percentage of Cream.	Percentage of Fat.	Percentage of Cream.	Percentage of Fat.	Percentage of Cream.	Percentage of Fat.
11.49	3.04	8	2	2.93	4.5	4.57	14.	2.97
11.67	3.05	6	16	4.83	20.	3.67	17.5	2.51
11.32	3.03	10	13	3.16	16.	2.76	11.5	2.64
11.65	3.02	7	12	2.34	3.	3.46	6.5	4.10

The samples examined by Dr. Kirchner in the above table were from four consecutive milkings of the same cow; and it will be seen that, although the fats and the solids were almost identical, there was a variation of four percent in the volume of cream. In the twelve samples examined by Prof. Long, as shown in the table, it will be seen that the percentages of cream varied from two to twenty, while the percentages of fat only varied from 2.34 to 4.57. In two of the samples (the first and the eighth in the table), it is observed that the percentages of fat in the milk are actually greater than the percentages of cream. These facts and figures prove that the cream gauge is utterly useless in testing the quality of milk or cream; experts only resort to it in connection with other instruments, and it is only then of value in cases of suspicion of adulteration, it being found that, as a rule, healthy, unadulterated milk should not yield much less than ten percent of cream. The Chevalier Cremometer is the most popular one in use; and, having the dimensions which I have mentioned, it is useful for containing milk when the specific gravity is being taken.

IV.—THE CENTRIFUGAL MILK TESTER.

But cream can be raised by a method other than by setting the milk, namely, by centrifugal force, and this system has been adopted for testing the volume of cream as well as for separating the cream for making butter. There are several designs of the centrifugal milk tester, but all of them work on the same principle. The instrument consists of graduated bottle-shaped glass tubes, which, when filled with milk and placed in metal receptacles, are made to spin around with such velocity that the cream gathers in the graduated necks of the tubes, and the percentage of cream can be instantly read as soon as the instrument ceases revolving. These receptacles, containing the glass tubes, are fixed at one end into a disc in such a manner that they hang perpendicularly when the instrument is at rest, but assume a horizontal position by the rapid motion of the instrument. Any number of tests may be made at once, corresponding to the number of tubes in the tester, and as high as fifty-four samples have been tested at one operation. The time required for keeping the instrument in motion varies from twenty to forty-five minutes, according to the design of the instrument. A new instrument has been completed which makes the test in less time.

The accuracy of this instrument depends largely upon the condition of the casein of the milk, as mentioned in connection with the ordinary system of cream raising, but the cream corresponds more closely with the fat obtained by chemical analysis than the results under the setting system. By the centrifugal tester, it is customary to add 100 percent of water to the milk, by means of which the fat globules rise more readily, so that the natural volume of cream is then obtained by multiplying the volume from the watered milk by two.

The distinguished investigators, Schulze and Kræmer, obtained the following results from twelve tests, expressed in the form of a ratio, 1 being taken to represent the percentage of fat obtained by chemical analysis:—

	Unchanged Milk.	Milk with 100% water.
Maximum	1 : 1.97	1 : 0.98
Minimum	1 : 1.51	1 : 0.74
Test No. 9	1 : 0.92	1 : 0.40
Average without No. 9	1 : 1.74	1 : 0.85
" with "	1 : 1.67	1 : 0.80

These tests prove that there is no constant relation between the butter fat in milk and the volume of cream obtained by centrifugal force. This tester is of little or no use for any purpose whatever, taking accuracy, labor and expense all into consideration.

V.—THE LACTOBUTYROMETER.

This instrument is extensively used by our dairymen for testing milk and cream. It is simply a graduated glass tube (of which there are several designs), closed at one end. A specified quantity of milk is first poured into the tube, a like volume of ether then being poured in, and the tube is then briskly shaken for four or five minutes, the open end being stopped by the thumb or a tight fitting cork. A similar measure of alcohol is then added, and the tube shaken again for five minutes. The ether dissolves the fat in the milk, and when the alcohol is added the fat appears on the surface of the mixture in the form of a concentrated ether-fat solution, which can be read on the graduated portion of the tube, and by reference to tables prepared for the purpose, the percentage of fat in the milk can be ascertained, the fat standing in a certain relation to the ether-fat solution. Before the observation is taken, the tube containing the solution is placed in a warm bath for a few minutes.

The most popular lactobutyrometer is Marchand's, improved by Schmidt and Tollens, and numerous have been the investigations made to compare the results with those obtained by chemical analysis, of which the following table is representative:—

	Examined by Schmidt and Tollens.		Examined by P. Vieth.		Examined by Kræmer and Schulze.	
	Analysis.	Lacto-butyrometer	Analysis.	Lacto-butyrometer	Analysis.	Lacto-butyrometer
	3.77	3.78	3.36	3.25	3.28	3.35
	3.84	3.68	3.31	3.15	3.40	2.95
	3.22	3.38	2.76	2.65	4.86	4.87
	3.65	3.68	3.38	3.30	3.75	3.13
	3.24	3.68	3.33	3.10	3.39	3.35
	3.17	3.12	3.36	3.25	3.76	3.35
	3.75	2.68	3.27	3.20	3.01	2.77
	3.24	2.97	3.22	2.90	3.10	2.77
	3.97	3.68				
Av.	3.54	3.18	3.25	3.10	3.57	3.32

Comparing this table with those showing the results of the lactoscope, we find that the lactoscope is a more accurate instrument than the lactobutyrometer, and behold what a difference in the cost, labor and time; a lactoscope analysis can be made in less than two minutes, and there is no waste of milk or cream. The main cause of the inaccuracy of the lactobutyrometer is the fact that the ether does not dissolve all the fat, and there is no ready method of ascertaining the quantity of fat left undissolved in the milk. It may be said, however, in favor of the lactobutyrometer that, by means of recently improved methods, where great care is observed in the hands of experts, such extreme variations do not occur as are occasionally found by lactoscope analysis. In a series of forty examinations made by Schmidt, the greatest variation did not exceed 0.20 percent, and the averages showed that the lactobutyrometer may be regarded as a useful instrument for some purposes.

[To be continued.]

The annual milk production per cow in the U. S. is estimated at 2,692 lbs. Valuing cheese at 10c. per lb., and 10 lbs. for 100 lbs. of milk, the income per cow would be $26.92 per annum. What farmer can keep a cow respectably on this sum?