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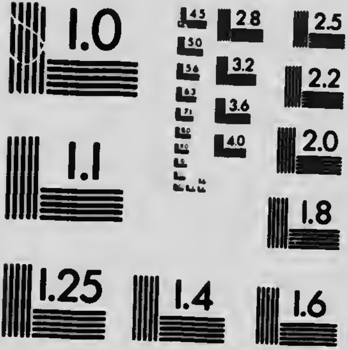


BULLETIN 266] [SEPTEMBER, 1918

Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

Cheese and Butter Making

By the Staff of the Dairy School

INTRODUCTION.

H. H. DEAN.

The Dairy School Bulletin is unique among bulletins which have been published. It was first prepared in 1893 by Committees appointed during the first session of the Dairy School at the Ontario Agricultural College of that year. Since then it has been revised from time to time, and brought up-to-date by the Dairy School staff. The matter herein contained, was prepared by the staff of 1918, and is a revision of Bulletins Nos. 205 and 206. Thus for twenty-five years there has been a continuity in the matter as given in this bulletin.

The manufacture of butter and cheese are still the most important branches of dairying in Ontario, and these have received most attention in the present revision, as in past bulletins, but there are other branches of dairying which have come rapidly to the front during recent years, among which may be mentioned soft and fancy cheese, condensed and powder milks, ice cream, and town and city milk supply. Except for brief reference to ice cream making, and outlines of the more common fancy cheeses, these newer dairy problems have not been treated in the present dairy bulletin, largely because of lack of definite information on these subjects. The manufacture of condensed and powder milks is controlled largely by corporations which have what is practically a monopoly of these lines. So far as the writer knows, investigations of these branches of dairying have not been made anywhere in Canada, nor is there equipment for carrying on such, at any Experiment Station in the Dominion. The manufacturers of condensed and powdered milks utilize *all* of the milk solids as human food, whereas cheese and butter manufacturers are able to convert but one-half to one-third of these solids directly into food for human consumption. Because of this fact, the condenseries and milk powder factories are able to pay higher prices for milk than can factories which make cheese and butter in the ordinary way, and still have a large margin of profit—how large, no one outside these concerns is aware. We are facing conditions which will practically revolutionize dairying in Ontario during the next ten years. The wise dairyman will make preparations to meet these new conditions as rapidly as possible. Our Agricultural Colleges and Experiment Stations should be leaders in these progressive and more remunerative lines of dairy advancement.

WHEY BUTTER.

One of the signs of this new movement is the great interest displayed at present in the manufacture of butter from whey. Tons of milk-fat have been practically wasted in the whey tanks of the Province. The increased scarcity, and high price of fats of all kinds, especially milk-fat, has forcibly called attention to this matter. Many cheese factories, having 5,000 lbs. or more, of whey daily, are preparing to "skim the whey" and either sell the cream or make it into butter. On the average, about three pounds of butter may be made per 1,000 lbs. of whey, depending on the fat lost in the whey, skill of the maker, etc. This butter will usually sell at from two to four cents less per pound than first class creamery butter. Sometimes it will bring a price equal to the best dairy or creamery butter, depending on quality and scarcity. A cheese factory having an average of 10,000 lbs. whey daily for a season of 200 days would be able to make about three tons of whey butter, which at 40 cents per pound, would mean a revenue of $2,400. If the cost of manufacture were ten cents a pound, there would be a net revenue of $1,800 for the season. As a rule, it is better to pay the cheesemaker so much per pound for skimming the whey and making the butter. Where conditions are favorable, the whey-cream may be sold or sent to a central point for churning, thereby saving the cost of a churn and labor of churning. A better quality of butter is more likely to be made under such conditions, especially where the make is small and the whey-cream held for several days before churning.

The butter made for sale must be branded "Whey Butter."

Skim Milk and Buttermilk Cheese.

Another sign of the times is the outcry against the waste of skim milk and buttermilk even for feeding animals. It is claimed that these should be converted directly into human food instead of indirectly and wastefully through feeding these to hogs, calves, poultry, etc. Directions for making these by-products into cheese are given in this bulletin, but the labor involved is considerable, which means heavy expense in manufacturing an article for which the market is uncertain, and which lacks keeping quality. These facts make the business somewhat risky. However, it is likely that a method of separating the solids of skim milk and buttermilk by means of centrifugal force, will be perfected in the near future, thus reducing labor costs, and doubtless a harmless preservative may be used which will lengthen the time for marketing and consumption, which at present is not more than a week or ten days, under the best conditions.

Testing Cream.

There are many complaints regarding the testing of cream. Special attention is directed to what is said on this point in the bulletin. The practice of using a *milk* pipette for measuring the cream for a test, or the use of any pipette for cream testing over 30 per cent. fat is probably a chief cause of "low tests" for cream. If a pipette be used, it must measure 18 c.c., not 17.6 c.c., and if the sample is above 30 per cent. fat a fine balance should be used. Because of the value of skim milk as food and feed, more of it is retained on the farm than formerly, consequently the cream contains a higher percentage of fat, hence a balance ought to be used, in testing cream, and nine or eighteen grams weighed for a fat test.

The practice of testing each delivery of cream is recommended, though fairly accurate results can be got by composite sampling if the work be done carefully and the samples are kept sweet and free from mould.

Payment for Milk Used in Cheese Manufacture.

This question is still in an unsettled condition. The majority of the cheese factories in Ontario continue to pay by weight of milk delivered, regardless of what the milk tests for fat and casein, which are the two milk constituents that determine the relative values of milk used in cheese manufacture.

The principles underlying the three systems now in use may be briefly stated as follows:

1. Paying for milk according to its weight having no regard for its composition, assumes that all milks are of the same value, practically, for cheesemaking, or, if there be any difference, it is so slight that the matter is not worth bothering about. This assumption is correct, where there is little or no difference in the composition of the milk delivered by the individual patrons of a factory. But where there is a difference in the fat and casein constituents, the division of money proceeds from sales of cheese on what is commonly known as the "pooling system," is unfair. This is shown by the following table based on experiments made at the O. A. College:

Average per cent. fat in milk.	Pounds cheese per 1000 pounds milk.	Pounds milk per pound cheese.	Increased yield of cheese per 1000 lbs. milk.	Pounds cheese per pound fat in milk.
3.0	88.9	11.2	....	2.92
3.5	95.4	10.5	6.5	2.70
4.0	103.6	9.6	8.2	2.57
4.5	110.8	9.0	7.2	2.47
5.0	117.7	8.5	6.9	2.36

Two things stand out strikingly in this table: The increased yield of cheese with the higher testing milk; and the decreased yield of cheese per pound fat in the milk, as the percentage of fat in the milk increases. At first, these statements appear to be contradictory. Interpreted rightly they mean that though the richer milk produced a greater yield of cheese per 1,000 pounds of milk than did the poorer, or lower testing milk, this increase was not in proportion to the fat contained in the milk. The milks containing a lesser percentage of fat produced more cheese per pound of fat contained in the milk. This is explained by assuming that such milks contain more casein in proportion to the fat than do the richer milks, and consequently give greater yields of cheese according to the fat contained.

2. Because of this, the Dairy Department of the O. A. College recommends that milk casein, as well as milk-fat, should be considered when dividing money among patrons of cheese factories. This system is commonly known as "The per cent. fat plus two" plan, in which it is assumed that when the factor two, is added to the percentage of fat in milk used for the manufacture of cheese, we have for all practical purposes, included the *available fat and casein* in milk for cheese making.

As a result of 15,000 tests made for fat and casein at representative cheese factories in the Province of Ontario, it was found that the average percentage of fat was 3.5, and of casein, 2.2. Some fat and part of the casein is always lost in the making of cheese. The excess percentage of casein in milk over two, is represented by the fat and casein lost in the whey. The application of this method is very simple. In case the percentages of fat in the milk were, 3, 3.5, 4.0, 4.5, 5.0, the percentages of available fat and casein would be 3 + 2=5, 3.5 + 2=5.5, 4 + 2=6, 4.5 + 2=6.5, 5 + 2=7.

The total pounds of available fat and casein delivered by each patron, are found by multiplying the total pounds of milk delivered during any period, by the average percentage of fat for the period, plus two. To find the value of one pound fat-casein, divide the net proceeds of the sale of cheese, by the total pounds of fat-casein which entered into the cheese manufactured. To find the money due each patron, multiply the total pounds fat-casein delivered by him, by the value of one pound fat-casein. In this system the value of one pound fat-casein is unity, when making calculations. If paying according to weight of milk, one pound of milk is unity; and when "paying by test" or percentage of fat, one pound of fat is unity for calculating money values of milk for patrons.

3. The third system is known as the "relative value" plan, "test plan," "fat system," etc. This method assumes that milk is valuable for cheese manufacture in proportion to the fat contained, which fat is determined by what is known as the Babcock test.

In the eastern part of the Province of Ontario, milk is commonly valued at so much per "standard." A "standard" is three thousand pounds of milk, which probably had its origin in this being the weight of milk commonly given during the cheese factory season by one cow.

In the case of three patrons furnishing milk to a cheese factory, testing respectively 3, 3.5, and 4 per cent. fat, where the milk averages forty dollars per "standard," "pooling" or dividing money by weight of milk delivered, the amounts of money each would receive dividing according to weight, "fat plus two" and "the fat" methods, are as follows:

Value per "Standard" (3,000 lbs.), Dividing According to

Per cent. fat in milk.	Weight of milk.	Per cent. fat plus two.	Per cent. fat.
3.0	$40.00	$36.36	$34.29
3.5	40.00	40.00	40.00
4.0	40.00	43.64	45.71

In this case, it makes no difference to the man sending milk testing 3.5 per cent. fat, which system is followed. The differences come in the patrons furnishing milk with the two extremes of fat percentage. In the method, "fat plus two" the differences in money received are not so great as by the "fat" system, and probably comes nearer to the actual cheese value of the milk, than paying by fat alone. Unfortunately, the weight of cheese produced per "standard" of milk testing the same percentages of fat and casein, is not constant, due to varying losses in manufacture, and varying percentages of moisture retained in the cheese. Because of these facts, there is no system of "pooling" or dividing proceeds among patrons of cheese factories which is, or can be, absolutely correct for all conditions. All that can be done is to adopt some system which is approximately correct, and which recognizes the principle that so far as the composition of milk is concerned, the fat and the casein are the two constituents which largely determine the relative values of milks for cheese manufacture.

Milk, Cream, Cheese and Butter Testing

MILK AND CREAM TESTING.

W. H. Sproule.

The commercial value of milk, whether used for manufacture into the various dairy products, for direct consumption, or for city milk trade, is largely dependent on its chemical composition. If the milk be used for buttermaking, the fat will be the index of its value, for it is the fat alone which is used for the manufacture of butter. Normal milk varies widely in composition, therefore in order to ascertain its market value, it is necessary to determine the relative amounts of its more important constituents. Chemical analysis will give the most accurate data, by which the value of milk may be estimated, but this method is too slow, and too expensive for use in commercial work.

The Babcock method of ascertaining the fat content in milk has solved the problem of a rapid, accurate and reliable method for testing milk and milk products for fat. It was invented by Dr. S. M. Babcock, of the Wisconsin Agricultural Experimental Station, and was made public in 1890. Since then, it has been the almost universal milk-fat test in America. It is an inexpensive test, and its accuracy is vouched for by chemists.

The cost of a small four bottle hand machine such as is used on many farms is $5.00 to $6.00. The price increases according to the capacity of the machine. Anyone with a little experience can obtain accurate results by exercising the necessary precautions and doing the work carefully and honestly.

The various details necessary to consider in making a Babcock test of a sample of milk are given systematically as follows:

1. Have the milk at a temperature of 60 deg. to 70 deg. F.

2. Mix the milk thoroughly by pouring it from one vessel to another, allowing it to run down the side of the vessel to prevent foaming. If the sample is not thoroughly mixed, a representative sample cannot be obtained.

3. With a 17.6 c.c. (cubic centimeter) pipette, measure this quantity of milk into a milk test bottle. To do this, suck the milk into the pipette, and quickly place the forefinger over the top to prevent the milk running out. Allow the milk to drop out until the surface of the milk is level with the 17.6 c.c. mark, which is on the stem above the bulb. Now place the tip of the pipette into the top of the bottle and allow the milk to run out slowly by removing the forefinger.

4. Add to the milk in the bottle 17.5 c.c. of commercial sulphuric acid at a temperature of 60 deg. to 70 deg. F., having a specific gravity of 1.82 to 1.83. Hold the bottle slanting and allow the acid to run down the side and under the milk. Use a graduate for this purpose. It is not a safe practice to use the pipette, as the acid may be drawn into the mouth, causing severe burning.

5. Mix the milk and acid thoroughly by giving a gentle rotary motion. Do not close the neck of the bottle while mixing.

6. Place the bottles in the machine, making sure they are properly balanced. and whirl at full speed for five minutes. The speed is indicated on the machine. Do not exceed the speed so marked.

7. Add hot water at a temperature of 160 deg. to 170 deg F. to float the fat into the neck of the bottle.

8. Whirl again for two minutes.

9. Remove the bottles from the tester and set in a water beth, which reaches to the top of the fat, at a temperature of about 140 deg. F. for a few minutes before taking the reading.

Theory of the Babcock Test.

A 17.6 c.c. pipette will deliver, practically, 17.5 c.c. of milk.

17.5 c.c. at an average specific gravity of 1.032 = (17.5 × 1.032)=18.06 grams.

18 grams is the weight of the milk required for a test.

The volume of the neck of the milk test bottle between zero and 10 is 2 c.c.

2 c.c. of melted fat, at a specific gravity of .9= (2 × .9)=1.8 grams.

The relation of 1.8 is to 18, as 1 is to 10, or 10 per cent. of the original volume of the milk. This is why that weight or volume of milk is taken and why the neck of the bottle is divided into 10 equal parts.

Notes.

1. Always make sure that the bottles and pipettes are clean before using.

2. Be careful to get the exact measurement of milk for the test.

3. If the milk is covered with thick cream, or is partially churned, it may be prepared for sampling by heating, then pouring from one vessel to another. Heating to 100 deg. to 110 deg. F. is sufficient for this. When it is thoroughly mixed, take the sample as quickly as possible and cool to about 60 deg. F. before adding the acid.

4. If the sample is frozen, warm both the frozen and liquid parts and mix thoroughly. Never test a sample immediately after being drawn from the cow. Allow to stand at least one hour.

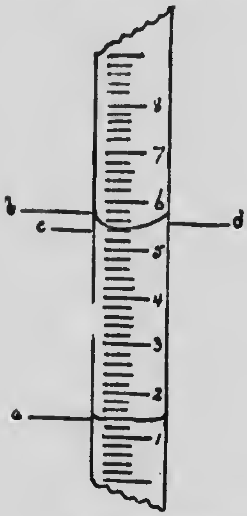
5. If the milk is sour or thickened, it is necessary to add an alkali to dissolve the casein. A small amount of strong ammonia or concentrated lye will answer, stirring and mixing it well until the sample has become liquid again.

6. The quantity of acid must vary with its strength. If it is too strong use less, if too weak use more, but if the acid is very much too weak or too strong, it should not be used. Weak acid is preferred to strong acid. Carboys or bottles containing acid should be stoppered with glass or earthenware stoppers, as the acid is very corrosive and will burn or eat stoppers made of organic material or metals.

7. Avoid pouring the acid directly on the milk. After the acid is in the bottle there should be two distinct layers—milk on top and acid underneath. with no charred material in between. Do not allow it to remain long in this condition.

8. The water added to the test bottles should be soft or distilled. If hard water is used the addition of about 8 or 10 cubic centimeters of sulphuric acid to the gallon will soften it. This will prevent foam above the fat.

9. It is advisable to use a pair of dividers or compasses for measuring the fat column. The points should be placed at the upper and lower limits of the column to get the length, and then place one point at zero and the position of the other point will show the percentage of fat in the sample tested. The accompanying illustration will show the correct method of reading milk tests when the fat is at 140 deg. F. Correct reading *a* to *b* not *c* or *d*.



10. Burnt or cloudy readings may be caused by:

(*a*) Having the temperature of the milk or acid too high.

(*b*) Using acid which is too strong, or using too much acid.

(*c*) Allowing acid to drop directly on and through the milk.

(*d*) Allowing the milk and acid to stand too long before mixing.

11. Light or cloudy readings or floating particles of curd are usually caused by:

(*a*) Temperature of milk or acid too low.

(*b*) Using too weak an acid or not enough acid.

(*c*) Careless mixing, or insufficient shaking to unite the milk and acid thoroughly.

12. The accuracy of the test bottles and pipettes used in Canada is provided for in an Act of the Dominion Parliament known as the Milk Test Act, which requires that all bottles and pipettes shall be tested for accuracy of graduation by the Standards Branch, Department of Inland Revenue at Ottawa, and that each bottle and pipette shall be marked at the time of testing with the letters G.R. (or first letter of reigning Sovereign) inside the Crown, thus: |G.R.|.

13. Carefulness and exactness are absolutely essential in every detail if accurate results are to be obtained in milk testing.

14. Sulphuric acid weighs about 18 lbs. to the gallon and costs 4 to 10 cents per lb. A gallon will make 250 to 260 tests.

Composite Samples.

A composite sample is a sample composed of a number of smaller samples taken from the same source at different times and kept by use of a preservative, the object being to obtain an average test of the number of smaller samples without the labor and expense involved in the testing of each lot separately. This method is used by cheese factories and creameries, and by Cow Testing Associations. In creameries and cheese factories a small sample is taken from each daily delivery of each patron and kept in bottles, one for each patron. Several kinds of preservatives are used, the most common being a mixture of five parts of potassium bichromate to one part of mercuric bichloride (corrosive sublimate). Potassium bichromate may be used alone if the samples are not kept longer than two weeks, enough being added to give the milk a lemon yellow color. If the mixture is used, it will require as much as will lie on a ten cent piece to preserve a pint for one month. Corrosive sublimate may be used, but it is rather dangerous, as it does not give any color to indicate that the milk contains poison. Formalin is sometimes used, about 20 drops (1 c.c.) per pint of milk, but it also is colorless. Tablets are now prepared and sold by the dairy supply houses, which may be used with excellent results. The amount of preservative used will depend to a certain extent upon the condition and size of the sample and the length of time over which the testing period extends, and also the manner in which it is treated. At the end of the period the mixture of samples may be tested with the Babcock test, and if the work of sampling has been done properly the test should be an average percentage of the fat in the different lots of milk.

Notes on Composite Sampling and Testing.

1. Pint or half pint milk bottles stoppered with cork or rubber stoppers answer fairly well for composite sample containers, although bottles fitted with glass stoppers are preferable, as they are not so likely to carry mould spores into the milk.

2. The bottles should be kept tightly stoppered to prevent evaporation of the moisture, which will cause the test to be too high.

3. Better results can be got by keeping the bottles in a cool place and out of direct sunlight.

4. It is absolutely necessary that each bottle should have a distinguishing mark—either name or number. Stovepipe, or bicycle enamel, answers very well for the purpose. Paint is not so lasting. Another method is to write the name or number on a gummed label, stick it on the bottle, and coat it over two or three times with shellac, or, the glass may be roughened with a whetstone or file, and the number written on with a lead pencil.

5. Place the preservative in the bottle before any milk is put in. It may be necessary to add a little more later if the sample shows indication of spoiling. Avoid using too much preservative as it hardens the casein in the milk. making it difficult to test and oftentimes causing a burnt or charred reading.

6. The sample for the composite jar should be taken after the milk has been poured into the weigh can. An ounce or half-ounce dipper is often used for this purpose. A sampling tube, or milk "thief," is also very satisfactory. It is very difficult to accurately sample frozen milk, and patrons should be warned against sending milk in that condition.

7. Each time a fresh sample is added, the jar should be given a gentle rotary motion to mix the cream and the fresh milk with the part containing the preservative. Avoid shaking the jar violently, as that has a tendency to churn the contents.

8. To prepare composite samples for testing, heat the sample to 105 deg. to 110 deg. F. by placing in warm water, to loosen the fat adhering to the sides of the bottle, then mix thoroughly by pouring. Take the sample quickly and place in the test bottle. Set the test bottle in water at 60 deg. to cool the milk before adding the acid. Strict attention paid to this point of cooling will usually prevent burnt readings. Sulphuric acid appears to act more strongly on samples containing preservatives, therefore it is advisable to use slightly less acid. If difficulty is experienced with burnt readings caused by an excessive amount of preservative, it is recommended to add the hot water at two different times, filling to the bottom of the neck of the bottle and whirling one minute and then filling to about the 8 per cent. mark and whirling again for another minute.

9. To find the correct average test of the milk from a herd of cows, find the total pounds of fat and total pounds of milk, multiply the pounds of fat by one hundred and divide by the pounds of milk. There is often considerable difference between the correct average test found in this way and the test obtained by adding the different tests together and dividing by the number of cows tested.

Cream Testing.

The percentage of fat in cream can be obtained as easily and as accurately by the Babcock test as can the percentage of fat in milk.

Cream test bottles with specially graduated necks to contain 30, 40, or 50 per cent. of the weight taken are used.

The same weight of cream as of milk is necessary, namely, 18 grams, but since cream has less specific gravity, or is lighter than milk, due to the larger proportion of fat, it is necessary to use more than 17.6 cubic centimeters. Sweet cream testing 25 per cent. fat has a specific gravity similar to that of water, so that if an 18 c.c. pipette is used, and the pipette is rinsed with a small quantity of water, the weight of the cream will be nearly 18 grams. Although the testing of cream by volume or measurement is a rapid and convenient method, yet, the results obtained are only approximate, due to the fact that the cream which comes into the average creamery from different patrons will differ greatly in fat content thereby making a difference in the specific gravity. Furthermore, very rich cream, ripe, or gassy cream which has gone through partial ripening, or even fresh cream from a separator cannot be measured with an 18 c.c. pipette and obtain 18 grams in weight. During the ripening process, the fermentation gases developed are held in the cream in the same way as bread dough holds the gases generated by yeast, hence the weight of a certain volume of cream will be diminished. Therefore, because of the foregoing reasons the only proper method for taking cream samples for testing in a creamery is by weighing the samples in either a 9 or an 18 gram cream bottle.

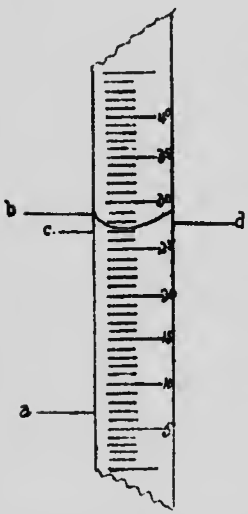
No definite amount of sulphuric acid can be given for testing cream, as some samples seem to require more than others in order to get satisfactory results, but as a rule less than 17.5 c.c. are required. A good guide is to notice the color of the mixture of cream and acid. It should be a dark chocolate color, but not black.

In milk testing, the bottles are whirled for five minutes before adding the water, but in cream testing this is not practised, as it usually results in cloudy readings.

The usual method is to add hot water immediately after mixing the cream and acid and whirl for five minutes; or better still, add the water at two different times, filling up to the neck of the bottle and whirling four minutes, and then filling nearly to the top and whirling again for two minutes. The fat column should be a bright, golden color.

Cream tests should be read at a temperature of 140 deg. F., and the fat measured to the bottom of the meniscus or curve at the top of the column. Errors due to expansion of fat amount to from one-half to one per cent., if the reading is taken immediately after whirling in a steam tester.

The accompanying illustration shows the correct method of reading the fat column in a 6-inch, 9 or 18-gram bottle. Correct reading *a* to *c*, not *b* or *d*.



Composite samples of cream are made and cared for similar to those of whole milk, but the sample for the composite bottle needs to be taken with greater care and accuracy.

The variation in the percentage of fat and the variation of the pounds of cream cause a wide range in the commercial value, therefore, it is necessary to take a proportionate, or aliquot, sample as well as a representative sample.

This is done very easily where the cream comes to the creamery in individual cans, by using a sampling tube, or a graduated pipette, and taking one cubic centimeter for every pound of cream delivered. Where the haulers take the sample at the time of collecting the cream, it is rather difficult to carry out this principle, and some buttermakers relieve the hauler entirely of this responsibility, and only ask that they take a representative sample, the buttermaker taking the proportionate sample from this when it arrives at the creamery.

The following tests show a comparison of weighed and measured tests from monthly composite samples :

Measured.	*Weighed.*	*Measured.*	*Weighed.*
17.5 p.c. fat.	18 p.c. fat	33.5 p.c. fat.	34 p.c. fat.
18.5 " "	19 " "	34 " "	35 " "
22 " "	22.5 " "	37 " "	38 " "
28 " "	29 " "	36.5 " "	37.5 " "
29.5 " "	30.5 " "	41 " "	42.5 " "

Skim Milk, Buttermilk and Whey.

As the percentage of fat in skim-milk, buttermilk and whey is usually very small, the best method of testing these is by the use of the double-neck test bottle. There are several different kinds of double-neck bottles in use, but those having the two necks joined together, and extending perpendicularly from the centre of the bottle, seem to give best results, as they are much stronger and less liable to give burnt readings.

The latest form of double-necked bottles are graduated to read in hundredths of one per cent. up to twenty-five hundredths, and the manufacturers claim that it is not necessary to add anything to the reading. The difficulty that was often encountered by having the contents foam and bubble over has been largely overcome by having a vent put in the tube in the bulb of the bottle. This also aids in emptying.

17.6 c.c. of skim milk, buttermilk, or whey are taken into a test bottle and the test is completed in the usual way. Very fine readings can be taken, as a small amount of fat can be made to extend over a long space in the small neck. Considerable difference of opinion exists amongst authorities on milk testing with regard to the correct method of reading the double-neck bottle; but chemical analyses indicate that the addition of .05 to the Babcock reading would give the most accurate results.

The fat column in the small neck can be raised or lowered slightly to assist in getting accurate readings by pressing the finger gently on the top of either neck.

It is recommended to use a little more than 17.5 c.c. of acid in testing skim milk; also to turn the tester a few revolutions faster per minute, and whirl for a longer time. Whey does not contain such a large percentage of solids as milk, and usually about 10 c.c. of acid are sufficient to cause a clean separation of fat.

The whole-milk bottle is not suitable for testing skim milk, buttermilk, or whey, as it is almost impossible to make an accurate reading of such a small amount of fat when it is extended over a broad surface. However, the whole-milk test bottle might be used to indicate whether or not much fat is being lost.

Testing Cheese for Fat.

1. Obtain a representative sample by cutting a slice from the outside to the centre of the cheese, or by taking plugs from different parts.

2. Cut the sample as finely as possible and weigh 2 grams or 5 grams into a milk-test bottle, or 9 grams into a cream bottle.

3. Add sufficient warm water at a temperature of 120 deg. F., to make about 18 grams in the bottle.

4. Keep the sample warm and mix occasionally, until the cheese and water form an emulsion.

5. Measure 17.5 c.c. of acid. Add a little at a time and continue mixing until the curd is all dissolved.

6. Sometimes, slightly more than 17.5 c.c. of acid are required for a test. Sufficient has been used when the mixture turns a dark chocolate color.

7. The hot water may be added before whirling in the tester.

8. To find the per cent. fat multiply the reading by 18 and divide by the number of grams used. For example: 5 grams give a reading of 8.5, the percentage of fat in the cheese $= \frac{8.5 \times 18}{5} = 30.6$.

Determination of the Per Cent. of Water in Cheese.

The percentage of moisture in cheese is determined by evaporating the moisture from a definite weight of cheese and calculating the per cent. from the loss in weight. The ordinary butter moisture scales may be used for weighing the sample.

The most satisfactory method of determining the percentage of moisture in cheese is by means of the high pressure steam oven which is constructed of castiron having the sides double jacketed. The space within the jacketed walls is fitted with a steam inlet, and an outlet to allow the condensed water to drain out. The interior or chamber is fitted with a perforated rack on which to place the samples and which permits free circulation of air around the samples. The temperature is regulated by adjusting the steam pressure applied in the hollow walls, and is read by means of a thermometer which extends into the chamber.

Making the Test.

The taking and preparing of a sample of cheese for a moisture test is outlined in the fat test for cheese and holds good in this case as well. The sample is thoroughly cut up, mixed and ten grams are weighed in an aluminum dish which has been thoroughly dried and balanced on the scale previously. The cheese must be spread as evenly as possible over the aluminum dish and as quickly as possible so as to avoid any escape of moisture due to evaporation. The ten grams sample is now placed in the oven, the door closed and 45 to 50 pounds steam pressure applied. This should give a temperature of 225 deg. F. to 250 deg. F. which is sufficient. The sample is heated until all the moisture has been evaporated. This is determined by successive weighings followed by further heating in the oven. The sample must always be allowed to cool before each weighing. When the sample ceases to lose weight, the evaporation of moisture has been completed. Ascertain the percentage of moisture from the loss in weight. For example:

If 10 grams of cheese lose 3.8 grams of moisture, 100 grams would lose $\frac{3.8}{10} \times 100 = 38$ per cent. The sample therefore contains 38 per cent. moisture.

Testing Butter for Moisture, Salt and Fat.

Butter-moisture Test.

The following is an outline of a method of determining the percentage of moisture in butter which is practised at the O. A. C. Department of Dairying. A number of tests for this purpose have been devised which are practicable and sufficiently accurate for commercial work. Like all other tests, accuracy and care must be exercised in order to obtain satisfactory results.

The method consists of weighing a definite, representative portion of the butter, evaporating the moisture and calculating the percentage of moisture from the loss in weight. A form of scales is especially constructed for this work which gives the percentage of water directly from the beam used to balance the scale after the water is evaporated.

Equipment Necessary.

(*a*) Scales.
(*b*) Aluminum cup.
(*c*) Wire device to hold cup while heating.
(*d*) An alcohol lamp.

Sampling and Preparing Butter for Testing.

A representative sample of the butter must be obtained. This is done by taking small portions from different parts of the whole mass. If sampling solids, use a trier and take three or more plugs from different parts of the whole mass.

In the case of pound prints which have been wrapped in parchment paper, the outer portion which has been in contact with the paper, should be sliced off, as the paper will absorb moisture to a greater or less extent from the butter with which it is in contact. When taking a sample from the churn, the surface of the mass should be cut away with a spade and a number of small samples taken from different parts of the interior of the whole mass.

The preparation of the sample requires considerable care. The butter is placed in a clean glass container with a lid to prevent any moisture from evaporating while heating. Heat slowly to a thick, creamy constituency. Too much precaution cannot be observed at this point as it would be detrimental to heat the sample until it becomes oily, because the water and salt would settle to the bottom. Water and fat do not readily mix and it would therefore be difficult to get the water evenly distributed through the sample for weighing.

Making the Test.

The aluminum cup in which the sample is weighed, is first dried thoroughly over the alcohol flame and placed on the pan of the scales. The cup is balanced by adjusting the weight on the tare beam and ten grams of the butter is then weighed. The cup is now heated slowly over the flame to evaporate the moisture. This process should be slow and with a constant gentle agitation to prevent any of the fat from becoming charred. Care is also taken not to allow any fat to splash out of the cup. Continue to apply heat until the butter has given up all its moisture which is indicated by the foam subsiding and the sample changing to a slightly brown color. A continuance of heat at this point would result in the volatilization of some of the butter and would be detrimental.

When the heating is concluded the sample is allowed to cool and is then re-weighed. The beam remains down as the sample is lighter than before. The weight is then moved and the percentage of moisture on the special balance is read directly.

The beam on which the moisture content is read is marked in tenths of one per cent. Where scales of this construction cannot be obtained the percentage of moisture is easily figured from the original weight of the butter used and the loss in weight from evaporation. Example:

Ten grams of a sample of butter were taken; after evaporating the moisture, the sample weighed 8.5 grams.

10 grams of the sample contained 1.5 grams of moisture.

1 gram of the sample contained $\frac{1.5}{10}$ grams of moisture.

100 grams of the sample contained $\frac{1.5}{10} \times 100 = 15$ grams.

Therefore butter contained 15 per cent. of moisture.

Determination of the Per Cent. of Salt in Butter.

The determination of the percentage of salt in butter is based upon the fact that salt and silver nitrate will neutralize each other in definite proportions. The reagents used are, silver nitrate solution and potassium chromate solution. The former is prepared by dissolving 2.906 grams of chemically pure silver nitrate crystals in a litre of distilled water (1 c.c. of a silver nitrate solution of this strength will neutralize .001 grams of sodium chloride or common salt). This solution must not be exposed to sunlight as it will weaken. The potassium chromate solution which is used as an indicator is prepared by dissolving 7.25 grams of potassium chromate in 25 cubic centimeters of distilled water.

The Apparatus Required.

(*a*) A scale or fine balance for weighing the sample of butter. The moisture scale may be used for this purpose.

(*b*) A cylindrical measuring glass, 1½ inches in diameter graduated to hold 250 c.c.

(*c*) A 25 c.c. pipette.

(*d*) A glass beaker and stirring rod.

(*e*) A burette graduated to 1/10 of one cubic centimeter, and clamp for holding the burette.

(*f*) A dropper bottle for the potassium chromate indicator.

(*g*) A pint bottle with wide mouth.

Making the Test.

A sample of butter is taken and prepared as previously described in the moisture test. Weigh ten grams of the prepared sample of butter on a small piece of parchment paper which has been previously balanced on the scale or in the aluminum cup used in the moisture test. (If a moisture test was made on ten grams of the butter, the substance remaining in the cup may be used for the salt test.)

The paper and butter are then transferred to the pint bottle and 250 cubic centimeters of water (preferably soft or distilled) at a temperature of 110 deg. F. to 120 deg. F. are measured and added to the bottle containing the butter. The bottle is thoroughly shaken to melt the butter and wash out the salt. After allowing the bottle to stand a few minutes it is again shaken to ensure an even distribution of the salt throughout the water. It is then allowed to stand until the fat rises to the surface. Twenty-five cubic centimeters of the salt solution is then measured, taking precaution not to include any of the fat in the measurement, and transferred to a glass beaker. One or two drops of potassium chromate is then added to the salt solution in the beaker from the dropper bottle. The burette is then filled with silver nitrate solution, care being taken not to allow any air bubbles to remain in the top of the burette. The silver nitrate solution is added slowly, drop by drop into the salt solution in the beaker until the neutral point is reached. The salt and the nitrate solutions are constantly stirred with the stirring rod to mix the salt and silver nitrate. The neutral point is indicated by the mixture turning a permanent faint, reddish-brown color. By reading the number of cubic centimeters used on the burette of silver nitrate we are able to ascertain the percentage of salt in the butter, as each cubic centimeter of silver nitrate required to neutralize the salt equals 1/10 or .1 per cent. of salt in the butter. For example, if 32 c.c. of the silver nitrate solution were used, the sample of butter contained 3.2 per cent. of salt.

Fat Test for Butter.

1. Secure a representative sample by taking small pieces from different parts of the whole mass of butter, or by taking a plug from end to end of a print, or from top to bottom of solids.

2. Put the samples in an airtight container and heat at intervals until the butter becomes a thin paste. The preparation of the sample as outlined in the moisture test, holds good in this test.

3. Weigh 4.5 grams, or 9 grams into an 18-gram cream bottle.

4. Add enough water at 70 deg. F. to make 18 grams.

5. Complete the test in the same way as for testing cream.

6. Per cent. of fat=$\frac{\text{Reading} \times 18}{\text{Number grams used.}}$

Example:

4.5 grams butter taken.
Reading=21.
Per cent. fat=21 × 18÷4.5=84.

Two Methods of Testing Ice Cream for Fat.

It is necessary for the ice cream maker to test his ice cream occasionally to guard against any errors in standardizing methods. Ice cream cannot be tested for fat in the same way as the ordinary cream, on account of the large percentage of sugar which it contains. The following methods will give satisfactory results if carefully carried out.

The Glacial Acetic and Hydrochloric Acid Test.

A representative sample of the ice cream is taken and melted and thoroughly mixed, a 9-gram sample is weighed into an 18-gram Babcock cream-test bottle. A mixture is prepared using equal parts of glacial acetic acid and concentrated hydrochloric acid. Twenty cubic centimeters of this acid mixture is added to the 9-gram sample of ice cream in the test bottle and then all is well shaken. The bottle is placed in a water bath of 120 deg. F. to 130 deg. F., and shaken at intervals until a brown color appears. It is then placed in the Babcock centrifuge and the test completed in the same way as for testing cream and the reading multiplied by 2.

The Sulphuric Acid Test.

To make the test with sulphuric acid, a 9-gram sample is weighed into an 18-gram test bottle. About 9 cubic centimeters of luke-warm water is then added to dilute the sample in order to have about 18 cubic centimeters of mixture in the bottle. The sulphuric acid is then added slowly, a little at a time, at minute intervals, shaking well after each addition until a chocolate-brown color appears in the bottle. No definite amount of acid can be stated as the quantity will vary with different ice creams. As soon as the chocolate-brown color appears in the ice cream a little cold water may be added to check the action of the acid. The bottle is then placed in the centrifuge and the test completed in the usual way. The reading is multiplied by 2.

The Lactometer and the Detection of Adulterations in Milk.

The lactometer is a special form of hydrometer used to determine the specific gravity (sp. gr.) of milk. The term specific gravity means the weight of a certain volume of any liquid or solid substance compared with the weight of the same volume of pure water at 4 deg. C.

There are different kinds of lactometers, but the Quevenne is the most suitable for milk testing. By means of it we can determine rapidly the relative weights of milk and water.

The Quevenne lactometer is standardized at a temperature of 60 deg. F. If the milk to be tested varies from this, corrections may be made according to the following rule: For each degree in temperature *above* 60, add .1 ($\frac{1}{10}$) to the lactometer reading, and for each degree *below* 60, subtract .1 ($\frac{1}{10}$) from the lactometer reading. This rule is practically correct, if the temperature is kept within a range of from 50 deg. to 70 deg. F. It can be readily recalled when we remember that the density of milk *increases* with a *reduction* of temperature and decreases with a rise in temperature. The scale on the lactometer is graduated from 15 to 40, and indicates a specific gravity of from 1.015 to 1.040.

Note. The correct lactometer reading (or L.R. at 60 deg. F.) + 1,000 ÷ 1,000 indicates the specific gravity.

The lactometer reading of whole milk usually ranges from 29 to 34, although it may fall as low as 27, or go as high as 35. The lactometer reading of skim milk varies from 33 to 38. The reading should be taken soon after placing the instrument in the milk; if cream be allowed to rise on the milk, the reading will be too high, as the bulb of the lactometer will be floating in partially skimmed milk. Milk should be cooled and allowed to stand some time (one to three hours) after being milked before taking the lactometer reading. Otherwise the readings will be too low.

The composition of milk is about as follows:

Fat	3.6	per cent.	
Casein	2.5	" "	8.9 solids not fat.
Albumin	.7	" "	
Sugar	5.0	" "	
Ash	.7	" "	
Water	87.5	" "	
	100.00		

It is the solids-not-fat in milk that cause its specific gravity to exceed that of water, and consequently its lactometer reading to be greater.

A number of different rules have been prepared for the calculation of milk solids when the lactometer reading and the percentage of fat are known. Of these, the following has been quite generally adopted. To find the per cent. of solids-not-fat in a sample of milk, add two-tenths of the per cent. of fat to one-quarter of the lactometer reading; and to find the per cent. of total solids add one and two-tenth times the per cent. of fat to one-quarter of the lactometer reading.

The following rule also is sufficiently accurate for practical purposes and has simplicity to recommend it. To determine the per cent. solids-not-fat, add the lactometer reading at 60 degrees and the per cent. of fat together and divide by four (4). Example: L. R.=32, fat 4% $\frac{32+4}{4}=9\%$ S.N.F.

Determination of Extent of Watering Milk.

By the use of the Babcock test in conjunction with the lactometer, we are enabled to determine both the nature and the extent of an adulteration.

The percentage of fat in milk varies and can also be influenced by skimming. therefore the lactometer alone is of little use in determining adulterations. The solids-not-fat are fairly constant, and thus afford a means of detecting adulterations.

Watered Milk. To find the per cent. of pure milk in a watered sample, multiply the per cent. S.N.F. in it by 100 and divide by the per cent. S.N.F. in the pure milk. This subtracted from 100 will give the per cent. of extraneous water in the watered sample. To take an example:

The per cent. of solids-not-fat in a sample of pure milk is 9; but after being watered the per cent. of solids-not-fat in the watered sample is 7.2. Find the per cent. of pure milk in the watered sample.

Per cent. of pure milk in watered sample, $\frac{7.2 \times 100}{9} = 80$.

Per cent. of extraneous water $= 100 - 80 = 20$

Determination of Extent of Adulteration of Milk by Both Watering and Skimming.

In case a sample of milk has been both watered and skimmed, the percentage of foreign water may be found according to the foregoing formula.

However, if we have an adulterated sample showing 2.4 per cent. fat, L. R. of 23, and 6 per cent. S.N.F., and a control showing 4.4 per cent. fat, L. R. of 32, and 9 per cent. S.N.F., it is plainly seen that the adulterated sample has been both watered and skimmed, as the fat is reduced in greater proportion than either the L. R. or the S.N.F.

By the previous formula we may calculate the percentage of foreign water as follows:

$$100 - \left(\frac{6 \times 100}{9}\right) = 100 - 66.6 = 33.4.$$

The fat abstracted by skimming does not to any extent affect the per cent. of solids-not-fat, while watering reduces both the fat and solids-not-fat in equal proportions.

Therefore the percentage of fat abstracted in a watered and skimmed sample may be ascertained by the following formula:

Per cent. fat in pure sample —

$$\frac{\text{Per cent. fat in adulterated sample} \times \text{per cent. solids-not-fat in pure sample}}{\text{Per cent. solids-not-fat in adulterated sample.}}$$

Using the above example we have:

$$4.4 - \left(\frac{2.4 \times 9}{6}\right) = 3.6 \text{ per cent.}$$

That is, the sample was skimmed to the extent of $4.4 - 3.6 = .8$ per cent.; the water added, reduced the solids-not-fat from 9 per cent. to 6 per cent., and also reduced the fat from 3.6 per cent. to 2.4 per cent., or $33\frac{1}{3}$ per cent. water is responsible for reducing the fat, $3.6 - 2.4 = 1.2$ per cent.

Lactometer Notes.

1. Have the temperature of the milk uniform throughout, and as near 60 deg. F. as possible when taking the lactometer reading.

2. Always mix the milk well before taking a lactometer reading.

3. Do not have milk on the upper part of the stem of the lactometer when reading, as this weighs the lactometer down and causes the reading to be too low.

4. Have the lactometer free from the side of the vessel and perfectly still when taking a reading.

5. Watering is indicated by:
    Low lactometer reading.
    Low per cent. fat.
    Low per cent. solids-not-fat.
  All three being reduced in equal proportion.
    e.g., L.R. 25; S.N.F. 6.75 per cent.; fat 2.5 per cent.

6. Skimming is indicated by:
    High lactometer reading.
    Low per cent. fat.
    High or normal per cent. solids-not-fat.
    e.g., L.R. 34; S.N.F. 9 per cent.; fat 2.7 per cent.

7. Watering and skimming are indicated by:
    Lactometer reading may be normal or slightly low.
    Low per cent. fat.
    Low per cent. solids-not-fat.

The fat is reduced in greater proportion than either the lactometer reading or the solids-not-fat.

e.g., L.R. 27; S.N.F. 6; fat 2 per cent.

The Hart Casein Test.

This is a simple test for determining the casein content of milk. The test has been introduced by Dr. E. B. Hart, of the Wisconsin Experiment Station, and its development and use is likely to prove of considerable value to the cheese branch of the dairy industry. No more ability or skill is required to make a casein test than is necessary in making a Babcock test for fat, and the test can be completed in a few minutes.

The principles involved in this method as outlined by Dr. Hart are:

1. The construction of a special bottle, with a graduated scale whereby the percentage of casein can be read when a definite volume of milk is used for a test.

2. The agitation of the precipitate with chloroform to dissolve the fat.

3. The precipitation of the casein by dilute acetic acid.

4. The application of a definite centrifugal force in order to mass the casein into a pellet.

5. Reading the per cent. of casein.

The details connected with the determination of casein are briefly as follows:

1. Measure 2 c.c. of chloroform into the test bottle.

2. Add to this, 20 c.c. of a .25 per cent. solution of acetic acid at a temperature of 70 deg. F.

3. Measure accurately 5 c.c. of sweet milk at a temperature of 70 deg.

4. Place the thumb over the opening of the bottle, turn the bottle over by rotating the hand and shake the contents vigorously for fifteen to twenty seconds.

5. Place the tests in the centrifuge and whirl for 7½ to 8 minutes at a speed of 2,000 revolutions per minute for a 15-inch diameter machine.

6. After whirling, allow the tests to remain for ten minutes to allow the pellets to relax slightly, before taking the readings.

Notes on the Casein Test.

1. Use only the best quality of chloroform.

2. See that the temperature of the milk and acid is as nearly 70 deg. F. as possible.

3. Use a watch to take the time in shaking the test and do not mix more than 20 seconds.

4. Make sure that the speed of the tester is correct. It is advisable to use a metronome for this purpose when the whirling is done by hand power.

5. Curdled samples of milk cannot be tested for casein.

6. Composite samples preserved with bichromate of potash for from three to four days can be tested more or less satisfactorily, but samples containing other preservative and those with bichromate of potash which are kept for a longer time, do not appear to give reliable results. Therefore, the test will need to be improved in this particular before it will be suitable for factory conditions.

7. A comparison of the results of the casein test with those of chemical analysis, conducted at the Ontario Agricultural College shows the casein test to be quite accurate. The average percentage of fat in 22 samples of sweet milk was 3.72. The average percentage of casein in these samples as determined by the Hart method was 2.395, and by a chemical analysis 2.415—a difference of only .02 per cent.

THE ALKALINE SOLUTION: ITS PREPARATION AND USE.

R. Harcourt, B.S.A., Professor of Chemistry.

Causes of Acidity in Milk.

The development of acid is caused by the breaking down of milk sugar into lactic acid, through the influence of certain acid-forming ferments in the milk. But even sweet milk, immediately after it is drawn from the udder, will have an acid reaction with certain indicators. This acidity is not due to lactic acid nor any free acid in the milk, but to the acid nature of the ash constituents, possibly also to the carbonic acid gas it contains, and to the acid nature of the casein. When phenolphthalein is used as an indicator, freshly drawn milk will generally show as much as .10 per cent. of acid and immediately after exposure to the atmosphere, lactic acid germs commence breaking down the milk sugar. At a temperature of 70 deg. to 90 deg. F., these germs multiply at an enormous rate, consequently lactic acid will develop very rapidly in milk during a warm or sultry day or night. Cooling retards the action, but even at a temperature of 40 deg. to 50 deg. F. they will multiply and considerable lactic acid will be formed. Milk intended for cheesemaking should not contain more than .20 per cent. acid when delivered at the factory; whereas it does not usually smell or taste sour until it contains .30 to .35 per cent. A further development of acid will cause the milk to curdle, or, in other words, will produce coagulation of the casein. There is, however, a limit to the development of acid; for, after a certain point, the germs which break down the milk sugar are destroyed by the acid they produce, and there is no further increase in acidity.

In many ways a knowledge of the acid contents of milk or its products is of value. In most cases, a determination of the percentage of acid in the milk when delivered at the factory will indicate the care the milk has received previous to that time. The acid test may be of value in selecting milk best adapted for pasteurization, or for retail trade, or manufacture of high-grade products. At the present time, however, the chief uses made of the alkaline solution in dairy work are to determine the acid in cream intended for churning, and the acid in milk and whey in the various steps in the process of the manufacture of cheese. Both in ripening cream and in cheesemaking, acid is developed, and the alkaline solution is now frequently used to measure the amount of acid present and thus control the work.

How to Measure the Acidity.

The measurement of the amount of acid or alkali in a solution depends upon the fact that it always takes a definite quantity of alkali to neutralize a definite quantity of acid. Thus, for instance, it always takes a definite quantity of caustic soda to neutralize a definite quantity of lactic acid, sulphuric acid, or any other acid. If, then, we know the strength of a given caustic soda solution and measure the amount of it used to render a definite amount of milk or cream neither acid nor alkaline, but neutral, we can figure the amount of acid in the sample taken. To make such a determination we require the following:

1. A standard solution of caustic soda, usually made of the strength known as .111 normal.

2. An indicator—some chemical which, added to the milk, indicates by change of color when enough of the alkaline solution has been added to render the milk neutral. Phenolphthalein is the one most commonly used for this purpose. It is made by dissolving 10 grams of phenolphthalein in 300 c.c. of 80 per cent. alcohol.

3. A burette, graduated to 1-10 of a cubic centimeter, in which to measure the amount of the solution used.

4. A pipette, to measure the milk or cream.

5. A glass or porcelain cup, and a stirring rod. A complete outfit suitable for use in butter and cheese factories may now be procured from almost any of the dairy supply firms.

For the information of those who want to make their own alkaline solution or who may wish to check the strength of a solution on hand, the following directions are given:

Preparation of Solutions.

The caustic soda solution may be prepared by a druggist or one who has a delicate balance at hand by carefully weighing out 4.4 grams of pure sodium hydroxide and dissolving in one litre (1,000 c.c.) of water. But impurities in the sodium hydroxide and lack of delicate enough balance make this method unreliable.

The most accurate way of preparing this solution is by standardizing it against an acid diluted to the same strength as the alkaline solution wanted. As it requires an experienced chemist to prepare this acid of the strength required, it is important that it be got from a reliable source.

Having on hand, then, a .111 normal solution of acid, the object is to make a solution of the alkali, 1 c.c. of which will exactly neutralize 1 c.c. of the acid. For this purpose, dissolve 5 grams sodium hydroxide ($NaOH$) in one litre of water. If the soda contains much carbonate, it must be removed by adding a little of a solution of barium hydroxide, boiling, and filtering off the precipitated carbonates. The relative strength of the acid and alkali solution is next determined. This is done as follows:

Rinse out a clean burette two or three times with the acid solution, and then fill it with the same. Note the exact point at which the surface of the liquid stands in the burette; measure out 10 c.c. of the alkaline solution and deliver into a clean beaker, glass or porcelain cup. Dilute with about 50 c.c. of water, add three or four drops of the phenolphthalein indicator, and then stirring all the time, let the acid from the burette drop slowly into the alkaline solution, until the color first produced by the indicator is just destroyed. This is the neutral point. Now, again note the exact point at which the surface of the liquid stands in the burette. The difference between the two readings is the amount of acid required to neutralize the 10 c.c. of alkali. If care be taken in coming to the neutral point slowly, it will be seen that one drop finally destroys the last of the light pink color. This work should be repeated until accuracy is assured. The following is an example of results:

1. 10 c.c. of alkali required 11.5 c.c. of acid for neutralization.

2. 10 c.c. of alkali required 11.45 c.c. of acid for neutralization.

3. 10 c.c. of alkali required 11.5 c.c. of acid for neutralization.

In this case, we would accept 10 to 11.5 as the relative strength of the two solutions. The alkali is, therefore, the stronger, and must be diluted. If 1.5 c.c. of water be added to 10 c.c. of the alkali solution, 1 c.c. of the alkali ought to exactly neutralize 1 c.c. of the acid. Therefore, for every 10 c.c. of the alkali solution add 1.5 c.c. of water. Measure out the amount of the solution and pour into a clean dry bottle. Calculate the amount of water required to dilute the alkali to the proper strength, and add it to the contents of the bottle. Mix well, and test correctness of work by proving that 10 c.c. of the one solution will exactly neutralize 10 c.c. of the other. If it does this, the solution is correct.

Testing the Acidity of Milk or Cream.

By means of a pipette (a 10 c.c. is a convenient size) measure out a definite quantity of the milk or cream to be tested and deliver into a beaker or cup. If distilled or rain water is handy rinse out a pipette once, and add the rinsings to the sample. Dilute with 50 c.c. of water, and add three or four drops of the indicator. Now, having the alkaline solution in the burette, carefully note the point at which the surface of the liquid stands in the burette and then cautiously let it drop into the cream or milk being tested. Keep the sample well stirred while adding the alkali. The acid in the sample will gradually be neutralized by the alkali added until at last a uniform pink color appears, which will slowly fade away. The most delicate point is the first change to the uniform pink color, which the sample shows when the acid contained therein has been just neutralized. Because of the influence of carbonic acid of the atmosphere the pink color is not permanent unless a slight excess of alkali solution has been added. The operator should not, therefore, be led to believe by the disappearance of the color after a short time, that the neutral point has not been reached. Having decided on the neutral point, again read the burette at the surface of the liquid, and the difference between this reading and the first is the amount of alkali solution used to neutralize the acid in the sample taken.

The calculation of the per cent. of acid is simple. The alkaline solution used is of such a strength that when a 10 c.c. pipette is used, the number of cubic centimeters of alkaline solution required to neutralize the acid in the milk or cream has simply to be multiplied by 0.1. Thus, if 5.6 cubic centimeters of the alkali be used then $5.6 \times 0.1 = .56$ per cent. acid.

To insure accuracy the utmost care and cleanliness must be observed in every detail of the work. All water used with the milk or cream or in making the alkaline solution should be either distilled or pure rain water. The burette and pipette, after being washed, must be rinsed out two or three times with the solution they are intended to measure.

The knowledge the operator may gain from such tests will not only make it possible for him to turn out more uniform products, but it will also enable him to act with confidence and more intelligently to pursue the work he may have on hand.

Boilers, Engines, Steam-fitting

GEO. TRAVIS.

Of all the apparatus necessary for the manufacturing of cheese and butter, the steam boiler seems to be the most essential. From it we get steam power for operating the other machinery, and steam for regulating the temperature of the milk and cream, and for other heating purposes as well; hence the selection, setting and care of the boiler, coupled with the construction of the arch and chimney so as to get the best results from the economic viewpoint, are matters of great importance to cheese and butter manufacturers.

SELECTING A BOILER.

When selecting a boiler, get one of sufficient capacity to furnish all the steam required without forcing the fire under it. A boiler cannot be forced beyond its capacity without injuring it. There would also be a waste of time and fuel forcing a steam boiler.

SETTING BOILER.

In setting a boiler a good substantial foundation for the arch or furnace should be provided. The arch is really a part of the boiler and unless it is properly built, good results cannot be obtained.

It is best to get a plan for building an arch from some reliable boiler maker. Then have the masonry done by an expert. Provide good fire brick for lining and have them laid with fire clay. Make the side walls of the arch thick with good common brick. This will make it more substantial and retain the heat longer, thus lessening the cost of fuel.

CHIMNEY.

Where coal is being used for fuel the chimney should be built of brick. The area should be at least one-fifth greater than the combined area of all the flues. The height depends largely upon its location—the higher the better.

FIRING THE BOILER.

Boilers newly set should not have fires put under them until the mortar of the brickwork has had time to harden naturally. When fire is started, heat very slowly and let the steam go through all the pipes before any pressure is put on them.

CARE OF BOILER.

Before lighting the fire in the morning, care should be taken to see that the boiler has sufficient water in it. The glass gauge in the water column cannot always be depended on at sight, therefore it is best to open the tap at the bottom of the glass to make sure that the pipes leading to, or from it, are not stopped with scale or mud. See that the safety valve is in working order. This is the most important valve in connection with the boiler. Every boiler should have a blow-off pipe at the bottom. In addition to this, it should have a surface blow-off or some "scumming" apparatus. Nearly all foreign matter held in solution in water on first becoming separated by boiling, rises to the top in the form of what is commonly called "scum," in which condition much of it may be removed by the surface blow-off. If not removed, however, the heavier particles will be attracted to each other until they have become sufficiently dense to fall to the bottom, where they will be deposited in the form of scale, covering the whole internal surface of the boiler below the water line, with a more or less perfect non-conductor of heat. Where the water is very hard, some good boiler compound may be used with good results. Different waters require different treatments. For ordinary water "sal soda" is all that is necessary.

The blow-off at the bottom should be opened enough each day to let any lime or mud that might have accumulated, escape. If this is not done, there is danger of the pipe being filled with dirt, thus excluding the water from the pipe. Then there is a danger of it becoming hot and bursting, causing a great deal of trouble.

If the pipe from the pump or injector which feeds the water into the boiler be attached so that the water will be fed in through the blow-off pipe, this danger will be largely overcome.

Pipe Fitting.

As there are also more or less steam pipes about the factory that need repairing, it is quite necessary that the maker should know how to do his own pipe fitting.

For ordinary work the tools required are, pipe, tongs, cutter, vise, and stock and dies. With these at hand any pipes or joints that may be leaking can be quickly repaired and will save the expense of sending out for a steamfitter. Steam escaping from bad joints or leaking valves makes a disagreeable noise, and money is evaporating into the air.

Engine.

The engine bed or foundation should be solid. If possible have the engine in a room separate from the boiler, as there is always more or less ashes and dust from the furnace and flues. This makes it difficult to keep clean. Any sand or grit lodging on the slides helps to wear them out sooner than it otherwise would.

Some of the chief points to be observed are: See that it is kept clean, well oiled, and properly packed to prevent steam from leaking.

Before starting the engine, open the taps of the cylinder to let the water out, turn the fly-wheel over once, then open the throttle valve gradually until the engine gets in full motion.

Pulleys and Belting.

The following rules for finding the size of pulleys and the required length of belting will be found useful in fitting up a creamery or in placing additional machinery.

To find the diameter of a driven pulley, multiply the diameter of the driver by its number of revolutions, and divide the product by the number of revolutions the driven pulley should go. The result will be the diameter of the driven pulley.

Example.—Diameter of pulley on the engine, 40 inches; speed of engine, 160 revolutions; speed of main shaft, 200 revolutions: $40 \times 160 \div 200 = 32$, which is the diameter in inches required for the driven pulley.

To find the required size of a driving pulley, multiply the diameter of the driven pulley by the number of revolutions it should make, and divide the product by the revolutions of the driver.

Example.—Diameter of the pulley in intermediate is 4 inches, which is required to run 900 revolutions per minute; revolutions of shaft, 200: $4 \times 900 \div 200 = 18$, which is the diameter in inches of the pulley required to drive the intermediate at proper speed.

To find the length of belt for any two pulleys, add the diameter of the two pulleys together, divide this sum by 2, and multiply the quotient by 3¼. Add the product to twice the distance between the centres of shafting, and the result will be the required length of belt.

Example.—Two pulleys are 8 and 24 inches in diameter, and 8 feet is the distance between the centres of shafting. $8 + 24 = 32$, $32 \div 2 = 16$, $16 \times 3\frac{1}{4} = 52$ inches=4 feet 4 inches, and 4 feet 4 inches + 16 (twice the distance between the centres and the shafting)=20 feet 4 inches, which is the length of the belt required.

Rules.—To find the circumference of a circle multiply the diameter by 3.1416. To find the diameter of a circle, multiply the circumference by .31831. To find the area of a circle multiply square of diameter by .7854. Doubling the diameter of a pipe increases its capacity four times.

Separators and the Separation of Milk

GEO. TRAVIS.

Factory or power separators may be divided into two classes—the steam or turbine, and the belt machine. A book of directions is furnished with each new separator, therefore general directions only can be given.

TURBINE SEPARATOR.

In setting it up, a solid foundation should be provided. It does not matter how solid a wooden floor is, it will vibrate more or less from the running of a churn or other machinery. With a stone, brick or cement foundation a separator is independent of any vibration from other machinery and will run much better, and for a longer time. If setting the separator on a cement floor probably the most permanent method of fastening it down is as follows: First mark the exact location for the holes. With a square, draw a line through the centre where the holes should be, then drill the cement to the desired depth (6 or 7 inches). To do this a common cold-chisel may be used providing the bit is wide enough for the body of the chisel, though a pointed chisel for this purpose is preferable. The dust may be removed from the hole while drilling by a small bellows, or blowing through a small rubber or glass tube. Have the bolt head somewhat rounded and place the bolt in the hole with the threaded end up, making sure to have it perpendicular and in line, and the necessary height above the floor, then pour melted lead in the hole around the bolt. If a method is desired whereby the bolts can be removed from the floor, drill holes as above, plug with wood, bore with a bit at least one-eighth of an inch smaller than the lag screws used and fasten down with lag screws. Another method whereby separators may be changed without drilling new holes is to drill the holes in the cement nearer to the centre than any separator will be likely to require, fasten a 2-inch by 4-inch piece of wood to the floor and bolt the separator to it.

In putting down a cement floor to be used for separators, it is well to have a pier built about two inches higher than the floor and about the size of the separator base. This tends to prevent dirt from lodging under the separator when scrubbing the floor.

If a pier has to be built, the nature of the soil will determine the depth to excavate, and the size of the frame or base of the separator will determine the length and breadth. The exact specifications are given in the book of instructions furnished with the separator.

Place the separator in position, being careful to have the separator frame perfectly level every way. Determine this by placing the spirit level upon the planed top of the frame.

The pipe to convey the steam to the separator may be the same size as the fittings of the separator, provided the distance from the boiler is not over twenty-five feet. When the distance is more than this, the size of the pipe should be one-quarter inch larger for every twenty-five feet of piping, to overcome the effects of friction and condensation of steam.

Exhaust pipes are usually made of galvanized iron, and should never be reduced in size at any point smaller than the outlet on the separator, and should be put up as straight as possible to convey the steam from the separator. It may be carried out at the side of the building. In either case, a piece extending upwards should be put up to cause a draught. Placing the exhaust pipe out through the roof is preferable when the surroundings will permit it. Have the pipe long enough to be higher than any part of the roof, in order that the draught may not be interfered with by change of wind. A drain pipe must be provided in any case at the lowest point on the pipe, to allow water to escape readily. If this should be in the making-room, a trap to prevent annoyance from escaping steam may be put on the drain pipe.

Belt Separator.

The directions given for the foundation of a turbine will apply to this. First, place the separator in position. This should be at an angle of at least 45 degrees in front or behind the driving shaft. The pulley provided for the driving shaft should be of sufficient width to allow the belt to be shifted from the tight to the loose pulley of the separator and of the proper size to give the exact speed required. Line the separator pulley with the pulley on the driving shaft. Level the separator in all directions by placing the level on the planed top of the frame. The separator bowl should revolve to the right, or with the sun, the same as the hands on a watch.

Wipe all the bearings well with a cloth, to remove all grit and dust. A little coal oil upon the cloth will be found helpful where any coating of dried oil is met with. See that all oil tubes are clear and free to feed oil. Wash the bowl and all parts that the milk comes in contact with. If everything has been properly attended to as directed it is ready to start. If a turbine, turn on steam very gradually to allow the water to get out of the steam pipes, when the required amount of steam may be turned on. When speed has been reached, start the feed of milk.

If a belt machine, start the engine at full speed, then shift the belt from the loose pulley part way on to the tight pulley, moving it at intervals until on full. From 6 to 10 minutes should be required to get up speed. Full speed is ascertained by means of speed indicators. A 100-notch wheel should be counted for one minute, and a 50-notch wheel for one-half minute, in order to know the number of hundred revolutions the bowl is revolving per minute. After speed has been reached, the milk should be turned on full speed, until both cream and skim-milk flow from the respective spouts; then it should be closed off until the cream is of the desired thickness. The cream should be the guide in operating the separator.

The cream left in the bowl when all the whole milk has been put through should be forced out with warm water. From one to two pails will be needed for this purpose. Shut off the feed-tap for a few seconds when about half the quantity has gone through; then turn it on again, allowing the remainder to complete the operation. Pure warm water is preferable to skim milk, as it is nearer the specific gravity of the cream, and consequently displaces it more readily.

Allow the bowl to stop of its own accord after the power has been removed. Remove the solid matter found at the extreme outside of the bowl and burn it at once. Clean out all milk tubes with the spiral provided; wash with tepid water thoroughly; scald with steam or boiling water; then place on a draining rack where the bowl and its parts may dry. Never close the bowl when wet inside, as it will cause it to rust. Leave it open when not in use so it will be thoroughly dry.

In ordering the parts for the separator always specify exactly what is wanted by the use of the proper name and number of the same. This can be found by consulting the book of instructions furnished with all machines. A duplicate set of the delicate or wearing parts of any machine should be kept on hand for emergencies.

Milk fresh and warm from the cow is in the best possible condition for a perfect separation. The difference in specific gravity between the fat and other portions of the milk is then greatest, and it is also more fluid, as there is no development of lactic acid, nor chemical changes due to its exposure to the air. At the creamery, it is not met with in this favorable condition; consequently it is necessary to produce artificially as many of the favorable conditions as possible to get the best results. When milk is received at a temperature below 85 deg. it should be heated to from 90 deg. to 100 deg.

A tempering vat should be elevated at a suitable height to allow the milk to flow into the separator; and it should contain enough milk to employ the separator for at least four minutes. If large bodies of milk are heated to the desired temperature in a vat before separating, acid develops too rapidly and clogging of the separator bowl is likely to follow. Should any accident happen whereby the separator is stopped, the milk would likely develop acid enough to thicken, when it could not be separated.

HAND CREAM SEPARATORS.

At present there seems to be an unlimited market for sweet cream of good quality. Since cream is a perishable product, that cannot retain its good flavor for any definite length of time, it is necessary to adopt methods for creaming, most favorable for the production of the desired article.

Where milk is properly cared for at the farm, good cream can be produced for buttermaking by means of the shallow pans or deep setting system, but on account of the length of time required to produce cream by this method it is not practicable for the sweet cream trade.

The best known method for creaming at the farm is the hand centrifuge, more commonly known as the cream separator.

Some of the advantages of the cream separator over the old style gravity systems are:

The milk may be put through the separator immediately after it has been drawn from the cow, at which stage conditions for efficient creaming are most favorable, and the skim-milk is then in the best condition for feeding purposes.

The richness of the cream may be regulated to the desired consistency by adjusting the cream screw. By this means it is possible to extract more of the milk serum from the cream, thus reducing the quantity to be cared for.

There are many other advantages which might be enumerated, such as: Less ice needed for cooling, fewer utensils to be washed, etc.

The chief objections to the hand separator are: the initial cost and the labor involved in turning and washing the machine, but when it is taken into consideration that the increased product made from the saving in loss of fat in the skim milk over the best of other methods of creaming, these objections may be overlooked.

In choosing a separator it is advisable to select one with sufficient capacity for the amount of milk produced; one which is simple in construction, strong and durable with reasonable care, and one having all parts, which come in contact with the milk, easily washed. The manufacturers should guarantee that the machine will do good work, or no pay.

There are many different makes of separators on the market, but which is the best, it is impossible to say, as no one separator possesses all the points of merit that the ideal might possess. The best separator might be described as that best suited to the special conditions under which it is to be used. For example, the closest skimming separator may be more difficult to operate, or possess other disadvantages in its construction less desirable than a machine which skims less closely, and these disadvantages may more than counterbalance its closer skimming qualities. It would be a very poor separator indeed that did not have some good points, and it would be the ideal if it did not have some weak points. A hand separator may be considered as doing good work when, running at its full capacity, it will produce a cream testing from 30 to 40 per cent. fat, and not leave more than .05 per cent. fat in the skim milk. To a certain extent the reputation of a separator as to its efficiency for creaming milk will depend upon the one who operates it.

With each separator is sent a book containing full directions for setting up, and operating the machi . These instructions should be strictly followed unless you know of something better, which you have proven to be so by practice.

Select a suitable place in which to locate the machine, where a pure atmosphere can at all times be assured. A well-built milk room in the barn that can be kept free from dust and stable odors, easily kept clean and tidy, may be most convenient, but it is advisable to have a separate milk house built in such a manner that it will be easily kept in a sanitary condition, with good ventilation and plenty of sunlight, not too far from where the cows are milked, so that the milk does not require to be carried a great distance.

The foundation on which the machine is to be fastened must be solid, and the part of the frame which carries the bowl must be level every way. Before putting the different parts of the machine together each part should be thoroughly cleaned by using a cloth made damp with kerosene or gasoline.

After the machine has been properly put together, before starting, see that the oil cups are properly delivering the oil to each bearing. If at any time the bearings appear to be gummed, a little coal oil may be used with good results.

The number of revolutions required to give the proper speed is usually tabulated on the crank of the machine. Two or three minutes should be taken to get up full speed. The supply tank or feed can should contain sufficient water, at a temperature of 110 degrees, to fill the bowl. This should be put through the machine first to warm the skimming device and prevent the milk from sticking. The milk then should be turned on full flow, and the supply can kept well filled until the milk is all in. The speed should be kept as uniform as possible. If the separator is to yield cream of uniform richness, it must be given the same speed at each time of using. Unless the operator times himself by counting the revolutions of the crank per minute, or by the use of some other speed indicator, there will be a tendency to run the machine at too low a speed.

The "metronome" is a very simple, inexpensive and practical device to time the speed of the separator. It works automatically and can be adjusted to mark time for any separator.

The rate of the inflow and the temperature of the milk will also cause a variation in the richness of the cream. The best practical temperature at which to separate the milk on the farm is from 90 deg. to 100 deg. F.

Milk is never in better condition for separation than immediately after it has been drawn from the cow. If the milk is allowed to cool, as is the case in winter, when the separator is used only once a day, or once in two days, the milk should be warmed to at least 90 deg. F. before it is run through the separator, otherwise there will be a considerable variation in the cream test and also an increased loss of fat in the skim milk. This increase in the richness of the cream and the excessive loss of fat in the skim milk, resulting from the separation of cold milk, will occur no matter what make of separator is used.

The practice of leaving the separator unwashed from time to time after using cannot be too strongly condemned. Only a clean separator can deliver cream that is pure, sweet, and of a desirable flavor, hence it is very important that all movable parts of the bowl should be taken apart and thoroughly cleansed after each separation. All remnants of milk, cream and slime, should be washed off with tepid water, after which they should be scalded and left exposed to the sunlight if possible until required for further use.

After each separation, the can containing the cream should be set in cold water, and the cream cooled immediately to a temperature as low as possible. The cream should remain in the cool condition until it leaves the farm. This will prevent souring in the summer and freezing in the winter.

When different lots of cream are to be mixed, the fresh cream should always be thoroughly cooled before it is put in with the old cream. Adding fresh, warm cream to cream that has been separated and held for some time causes the development of lactic acid, which if not properly controlled, will cause undesirable flavors in the cream and butter.

Creamery Buttermaking

D. McMillan.

Owing to the fact that the cream-gathering system of operating a creamery is almost universally adopted in Ontario, this part on buttermaking will pertain largely to the above-mentioned system.

How to Prepare a Culture.

The preparation of a culture is described under cheese-making in this bulletin, and as the preparation for both cheese and butter cultures is the same, the method of preparing a culture will be found under the above heading.

Transportation of Cream.

It is very important that the cream should be delivered frequently, and be protected from the sun and dust while in transit to the creamery. Where possible, the best method of getting the cream from the farm to the creamery is for the patron to deliver his own cream. This plan saves the hauling cost, which is one of the big items of expense in operating a creamery. Also, by this method, the patron and maker are brought more in contact with each other, hence better co-operation.

Where patrons are unable to deliver their own cream, it should be collected in individual cans. By this method each patron's cream reaches the creamery unmixed with that of the other patrons, and the maker is able to inspect the cream, and to assist those who are sending poor cream in improving the quality.

Also, the weighing and sampling are directly under the maker's control. Where cream is mixed in large cans or tanks, the weighing and sampling must be done by the cream-haulers, which is sometimes very unsatisfactory.

Receiving the Cream.

Where patrons deliver their own cream, or where individual cans are used, each can should be carefully weighed and sampled and the weight recorded on a cream report sheet. The sampling should receive careful attention.

In case large cans are used, which necessitates the hauler doing the weighing and sampling, the hauler's load should be weighed when it reaches the creamery. The weight of the load is then compared with the total weight recorded on the hauler's cream-book. This is a check on the hauler's weighing. To check the accuracy of his sampling, his samples should be tested occasionally, and the total fat which he has on his cream-book figured out. Then by taking a representative sample of his load of cream the total fat on his wagon may be found. In this way the fat on his wagon and the fat credited to patrons on his cream-book, can be compared and the accuracy of his work determined.

Cream Grading.

As the quality of the butter depends on the quality of the cream from which it is made more than on any other factor in connection with its production, it is very important that the cream be of the very best quality, if uniformity and high prices are to be secured. Pasteurization and the addition of a good culture will, it is true, make a great improvement on the quality of the finished butter, but pasteurization and the addition of a good culture will not make finest butter from cream of poor quality.

At the present time there is a lack of uniformity in the quality of the cream delivered to our creameries, and the best solution of this problem appears to be the grading, and paying for cream, according to quality. This is a just system, since it pays the producer for the quality of the product which he delivers.

Where individual cans are used, the grading of the cream is not very difficult, but where large cans or tanks are used and the cream is graded from the haulers' samples, the work is more complicated and a few precautions are necessary.

(1) Where the small sample bottle with the screw top is used, it should be well washed and scalded and the top left off as long as possible; where the long sample bottle with the cork is used, it should be well washed and scalded and both bottle and cork allowed to dry before placing the corks into the bottles.

(2) Care should be taken to see that all samples are carried in a clean sample case, protected from the sun, and kept as cool as possible while in transit.

(3) Immediately on arrival at the creamery, the samples should be graded by first removing the cream from the sample bottle into a clean container. A small cup is suitable for this work.

Note.—Cream for grade No. 1, must have a good clean flavor, a smooth appearance, and test not less than 30 per cent. fat, and not more than .27 per cent. acidity.

Grade No. 2, will include cream which is lumpy or slightly off in flavor, but not stale, and which in the opinion of the grader, will not make first class butter.

Cream which is very sour, low in fat, and showing old or stale flavors will, if accepted, grade No. 3.

Pasteurizing and Ripening.

As soon as the cream is received, it should be pasteurized. The chief object in pasteurization is to destroy most of the bacteria present in the cream. This enables the buttermaker to more completely control the nature of the fermentation, by the addition of a pure lactic acid culture. In this way it is possible to secure a more uniform product.

Pasteurization also improves the flavor, and the keeping quality of the butter. There are two methods of pasteurizing in use—the "flash" or "continuous," and the "holder" or "vat." By the flash method the cream is heated while passing through the pasteurizer, to a temperature of 180 deg. F. to 185 deg. F. It is then passed over a cooler and cooled to ripening or churning temperature. At the present time the vat method has almost entirely replaced the "flash" method of pasteurizing cream for buttermaking.

By the "vat" method, the cream is put into a vat pasteurizer, heated to a temperature of 145 deg. F. to 150 deg. F., and this temperature is maintained for a period of twenty to thirty minutes. As the efficiency of pasteurization is dependent largely on temperature, it is very important that the proper temperature be used, and, with the vat method, that it be maintained for the full holding period. The cream should then be cooled as quickly as possible to the ripening temperature of 60 deg. F. to 70 deg. F.

Adding the Culture.

As soon as the cream is cooled to ripening temperature, the culture should be added. The amount of culture to add will depend on the quality of the cream. With cream of good quality 5 to 10 per cent. will be sufficient, but with cream of poor quality, add a larger amount of culture. When the desired amount of acidity has developed, cool the cream to churning temperature, and hold at this temperature for several hours before churning. It is a well-known fact that the butter fat in cream needs several hours of thorough chilling prior to churning, if good body and grain are to be attained. It is also known that butter made from cream churned immediately after cooling will be much softer in body than the same butter would have been, had the cream remained cold for several hours immediately prior to churning. Under conditions where cream is received in the afternoon, the usual practice is to pasteurize, ripen and cool to churning temperature, then hold the cream at this temperature until next morning.

Under present conditions, and especially during the summer months, most of the cream is ripe enough for churning before it reaches the creamery; pasteurization of this kind of cream will produce a more desirable flavor and a more uniform quality of butter than if not pasteurized.

If pasteurization is not practicable the cream should be cooled to the churning temperature as quickly as possible after delivery at the creamery.

Creamery Churning.

Churning is the process of separating the butter fat from the other constituents in the cream. The time required to complete this process is affected by many factors, chief of which are:

The percentage of fat in the cream, the temperature of the cream, the speed of the churn, the amount of cream in the churn, the acidity of the cream, the nature of the agitation, the size and nature of the fat globules.

The fat globules exist in the cream in large numbers, and the richer the cream the more closely they will come into contact with each other; for this reason, rich cream will churn more easily than poor cream. Under ordinary conditions, a cream containing 30 to 35 per cent. of fat is the most satisfactory for churning. A cream much richer than this, will adhere to the sides of the churn, which reduces the amount of concussion. The addition of water to the cream will overcome this, and cause the butter to come in a reasonable length of time. It is better, however, to avoid an excessive richness in the cream. The temperature of the cream is an important factor in determining its churnability. Other conditions being equal, the higher the temperature the sooner the churning process will be complete; however, it should always be well below the melting point of the butter fat. If the temperature is too high, there will be a large loss of fat in the buttermilk, the butter will have a greasy texture, and too much buttermilk may also be incorporated in the butter. On the other hand, if the temperature be too low, the churning process will be very difficult to accomplish, the butter granules will be too small, and there will also be a loss of time and power. Churning temperature is of great importance, and will vary considerably under different conditions. The proper temperature to use must be determined by the buttermaker based on his knowledge of local conditions, but under normal conditions, the proper churning temperature will be between 48 deg. F. and 58 deg. F.

The speed at which the churn is revolved has a marked effect on the time required for churning and varies with the construction of the churn. For this reason, no definite directions can be given as to speed, but it should be such as to give the greatest degree of agitation to the churn. Should it be too rapid, the force will hold the cream against the inner surface of the churn and it will receive very little agitation. If the speed be too slow, the cream will not be carried up the sides of the churn from which it falls, before reaching the top.

The acidity of the cream affects its ease of churning. This is due to the fact that the development of the lactic acid reduces the viscosity of the cream, and the ease with which the fat globules travel in the cream becomes greater, the less the viscosity.

The ease with which cream may be churned is affected by both size and quality of the fat globules. The character of the fat is influenced by the breed of the cows, the period of lactation, and the feed given to the cows.

In case the churn is too full, there will be little opportunity for the cream to fall, hence little agitation, and a large loss of fat in the buttermilk; on the other hand, if too small an amount of cream be used, it may adhere to the sides of the churn and receive little or no agitation. Best results will be obtained if the churn is from one-third to one-half full of cream. With this amount, other conditions being correct, the churning process should take place in approximately forty-five minutes.

Churning Operations.

Before adding the cream, the churn should be scalded, and thoroughly cooled with cold water. This will freshen the churn and fill the pores of the wood so that the butter will not stick to the inside of the churn.

All cream should be carefully strained into the churn, as this removes the particles of curd which, if allowed to enter the churn, will cause specks to appear in the butter.

Adding Color.

If color is necessary, it should be added to the cream before starting the churn. The amount of color to add will depend on the natural color of the cream, and the market demands.

Starting the Churn.

Before starting the churn, care should be taken to see that all vents are closed, and during the first five minutes of churning the churn should be stopped several times and the vent opened to relieve the air pressure developed inside.

When to Stop the Churn.

When butter granules appear in the buttermilk and are about the size of small peas, the churning process is completed. The two things aimed at are, the completeness of the churning and the removal of the buttermilk. If the granules are too large, buttermilk will be incorporated in them and cannot be washed out. As soon as the churning has been completed, the buttermilk should be drawn off into a fine strainer to prevent the loss of small particles of butter.

Washing the Butter.

The purpose of washing the butter is to remove the buttermilk, and, under some conditions, modify the hardness or softness of the butter fat. The amount of washing which the butter should receive will depend on the quality of the cream. Having the cream of good quality, spraying and one washing will be sufficient; but with cream of poor quality, the butter should be washed twice. Nothing but pure water should be used. The amount of water should be equal ordinarily to the amount of cream in the churn. In the case of over-churned butter, add a large amount of water. The churn should then be revolved a few times at churning speed. (Eight to ten revolutions are sufficient.) Under normal conditions the temperature of the wash water should be similar to that of the temperature of the cream. but if the room temperature is high and the butter is soft, water a few degrees lower than the temperature of the butter should be added and this allowed to stand until the butter is cooled to the temperature of the water. If the butter is too hard, it can be softened by adding water a few degrees warmer than the temperature of the butter.

Salting the Butter.

The rate at which the butter should be salted depends on the requirements of the market, and may vary from nothing, to four per cent., in the finished butter. It is well to remember, however, that for general trade, a mild-salted butter is usually preferred. Nothing but the best grades of dairy salt should be used. It should be sifted through a fine sieve, and if very dry, it should be moistened before applying it to the butter. After the wash-water has been removed, the butter should be salted. Apply evenly over the surface of the butter while in the granular form, about one-half the amount of salt, then, with the Success or Simplex type of churn, give the churn one-half revolution which will turn the butter over; with the Alpha or Victor type of churn, give the churn one revolution with the rolls stationary; apply the remainder of the salt and adjust the worker.

Working the Butter.

The objects of working butter are, to evenly incorporate the salt, and to give the butter a close texture. The butter should be worked just enough to give it a firm, even body, and to prevent the appearance of mottles after it is printed or packed. Just how much working this requires, every buttermaker must determine for himself, for the reason that there are a number of conditions which cause a variation in the length of time required to work the butter properly. These conditions are: (1) the amount of butter in the churn; (2) temperature of the butter; (3) the size of the granules; (4) the condition of the salt. When there is a fairly large amount of butter in the churn, fewer revolutions will be required than with a small amount, for the reason that the small amount of butter will receive little or no pressure while passing through the rolls and it will be difficult to distribute the salt evenly; on the other hand, if the capacity of the churn is overtaxed, satisfactory working cannot be secured.

The butter should have sufficient firmness to stand the pressure required to work it properly. Hard, cold butter is difficult to work, because the particles will not knead together. If too soft, it will receive little or no pressure, resulting in a poor body and too much free moisture.

If the butter is over-churned, it will require more working because of the greater difficulty of distributing the salt.

Cold, dry salt will be hard to dissolve and require more working.

While it is important that the butter should be worked sufficiently to give it a smooth, firm body, overworking will break down the body and give a greasy texture. Where conditions will permit, the churn should be allowed to stand for a few minutes during the working period. This will aid in dissolving the salt, and lessen the danger of mottles appearing in the finished butter. If the churn has been stopped at the right time and the butter properly washed, no special effort will be required to remove an excess of moisture.

Packing and Printing.

Butter is usually in the best condition for packing immediately after it has been worked. The form in which the butter is finished will depend on the market demands. When made for immediate use, the one-pound print is usually preferred; but if it is intended for export, or to be put into cold storage, the 56-pound box is required.

Printing.

There are two methods in common use for making one-pound prints—the hand printer, and the printing machine. Where the hand printer is used, the butter should be handled at such a temperature as not to affect its body, the prints should have square corners, be free from holes or finger marks, and be neatly wrapped in good quality parchment paper. They should weigh 16¼ ounces (with wet wrapper) to allow for shrinkage. When filling 90-pound boxes for the printing machine, care should be taken to have the butter well packed into the box and when about half full, press the butter spade down between the butter and the inner surface of the box until it reaches the bottom: repeat this operation when the box is nearly full. This will lessen the danger of air holes and give the butter a smoother surface when pressed out of the box.

If the butter be put into 56-pound boxes, the box should be new, well paraffined on the inside, and lined with good parchment paper. The parchment paper should be soaked for at least 24 hours before using, in a strong brine solution, containing a small amount of formalin, to prevent mould. After lining the box, and before adding the butter, each box should be weighed and the weight marked on the side of the box. The butter should be carefully packed into the box and the top neatly finished. A 56-pound box should contain from one-half to one pound butter extra, to allow for shrinkage. The date and the number of the churning should be placed on the side of each box.

Storing and Shipping.

As soon as the butter is printed or packed it should be put into the refrigerator. The refrigerator should be kept clean and tidy, and be whitewashed frequently to keep it fresh and sweet. It should be kept at as low a temperature as possible. Where the ice is stored above the refrigerator, the ice chamber should be kept well filled with ice. If round cylinders are used for cooling, they also should be kept well filled with ice. The addition of salt to these, will help reduce the temperature. It is well to remember that butter is a perishable article, and unless stored in a temperature below freezing the quality will deteriorate very rapidly.

When shipping, see that the boxes are handled carefully, kept clean, and protected from the sun while in transit to the reffigerator car.

Care of Churns, Cream Vats and Other Utensils.

After the butter has been removed, the churns should be washed first, with moderately hot water, then twice with boiling water, after which allow plenty of pure air to circulate through the churn, as this will dry the inside and prevent musty odors. Once a week the churn should be given a wash with lime water, to keep it fresh and sweet. The gear and outside of the churn should receive careful attention and be kept clean and tidy.

Cream vats, pasteurizers, and other creamery utensils, should be first rinsed with warm water, then washed with hot water and a brush. (A small amount of good washing compound may be added to the wash water.) Then thoroughly scald with boiling water. Boiling water and human labor are both expensive yet both are essential for cleanliness.

Ice Cream

D. McMillan.

Although the history of ice cream dates back to the seventeenth century, until recently, its development has been rather slow. This is no doubt due to the fact that it was eaten largely on account of its pleasant taste and as a luxury. rather than as food. Conditions change, however, and after a thorough investigation, it is now claimed by some, that a considerable quantity is eaten primarily for its food value. Whether eaten solely for its pleasure-giving properties, or as a food, ice cream, when properly made, has not only a pleasant taste, but it also contains considerable food value.

In recent years, the production of ice cream has become quite an important branch of the dairy industry of this country. As the bulk of it is made during the summer months, or in other words, at a time when there is usually a surplus of milk and cream, the manufacture of ice cream fits in very nicely with the city creamery or city milk plant. A number of these have added ice cream making as a branch of their business. There are also a number of large plants, devoted almost exclusively to its manufacture, which should insure a more uniform product, made under good sanitary conditions.

It is not the intention in this bulletin to go into all the details of ice cream manufacture; there are, however, in this, as in all other dairy practices, certain phases of the work which require careful attention. The quality of the cream to be used in ice cream making is an important factor. It should contain a liberal amount of butter fat, and above everything else, it should be free from all contaminations.

Care of Cream.

First standardize the cream to the desired percentage of fat. If necessary, pasteurize by heating the cream to 145 deg. F., and hold it at this temperature for a period of twenty-five minutes; then cool as quickly as possible to a temperature close to, but above freezing, hold at this temperature for at least twenty-four hours before being made into ice cream. This should be done for several reasons—at this temperature it will remain sweet longer than if held warmer: its viscosity is increased; and a better bodied ice cream may be made when the fat has been cooled for a sufficient length of time to allow a thorough hardening. Perhaps the most efficient method of holding or cooling cream with ice, is to set the filled cans into an insulated tank of water in which the ice is floating. This will ensure thorough chilling without the danger of freezing. If the cream be allowed to freeze during the holding period, the properties which give body and yield, will, to some extent, be injured.

Standardizing Cream for Ice Cream Making.

It is very desirable that a uniform fat percentage be maintained in the cream used from day to day. Hence, there should be some means at hand for standardization. The most accurate method of standardizing cream to any desired percentage of butter fat, is the following:

Example 1. Given a 36 per cent. cream and skim milk to be mixed to produce a 20 per cent. cream. The weights to be used can be determined in the following way:

1. Subtract the figures representing the desired quality from the known per cent. of fat in the cream. This will give the weight of skim milk to be used.

2. Subtract the per cent. of fat in the milk (which in skim-milk is 0) from the desired percentage of the mixture to obtain the weight of cream to be used.

This can be best illustrated by placing the figures as shown in the square.

36		20	(20 - 0=20)
	20		
0		16	(36 - 20=16)
		36	

It will be noticed that by mixing twenty pounds of 36 per cent. cream and sixteen pounds of skim milk, there will be obtained thirty-six pounds of twenty per cent. cream. Suppose we require 220 pounds of 20 per cent. cream, $220 \times 16 \div 36$, will give the weight of skim-milk required; and $220 \times 20 \div 36$ will give the weight of 36 per cent. cream required to make 220 lbs. of 20 per cent. cream.

***Example* 2.** Given 367 lbs. of 38 per cent. cream to be reduced by skim milk to an 18 per cent. cream, the square will be:

38		18	(18 - 0=18)
	18		
0		20	(38 - 18=20)

$367 \times 20 \div 18$ will give the weight of skim-milk required.

Example 3. Given a 26 per cent. cream and a 4 per cent. milk to be mixed to produce a 16 per cent. cream the square will be:

26	12	(16 - 4 = 12)
	16	
4	10	(26 - 16 = 10)
	22	

Thus, we see that by mixing 12 lbs. of 26 per cent. cream and 10 lbs. of 4 per cent. milk, there will be obtained 22 lbs. of 16 per cent. cream. But supposing we require 110 lbs. of 16 per cent. cream, 110 × 10 ÷ 22 will give the weight of 26 per cent. cream required to make 110 lbs. of 16 per cent. cream.

Example 4. Given 264 lbs. of 34 per cent. cream to be reduced by 3.5 per cent. milk to a 22 per cent. cream, the square will be:

34	18.5	(22 - 3.5 = 18.5)
	22	
3.5	12	(34 - 22 = 12.)

264 × 12 ÷ 18.5 will give the weight of 3.5 per cent. milk required.

Note.—It will be found that one of the four examples described above, will be suitable for any condition which may arise in connection with the standardization of cream. Also, if found more convenient, gallons, quarts, or pints may be used instead of pounds.

Preparation of the Mix.

There should be no place in the up-to-date ice cream plant for guess-work. Accuracy in the preparation of the mix is essential, if a uniform product is to be secured. The cream and sugar should be carefully weighed, and the flavoring measured. As the capacity of most brine freezers is rated on the wine-gallon basis, it is necessary to arrange formulas to suit the capacity of the freezer. The ten-gallon formula is the most convenient. A formula for ten wine-gallons of vanilla ice cream is, 44 to 48 lbs. of cream (depending on the fat content) 8 lbs. of sugar, and 4 oz. of vanilla extract. This will make approximately eight imperial gallons of finished ice cream.

When fruits, nuts, or other solid materials are used, they should be added after the ice cream has become partly frozen, otherwise they will settle and remain at the bottom of the freezer. If fresh fruit of any kind is to be put into the cream, it should be well chopped or crushed, and sweetened, suitable for table use, some time before using.

Probably the strawberry is the most popular of fruit ice creams. A formula for ten wine-gallons is: 44 lbs. of cream, 8 lbs. of sugar, and 64 oz. of strawberry syrup. After the ice cream is partly frozen, add one-half gallon of preserved strawberries.

The Freezing Process.

The length of time required to freeze a batch of ice cream will depend on the temperature of the mix, the temperature of the brine, and the amount of sugar used. If the mix be placed in the freezer at a temperature of 50 deg. F. to 60 deg. F., there is danger of churning. It will also require several minutes to cool the cream to the whipping point, and from 5 to 10 minutes to finish the freezing process. It is, of course, possible to freeze it more quickly, in which event the cream passes through the whipping temperatures too rapidly to insure thorough whipping. If the mix be put into the freezer at 34 deg. to 37 deg. F. it may be frozen in from seven to ten minutes and ample time is allowed for whipping. So far as "swell" is concerned, it practically all takes place during the time the cream is cooling from 35 deg. F. to 28 deg. F. Sugar is a resistant of freezing, and ice cream sweetened to the average taste contains approximately 13 to 17 per cent. of added sugar, and has a freezing point of about 28.5 deg. F. to 27.5 deg. F. Remove the ice cream from the freezer when it has reached the consistency of extra heavy condensed milk. So far as possible, all handling of the finished product should be done while it is in this semi-solid condition. If placed in large containers and hardened, then later removed and packed into small containers, there will be a loss of volume.

Where ice cream bricks are hardened in a mixture of salt and ice, care should be taken to see that the moulds are well filled with ice cream, otherwise the salt brine will work into the moulds and spoil the contents.

Factory Cheddar Cheese Making

T. J. McKinney.

The Curd Test.

Provide pint glass jars or porcelain cups sufficient in number to test the milk of at least the number of patrons supplying milk to the factory. A convenient size for the porcelain cup is two inches in diameter and three inches deep. Each jar or cup should be plainly numbered or tagged. Provide a tin or galvanized iron box with a neat-fitting cover, large enough to hold the jars or cups. This box should have both water and steam connections. When taking the sample for making the test, place the milk in the cup or jar with the same number as is opposite the patron's name. Place them in the box, adding water to the depth of the milk in the jars or cups. Raise the temperature of the samples to 86 deg. F. When transferring the thermometer from one cup to the other, special care must be taken to sterilize the thermometer each time. When the milk has reached a temperature of 86 deg. F., add one dram of a diluted rennet solution made of one part rennet to twenty-four parts water. The rennet may be stirred in by using a knife with a solid metal handle, or by giving the cup a rotary motion. Care should be taken if a knife be used, to sterilize the knife between the stirring of each sample so as not to contaminate one sample from another. When the samples are firm enough, cut into small pieces with the same knife as was used for stirring in the rennet using the same precautions to sterilize between the cutting of each sample. Raise the temperature to 98 deg. F. Stir the curd at intervals, sufficiently to keep it from matting, for three-quarters of an hour.

When the cubes are quite firm, pour off the whey and allow the curd to mat in the bottom of the jars. After the samples stand for awhile, more whey can be poured off the curd. The water around the jars should be kept at a temperature of 98 deg. F. for five or six hours. By smelling the curd, bad flavors can be detected which could not be found in the milk. This test is valuable in helping to convince patrons that their milk is not in good condition for cheese-making.

The Preparation and Use of a Culture.

First provide suitable cans of good tin, which are well soldered, and about twenty inches deep and eight inches in diameter. It is better to have a duplicate set, as this gives a better opportunity for keeping them in good condition. When the milk is in small lots it can be more readily heated and cooled than if kept in larger quantities. For convenience in heating and cooling, a special box large enough to hold the cans containing the culture for one day's use should be provided. This box should be made of wood, or if made of metal, should be insulated, so as to maintain a constant temperature while the culture is setting. This is essential if best results are to be obtained. The box should be supplied with steam and cold water connections.

Better results may be obtained by using the milk from the same source each day, as we are more likely to get a uniform flavor and acidity from day to day by so doing. After selecting the milk, place the cans in the tank with cold water, and cover the cans with a granite plate, thus guarding against contamination from outside sources. Heat gradually to a temperature of 185 deg. F. This may be done without stirring the milk. Hold at this temperature for a few minutes to make sure that the milk in the cans has reached this temperature. Then run off the hot water and turn on cold water, and cool (in the same manner without stirring the milk), to a temperature of about 60 deg. F. In case proper means for heating and cooling, such as described, are not available, then stirring will be necessary. Now add a small amount of the mother culture sufficient to give the desired acid at the time required for use. In our work we find that about one ounce (by measure) to ten pounds of milk gives very good results. In starting a culture it is advisable to use a commercial, or pure culture. These may be obtained from the Bacteriological Department of the College, or from any of the dairy supply houses. Special temperatures are required for the first propagation of these cultures. Empty the mother culture into a quart of pasteurized milk cooled to a temperature of 75 deg. to 80 deg. F., and allow to stand until coagulation takes place. It is advisable to propagate a commercial culture at least two or three times before using. If the culture is to be kept more than 24 hours, it is advisable to set accordingly, by using a lower temperature and using less of the mother culture. Aim to produce the same acidity from day to day. When the culture is first broken up, take out a small quantity to propagate the culture for next day. A glass sealer should be provided for this purpose. The indications of a good culture are as follows: The whole mass is coagulated, no liquid is found on top, and it has a mild acid flavor, pleasant to the taste and smell.

A culture may be used to advantage when the milk is maturing slowly, or when it is tainted or gassy. One-half of one per cent. is the greatest quantity that should be used, and this only when the milk is known to be in sweet condition.

Milk should be set slightly sweeter when culture is used. With gassy milk its use is especially beneficial. Culture with bad flavor or with too high an acidity should not be used. All utensils must be thoroughly cleansed and sterilized before using in culture making.

Co-operation Between Maker and Patron.

That there has been a marked improvement in the milk delivered to the factory for cheese-making is quite apparent from the improved quality of the cheese produced, but there is still room for more co-operation between the maker and his patrons; first by the maker keeping his factory and its surroundings in a better condition as to cleanliness and sanitation, thereby making it a more attractive place, which the farmer can look at with pride instead of disgust; secondly, by returning the by-product, whey, in better condition. This latter can be accomplished only by the pasteurization of the whey and the proper cleaning of the tank. It is useless heating the whey unless it is all removed each day and the tank thoroughly washed.

There can be no hard and fast rules given for heating the whey, as this must be varied according to the conditions at the factory, although there are a few general principles which must be observed if this work is to be done successfully and profitably. The heating should be commenced as soon as possible after the first whey is put into the tank. This should be done for two reasons—first, to take advantage of the temperature the whey is already at; and second, to prevent the further development of acidity. The whey should be heated to at least 150 deg. F. in order to obtain the best results. Care should be taken not to exceed 160 deg. F., as heating above this temperature will cause the whey to become slimy.

The benefits to be derived from pasteurizing whey are: It conserves the food value of the whey in preventing the development of acid; it ensures a more even distribution of the fat in the whey; it also prevents the spread of contagious disease through the whey when being returned to the farm and fed to young stock; the sweet whey is not so hard on the cans as is sour whey, and the cans are more easily cleaned when the whey is kept clean and sweet. According to experiments made, the whey may be heated at a cost of from 50c. to $1.00 per ton of cheese, according to the efficiency of the equipment of the factory.

Milk for Cheese-making.

To obtain the best results, it is necessary to have the milk delivered at the factory clean, sweet, and of good flavor. The evening milk should be cooled to 60 deg. F., or under. and the morning's milk cooled before mixing with the evening's milk. The maker who accepts other than good milk is not acting fairly with the other patrons who furnish a first class quality of milk for cheese manufacture.

Testing for Ripeness.

Rennet Test.

The rennet test should always be made after the color is added to the milk. When a number of tests are made, and afterwards poured into the vat without having the color added, white specks are most likely to appear in the cheese.

To make the test, measure exactly eight ounces of milk in an eight-ounce glass, at a temperature of 86 deg. F. Place a piece of match or wood in the milk, then add one dram of rennet. note the time on the second hand of a watch or clock, stir the rennet into the milk for ten seconds, count the time from adding the rennet until the match, or piece of wood stopped. When the milk has the required acid, this will take from twenty to twenty-four seconds.

Acidimeter.

The ripeness or acidity of milk may be tested also with the acidimeter. No definite degree of acidity can be given as a hard and fast rule to go by. The best rule, is to set at that acidity which will allow the curd to remain in the whey from $2\frac{1}{2}$ to 3 hours from the time of adding the rennet, until the whey is removed with the right degree of acidity developed. This is usually about .17 per cent. on the acidimeter.

If using the acidimeter and making colored cheese, the acidity should be ascertained before adding the color to the milk, as it is more difficult to detect the neutral point with the color added to the milk.

Another point to note carefully when using the acidimeter is, the effect of the presence of rainwater in the milk. When the milk is diluted, less milk is taken in the sample, and will show a less degree of acidity than is contained in the milk to the extent of the percentage of dilution, thereby misleading the cheesemaker.

The Use of Pepsin or Other Substitutes for Rennet.

Pepsin in powder. or solid form is prepared by dissolving about one-quarter ounce of pepsin in eight ounces of pure water. This solution is then added to one thousand pounds of milk or sufficient of it to coagulate the milk in from twenty-five to thirty minutes.

Liquid rennet substitutes are already prepared for use and the directions are given by the manufacturer. The quantities usually recommended are from four to five ounces to one thousand pounds of milk. Pepsin does not seem to work so well in very sweet milk as does rennet.

If setting a vat of milk at .17 per cent. acidity by using rennet, for pepsin or other rennet substitutes, the milk should have .18 or .185 per cent. acidity in order to obtain similar results. Care should be taken not to develop too much acid on the milk, as it will injure the quality of the cheese.

Spring Cheese.

If color is used it should be thoroughly mixed with the milk before the rennet is added, using one to one and one-half ounces of color per thousand pounds of milk. Add color in amount as the market may require. The use of cheese coloring should be discouraged, as it is a needless expense.

When making early spring cheese it is usually necessary to make a quick-curing cheese in order to reach an early market.

To make this class of cheese it is advisable to use a large quantity of rennet and a small quantity of salt, as this hastens the ripening process and overcomes the tendency of milk at this time to make a dry, hard cheese due to the low per cent. of fat in the milk and the tendency of this class of milk to develop acid rapidly. Heat the milk to 86 deg. F., and stir slowly while heating. When the desired acidity is obtained, add the rennet, using four or five ounces per thousand pounds of milk, or sufficient to coagulate the milk firm enough for cutting in fifteen or twenty minutes.

Commence to cut early, using the horizontal knife first, cutting slowly lengthwise of the vat.

Then with the perpendicular knife cut crosswise and afterwards lengthwise of the vat. We would advise strongly the use of the ¼-inch wire knife, as this leaves the curd in better condition for the moisture to escape with the least possible loss in the whey, as the cubes are smaller, and more uniform, and are not so easily broken as the larger ones.

Commence stirring at once with agitators or the McPherson rake. Stir carefully for ten or fifteen minutes, then see that the curd is free from the sides of the vat before applying heat. This loosening of the curd from the sides of the vat can be done at this stage with less loss than if done immediately after cutting, as the curd has become somewhat firmer and does not break up so readily. Curds should be handled carefully and in such a manner that the cubes will not be broken, nor allowed to mat together. Rough handling or breaking of the curd causes a serious loss to both quality and quantity.

Heat to a temperature of 98 deg. F. in 1½ hours from the time of setting. We formerly advised taking the agitators out soon after heating was completed with the idea that we were able to firm the curd better with the small rake, but since the introduction of the ¼-inch knife, we have found that we get better results, with less labor, by allowing the agitators to run for a longer time.

There is nothing gained by harsh treatment of the curd, as such treatment will allow the moisture to escape only in so far as it breaks the curd. It is much better to allow the curd to firm by natural agencies, namely, acid development, heat, and rennet action. Acid usually develops very rapidly in the spring, therefore it is necessary to be prepared to remove the whey quickly when sufficient acid has been developed, which may be from .16 to .19 per cent. as shown by the acidimeter. Curds at this stage should be nice and firm (not hard or harsh), and be kept in a loose, open condition in the sink a sufficient length of time to allow the free moisture to escape, as the moisture can be removed at this stage with very much less loss than it can later on. Leave the curd about 8 inches deep in the curd sink. When it is well matted, cut into strips 6 to 8 inches wide and turn upside down, and in about fifteen minutes turn again, piling two deep. Continue turning every fifteen minutes until the curd is ready to mill. When the curd is well matted and flaky and shows .7 to .8 per cent. of acid it should be milled, and well stirred afterwards. This stirring should be repeated often enough to prevent the curd matting until ready to salt. This will be when the curd has mellowed down nicely and shows 1 to 1.2 per cent. of acid. Stir and air the curd well before adding the salt, as this improves the texture and flavor of the cheese. Salt at the rate of 1½ to 2 pounds of salt to 1,000 pounds of milk. It is important that the temperature of the curd from dipping to milling should not go below 94 deg. F. After milling allow the curd to cool gradually to about 85 deg. F. when ready to salt. Put to press at a temperature of 82 deg. to 84 deg. F. Weigh the curd into the hoop, tighten the press gradually and leave the cheese 45 minutes before taking out to dress. When dressing, use plenty of clean, hot water and what are commonly called "skirts." These cloths help to make a good rind on the cheese, keep them clean, and cause the cheese to come out of the hoop more readily. Turn all the cheese in the hoops every morning, and allow no cheese to be taken to the curing-room that do not present a clean, neat appearance.

Summer Cheese.

In making summer cheese one ounce of color to one thousand pounds of milk is usually sufficient, but this may be varied according to requirements of the market. Use from 3 to 3½ ounces of rennet extract per thousand pounds of milk, or sufficient to coagulate the milk for cutting in 25 to 30 minutes. If this limit is exceeded we have too great a loss in the whey. The cutting and firming of the curd is the same as given for spring cheese.

It may be necessary to raise the cooking temperature slightly higher, as we may be dealing with milk of a different composition from that used in the spring. The acidity should be allowed to develop to such a point that is found from day to day to give the best results in the working of the curd later in the process, aiming to have the curd with good body, well matted and in a flaky condition when ready to mill. At this time it should have an acidity of .7 to .8 per cent. in about two hours from the time of dipping. The curd should be well stirred after milling, and, if cut crosswise of the grain, the stirring may be done better and with much less labor. Curd should be well matured, stirred, aired thoroughly and cooled to a temperature of 85 deg. F. before salting. Use from 2 to 2½ pounds of salt on the curd from one thousand pounds of milk.

Fall Cheese.

When making fall cheese it is a mistake to use too much culture or to ripen the milk too much, giving the cheese the appearance of having been made from over-ripe milk, which is very objectionable in fall cheese; rather use a smaller amount of culture, not more than one-quarter of one per cent., and add it to the milk when there is a small quantity in the vat, as it starts a gradual fermentation which continues all through the process. Always heat the milk to at least the temperature of the culture before the culture is added. Set slightly sweeter than usual, as we are able to work closer to the "sweet line" all the way through, owing to the fact that we receive the milk in better condition.

Gassy Milk.

The presence of gas in the milk retards the development of acid, and as acid is necessary in the manufacture of cheese, we should make the conditions as favorable for its development as possible without injury to the body of the curd. To do this, use ¼ to ½ per cent. of good culture, as by so doing we introduce into the milk an abundance of lactic acid bacteria, which will, under favorable conditions, overcome the gas-producing bacteria.

The next step is to ripen the milk slightly more than usual before setting. When cutting, aim to have the cubes as even in size as possible. Allow the acid to develop slightly further before applying the heat, stir carefully, and heat slowly, aiming to have the curd in normal condition at dipping. Use the same temperature for cooking and the same acid for dipping as with a normal curd. A gassy curd does not require so much stirring as a normal curd, because the moisture leaves it more readily. Mill as soon as the curd is well matted and the acidity has developed to .8 to .85 per cent. About half way between milling and salting, commence piling the curd. Allow it to stand 15 or 20 m[illegible], then spread it out, stir and pile again. Continue to do this until the curd feels mellow. Give plenty of fresh air before salting. Use a normal amount of salt and put to press at a temperature of about 80 deg. F., if possible.

Over-ripe Milk.

What is over-ripe milk? It is milk with one of the agents used in cheese-making out of proportion; or milk with the lactic acid developed in too great a degree in order to obtain the very best results in converting the milk into cheese. What are the agents used in separating the solids from the moisture or water content of the milk? They are rennet, heat, and acid development, together with the cutting of the curd to get it into a convenient condition for the escape of the moisture. The heat should not be applied until enough milk is in sight to fill the vat. Why? Because as we raise the temperature, we make more favorable conditions for the development of acid. Heat as quickly as possible to 82 deg. or 83 deg. F., and after testing for acidity, set at this temperature. Why?

Because, first, 82 deg. is less favorable for acid development than 86 deg. F., and the time for heating to 86 deg. is saved; and what is more important, you are able to get the rennet in sooner and a larger quantity of it, thereby getting the acid under control more quickly; if not under control, it is difficult to get it to work in conjunction with the other agents which contract and expel moisture from the curd. In handling over-ripe milk it is always advisable to use more rennet—at least one ounce more, per thousand pounds of milk, for several reasons: first, that it may coagulate the milk more quickly; second, it gives a firmer curd more quickly, and renders the curd less liable to be broken when handling it, thereby saving to a great extent the great loss which usually is sustained from making over-ripe milk into cheese. It also helps to break down the caseous matter in the cheese, giving it a better texture. Commence cutting the curd early and cut rapidly so as to keep pace with the rapid firming of the curd. If this is not done the curd will get into a condition which makes it very hard to cut properly. Use the ¼-inch knife rather than cut the curd four times, as it leaves the curd more uniform and in better condition than when it is chopped finely. Heat quickly, and if necessary, raise the temperature two or three degrees higher than for normal milk.

A great many cheesemakers make a mistake at this point, by stopping the stirring and running off part of the whey when the curd is quite soft; while the whey is running off, the curd is matting, then they go at it with a little rake and break it all up, thereby liberating a lot of the milk solids, giving them a high acid reaction in the whey, and the result is, they have a sweet curd and a sweet cheese. The natural tendency for this kind of curd is to run together, so the best way is to keep it stirred in all the whey until it firms up a little. Hard raking does not firm the curd, except in so far as it breaks the cubes. If agitators are used, the curd can be kept apart and the whey lowered quite soon enough without resorting to this rough handling. One can readily see that if the whey be lowered quite close to the curd while it is in a soft condition that it will be quite difficult to keep it from matting; and while you are keeping it apart with a small rake, you are breaking it up, causing a loss, and also causing rough texture in the cheese. It is always advisable to have the whey run down shortly before the dipping point is reached to avoid being caught with too much acid. When the curd is in a soft condition it is advisable to dip with slightly less acid and to keep it in a loose, open condition in the curd sinks until all the surplus moisture is drained from the curd. If the curd is still a little weak, mill slightly earlier than usual. If not, treat as a normal curd. Mature the curd well before salting.

Ripening or Curing Cheese.

The ripening or curing of cheese is one of the most important points in the process, as no matter how well a cheese is made, if the curing is not properly done the quality cannot be the finest. Therefore it is necessary to provide a room where the temperature can be controlled at all times. It is important that some means be provided to control the moisture in the room so as to prevent the growth of mould, which occurs where too much moisture is present. An excessive shrinkage takes place if there is too little moisture in the room. Proper temperature and moisture may be obtained by building an ice chamber in connection with the curing-room and having a free circulation of air over the ice. This cools the air and causes a deposit of moisture on the ice. In putting the cheese in the curing-room, place them straight and even on the shelves and turn them every morning except Sunday. Keep the room well swept and looking clean and tidy. Use good strong cheese-boxes, have them dry, and of such a size as to fit the cheese nicely.

Weigh carefully, and stencil the weights neatly on the boxes. Load the cheese on clean wagons, and provide canvas covers to protect them from rain and heat while on the way to the station.

If the cheese are to be kept for two weeks, or longer, at the factory, it will pay to dip the cheese in paraffine wax. A small outfit for this purpose can be bought for about thirty-five dollars. The saving in shrinkage of the cheese will soon pay for the tank and wax used. The cheese should be coated when about one week old.

Farm Buttermaking

BELLA MILLAR.

A dairy instructor once said "Buttermaking begins in the stable, but it does not end until the finished product reaches the table of the consumer." Realizing the truth of that statement, care should be exercised in every step of the work and the dairyman's watchword "Cleanliness" should be adopted.

In any line of work it is necessary to have good raw material in order to make a first-class article. In the manufacture of butter, if the raw material, the milk, does not receive proper care, the most skilful maker cannot produce the best quality of butter.

"Prevention is better than cure," thus every effort should be made to keep dust and dirt out of the milk pail. As soon as possible after milking, remove the milk from the stable and strain it through a strainer that is perfectly clean and sufficiently fine to prevent tiny particles being carried through.

CREAMING THE MILK.

Cream separators are very largely used in our farms to-day, and have many advantages over the gravity system of creaming milk. However, some still use shallow pans and deep cans for creaming purposes.

Shallow Pans.

When using shallow pans, the milk should be strained into the pans as soon as possible after milking, and then be allowed to stand perfectly still in a pure air, free from draughts, at a temperature of about 50 deg. to 60 deg. F. for 24 to 48 hours.

Remove the cream while sweet by first loosening the cream from the pans by means of a thin-bladed knife; then tip the pan and allow just enough skim milk to run over to wet the tin before gliding the layer of cream into the cream can.

Deep Setting System.

The day is past for the use of the shallow pan system for creaming milk. If you have not a separator, then use the deep setting system. When using this method, the cans of milk should be placed in cold water and kept at a temperature of 45 deg. F., or lower, for 24 to 36 hours. By this system ice is required, unless the water be cold enough to cool the milk to, and maintain it at, 45 deg. F. while creaming. If the cans are not provided with taps at the bottom, a cone-shaped dipper should be used for removing the cream. Loosen the cream from the can with a knife. Dip the skimmer in skim milk or water, then lower it, point first, into the can, and allow the cream to flow evenly into it.

The loss of fat in the skim milk by gravity creaming, even under the best conditions, is much greater than when centrifugal force by means of a cream separator, is applied.

Cream Separators.

The surroundings of a separator, as well as all its parts, should be kept clean.

Immediately after separating, the cream should be allowed to cool quickly to at least 55 deg. before adding it to the cream can.

The cream should be of such a richness that from 3 to 3½ lbs. of butter can be made from one gallon of cream, or the cream should contain from 25 to 30 per cent. butter fat. This can be regulated by the screw on the separator bowl.

Taking a rich cream for buttermaking means less labor, lower churning temperatures, and less loss in the buttermilk.

Care and Ripening of Cream.

The cream can should be large enough to hold the cream for one churning and should be provided with a cover.

A simple and cheap cream stirrer consists of a saucer-shaped piece of tin about three inches in diameter with a long handle of heavy iron (tinned) fastened to the centre of it.

When collecting cream for a churning, care should be taken to keep it in a clean, cool place, and to stir it thoroughly from the bottom of the can every time fresh cream is added.

Cream Ripening.

Natural Ripening.

In farm buttermaking, cream is very often ripened naturally, that is, no "culture" or "starter" is added, but the lactic acid bacteria present in the cream are allowed to develop. This method may be used, if the flavor is satisfactory.

Ripening by Using Cultures.

A culture may be obtained from the Bacteriological Department at the College, or from a dairy supply house and directions for its propagation and use are sent out with it.

To carry on a culture from day to day: pasteurize some skim milk by heating it to 180 or 185 deg. F., hold it at that temperature for 30 minutes, then cool it to 60 or 65 deg. and add from one to two ounces of culture for each ten pounds of milk.

Let it stand undisturbed until next day when it should be nicely coagulated and ready for use.

By using a culture to assist in cream ripening, the buttermaker has more control of the flavor and is able to make a more uniform product.

In farm dairy work some sour cream, sour skim milk, or buttermilk may be used, if the flavor is alright. One method is to add one or two cupfuls of culture to the cream can when beginning to collect cream for churning. By doing this the sweet cream becomes inoculated with bacteria that will produce a desirable flavor.

Another method is to keep the cream sweet until twenty-four hours before churning, then heat it to 65 deg. F. and add from one cup to one pint of culture for each gallon of cream. When the cream begins to thicken, cool it to churning temperature, or lower, and hold it at that temperature over night.

Pasteurize and Add Culture.

This method of cream ripening is commonly used in creamery practice. By it we have the greatest control of the flavors, but more labor is involved.

Place the can of cream in a vessel of hot water on the stove. Bring the cream to a temperature of 145 deg. to 150 deg. F. Hold it at that temperature for twenty minutes, then cool rapidly to 60 deg. or 65 deg., and add a culture to ripen the cream.

Cream from cows that have been a long time in milk is sometimes difficult to churn and can be rendered churnable by means of pasteurization. Bad flavors are, to a certain extent, eliminated by this treatment.

Sometimes cream held at a low temperature develops a bitter flavor. The trouble may be kept in check by keeping the cream at a higher temperature to encourage the development of the lactic acid bacteria, which cause the souring; or, pasteurization may be resorted to.

Cream when ready for churning should have a pleasant acid taste and smell. It should be smooth and glossy and perfectly free from lumps. Cream should not be allowed to become over-ripe before churning. If for any reason a churning is put off for a day, the development of acid can be checked by lowering the temperature of the cream.

There will be an excessive loss of fat in the buttermilk if sweet cream is added to the ripened cream just before churning.

Although a mild-flavored butter is in demand, only a limited amount of sweet-cream butter is required for the Ontario markets at the present time. [illegible] catering to this trade should cool the cream and churn at the temperature that will give an exhaustive churning.

Churning.

On many thermometers at 62 deg. the word "Churning" is printed. If the manufacturers placed it there as a guide, many have mistaken it for a rule.

There is no standard temperature for churning, as conditions vary and many things should be taken into consideration; for example, low churning temperatures may be used when we have such conditions as rich cream, not too much in the churn, succulent feed, and cows fresh in milk.

Choose the temperature that will bring the butter in nice, firm granules in from 20 to 30 minutes.

A range of temperatures that will cover most farm conditions would be—54 to 58 deg. F. in summer, and 56 to 64 deg. in winter.

Always strain the cream into the churn, using a perforated tin strainer dipper. The small white specks sometimes seen in butter are caused by particles of curd which should not have been in the cream and would not have been in the churn if a strainer had been used. These particles injure both the appearance and keeping quality of the butter.

In farm dairies the barrel churn is used and having it about one-third full will make the work easier. A great many of the long churnings are caused by having too much cream in the churn. Another cause of long churning is having the cream too cold. If after churning about thirty minutes, there is no sign of butter coming, raise the temperature of the cream a few degrees. Take the cream from the churn, place the can in a vessel of warm water and stir the cream until the required temperature is reached.

With very thin cream it is difficult to gather the butter and it may be necessary to draw off part of the buttermilk and continue the work, revolving the churn slowly.

If the butter breaks and will not gather, but remains about the size of clover seed, take the temperature of the contents of the churn, add a quart or two of water a few degrees warmer, revolve the churn a few times, let it stand a minute or two, then draw off part of the diluted buttermilk, and continue the churning.

If a rich cream thickens during the process of churning and concussion ceases, add enough water at the same temperature to dilute it so that it will drop again.

Difficult churnings are caused in a number of ways but can be avoided if a little thought is given to the question.

When the granules of butter are about one-half the size of wheat grains, add a couple of quarts of water several degrees colder than the temperature of the cream and continue churning until the granules are the size of wheat grains, when the churning as a rule is completed.

If butter comes with the first drawn buttermilk, it is a sign that the churning is not quite completed. Give a few more turns to the churn.

Washing the B[illegible]er.

After drawing the buttermilk, rinse the butter with two or three quarts of water before putting on the wash water.

In winter, it is necessary to temper the wash water, taking into consideration the condition of the butter and the temperature of the room. Choose such a temperature that the butter will be in a nice condition for working.

Always put in plenty of water, revolve the churn quickly about a dozen times, then allow the wash water to drain. One wash water will be sufficient, if the water comes away clear, and the butter is firm.

Salting and Working the Butter.

Salt to suit the customer, or market, using a good dairy salt. Although some markets require three-fourths of an ounce to the pound of butter, others prefer less.

The butter may be salted on the worker or in the churn.

Salting on the Worker.

The lever butter worker is inexpensive and suitable for farm dairy work. It consists of a V-shaped table, simple in construction, and a pole or lever for pressing the butter.

Spread the butter evenly over the worker. Sift on the salt, fold over the butter, and work, by using only gentle pressure. Other methods, such as a sliding or cutting movement, injure the texture of the butter.

If the butter is too hard or too soft, give but a small amount of working, put the butter in a suitable place until it is of proper firmness, then finish the working.

The salt should be evenly distributed, otherwise the butter will be uneven in color.

Salting in the Churn.

Have the butter in an even layer over the bottom of the churn. Sift over it one-half the amount of salt required, tip the churn forward to cause the butter to lap over. Sift on some more of the salt, tip the churn backward to cause the butter to fall over, then add the remainder of the salt. Tip the churn back and forth a few times, then put on the lid, and give a few revolutions, very slowly.

If possible, allow the butter to stand for an hour or two before working. If this plan cannot be followed, it may be worked immediately. The amount of salt required can be estimated from previous churnings. Use a little more salt than when salting on the worker, as more drains off.

Printing and Packing Butter.

All butter packages should be put up neatly and attractively. The one pound brick print is the style most used. It is filled by pressing the printer down into the butter, then cutting off the surplus butter with a ladle. The prints should weigh 16¼ oz. when made.

The parchment paper should be of good quality, of proper size, and should be dipped in cold water before wrapping it on the butter.

On the average farm it requires more than one churning to fill a large butter package, therefore great care should be taken in order that the flavor, color, and salt shall be uniform throughout the tub, box or crock. Line tubs and boxes with heavy parchment paper. Crocks should be well glazed, having no breaks or cracks.

As large packages are often held for some time, endeavor to make the best quality of butter for packing. Pasteurizing the cream, and washing and working the butter twice are means that may be employed in the manufacture of butter for packing.

The place of storage is important, and should be clean, cool, and of even temperature.

Protect the packages in transit from sun, dust, and rain.

The object should be to get the butter to the consumer in the best condition possible.

The Care of the Dairy Utensils.

Dairy tinware should be rinsed in luke-warm water, then be washed in hot water containing a little washing soda, using a brush on both the inside and outside. Next, scald thoroughly with boiling water, and place where they will drain and dry. Sunshine and fresh air are beneficial.

The churn should be scalded with boiling water, then cooled with cold water before using. After using, remove particles of butter with hot water. Wash with hot water that contains a little washing soda, then scald with boiling water. Leave the lid off when not in use.

The butter worker, ladle, and printer should be scalded with hot water, scoured with salt, and cooled with cold water before using. After using, remove any butter with hot water, scour with salt, and scald with boiling water. Place the woodenware where it will dry, but do not put it in the sun, or it will warp and crack.

Farm Dairy Cheese

Bella Millar.

A cheese of the "Cheddar" type is a suitablo kind to make on the farm when a long-keeping cheese is desired.

Proper appliances for cheese-making lessen the labor to a great extent but cheese can be made in the home with the utensils on hand.

It will be necessary to secure a few ounces of rennet extract and a strong cheese hoop or mould.

For every ten pounds of cheese required, take 100 lbs. of milk (10 gallons). The milk should be of good quality, clean and sweet, as it is impossible to make the cheese of any better quality than the milk from which it is made.

Take the fresh morning's milk and mix it with the night's milk in a vat, or some vessel suitable for holding milk; a clean wash boiler will answer the purpose.

Heat the milk to 86 deg. F. by placing a clean can of hot water in it, or by setting the vessel containing the milk on the stove and stirring until the desired temperature is reached.

If colored cheese is wanted, use one teaspoonful of cheese coloring for each 100 lbs. of milk. Add the coloring to a dipperful of milk and mix it thoroughly with the milk in the vat before adding the rennet.

Use one teaspoonful of rennet for every 25 lbs. of milk. Dilute the rennet with a pint of cold water and mix it thoroughly through the milk by stirring with a dipper for about three minutes.

Cover the vat until coagulation takes place, which will be in about twenty minutes, depending on the ripeness of the milk; the sweeter the milk, the longer the time required.

To ascertain when the curd is sufficiently coagulated for cutting, push the forefinger into the curd at an angle of 45 deg., until the thumb touches it, make a slight break in the curd with the thumb, then gently move the finger forward. If the curd breaks clean across the finger without any flakes remaining on it, it is ready to be cut.

For cutting, regular curd knives are best. Use the horizontal knife first cutting lengthwise of the vat, then cut both lengthwise and crosswise with the perpendicular knife. This gives small cubes of even size.

When curd knives are not available, a long-bladed knife may be used, cutting the curd lengthwise and crosswise of the vat in strips about one-third of an inch wide, then cut horizontally. By this method it is difficult to cut the curd evenly.

After the curd has been cut, it should be gently stirred with the hand, or with a small, wooden rake for ten minutes before applying heat.

[illegible]t the curd to 98 deg., taking about 30 minutes to do so. Continue stirring unt[illegible] [illegible]urd is ready for dipping: this is usually about 2¾ to 3 hours, from the tim[illegible] [illegible] vat was set.

When the curd becomes firm and springy and falls apart when a handful is pressed together, it is ready to have the whey removed.

After drawing off the whey, stir the curd over once, then pile it evenly at one end of the vat and cover it with a heavy cotton cover.

In about 20 minutes the curd will be well matted and should be cut into blocks about four inches square and turned over.

Turn the blocks every 20 minutes until the curd becomes flaky when it is ready for milling (this usually takes about one and one-half hours after dipping).

A knife may be used instead of a curd mill cutting the curd into strips about the thickness of your finger. Stir the curd well, then apply salt at the rate of one ounce for each 25 pounds of milk used. Sprinkle the salt well over the curd, mix it thoroughly, and when the salt is dissolved, the curd will be ready to put to press. Between 80 and 84 deg. F. will be a suitable temperature to have the curd at this stage.

The cheese hoop, or hoops, should be made of heavy tin with two handles on the outside. A suitable size for home use would be 7 or 8 inches in diameter and 12 or 14 inches high. It is also necessary to have a wooden follower, which will fit nicely on the inside of the hoop.

Place a piece of cotton at the bottom of the hoop, as a temporary cap, then put the cheesecloth bandage inside the hoop. Carefully pack in the curd, fold over the end of the bandage, place on top a piece of cotton similar to the one at the bottom, then put on the wooden follower and put to press.

If a press with a screw is not available use a lever press. Take a piece of scantling 10 or 12 feet long for a lever. Place the cheese hoop on a strong box about three feet from the wall. Nail to the wall a piece of scantling, and under it put one end of the lever. Put a block of wood on top of the follower for the lever to rest on. A pail containing stones or iron may be used for the weight. Do not apply full pressure at first.

In three-quarters of an hour the cheese may be taken from the press, the bandages wet with hot water, pulled up smoothly, and trimmed neatly, allowing one-half inch to lap at the ends. Cover the ends with circles of stiffened cheese-cloth: over that place a piece of cotton dipped in hot water. Return the cheese to the press until the following morning, when they should be turned in the hoops and pressure continued a few hours longer.

After removing the cheese from the press, place them in a cool, dry cellar to ripen.

Turn the cheese end for end on the shelf every day for a month and afterwards occasionally. These cheese will be ready for use in about 6 or 8 weeks.

To prevent the cheese moulding and to keep them from drying too much they may be dipped in hot, melted paraffine wax. Another method to prevent mould is to put a double cloth on the cheese until ready for use. The mould will be on the extra cloth, leaving the cheese clean when it is removed.

Soft Cheese Making

BELLA MILLAR.

Soft cheese is made from cream, whole milk, skim-milk, and buttermilk, and by making slight variations in the method of manufacture a great variety may be made.

These cheese contain a high percentage of moisture and will not keep long, therefore, it is necessary to have a ready market for them.

It is well to have, "Keep in a cool place until used," and "Use while fresh" printed on the soft cheese wrappers.

FRESH CAMEMBERT CHEESE.

Apparatus Required.

½ pint bottle of rennet.
1 measuring cylinder graduated in c.c.'s or 1 teaspoon.
1 thermometer. 1 dipper.
1 granite pail of convenient size to hold the milk.
Straw mats, size 13 inches by 9 inches.
Boards 14 inches by 8 inches, ½ inch thick.
Moulds, small size, 4 inches high, 4 inches in diameter.
Moulds, large size, 5 inches high, 5 inches in diameter.

Process of Manufacture.

Five pounds, or two quarts of new milk are required to make one large size, or two small size Camembert cheese.

First add a small quantity of culture ("starter") if required. No culture is needed where good, clean, sweet milk can be obtained. The milk is now regulated to a temperature of 86 deg. F. and rennetted at the rate of 1 c.c.

or 20 drops to 10 lbs. of milk, the rennet being diluted in ten times its volume of water, before adding to milk. Stir the rennet in for five minutes and then stir over the surface with a wooden paddle for two minutes, as this prevents the cream from rising, which causes the cheese to break after they are made.

Cover the pail and leave till coagulation has taken place, which will be in about one hour. The correct stage is when the curd breaks easily over the finger.

Scald the required number of straw mats, boards, and moulds, then cool them in water. Place the boards on a drainer with the straw mats and moulds on top. Next ladle out with the dipper a little curd into each mould, and repeat the same every 20 minutes, until all the curd is transferred and the moulds are full. In ladling the curd care should be taken not to break it, but obtain it in thin slices. When all the curd has been filled into the moulds, turn the cheese, by putting a straw mat and board on top and turning over.

Leave the cheese on the drainer till the whey has drained off and the cheese are firm enough to turn by hand. After turning, the cheese is left in the mould for six hours longer, when the mould can be removed, and in another six hours the cheese is ready to salt.

Salting is done by rubbing about ½ oz. of salt on the outside of each large cheese and ¼ oz. for the small size. After salting, the cheese are left on the straw mats for 12 hours, where further draining takes place. When the cheese is sold fresh, it is now ready to pack and send away.

NOTE.—The room in which the cheese are made should have a temperature from 62 deg. to 70 deg. F.

GERVAIS CREAM CHEESE.

Apparatus Required.

½ pint bottle rennet.
1 measuring cylinder graduated in c.c.'s, or 1 teaspoon.
1 thermometer. 1 dipper.
1 granite pail of convenient size, to hold milk and cream.
Moulds—2½ inches high by 2⅛ inches in diameter, in a group of six.
Straw mat and board as in Camembert cheese.
Strips of blotting paper 2½ inches by 7½ inches.
Cloths made of duck material 27 inches square.

Process of Manufacture.

This dainty little cheese is made from a mixture of new milk and cream, the mixture being in the proportion of two parts milk to one of cream, testing 22 per cent. to 30 per cent. fat.

Take the required quantity of this mixture and bring to a temperature of 70 deg. to 80 deg. F., depending on the temperature of the room. Add the required quantity of culture—no culture being needed where the milk and cream is sweet and clean. Rennet, at the rate of 1 c.c. or 20 drops to 10 lbs. of the mixture, is added, but first dilute the rennet in 10 times its volume of cold water.

In about five or six hours after the rennet has been added, the coagulation is firm enough to dip the curd with a dipper into the cloth, previously wet, which should be placed over a basin. The cloths should then be hung up by the four corners and left to drain.

After the curd has been draining for a few hours, open out the cloths and scrape down the sides to aid draining. Repeat the scraping at intervals of a few hours, until the cheese is firm enough to salt.

Turn the curd out of the cloths into a basin and salt at the rate of 1 oz. to 3 lbs. of curd. The salt, which should be fine dairy salt, must be worked in well with a spoon and the cheese left for a short time for the salt to dissolve before putting it into the moulds. The moulds should be lined with clean, white blotting paper and placed on a scalded straw mat, or cloth, and the cheese pressed in with a bone spoon. The cheese may then be taken out of the mould, wrapped, and sold.

NOTE.—Coloring may be done by adding cheese annatto, which somewhat improves the look of the cheese. Use about 1 c.c. or 20 drops coloring for each gallon of milk and cream.

DOUBLE CREAM CHEESE.

Apparatus Required.

½ pint bottle of rennet.
½ pint bottle of cheese annatto.
Suitable pail for holding cream.
1 thermometer. 1 dipper.
1 measuring cylinder graduated in c.c.'s or 1 teaspoon.
Moulds—size 2 inches by 3½ inches, 1¼ inches deep.
Cloths of duck material, size 27 inches square.
Butter muslin, grease-proof paper, boards and weights.

Process of Manufacture.

Take any quantity of cream testing about 22 per cent. fat. Have the cream at a temperature of between 70 deg. and 80 deg., depending on the room in which the cheese is to be set. When the cream is at the correct temperature, add the required quantity of culture, if the cream is likely to develop bad flavors. Cheese color may then be added if required. (About 1 c.c. or 20 drops of color to 10 lbs. of cream will usually give satisfaction.)

Rennet is next added at the rate of 3½ c.c. or 1 small teaspoonful to 10 lbs. of cream, after diluting it in ten times its volume of cold water. Stir into the cream.

In about five or six hours, when the cream has thickened, ladle into dry cloths and hang up in a dry place. It is advisable not to put too much into one cloth, as it will be likely to develop too much acid before draining.

A few hours later open the cloths and scrape the sides to facilitate draining, then hang up again. Repeat the scraping at intervals of about three hours, until the curd is fairly firm. Then turn the curd out into butter muslin (used double thick), and salt the curd by adding 1 oz. of salt to every 3 lbs. and mixing it well into the curd. Fold the muslin over the curd, place on a board having another board and weight on top.

When the curd is ready to mould, it should be of a thick, pasty consistency but not sticky. Line the tin mould with wax paper and press the cheese in with a knife or bone spoon, making the curd quite flat on top. Fold over the ends of the paper and shake the cheese out of the mould, they are then ready to be eaten; if kept, they should be put in a refrigerator or cold storage until used.

GENERAL NOTES.

The rennet and color are the same as are used in factory cheese-making.

10 lbs. of milk or cream	=approximately, 1 gallon.
1 c.c.	=20 drops.
3½ c.c.	=1 dram.

As regards packing for shipment, we use ordinary rice paper to wrap the cheese in, and then place them in pasteboard boxes of proper size.

When keeping the above-mentioned soft cheese they should be kept in as cold and dry an atmosphere as possible, the best temperature being just above freezing.

Neufchatel Cheese.

This cheese is made from whole milk or whole milk with cream added to bring the test up to between 4 per cent. and 5 per cent. fat.

In the morning, pasteurize the milk by heating to a temperature of from 140 deg. F. to 150 deg. F., and hold it at that temperature for 20 to 30 minutes, then cool to 70 deg. F.

To each ten pounds of milk add 2 c.c. (about half a teaspoonful) of culture, or good-flavored, sour skim milk. Late in the afternoon add the rennet at the rate of ¼ of a c.c. or five drops to each ten pounds of milk.

If the milk has cooled, bring it to a temperature of 70 deg. F. Dilute the rennet with cold water, and add it to the milk, stirring for a few minutes to ensure even distribution. Cover the vessel containing the milk and leave undisturbed until next morning. In the morning the curd should be firmly coagulated and ready for cutting. Cut the curd in squares with a knife, then ladle it out on a rack covered with cheesecloth. When the free whey has drained away, apply pressure very lightly at first and increase the pressure as the curd becomes firmer.

When sufficiently drained, put the curd through a food chopper to break it up finely and make it more creamy. Add the salt at the rate of 1 oz. to 3 lbs. of cheese and mix thoroughly. When the salt is dissolved the cheese is ready to be put in packages suitable for the market.

Fancy Cream Cheese.

Neufchatel cheese is used as a base for a variety of fancy cheese by adding such flavorings as pimentos, olives, or nuts. These should be chopped finely and well mixed through the cheese.

Cottage Cheese with Rennet.

This cheese is made from skim milk. The method outlined for Neufchatel cheese is followed, but a small amount of cream is added at the time of salting, usually about 1 oz. cream to a pound of cheese. Salt at the rate of 1 oz. to 4 or 5 lbs. of cheese.

Cottage Cheese by Heating.

Pasteurize skim milk, then cool to 60 deg. or 65 deg. F., and add from one to two ounces of culture to each ten pounds of skim milk. Next morning the curd will be nicely coagulated and ready to make into cottage cheese.

Stir the curd to break it up, then place the can of milk in a vessel containing hot water. Stir gently until the curd and whey separate. This usually takes place between 85 deg. F. and 100 deg. F. If the separation is not complete at 100 deg. F., do not heat higher but allow the cans to stand until the whey is clear. High temperatures give a dry, grainy curd.

Drain the curd by hanging it up in cotton bags or putting it on a draining rack covered with cheesecloth.

When sufficiently drained, salt and cream are added as in "Cottage Cheese with Rennet."

Buttermilk Cheese.

Buttermilk cheese is made by heating the buttermilk to a temperature of 130 to 140 deg. F., holding at that temperature for about an hour, then draining off the whey.

During the heating process the buttermilk should be stirred just enough to ensure even heating. After leaving it undisturbed for about an hour it should be dipped or poured out on a draining rack which is covered with a cotton cloth.

When sufficiently drained the curd should be salted at the rate of 1 oz. of salt to 4 or 5 lbs. of curd. The addition of about 1 oz. of cream to each pound of curd makes a richer cheese.

These directions are suitable for raw-cream buttermilk, or for buttermilk from cream that was sweet when it was pasteurized and afterwards ripened.

If the buttermilk is from cream that was ripe when it was pasteurized the curd particles will be very fine and it is necessary to use a different method of making in order to have good results. This was worked out by the Wisconsin Agricultural Experiment Station, and is valuable for creamerymen.

Add a caustic soda solution to the buttermilk to completely neutralize the acid and then acidulate it with hydrochloric acid before applying heat.

The caustic soda is first dissolved in an equal weight of water by adding the dry alkali to the water. The acid is also diluted in an equal volume of cold water.

First test the buttermilk for acidity in order to know how much of the alkali solution will be required.

Forty parts by weight of dry alkali will neutralize ninety parts by weight of lactic acid. For example, 1,000 lbs. of buttermilk testing .75 per cent. acidity contains 7.5 lbs. of lactic acid. For neutralizing 7.5 lbs. of lactic acid it will require 3.3 lbs. of caustic soda, or 6.6 lbs. of the caustic soda solution.

Try a small amount in a cup, and if the buttermilk shows a permanent pink color when a few drops of phenolphthalein indicator are added, enough alkali has been used.

It will require two and a half to three times as much dilute acid as alkali used. To determine if enough has been added, take a small amount of buttermilk in a shallow dish and hold it for a few minutes in water about 145 to 150 deg. F. Enough acid has been added if the whey separates clear. If the whey is not clear more acid should be added in small amounts until a clear separation is obtained. The buttermilk is now ready for heating and the directions already given for heating, draining, and salting should be followed.

Club Cheese.

This is a very popular variety of fancy cheese, and is made from ripened cheddar cheese.

Take one pound of cheese, remove the rind, then cut the cheese in pieces and put it through a food chopper.

To this, add two level tablespoonfuls of butter and put it through the chopper again.

Add ¼ cup of cream and mix thoroughly. Pack the cheese in small jars, or put it up in small blocks and wrap them in tinfoil.

Either butter or cream may be used alone, and the amounts may be varied to suit conditions, such as the dryness of the cheese or the preference of the consumer.