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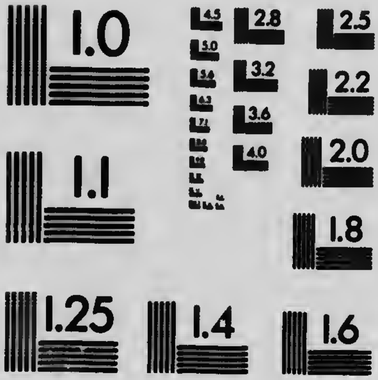

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Bulletin 143.

June '05

Ontario Agricultural College and Experimental Farm.

DAIRY SCHOOL BULLETIN.

INTRODUCTION.

By H. H. Dean, B.S.A., Professor of Dairy Husbandry.

The bulletins which have been prepared by the members of the Dairy School Staff at the Ontario Agricultural College appear to have been appreciated, and there is a great demand for them. We trust that this one will prove as helpful as those published in the past. The aim is to make the bulletin popular and practical. In some departments there is not much change from the last. Our system of buttermaking has undergone more changes than any other branch of dairy work, and there is yet great room for improvement. We hope that the bulletin will prove useful for the man who cares for and milks the cows, and also to the manufacturers of cheese and butter in the factory and on the farm.

Dairy Farmer. Many dairy farmers grow discouraged during the season of low prices and sell their cows. This is a great mistake. No branch of agriculture is so stable and so remunerative as dairying during a series of years. A year of low prices is usually followed by one of high prices. The cow is undoubtedly the best paying animal on the farm if she is fed and handled properly. However, in order to make a cow pay it is necessary that her owner shall possess certain qualifications. The most important of all is that he shall have a real liking for the cows, not only because of the money which they earn, but he must like them simply because they are cows. A person who really likes cows will take pleasure in feeding and looking after them. To him it is not drudgery. This person will always treat cows kindly and considerately. There will always be a bond of sympathy between the owner and the cow. Each will strive to do the best possible for the other.

This owner of cows must study their habits, likes, and dislikes. He must feed them liberally and make them as comfortable as possible. Unless he or she is prepared to be a student of cows, success is not probable. To the dairy farmer we should say, know your cows *individually*. This can be best done by weighing the milk from each cow daily, once a week, on two consecutive days each month, or even once a month. Samples for testing should also be taken on the day or days for weighing in order to know the percentage of fat in the milk. This, together with a close observation of the feed consumed by a cow, will enable a dairy farmer to determine whether or not his cows are making a profit. It will also enable him to intelligently weed the poorer cows.

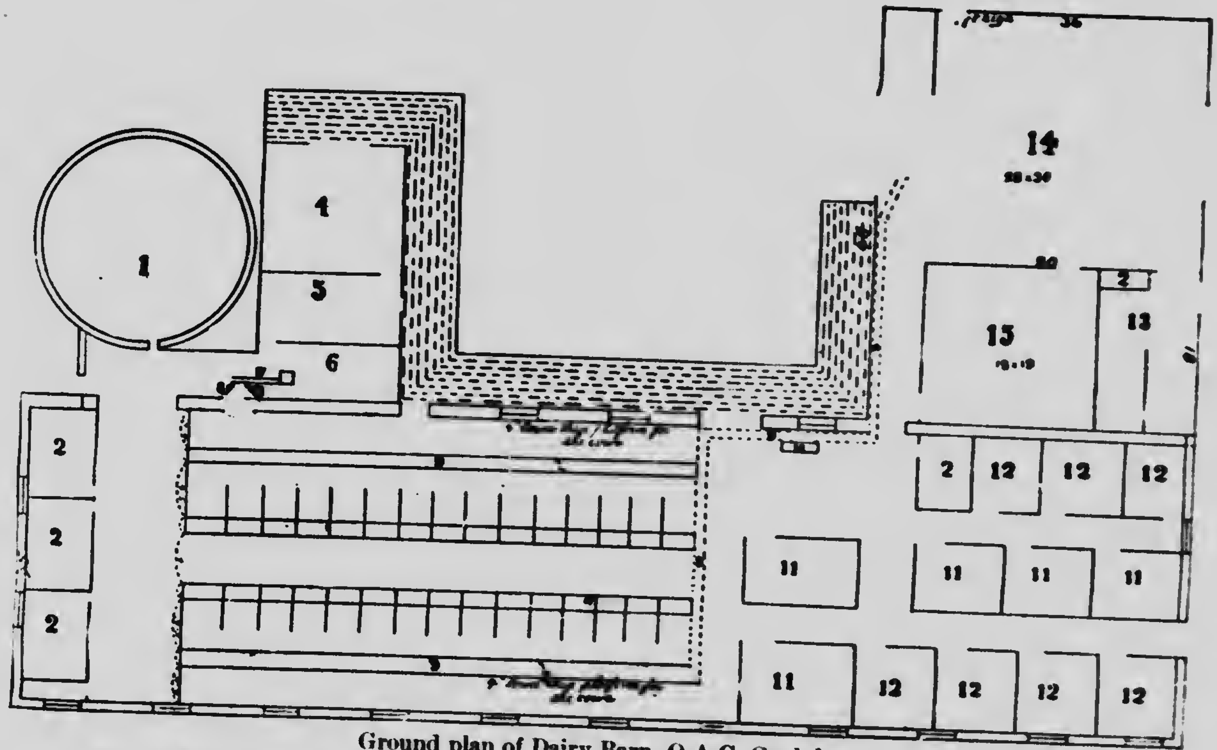
Dairy Cows may be purchased or they may be bred. Frequently good cows may be bought at reasonable prices, but generally speaking they must be reared by the dairy farmer. For the dairyman, who cannot afford to keep pure-bred cows, it is desirable to select grade or native cows and breed these to a pure-bred male belonging to one of the dairy breeds. Great attention should be paid to the sire, as milking quality in the female depends more on the sire than on the dam. Dairy farmers do not sufficiently realize the importance of this point. Excellent dairy cows may be secured at small cost by using a dairy sire belonging to a dairy breed and a dairy family. In this way a herd of ordinary or inferior breeding may soon be transformed into a herd of good milkers. The fundamental mistake made by many breeders of dairy cows is in the use of inferior or what are commonly called "scrub" sires. The patrons of every cheese factory and creamery ought to have the use of a pure-bred bull at nominal cost. It would pay the factories to adopt some co-operative plan to secure this result.

Calves and heifers for the dairy should be kept in a thrifty condition but not too fat. They should commence milking when about two and one-half years old. At the end of the second lactation period and during all future years they should produce not less than 6,000 lbs. milk or 250 lbs. butter yearly. This may be taken as a minimum standard of production for profitable dairy cows. Stated another way, they should earn from $25 to $100 per cow each year, above the cost of feed.

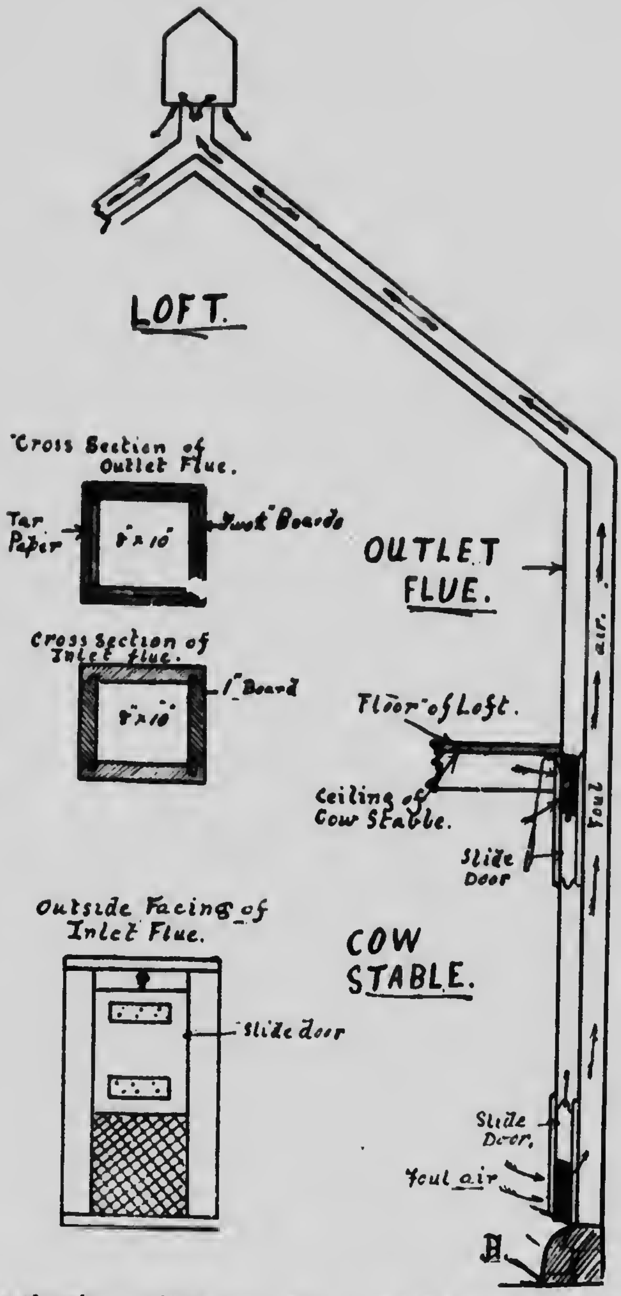
Dairy Stable. The chief requirements in a dairy stable are that it shall be light, clean, and healthful. The first is got by having plenty of clean windows, the second by having cement floors, with stalls of proper length and a gutter or drop behind the cows, and the last by having the stable well ventilated, and whitewashed at least once a year. Mangers are not necessary in a modern cow stable.

Conditions vary so much on different farms that it is difficult to give a plan suitable for all farms. The accompanying illustrations will show the arrangements in the dairy stable of the College and on the whole it is quite satisfactory. The feed bins are located at one end of the stable and the box stalls, eleven in number, at the other. There is room for thirty cows to be tied up. A large room above the stable holds the hay and straw. This is not the most sanitary arrangement, but it is convenient.

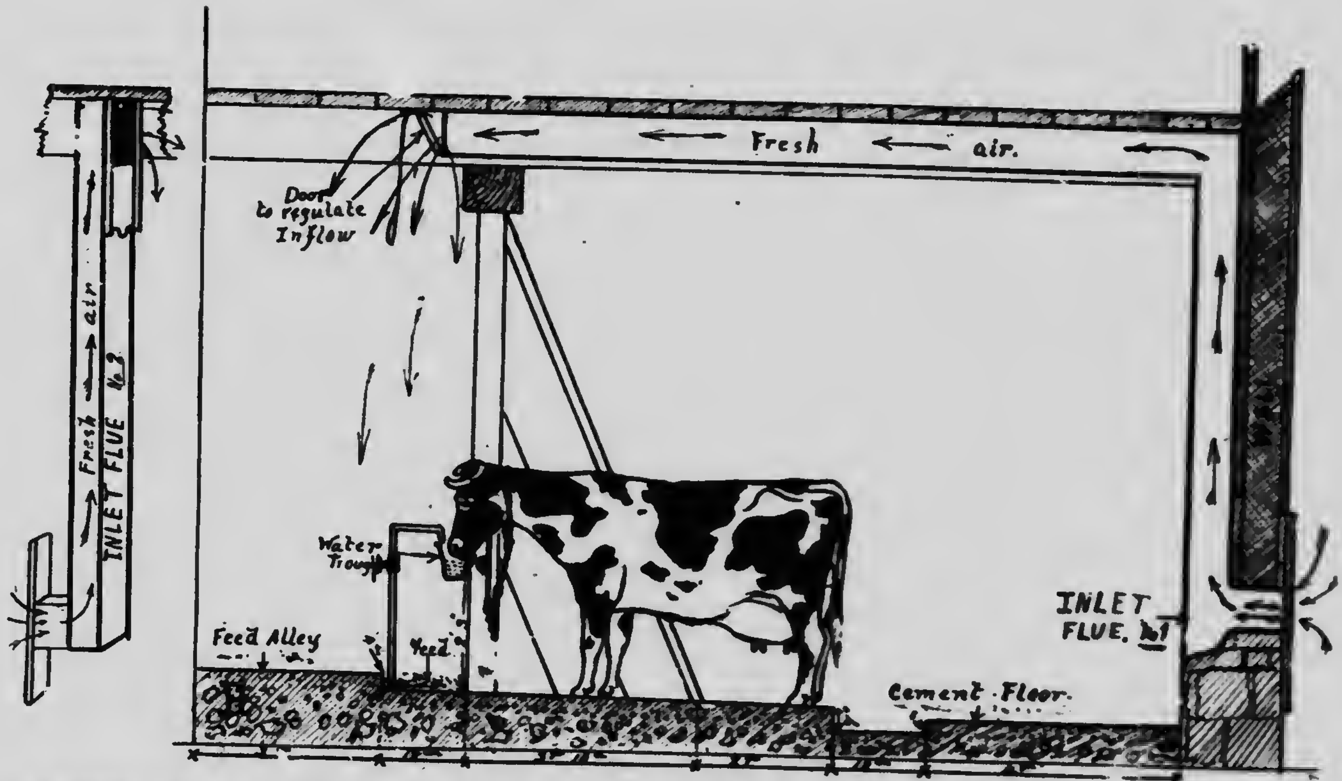
The King system of ventilating is the one adopted in the dairy stable and it is quite satisfactory. There are six inlets and eight outlets. The cost of putting in the ventilation was $136, including the cost of galvanized iron ventilators, of which there are four connected with the eight outlets from the stable.



Ground plan of Dairy Barn, O.A.C. Guelph.
1, silo; 2, feed bins; 4, 5, 6 and 15, storage rooms; 9, gutter behind cows; 11 and 12, box stalls; 13, horse stalls; 14, manure shed.



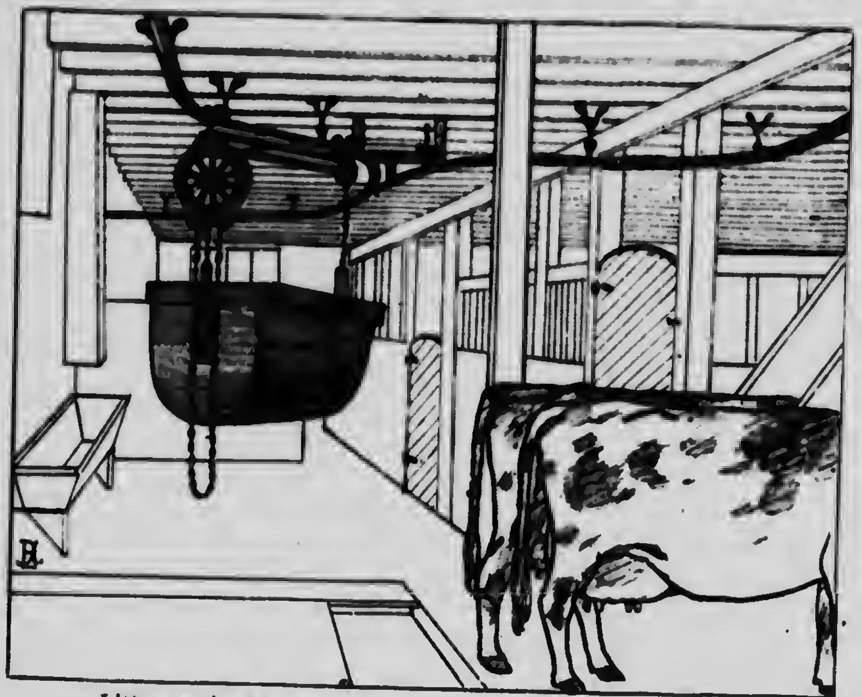
Plan showing outlet for foul air. There are eight of these in the stable—four on each side. One from each side enters a ventilator at roof.



Cross section of stable showing one-half the feeding alley, place for feeding, water trough, stall, gutter, passage behind the cows and inlets for fresh air. There are six of these, one-half of which open at the ceiling behind the cows and one-half in the centre of the stable.

Feeding the Cow. The natural food of the cow is grass and nothing is equal to good pasture for cows. In order to secure good pasture on cultivated land it is advisable to give more attention to the method of, and mixture used for, seeding. A very good combination of grasses and clovers, where a rotation of crops is practised, is the following: 4 lbs. timothy, 5 lbs. orchard grass, 7 lbs. red clover, and 2 lbs. alsike clover, making 18 lbs. of seed per acre.

On fields which may be allowed to remain in pasture for several years, the following mixture is recommended by Prof. Zavitz: 4 lbs. or-



Litter carrier, a great convenience for cleaning Dairy Stable.

chard grass, 4 lbs. meadow fescue, 3 lbs. tall oat-grass, 2 lbs. timothy, 2 lbs. meadow foxtail, 5 lbs. lucerne clover, 2 lbs. alsike, and 2 lbs. white clover, making 24 lbs. of seed per acre.

The same authority recommends for a pasture crop to be used the same year as sown, 51 lbs. oats, 30 lbs. early amber sugar cane, and 7 lbs. red clover—a total of 88 lbs. per acre. Cows are very fond of this mixture.

Lucerne or Alfalfa is another crop which dairy farmers should grow. It may be used for green fodder, hay, pasture and for green manure. For hay it should be cut when less than one-third in bloom. It is claimed that a ton of lucerne hay is equal to a ton of bran for milk production. This crop should receive more attention on dairy farms. About 18 lbs.

of seed per acre should be sown on well-drained land in the spring, with or without a crop. It should not be pastured or cut the *first* year. It will give two or three cuttings each year after it is established.

To supplement pastures, green peas and oats, or summer silage are often necessary. These help to maintain the milk flow at a time when the shrinkage would otherwise be considerable. From two to four pounds of meal per cow each day will often pay when the prices of dairy produce are good. This meal may consist of bran and oats, or either of them alone.

For winter feeding, corn silage is undoubtedly the cheapest bulky food at the disposal of dairymen. However, corn silage alone is not sufficient for milking cows. They also need some clover hay, roots, and meal. When dry it pays to feed the cows a moderate amount of meal, as it seems to be a recognized principle that the time to renew a cow is when she is not milking. Too many put their cows on short rations when they are not milking, thus violating the foregoing principle, and the results are not satisfactory. It pays to feed a good cow well when dry. With heavy milkers there is danger of losing the cows through "milk fever," but modern methods of treating this disease make it comparatively harmless, and there is very much less risk now than formerly. Under ordinary conditions the best plan with heavy milkers in high flesh is to not milk the cow any more than is required for the calf for the first two or three days. If the cow is attacked, the "air treatment" is simple and effective.

On the one hand many cow feeders fail to give their animals sufficient to maintain a proper milk flow, while on the other some feeders give more meal than the cows can profitably assimilate. Experiments indicate that cows in full flow of milk should receive about eight pounds of meal daily, together with all the roughage which they can consume. An increase to twelve pounds of meal daily in most cases means an added cost for the milk and butter out of proportion to the increased yield.

The winter feed at the dairy barn of the College is prepared as follows: The hay is cut and mixed with the corn silage and pulped mangels for several hours before feeding. This roughage is given at two feeds, and on it is placed the meal for each cow at the time of feeding. The meal consists of bran, oats and oilmeal. A feed of long hay is usually given once a day in addition to the regular feed.

Our standard ration consists of about

40 lbs. corn silage,	4 lbs. wheat bran,
10 lbs. clover hay,	3 lbs. ground oats,
30 lbs. mangels,	1 lb oil meal.

The following table is based on Bulletin 154 from Cornell Station:

DIGESTIVE NUTRIENTS IN ONE POUND OF SOME COMMON FEEDING STUFFS.

Kind of Food.	Total dry matter.	Pounds of digestible nutrients.			Nutritive Ratio.
		Protein.	Carbo-hydrates. + (fat x 2 25.)	Total.	
Green fodder corn, 1 lb	0.20	0.10	0.125	0.135	1:12.5
" peas and oats, "	0.16	0.018	0.076	0.094	1:4.2
" red clover, "	0.29	0.029	0.164	0.193	1:5.6
" alfalfa clover, "	0.28	0.039	0.138	0.177	1:3.5
Corn silage, "	0.21	0.009	0.129	0.138	1:14.3
Potatoes, "	0.21	0.009	0.165	0.174	1:18.3
Mangels, "	0.09	0.011	0.056	0.067	1:5.1
Sugar beets, "	0.13	0.011	0.104	0.115	1:9.4
Carrots, "	0.11	0.008	0.082	0.090	1:10.3
Turnips, "	0.10	0.010	0.077	0.087	1:7.7
Timothy hay, "	0.87	0.028	0.465	0.493	1:16.6
Mixed hay, "	0.87	0.062	0.460	0.522	1:7.4
Red clover hay, "	0.85	0.068	0.396	0.464	1:5.8
Alfalfa hay, "	0.92	0.110	0.423	0.533	1:3.8
Corn fodder, "	0.58	0.025	0.373	0.398	1:14.9
Corn Stover, "	0.60	0.017	0.340	0.357	1:19.9
Pea Straw, "	0.86	0.043	0.341	0.384	1:7.9
Wheat straw, "	0.90	0.004	0.372	0.376	1:93
Oat straw, "	0.91	0.012	0.404	0.416	1:33.6
Corn, (grain) "	0.89	0.079	0.764	0.843	1:9.7
Wheat, " "	0.90	0.102	0.730	0.832	1:7.2
Rye, " "	0.88	0.099	0.700	0.499	1:7.1
Barley, " "	0.89	0.087	0.692	0.779	1:7.9
Oats, " "	0.89	0.092	0.568	0.660	1:6.2
Buckwheat, " "	0.87	0.077	0.533	0.610	1:6.9
Peas, " "	0.90	0.168	0.534	0.702	1:3.2
Corn and cob meal, "	0.85	0.044	0.665	0.709	1:15.1
Wheat bran, "	0.88	0.122	0.453	0.575	1:3.7
Wheat middlings, "	0.88	0.128	0.607	0.735	1:4.7
Low grade flour, "	0.88	0.082	0.647	0.729	1:7.9
Gluten feed, "	0.92	0.194	0.633	0.827	1:3.3
Gluten meal, "	0.92	0.258	0.656	0.914	1:2.5
Linseed meal (new process) 1 lb	0.90	0.282	0.464	0.746	1:1.6
Cotton seed meal, "	0.92	0.372	0.444	0.816	1:1.2
Sugar beet pulp, "	0.10	0.006	0.073	0.079	1:12
Apple pomace, "	0.233	0.011	0.164	0.175	1:14.9
Skim-milk (separator) "	0.094	0.029	0.059	0.088	1:2
Buttermilk, "	0.10	0.039	0.065	0.104	1:1.7

To find the pounds of nutrients in any given number of pounds of any feeding-stuff, multiply the pounds by the amount of nutrients in one pound as given in the table.

By referring to the preceding table we find that our ration contains digestible material as follows:

Feeding Stuffs.	Total dry matter.	Pounds of digestible nutrients.			Nutritive ratio.
		Protein.	Carbo-hydrates. + (fat x 2.25.)	Total.	
Corn silage, 40 lbs.	8.40	0.360	5.160	5.520	
Clover hay, 10 "	8.50	0.680	3.960	4.640	
Mangels, 30 "	2.70	0.330	1.680	2.010	
Bran, 4 "	3.52	0.488	1.812	2.300	
Oats, 3 "	2.67	0.276	1.704	1.980	
Oil-cake, 1 lb	0.90	0.282	0.464	0.746	
	26.69	2.416	14.780	17.196	1:6.1
Wisconsin standard	24.5	2.20	14.900	17.100	1:6.8
German "	24.0	2.50	13.400	15.900	1:5.4

By comparing it with the Wisconsin and German standards, we find that it contains more dry matter than is called for by either, more protein than is asked for in the Wisconsin and less than the German, more carbonaceous material than the German and slightly less than in the Wisconsin, the total digestible material is greater than in the German and about the same as the Wisconsin, while its nutritive ratio is between the two standards, but conforming more nearly to that of Wisconsin.

By using the table as directed any farmer can readily find out the amount of digestible material in his ration and compare it with the standards given. If he finds that the ration is too low in protein or muscle-forming material, then bran, oil-meal, gluten meal, peas or clover hay should be added to the ration, and if necessary some of the more carbonaceous foods such as silage, may be reduced. However, silage, roots, beet pulp, etc., give succulency to the ration which is very important in the economical production of winter milk.

Factory Floods. Substitute, as soon as possible, a cement floor for the wooden floor now in the factory. Grade the ground to a slant of one inch in six feet to a central gutter, then pack the earth firmly and cover with four to six inches of gravel. Pound the gravel solidly. Mix sand and gravel with good cement in the proportion of four or five to one,. and lay the grouting about four inces thick on the firm gravel. Finish with one inch of screened sharp sand and the very best brand of cement mixed in the proportion of two to one for the finishing coat. Have the surface smooth so that pools of water will not lie on the floor. The gutter should have a fall of one inch in six to eight feet, to an outlet, and should be made specially solid and even on the side and bottom. Employ a skilled workman to lay the floor, and use none but the very best material.

Place a "bell-trap" at the outlet from the gutter. Use sewer tile with cemented joints in underground drains near the factory, to prevent sewage soaking into the well. The sewage may be disposed of by means of a filter-bed or by the sub-earth system. Do not allow it to accummulate about the factory.

PAYING PATRONS. Milk is valuable for butter-making in proportion to the fat which it contains, and the pounds of fat delivered in the milk or cream should form the basis of dividing proceeds among patrons of the creameries.

As butter consists of fat, together with about 16 per cent. of water, salt, and curdy matter, there will always be more butter than the fat contained in the milk. This excess of butter over fat constitutes what is known as the "overrun." The "overrun" varies from twelve to sixteen per cent., *i.e.*, 100 lbs. fat in the milk makes from 112 to 116 pounds of butter, and this "overrun" belongs to the patrons, unless otherwise understood. It is unwise for creamery managers to take the "overrun" as part payment for manufacturing.

In cream-collecting creameries the overrun usually varies from twelve to eighteen per cent.

For calculating the yield of butter from fat in the milk, adding one-sixth to the fat is near enough for practical purposes.

Cheese is made largely from two constituents in the milk, viz., fat and casein; therefore, the method of dividing proceeds among the patrons of cheese factories is more complicated than for creameries. Three systems are now in use among factorymen:

1. Paying according to the weight of milk delivered regardless of its quality.

The principle of this plan is that all milk is of equal value per 100 pounds for cheese-making. It rests on a false assumption, is unjust, and it tends to promote dishonesty. Factorymen and honest patrons who complain that some of the milk is skimmed and watered by dishonest patrons, deserve little sympathy, because a remedy is within the reach of all at a very small cost. The milk of all patrons should be tested regularly, and be paid for according to its value for cheese-making.

2. Paying according to the weight of the fat delivered in the milk, the same as at creameries.

The principle of this system is that all milk is valuable for cheese-making in proportion to the fat which it contains. The system is manifestly more just and equitable than the first named, and is to be commended in preference to "pooling" by weight of milk. The chief weakness of the plan is that the yield of cheese is not in direct proportion to the fat contained in the milk; therefore, it gives an undue advantage to the patrons sending milk containing a high percentage of fat.

3. Paying according to the fat and casein in the milk, the casein being represented by the factor 2, added to the percentage of fat.

The principle of this system is that milk, is valuable for cheese-making in proportion to the fat and casein contained in it, and it further assumes that the percentage of fat + 2 represents the available fat and curdy compounds in milk for cheese-making.

The application of the third system is very simple. To illustrate: The tests for fat of patrons' milk are 3.0, 3.5, 3.8 and 4.0. The percentage of fat and casein are 3+2=5.0; 3.5+2=5.5; 3.8+2=5.8; and 4+2=6.0. The pounds of fat and casein are calculated by multiplying the pounds of milk delivered by the percentage of fat and casein. Thus, if the first patron had 1,500 lbs. milk, he would be credited with 1500×5÷100=75 pounds of fat and casein. If the second delivered 2000 pounds milk he would be credited with 2000×5.5÷100, or 110 pounds of fat and casein, and so on with all the others. The value of one pound of fat and casein is ascertained by dividing the net proceeds of the sale of cheese by the total pounds of fat and casein delivered.

The following table gives a summary of the results obtained during five years experiments, in which 250 experiments were made with nearly 200,000 pounds of milk, which contained percentages of fat varying from 2.7 to 5.5.

Av. p.c. fat in milk.	Lbs. cheese made per 100 lbs. milk.	Lbs. cheese made per 1 lb. fat in milk.	Lbs. cheese made per lb. fat and casein or p.c. fat + 2.	Lbs. loss of fat and casein in whey.		Per cent. lost in curing in four weeks.	Average score.	
				Per 1,000 lbs. milk.	Per 100 lbs. cured chees		Flavor max. 35.	Total max. 100.
2.87	8.75	3.04	1.79	2.71	3.09	4.26	30.4	89.9
3.22	9.03	2.80	1.72	2.75	3.15	4.43	30.2	89.4
3.83	10.02	2.61	1.71	3.34	3.21	4.10	30.8	90.3
4.23	10.67	2.53	1.71	3.21	3.02	4.05	31.0	90.4
4.74	11.44	2.41	1.69	3.64*	3.18*	3.07	31.0	89.8
5.21	12.13	2.32	1.68	3.40*	2.80*	3.53	31.5	91.6

* Fat only. Casein not determined.

Amounts of money (cheese 8c per pound) credited by three systems and also value of cheese.

Average p. c. fat in milk.	Weight of milk—1,000 lbs. milk.	Weight fat in 1,000 lbs. milk.	Weight of fat and casein in 1,000 lbs. milk, or fat plus 2.	Value cheese made from 1,000 lbs. milk.
	$ c.	$ c.	$ c.	$ c.
2.87	8 27	5 91	6 69	7 00
3.22	8 27	6 63	7 18	7 22
3.83	8 27	7 89	8 02	8 02
4.23	8 27	8 71	8 56	8 54
4.74	8 27	9 76	9 27	9 15
5.21	8 27	10 .73	9 91	9 70

"Our five years' experiments prove that this third system comes nearest to the actual value of the cheese produced, though it still places a slight premium on the milk-fat. It encourages the production of good milk, and at the same time does not discourage the majority of patrons who have average milk, and who are apt to envy those whose cows give a small amount of rich milk, and who draw a large share of the proceeds of cheese-sales, when the money is divided on the basis of the fat only." —O. A. C. Report, 1898, p. 52.

Skim Milk and Whey. The value of skim milk for young calves and pigs is much increased by feeding it sweet. The separator creamery should heat all skim milk to 185 degrees, before it leaves the creamery. Sweet skim milk is probably worth 15 to 20 cents per 100 pounds. It has also about the same value for grown pigs when sour, if fed along with meal.

Butter milk has about the same value as sour skim milk, if it does not contain too much water. When selling butter milk in bulk at the creamery, a convenient way is to value it at so much per ton of butter. From three to five dollars per ton of butter is a fair price.

Experiments made at the Ontario Agricultural College showed that 100 pounds of whey were equal to 14 pounds of meal in the production of bacon. Both skim milk and whey had a marked influence in the production of *firm* bacon. When seling whey in bulk at the factory, it is usually valued at from three to six dollars per ton of cheese.

The by-products of cheese-making and buttermaking are valuable factors in adding to the wealth of dairymen through bacon hogs, and the rearing of young cattle for beef and the dairy.

THE ALKALINE SOLUTION: ITS PREPARATION AND USE.

By 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 degrees to 90 degrees 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 temperaure of 40 degrees to 50 degrees F., they will multiply and considerable lactic acid will be formed. Milk intended for cheese-making 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 cheese-making, 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:

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

2nd. 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.

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

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

5th. 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 (1000 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, one c.c. of which will exactly neutralize one c.c. of the acid. For this purpose, dissolve about 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:

1st. 10 c.c. of alkali required 11.5 c.c. of acid for neutralization.
2nd. 10 c.c of alkali required 11.45 c.c of acid for neutralization.
3rd. 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 exactly to 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 milk or cream 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 neuralize 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.

MILK AND CREAM TESTING.

By J. A. McFeeters.

Normal milk may be considered as an emulsion. The chief constituents are fat, casein, sugar, albumen, a small amount of mineral matter—ash, together with a large percentage of water.

As fat is the most variable of the milk constituents the ability to accurately determine the percentage present is an essential qualification for a successful dairyman.

The importance of this becomes at once apparent under conditions where the commercial value of milk is in direct proportion to its fat content. A means of detecting mechanical losses, due to faulty methods in the course of manufacture, adulterations by the producer or dealer, or of testing the real worth of the different members of the dairy herd, is of inestimable value to a dairyman.

The details connected with an accurate, speedy fat determination of a normal sample of milk, by means of the Babcock test, are briefly as follows:

1. After thoroughly mixing, preferably by pouring from one vessel to another, a *representative* sample should be taken. Too great care cannot be exercised at this step. A test is of no value whatever if this point be overlooked.

2. By means of a 17.6 cubic centimeter (c.c.) pipette, take 18 grams of milk at a temperature of from 60 to 70 degrees.

3. Add to this 17.5 c.c. of commercial sulphuric acid with a specific gravity (sp. gr.) of 1.82 to 1.83, and thoroughly mix the acid and milk by giving the bottles a gentle rotary motion.

4. Place the bottles in the tester and whirl for from four to five minutes, at a speed varying from 700 to 1,200 revolutions per minute, according to the diameter of the machine (700 revolutions per minute with a machine twenty inches in diameter).

5. Add hot water at a temperature not lower than 140 degrees F. to float the fat into the neck of the bottle.

6. Rotate the machine again for about two minutes and take the readings before the fat cools. If troubled with burnt readings, add the water twice instead of all at once, filling the bottle just to the neck the first time, then turn the machine about a minute, fill to about the eight per cent. mark the second time, and whirl for another minute.

7. Read the fat column at a temperature of from 120 to 140 degrees F.

NOTES.

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

2. Be very careful to measure the exact amount of milk for a test. A 17.6 c.c. pipette will deliver about 17.5 c.c. of milk. This measurement of milk of average quality will weigh about 18 grams.

3. A partially churned sample of milk may be prepared for sampling by heating it to about 110 degrees F. and pouring it from one vessel to another, to mix it thoroughly. When it is thus prepared, take a sample as quickly as possible, and cool to about 60 degrees F. before adding the acid.

4. In sampling frozen milk it is necessary that both the liquid and the frozen part be warmed and mixed thoroughly. The unfrozen part is richer in fat and solids than the frozen.

5. A sample of milk that has soured and thickened may be prepared for sampling by adding a small amount of some alkali to neutralize the lactic acid, and cause the curd to redissolve. A small amount of powdered concentrated lye is very suitable. Add just a small amount of lye at a time, and pour the milk from one vessel to another, to mix the lye with the milk, which causes the casein to become dissolved.

6. The amount of acid used must be varied to suit its strength. The right amount is being used when the fat presents a bright golden appearance. Acid that is much too strong or too weak should be discarded, as satisfactory results cannot be obtained from its use. Acid a little weak is to be preferred to very strong acid. Carboys or bottles containing acid should be kept well corked, to prevent the contents from becoming weakened by absorbing moisture from the atmosphere.

7. Avoid pouring the acid directly on the milk. The test bottle should be held at an angle so as to cause the acid to follow the side of the bottle and go directly underneath the milk. After the addition of the acid to the test bottle the milk and acid should be in two distinct layers without any charred matter between them. A thorough mixing by means of a gentle rotary motion should be given at once.

8. If using a hand tester in a room at a low temperature, it may be necessary to keep sufficient hot water in the machines to maintain a temperature of from 120 to 140 degrees F in the test bottles.

9. The water added to the test bottles should be soft or distilled. If hard water is used, add a little sulphuric acid (half an acid measure, or a little more to a gallon of water) to soften it; this will prevent foam above the fat.

10. If there are several readings to take, *always* set the samples in hot water (120 to 140 degrees F.) extending to *the top of the fat* before reading.

11. It is well to use a pair of dividers or compasses for measuring the column of fat. The points of the dividers should be placed at the upper and lower limits of the fat column; then if one point be placed at the zero mark of the scale, the division at which the other point touches will show the percentage of fat in the sample tested.

12. Burnt or cloudy readings may be caused by:

(1) The use of too much or too strong acid.
(2) Allowing the acid to fall directly on the milk.
(3) Having the milk or acid at too high a temperature—the higher the temperature the less acid is required.
(4) Allowing a sample to stand too long after adding the acid, before mixing the milk and acid.

13. Light colored readings and floating particles of curd are usually due to:

(1) The use of too little or too weak acid.
(2) Having the milk or acid at too low a temperature—the lower the temperature of either, the more acid is required.
(3) Insufficient shaking of the bottles to unite the milk and acid thoroughly.
(4) Lack of required speed or time in whirling.

14. A convenient method of testing the accuracy of the graduation is to test the same milk in the different test bottles and compare the readings. A bottle that differs by more than .2 (2-10) in its reading from the rest should be discarded. As the capacity of that part of the neck over which the scale extends should be 2 c.c., the accuracy of the scale may be tested by filling the bottle to the bottom of the scale with water at the temperature of the room, and then adding 2 c.c. of water at the same temperature by means of a 2 c.c. pipette or a finely graduated burette.

15. Care and exactness in every detail are absolutely essential requisites for reliable results in milk testing. There is more to learn in *care* than in principle. Carelessness on the part of the operator has frequently thrown suspicion on the Babcock test.

Composite Samples.

Whole milk creameries, and in many of the advanced cheese factories, the patron receives payment, not in proportion to the amount of milk, but in proportion to the butter or cheese value of the milk supplied by him. Such a system, of course, necessitates the use of the Babcock test. A test of the milk cannot be made daily; and to overcome this difficulty a small sample of the milk supplied by each patron is taken at each time of delivery and put into a bottle, called a composite sample bottle, which contains a small amount of some kind of preservative, such as bichromate of potash or corrosive sublimate. It is not advisable to use the latter alone, as it is quite poisonous, and imparts no color to the sample to indicate its presence. An excellent preservative is a mixture composed of about seven parts bichromate of potash to one part corrosive sublimate.

From what can be taken on a five cent piece to what can be taken on a ten cent piece will usually be found sufficient to preserve a sample for two weeks in summer and a month in fall and winter, when an ounce of milk is taken daily. The amount of preservatives required depends upon the weather, the size of the samples, and the length of time over which the testing period extends. A Babcock test of the sample is made at the end of two weeks or a month; and if the daily sampling and the testing of the sample are carefully done, it gives the average quality of the milk supplied during the time over which the test extends.

The samples may be tested twice per month, but by keeping them in a fairly cool place satisfactory results can be obtained by testing, but once a month.

Notes on Composite Sampling and Testing.

1. For holding composite samples, pint jars with long corks are preferable. Turned wooden corks are more satisfactory than porous corks.

2. The jars should be kept well corked, as the samples will dry on the surface and a tough skin, composed largely of cream, will be formed when exposed to the atmosphere in warm weather.

3. Paste a plainly written label on each patron's jar, fasten its edges down well, and give it at least two coatings of heavy shellac to prevent it from washing off when cleaning the bottles.

4. Add the preservative to the composite sample jars at the beginning of the testing period, and before any milk is added to them. It may be necessary to add a little extra preservative later on. Be guided by the color of the samples and how well they are keeping. An excess of preservative has a strong tendency to produce burnt readings.

5. The sample for the composite jar should be taken after the milk is poured into the weigh can. For this purpose an ounce or a half-ounce dipper is often used. A tube or milk "thief" and a drip from the conductor are also satisfactory means of obtaining a sample. When receiving milk that is partly frozen, guard against taking a sample from only the unfrozen portion.

6. Give the jar a gentle rotary motion each time a sample is taken, to mix with it the cream that has risen and also to incorporate the fresh sample with the part containing the preservative; and avoid shaking the jar, as shaking tends to churn the contents.

7. It is sometimes necessary to place the samples in a cool place each day when through using them.

8. To prepare composite samples for testing: Set the sample jars in warm water at about 110 degrees F., to loosen the cream from the sides of the jars, and also to warm the samples to cause the cream that has risen to mix more readily with the milk. Mix well by pouring from one vessel to another—never by shaking. Should difficulty be experienced in getting a thorough solution, the addition of a small amount of potash will facilitate the operation.

When the composite samples for the Babcock test have been added to the test bottles, cool to about 60 degrees F., before adding the acid. One of the points most frequently neglected and underestimated is attention to temperatures. Sulphuric acid acts more strongly upon milk that is at a high temperature, than upon milk at a lower temperature; also the higher the temperature the more the fat will expand and the greater the reading will be. Adopt some *constant* temperatures for each step of the work; the following have been found very satisfactory. About 60 degrees for the milk when the acid is added, about 140 degrees for the water added to the test bottles, and between 130 degrees and 140 degrees for the water into which the test bottles are set before a reading is taken. If you prefer different temperatures from those suggested, adopt them, but do not neglect to adopt *constant* temperatures.

It sometimes is an advantage to add the water to the test bottles at twice rather than all at once, filling each bottle just to the neck at first, and to about the eight per cent. mark the second time. Whirl the tester for a minute after each addition of water.

9. Cost of testing composite samples: In a gallon of sulphuric acid there is enough for about 260 tests. Estimating the value of the acid to be 3½c. per pound, the cost of the acid for a single test would be one-quarter of a cent.

To find the average test of a number of samples: If the weights and tests of a number of different lots are fairly uniform, the average weight and test may be found by dividing the sum of the weights and tests by the number of lots, but when there is *no uniformity* in the different lots, the *true average* test can be obtained only by multiplying the total pounds of fat by 100 and dividing the product by the total pounds of milk. There is sometimes a wide difference between the mathematical average and the true average test of different lots.

Testing Cream.

The need of an accurate, simple, and speedy method of determining the butter value of cream has become more and more urgent with the general adoption of the Cream Collecting System of Creamery management.

The Oil Test has been used for many years with a measure of success, but it may no longer be regarded as a reliable test for creamery work.

Its chief weak points and objections are as follows:

1. The readings or tests vary with the churnability of the samples. For example, a sweet sample, low in fat, will rarely yield an exhaustive separation of clear oil or fat. A low reading or poor test is usually obtained from such a sample.

2. The amount of labor involved in properly caring for the tests.

3. The machines used for the churning process are usually very noisy and often troublesome.

The Babcock test for cream has stood the test of several years' criticism and experience, and may be regarded as a simple, accurate, and satisfactory test for creamery work.

Cream test-bottles are graduated to read 30, 40, or 50 per cent. fat, and differ from whole milk bottles only in the diameter of the neck. The intermediate size is usually the most satisfactory for factory work. The scale on the neck of the ordinary milk or cream test bottle is graduated to read directly the per cent. of fat, only when 18 grams are used in the test, *i.e.*, the fat extending over one of the larger divisions of the scale weighs *one per cent.*, or the one-hundredth part of 18 grams. This fact will explain the various rules for determining the per cent. of fat when 18 grams cannot be used in a test—as in the case of cream and cheese, in which the per cent. of fat is high.

RULE. To find the per cent. of fat when less than 18 grams has been used; multiply the reading obtained by 18 and divide by the number of grams used.

This weight may be most accurately obtained by means of a delicate balance, but in the hands of the average dairyman it is a question if the use of a balance would result in greater accuracy than a pipette for sampling cream in a normal condition. The specific gravity of average cream (25 to 30 per cent.) being nearly *one*, the weight delivered by an 18 c.c. pipette would be approximately the required amount, viz., 18 grams.

During the process of cream ripening, however, more or less gas is usually formed which tends to reduce the specific gravity and thus lessen the weight of a given volume of the cream. It will thus be seen that sour cream sampled with a pipette would tend to give readings slightly lower than sweet cream. The difference in the test would scarcely be perceptible at a low per cent. of acid, but would be more marked at a high, sharp, acidy condition.

The use of a pipette for sampling in creamery work places a slight premium on sweet cream, thus affording a pertinent means of discriminating against overripe and otherwise objectionable grades of cream.

A sample containing an unusual amount of air or gas may be more accurately sampled if warmed to a temperature of about 110 degrees F. and after the necessary mixing, cooled to about 60 degrees F.

NOTES.

1. A pipette graduated to read both 17.6 c.c. and 18 c.c. is a convenience, the former measurement being required for whole milk, skim milk, butter milk, and whey, and the latter for cream.

2. When sampling viscous cream the pipette should be rinsed with about one-third measure of warm water, which should be added to the test bottle.

3. The addition of a small amount of caustic soda or concentrated lye to viscous or lumpy samples renders sampling more speedy and accurate.

4. Composite samples of cream may be cared for and treated in the same manner as outlined for milk under the heading, "Composite Samples." Page 18.

5. Sample jars should be kept well corked during warm weather to prevent evaporation. Carelessness in this matter may allow the samples to give off sufficient moisture to cause the test to read from 1 to 10 per cent. too high.

6. No specific measurements of sulphuric acid can be given for cream as some samples require more than others. The proper amount is being used when the fat column presents a clear golden color. It is well to use the minimum amount at first, and if a light shade is produced at the time of mixing, more may be added.

7. If troubled with cloudy or muddy readings, the addition of a few cubic centimeters of water to a sample before adding the acid is a good practice.

8. Experiments prove that after mixing the cream and acid the necessary hot water may be added before whirling.

9. Under favorable conditions, composite cream samples may be tested monthly. Under conditions where difficulty is experienced in preserving the samples it may be well to test semi-monthly.

10. As the Babcock test is based on weight, it is necessary to either weigh the cream or estimate the weight from the number of creamery inches. According to experiments conducted at the Ontario Agricultural College, an inch of average cream in a pail 12 inches in diameter will weigh 4.1 pounds. Thus, if it were found more convenient to measure the cream than to weigh it, the weight could be determined by multiplying the number of inches by 4.1. The number of pounds of cream furnished by a patron during a month, multiplied by the test, or the per cent. fat, and divided by 100 will give the number of pounds of fat which the cream contained.

11. A spring balance is a convenience when it is necessary for collectors to weigh cream at the farm. The use of these scales is allowable only when they pass the necessary Government inspection.

The Oil Test.

This means of ascertaining the butter value of cream is still employed in a few sections, and is simply a churning process.

The cream collector is supplied with a pail 12 inches in diameter in which the depth of cream supplied by the patrons should be carefully *measured*. After thoroughly mixing the cream the collector should take a representative sample, filling the test tubes carefully to the mark, which should be five inches from the bottom.

To Make an Oil Test. Upon their arrival at the creamery, place the samples in a warm place, as over the boiler, and leave over night to ripen thoroughly. *They will not churn properly unless well ripened.*

The next morning place the samples in water at a temperature of about 90 degrees; and as soon as the cream will flow freely from one end of the tube to the other, place in the oil test churn and begin the churning. Should the cream at any time cool and thicken, place the samples in warm water to liquify the cream again. Continue churning until there is evidence of a clear separation of the fat; then place the samples in hot water, at a temperature of from 160 to 170 degrees, for from fifteen to twenty minutes.

If the separation be complete, the fat will be clear and yellow, and there will be three distinct columns with sharp lines of division between them, viz., a column of clear fat on top, one of whey next, and one of curdy matter at the bottom. If there be not a clear separation, cool to about 90 degrees, churn again and proceed as before.

To Take a Reading. There is a chart prepared for the purpose. Placing the bottom in an upright position on the "base line" of the chart, move it along until, when looking by the right side of the bottle, the top of the column of fat comes even with the uppermost slanting line on the chart. Next, still looking by the right side of the bottle, observe the line to which the bottom of the fat comes; the number on this line gives the reading.

A small rule made specially for the purpose is more convenient than a chart. This, however, will give a correct reading only when the test-tubes have been filled precisely to the mark. The chart consists of a sliding scale, and gives the proportion of oil regardless of the depth of cream taken or the diameter of the test-tubes

Sometimes the fat, though clear, is somewhat open. In such cases, or when the fat is not clear, allow the samples to become cold, and then place in water at a temperature of about 120 degrees F., before taking a reading. About 120 degrees is a very suitable temperature at which to take readings.

Meaning of the Reading. Cream that gives a reading of 100 in the oil test will make one pound of butter for every inch of such cream in a cream pail 12 inches in diameter; cream testing 120 will make 1.20 pounds of butter per inch. To find the pounds of butter, multiply the number of inches by the reading and divide by 100.

Theory of the Test. A standard or creamery inch is one inch of cream (in a twelve inch pail) testing 100.

One inch, therefore, contains 113 cubic inches. One pound of butter contains about 25 cubic inches of butter oil, which is 22 per cent. of 113. Therefore, any cream which will yield 22 per cent. of its volume in butter oil, will yield one pound of butter per inch. Tubes filled to the depth of 5 inches with cream which gives 1.1 inches of butter oil, will yield one pound per inch, as 1.1 is 22 per cent. of 5.

A reading of 100 by the oil test would, therefore, theoretically, be equal to 22 per cent. of fat.

The relation between the oil test and percentage of fat or Babcock test, may be viewed from the Babcock side as follows: The overrun in Collecting Creameries may vary from 12 to 13 per cent. to as high as about 18 per cent. Then 100 pounds fat would probably yield about 115 pounds butter.

1 pound of butter would thus be obtained from $\frac{100}{115}$ pounds fat.

1 inch of cream weighs 4.1 pounds.

Therefore in order to yield 1 pound butter per inch,

4.1 pounds cream must contain $\frac{100}{115}$ pounds fat.

1 pound cream must contain $\frac{100}{115}$ divided by 4.1 pounds fat ($\frac{100}{115} \div 4.1$).

100 pounds cream must contain $\frac{100}{115} \times \frac{1}{4.1} \times \frac{100}{1}$

Equal to 21.2 pounds fat.

According to experiments conducted at the Ontario Agricultural College Dairy School, the actual percentage of fat in cream yielding 1 pound of butter per inch is 21.1 per cent.

The relation between the value of a pound of fat and a pound of butter may be found to vary somewhat according to the percentage of overrun obtained.

With an average overrun of 15 per cent. and butter worth 17 cents per pound, the value of a pound of fat may be estimated as follows: A 15 per cent. overrun would prove 100 pounds fat to yield 115 pounds butter; 115 pounds butter at 17 cents equals $19.55; then 100 pounds of fat must be of the same value—$19.55. Therefore, 1 pound fat must be worth 19.55 cents. If *fat* were worth 17 cents a pound, the value of 1 pound could be estimated as follows:

100 pounds fat at 17 cents equals $17.00.

100 pounds fat should yield about 115 pounds butter, therefore, 115 pounds butter are worth $17.00.

1 pound butter is worth $17÷115 equals 14.78 cents.

With an average overrun and butter worth from 16 to 18 cents per pound the difference between the value of a pound of fat and a pound of butter would be from 2 to 2½ cents per pound.

Skim-Milk Buttermilk, and Whey.

As the percentage of fat in skim milk, butter-milk, and whey is so small, the best method of testing these is by the use of the double-neck skim-milk bottle.

The usual amount of milk or whey is taken and the test is made in the usual way. Very fine readings can be taken, as a very small amount of fat will extend over quite a length in the small neck. Considerable controversy has taken place from time to time among the leading authorities as to how each division on the scale should be read, but it has been demonstrated that reading the first divisions as .1 ($\frac{1}{10}$) and each succeeding division as .05 (½ of $\frac{1}{10}$ equals $\frac{1}{20}$ or .05) gives results comparing quite favorably with gravimetric analysis.

Slightly more than 17.5 c.c. of acid may be used to advantage when testing skim-milk; it is also advisable to increase the speed of the tester or the length of time it is whirled.

The fat column in a double-necked bottle may be raised to any desired point on the scale by gently pressing with the finger on the mouth of the large neck.

It is not necessary to use quite the full amount of acid when testing whey.

The ordinary 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.

The Lactometer and the Detection of Adulterations in Milk.

The lactometer is an instrument used to determine the *specific gravity* of milk. The term specific gravity means the weight of a certain volume of any substance compared with the weight of the same volume of pure water at a standard temperature.

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 weight of milk and water.

The Quevenne lactometer is standardized at a temperature of 60 degrees; 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 to 70 degrees. 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 F.)+1000÷1000 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 (1 to 3 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.
Albumen	.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 than that of water.

A number of different formulas have been prepared for the calculation of milk solids when the lactometer reading and percentage of fat are known. As the percentage of solids-not-fat increases .25 per cent. for each lactometer degree and .2 per cent. for each per cent. of fat, the following formula has been very generally adopted: (¼ + .2 fat. To find the *total solids* in a sample of milk, add ¼ of the lactometer reading to 1.2 times the per cent. of fat.)

The following rule is sufficiently accurate for practical purposes and has simplicity to recommend it: To determine the per cent. S.N.F., add the correct lactometer reading and per cent. fat together, and divide by 4. $\frac{L+F}{4} = \%$ S.N.F.

Adulterations.

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 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.

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

Note. When a sample of pure milk cannot be obtained, use 8.5 in the early part of the season, and 9 in the later part, for the per cent. S.N.F. in pure milk.

The per cent. of *water added to the pure* milk may be estimated as follows: The per cent. S.N.F. in a pure sample, multiplied by 100, divided by the per cent. S.N.F. in the watered sample, less 100. The above may be worked as follows.

$\frac{9 \times 100 - 100}{7.2}$ equals 25 per cent. water added, or

To 80 lbs. pure milk, 20 lbs. water were added, then to

1 lb. pure milk, $\frac{20}{80}$ lbs. water were added.

To 100 lbs. " $\frac{20}{80} \times \frac{100}{1}$ lbs. water were added.

equals 25 lbs. water added to 100 lbs. milk or 25 per cent.

Notes.

1. Have the temperature of the milk uniform throughout, and as near 60 degrees as possible when taking a 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. A high lactometer reading accompanied by a low per cent. of fat indicates skimming, e.g., L. equals 34, F. equals 2.4.

6. A low lactometer reading accompanied by a low per cent. of fat, is indicative of watering, e.g., L. equals 22, F. equals 2.4.

7. A normal lactometer readng with a very low per cent. of fat indicates both watering and skimming. Also, if the lactometer reading of a sample of milk be low, yet not so low accordingly as the per cent. of fat, this is indicative of both watering and skimming. Both of the following indicate watering and skimming; L. equals 31, F. equals 2; L. equals 26, F. equals 1.8.

Testing Cheese for Fat.

The fat content of cheese may he obtained by weighing from 2 to 5 grams, adding sufficient water to make up 18 grams and testing in the usual way.

$\frac{\text{Reading} \times 18}{\text{grams used}}$ equals per cent. of fat in sample tested.

Accurate and satisfactory results in testing may be obtained only by exercising the greatest care at every step in the work, coupled with sound judgment and experience.

HINTS ON THE CARE OF MILK FOR CREAMERIES AND CHEESE FACTORIES, AND CANADIAN CHEDDAR CHEESE-MAKING.

By W. Waddell and A. McKay.

Milk is the raw material from which the cheese or butter maker manufactures a valuable and concentrated food product. It is a perishable article and very susceptible to contamination; hence it is important that great care be taken to keep it sweet and free from any undesirable germs or taints. Milk should be supplied only from cows in good health furnished with an abundance of wholesome food, pure water, and having free access to salt at all times.

Cows giving milk should not be allowed to eat turnips, rape, foul weeds, musty or decayed food, or anything that will impart an objectionable flavor to the product, as injury to the milk from any cause results in a positive loss to the producer.

It is very important that there be no dust or bad odors in the stable at the time of milking, as the thin stream of milk passing from the teat to the pail will collect a large amount of any impurities that may be in the atmosphere. Before commencing to milk the udder and flank of the cow should be brushed or wiped with a damp cloth to remove loose hairs or fine particles of dust or filth. The milker should be clean, kind, and sympathetic and free from any contagious disease. Milking should be done quickly and as exhaustively as possible. Immediately after milking remove the milk to a clean, pure atmosphere and strain thoroughly to remove fine particles of dirt, as, no matter how carefully the milking is done there is likely to be some dirt in the milk, and this should be removed as quickly as possible. Special provision should be made for cooling the milk quickly to at least 65 degrees F., and for keeping it at that temperature over night, and to 50 degrees and holding it at that temperature if keeping the milk over Sunday. This may be accomplished by providing a tank large enough to contain cans holding at least two milkings and surrounding them with cold water. The milk should be stirred occasionally while cooling. A wire handled dipper should be provided for this purpose. Provision must be made for changing the water used to keep down the temperature. Ice is almost a necessity for keeping Saturday night's or Sunday's milk. The warm milk should in no case be mixed with that already cooled, and where possible send it to the factory in separate cans. If this is not done the morning's milk should be cooled before mixing with the evening's milk.

When purchasing tinware examine the seams carefully and see that all joints are well soldered so as to facilitate cleaning. Wash and cleanse thoroughly all utensils used in handling milk. First rinse them with warm water, then wash well with water at a temperature of 110 to 120 degrees and then scald or steam. Do not wipe with a cloth, but place to drain where they will get plenty of sunlight and pure air. Use a brush in preference to a cloth for washing tinware. A free use of washing soda will be found beneficial, but soap should not be used on milk cans or pails. The occasional scouring with salt will serve a good purpose. Wooden pails should never be used for milking.

The whole secret of keeping milk in good condition is cleanliness, and low temperature and under no condition should chemicals be used for preserving milk.

The Curd Test.

Provide tin or porcelain cups sufficient in number to test the milk of at least half the number of patrons supplying milk to the factory. A convenient size would be two inches in diameter and four inches deep. Each cup should be plainly numbered. Provide a box of tin or galvanized iron with a neat fitting cover large enough to hold the cups. For convenience this box should have both steam and water connections. In taking samples for making the test place the number of the cup opposite the patron's name from whose milk the sample has been taken. When the samples have all been taken, place them in the box already described, adding water to the depth of the milk in the cups; raise the temperature to 86 degrees F.

Set the samples, by using one dram of a dilute rennet made of a strength of one part rennet to twenty-four of water. Stir in the rennet with a knife having a solid metal handle, being careful to sterilize the knife between the stirring of each sample so as not to contaminate one sample with flavors from another. When firm enough cut with the same knife, using the same precautions to sterilize between the cutting of each sample. Raise the temperature gradually to 98 degrees F., and handle the samples as nearly like the milk and curd in the vat as possible. In two and a half or three hours after setting pour off the whey. Keep up the temperature for three or four hours after this, and examine the samples occasionally for flavor by smelling and the texture by cutting with a sharp knife.

If looking for bitter flavor, and the milk is in a sweet condition, it may be advisable to add a few drops of culture to the samples before setting, as this flavor is rarely detected without the presence of acid.

This test is particularly valuable in detecting flavors which develop in the curd, but cannot be detected in the ordinary way when milk is delivered. It is also valuable for convincing patrons, who may doubt that the flavor of their milk is as bad as represented by the cheesemaker, as it is possible to have them see and smell the curd made from each patron's milk as delivered at the factory.

The Preparation and Use of a Culture.

That there has been such a strong prejudice against the use of cultures in the minds of some of our best cheese buyers is not to be wondered at when we consider the careless slip-shod methods in which some makers prepare cultures, and the unrestricted use of them by others, regardless of the ripeness of the milk, or the acidity and flavor of the culture. The flavor of the culture used will largely determine the flavor of the cheese or butter made. Therefore, the need of full and exact knowledge of the proper method of preparing and using cultures is manifest.

First provide suitable cans. It is better to have a duplicate set if possible. Cans similar to the ordinary shot-gun cans whch are eight inches in diameter and twenty inches deep are quite suitable. 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 or tank large enough to hold the cans containing the culture for one day's use should be provided. This should have steam and cold water connections. The cans may be left in this box so as not to be influenced by the outside temperature.

In starting a culture it is advisable to use a commercial, pure culture. These may be obtained from our Bacteriological department or from any of the dairy supply houses. Empty the mother culture into a quart of cooled pasteurized milk, and allow it to stand at a temperature of 75 degrees F. until coagulation takes place. Two per cent. of this culture may then be added to pasteurized milk at a temperature of 70 degrees for the next propagation.

After selecting the milk for culture, heat to a temperature of 185 degrees, stirring occasionally while heating. Allow it to stand at this temperature for 20 or 30 minutes, then cool rapidly to a temperature of 65 or 70 degrees F. To this milk add sufficient of the culture already prepared to develop an acidity of not more than .7 at the time the culture is required for use.

If the culture is to be kept for more than 24 hours, it is advisable to use a lower temperature—60 degrees F. or under. Aim to produce the same acidity from day to day. Before using, remove one or two inches of the milk from the surface of the can, as the surface is more liable to contamination from outside sources; break up the remainder by stirring well in the can. At this time take out a small quantity to propagate 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 firmly coagulated, no liquid is found on top, and it has a milk acid flavor pleasant to 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 which should be used at any time, and this quantity should be used only when the milk is known to be in a 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.

A wire handled dipper is preferable for stirring milk for culture and all utensils must be thoroughly cleaned and sterilized after each time of using.

CHEESE-MAKING.

Need for Improvement.

That there are some improvements being made in our factory buildings and equipment and in the sanitary condition in which they are kept cannot be denied, but it is also true that there is room for great improvement in this direction. We still have some factories that are not up to date and are wholly unfit for handling, in a sanitary condition, so delicate a food product as milk. We have also some makers who do not put forth the effort necessary for keeping their factories in a proper condition. The time has come when it is necessary that all interested in the cheese business join hands to have these hindrances to the best quality of our goods speedily removed. The training which our cheese-makers receive at the dairy schools should have a marked tendency to improve the appearance of the maker, and also the inside and surroundings of his factory. It has also been proved beyond a doubt that to make the finest quality of cheese, we must have our curing-rooms so constructed that an even and comparatively low temperature can be maintained. This should not be allowed to exceed 65 degrees in the hottest weather.

Milk for Cheese-Making.

In the manufacture of cheese the first and most important matter is to have the milk delivered at the factory clean, sweet, and of good flavor. How this may best be accomplished is a subject that should engage the attention of all interested in the dairy business. We would suggest that our instructors spend as much time as possible among the patrons and with the assistance of our chemists and bacteriologists find out the causes and remedies for so much bad-flavored milk and cheese. We would urge upon makers the necessity of rejecting at the weigh stand all milk which is not in a fit condition for the manufacture of first class cheese, as receiving milk of this kind is a serious injustice to patrons supplying milk of good quality.

Testing for Ripeness.

This may be done for setting, with the acidimeter or rennet test. Good results may be obtained by the use of either test. No definite degree of acidity can be laid down as a rule to go by. The proper rule is to set at the degree of acidity that will give the best results later in the process, or will allow the curd to remain in the whey until properly cooked, which will usually take from 2¾ hours to 3 hours from the time of setting the vat to the time of dipping the curd with the right amount of acid developed. This will be found to be slightly less than the acidity of the milk at setting as shown by the acidimeter.

In 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 amount of salt, as this hastens the ripening process and overcomes the tendency in milk at this season to make a dry, harsh cheese due to the low per cent. of butter fat in the milk. Heat the milk to 86 degrees and stir slowly while heating.

If using the acidimeter and making colored cheese, the acidity should be taken before adding the color to the milk, as it is more difficult to detect, the neutral point with color added. Another point to note carefully when using the acidimeter for setting, is the effect of the presence of rain water in the milk. When the milk is diluted, less milk is taken in the sample, and will show a lesser degree of acidity than is contained in the milk to the extent of the percentage of dilution. If color is used it should be thoroughly mixed with the milk before the rennet is added, using one to one and a half ounces of color to 1,000 pounds milk. Add color in amount as the market demands it.

When the desired acidity is obtained add the rennet, using four to five ounces per 1,000 pounds milk or enough to coagulate the milk, fit to cut in 15 to 20 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, which will be sufficient for normal milk. Commence stirring at once with agitators or with a McPherson rake. Stir carefully for 10 to 15 minutes before applying heat, and be careful to have the curd all free from the bottom and sides of the vat before turning on the steam. Curd should be handled carefully, and in such a manner that the cubes will not be broken or allowed to mat together, as rough handling or breaking of the curd causes a serious loss in both quantity and quality. Heat to the cooking temperature of about 98 degrees F. in one-and-one-half hours from the time of setting. If using agitators, take them out in 10 or 15 minutes after the cooking temperature is reached. Remove at least half the whey, and keep the curd stirred sufficiently to prevent it matting. Acid usually develops very rapidly in the spring, therefore, it is necessary to be prepared to remove the whey quickly when enough acid has developed, which may be from .17 to .2 as shown by the acidimeter. Be careful to stir the curd dry. Curd must be well cooked and stirred dry if a fine cheese is expected. Leave the curd about eight inches deep in the curd sink. When it is well matted together cut into strips six to eight inches wide and turn upside down, and in about 15 minutes turn again and pile two deep. Continue turning every 15 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 then well stirred afterwards. The 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 from 1 to 1.2 per cent. acid. Stir the curd well before adding the salt to give the cheese good body and improve the flavor and texture. Salt at the rate of 1 1-2 to 2 pounds of salt to 1,000 pounds milk. It is important that the temperature of the curd from dipping to milling be about 94 degrees. After milling, allow the curd to cool gradually to about 85 degrees when ready to salt. Put to press at a temperature of 82 to 84 degrees. Weigh the curds into the hoops; tighten the press gradually and leave the cheese 45 to 60 minutes before taking out to dress. When dressing use plenty of clear hot water, and what are commonly called skirts. These cloths help to make a good rind on the cheese and keep them clean and cause the cheese to come out of the hoop more readily. Turn all cheese in the hoops every morning and allow no cheese to be taken to the curing-room that are crooked, have wrinkles in the bandage, or rough edges.

SUMMER CHEESE.

In making summer cheese one ounce of color per 1,000 pounds of milk is usually enough, but this may be varied according to the requirements of the market. Use from three to three-and-one-half ounces of rennet extract per 1,000 pounds of milk, or sufficient to coagulate the milk fit to cut in 25 to 30 minutes. The cutting and cooking of the curd is the same as given for spring cheese.

It may be necessary in some cases to raise the cooking temperature slightly higher, or to about 100 degrees, shortly after normal cooking temperature is reached. T. whey should be partially drawn off and the curd well stirred by hand or with a rake to insure thorough cooking. The acidity should be allowed to develop to such a point that is found from day to day to give best results in the working of the curd later in the process, aiming to have the curd with good body, ell matted and in a flaky condition when ready to mill. At this time it should have an acidity of .75 to .85 in 1¾ to 2 hours from the time of dipping. Curd should be well stirred after milling. Care must be taken not to salt the curd too soon as open cheese may be the result. Curd should be well ripened, stirred and aired thoroughly and cooled to a temperature of 85 degrees before salting. Use from 2 to 2½ pounds of salt to 1,000 pounds of milk.

FALL CHEESE.

In making fall cheese it is a mistake to use too much culture, or to ripen the milk too much, giving the cheese the appeaiance of having been made from over-ripe milk, which is very objectionable. Rather use a smaller amount of culture, not more than 1-4 of one per cent. and add it to the milk as early as possible, then allow the milk to ripen. 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 when culture is used.

GASSY MILK.

The presence of gas in 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 ½ to ¾ per cent. of good culture, ripen slightly lower for setting than for normal milk, when cutting aim to have the cubes even in size and as large as possible, allow the acid to develop slightly farther before applying heat, stir carefully, and heat slowly, aiming to have the curd in normal condition at dipping. Use the same cooking temperature and the same acid for dipping as with a normal curd. A gassy curd does not require so much stirring, as the moisture leaves the curd more readily. Cut and turn as usual and pile according to the body of the curd. Mill as soon as the curd is well matted, and the acidity has de oped to .8 to .85

per cent. About half way between milling and salting, commence piling the curd, allow it to stand for 15 to 20 minutes then spread out, stir well and pile again. Continue to do this until the curd is nice and mellow. Give pl y of fresh air before salting. Use a normal amount of salt, and to press at a temperature of 80 degrees, if possible.

Over-ripe Milk.

This class of milk should be avoided, as the loss is too great, even when handled in the best possible way. The heat should not be applied till milk enough is in sight to fill the vat, and then heat as quickly as possible to 82 or 83 degrees, and after testing for acidity, set at these temperatures using one ounce extra of rennet per 1,000 pounds milk. Stir for about two minutes. Commence cutting early and cut fine, using the horizontal knife for the fourth cutting, cutting lengthwise of the vat. Where possible use a finer knife than usual. Cook quickly and if necessary raise the temperature two or three degrees higher than for normal milk. Run off the whey as soon as possible, and stir the curd well in the small amount of whey before dipping, so as to have the curd well firmed before sufficient acid is developed. Dip with slightly less acid where possible. Stir dry, and if the curd has been well handled, treat the same as a normal curd. If the curd is not well cooked and the moisture properly expelled from it, mill early and ripen well before salting.

Ripening or Curing Cheese.

The ripening or curing of cheese is one of the most important points in the whole process, as no matter how well a cheese is made if the curing is not properly done the quality cannot be the finest. Hence it is a necessity 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 to prevent the growth of mould which occurs when too much moisture is present. An excessive shrinkage takes place if there is too little moisture in the room. This may be accomplished 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 the moisture on the ice.

In putting the cheese into the curing-room, place them straight and evenly on the shelves and turn them every morning except Sunday. Keep the room well swept and looking neat and tidy.

Use good strong cheese boxes. Have them dry and made to fit the cheese neatly. Put two scale boards on each end, weigh carefully and stencil the weights plainly on the boxes. Load the cheese on clean wagons, and have canvas covers to protect them from rain and heat while on the way to the station.

SEPARATORS AND THE SEPARATION OF MILK.

By R. W. Stratton.

In dealing with this subject, general directions only can be given. Space will not permit giving detailed directions for the different makes of separators. A book of directions is furnished with each new separator sent out, and the specific instructions contained therein should be strictly followed unless you know of something better, which you have proven to be so by practice, not theory. Separators may be divided into two classes—the steam or turbine, and the belt separator.

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 foundaton 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 would be 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 to 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 ⅛ 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 stone or brick pier (bricks are neatest) 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 instructons 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 there is more than this distance the size of the pipe should be one-quarter inch larger for every twenty-five feet of piping, to overcome 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 Separators.

The directions given for the foundation of a turbine will apply to this. First place the intermediate or jack in position. This should be at an angle of at least 45 degrees in front or behind the driving shaft. Level it by placing a level perpendicularly on the planed rim of the separator pulley of the intermediate. Be sure to have the shaft of the intermediate parallel with 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 intermediate, and of the proper size to give the exact speed required. Next place the frame of the separator in position. Level it in all directions by placing the level on the planed top of the frame. Line the separator with the intermediate, so that looking from the intermediate the right hand edge of the small pulley of the separator is in line with the right side of the large pulley of the intermediate, having the vertical centre line of the spindle pulley level with the underside of the intermediate pulley.

The separator bowl should revolve to the right, or with the sun, the same as the hands on a watch. The intermediate should run from the separator, so as to place the draw belt on the upper side of the intermediate pulley, with a view to remove some of the weight of the bowl from the foot-step bearing when the separator is running. If an idler or belt-tightener is used, always place it on the "return" side of the belt—***never*** on the "draw" side.

Do not use the belt tightener any more than is absolutely necessary as it shortens the life of the belt very materially. It would be an improvement if the intermediate could be adjusted to suit the stretching of the separator belt.

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 the 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, and only one in use, put all belts in position, and start the engine slowly, allowing the speed to increase gradually. If more than one separator is used, it is better to start the engine at full speed, then shift the belt from the loose to the tight pulley after starting the separator by pulling the belt with the hand until the bowl has attained some 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 a 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 feed, 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.

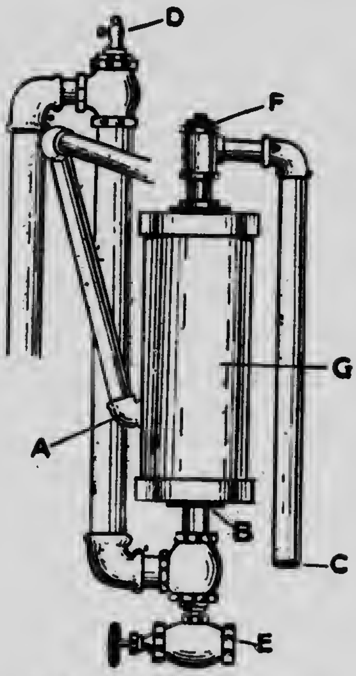
The cream left in the bowl when all the whole milk has been put through should be forced out with warm water. From one to two pails will be needed for this purpose. Shut off the feed-tap for a few sconds when about half the quantity has gone through; then turn it on again allowing the remainder to complete 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; never apply any brake or friction to the intermediate. 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 specity 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 degrees, it should be heated to from 90 to 100 degrees.

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 em-



SKIM-MILK PASTEURIZER USING EXHAUST STEAM.

A. Milk inlet 1¼" pipe. B. Exhaust steam inlet 2" pipe. C. Overflow 2". D. Small valve on exhaust steam pipe to prevent suction of skim-milk back into steam pipe. E. Valve to drain heater. F. Plug which may be removed in order to see if heater is filling with material from skim-milk. G. Heater 6" diameter. 18" long with caps screwed on each end.

ploy 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.

While it is doubtless true that better butter can be made by pasteurizing the whole milk before separating, still the improvement is not enough to compensate for the extra labor required in cleaning the separator and utensils. There is also the fact that the separator bowl will need to be retinned often if separating pasteurized milk.

The plan followed at the Dairy Department at the present time is to heat the milk to about 95 degrees before separating. The cream is delivered from the separator into the pasteurizer and heated to 180 to 185 degrees. The skim-milk is elevated by a rotary pump and just before entering the tank it passes through a heater in which exhaust steam from the engine is used for pasteurizing the skim-milk. The cut will show how this heater may be made. A union should be put in the steam pipe somewhere near the heater, as the heater will need to be taken apart at intervals to be cleaned. This can best be done by burning in the furnace. The amount of milk, and the temperature to which it is heated will determine how often it should be cleaned. Usually it will run from six to eight weeks without requiring to be cleaned.

A great saving in fuel can be made by utilizing the exhaust steam from the engine. At the Dairy Department the pipes are so arranged that the exhaust steam can be used for heating the whole milk before separating, heating water, pasteurizing the skim-milk, and heating the building.

Two other labor and trouble saving devices are in use at the dairy which are worthy of special mention. One is a skim-milk weigher which after four year's use we would find it very difficult to get along without. The other is an Ideal hoist for elevating milk at the intake. Having the driveway graded so that no lifting of the can is required is the best plan, but where this cannot be accomplished, the Ideal hoist would seem to be a very satisfactory means of elevating the milk.

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.

[illegible] find the diameter of a driven pulley, multiply the diameter of the di[illegible]ts number of revolutions, and divide the product by the number of r[illegible]utions 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 in 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 four 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 $3\frac{1}{7}$. 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 the shafting. 8+24=32, 32÷2=16, 16×3¼=52 inches=4 feet 4 inches, and 4 feet 4 inches+16 (twice the distance between the centres of the shafting)=20 feet 4 inches, which is the length of belt required.

CREAMERY BUTTERMAKING.

By C. W. McDougall.

The practice of the art of buttermaking must always be one of evolution. Advancement is an assured result when we earnestly endeavor to make our practice conform to methods that have been proven to be superior to our own. These superior methods may be the result of scientific investigation or of the intelligent observation of practical men. To teach any method as an infallible one would be assuming a false position. The claims made for the perfection of the method would in reality be a reflection upon the intelligence of the scientists and buttermakers of the future. On the practical side of the question, however, we know that we do not adapt with sufficient readiness methods which would produce a marked improvement.

We should all like to have our supply of milk and cream in what we now think is first class condition, and have the butter made in a modern creamery by the most improved method. Granting that we accomplish all this, we should find that there still remains room for much investigation and improved practice. When we recognize this fact where are we to look for justification in our too common method of blundering along in the dark at the mercy of so many foes? It would be quite difficult to find a more unscientific practice than that of some of our buttermakers at the present time.

On the farm, the intelligent production of milk and the proper care of this milk, or the cream obtained from it, are very essential factors in the manufacture of good butter. This is especially true in the case of creameries operated on the cream-gathering system, for here each patron becomes to a large extent a buttermaker as he handles the cream at one of the most important stages of buttermaking. It is to be taken for granted that all creamery patrons know the value of having good cows supplied with an abundance of good food, pure air, water, etc. On these we must depend for the natural flavor or individuality of the milk or cream, and it may be said on behalf of our creamery patrons that very little complaint can be made on account of poor flavored milk at the time it is taken from the cow. But when we consider the length of time the milk or cream is cared for by the patrons, and the quality of this care, we find evidences of inexcusable neglect. To take wholesome milk from a kind and generous cow amid foul surroundings and deliberately put it into unclean pails, through unclean strainers, run it through a filthy separator, or leave the milk or cream at a high temperature, is nothing short of a crime against the state. As soon as milk is produced it begins to decay, and the rate at which this decomposition takes place will almost entirely depend upon the amount of dirt which has been incorporated with it, and upon the temperature at which it is held. On these two points there is still much room for improvement.

It is practically impossible to avoid getting at least a small amount of dirt into the milk, and with this dirt are introduced countless numbers of bacteria. At this stage we must act with promptness to prevent as far as possible the harmful effects of these bacteria. Where the milk is to be sent to a whole milk creamery, cool at once to a temperature of 60 degrees or below, cooling Saturday night's and Sunday morning's milk much lower. The holding of cream for two, three, or more days is a very bad feature of our cream-gathering system. This means the hopeless destruction of fine butter quality in the cream unless ample preparation is made for, and thorough care taken of, each lot of cream. Treatment that will assist in retaining this fine butter quality is to be found in skimming a rich cream, pasteurization, or holding the cream at a low temperature. The cream separator furnishes the best means of getting a rich cream, but if we cannot get a separator that will do close skimming, while delivering a rich cream and that can be purchased at a reasonable price, we are better without one. The serum or skim-milk portion of the milk furnishes the bacteria with food for growth and reproduction, the fat in itself not being a bacterial food. For this reason the more milk drawn off as skim-milk the few bacteria we have in the cream and the less serum for them to feed upon.

The cream from the separator should test not less than 30 per cent. fat. A rich cream gives the buttermaker better control of his part of the process as well as being beneficial to the patron. The cream should be cooled immediately to at least 45 degrees. This temperature applies to all creams to be sent to a creamery whether they be from the centrifugal or gravity methods. Pasteurization is a very efficient method of preservation. The heating and extra cooling, however, mean more work and expense than would be considered practicable under average conditions. Nature, in her kindness, has in this country supplied us with an abundance of ice for keeping our cream cold, but the average creamery patron simply ignores this fact, supplies a cream out of which a first class butter cannot be made, and then grumbles at everyone but himself when he is reaping the reward of his own transgression.

A great many creamery patrons will argue that cream is not sour until it has coagulated or thickened, whereas about half of the possible acidity is produced before this condition is noticed. Cream must be in good condition when taken up by the cream hauler so that good butter can be made from it after being on the cream wagon and in the creamery for the greater part of a day. The fact of a cream hauler accepting a patron's cream is certainly not the end of that patron's responsibility.

The transportation of cream in cream tanks and the ignorance and indifference of the cream-gatherer have permitted abuse in putting poor lots of cream into the tanks. It is true that the tanks and jacketed cans in use are important factors in maintaining a low temperature of the cream, but the abuses connected with their use would seem to make the adoption of the individual can system very desirable.

The adoption of the individual can system permits of the rejection of poor cream or the proper recognition of the patrons supplying good cream by payment according to quality. In addition to this the possible abuses existing through the work of the poor cream hauler are largely avoided, and the chief qualification of all cream haulers under this system consists in their ability to deliver the cream at the creamery in the shortest possible time.

To have a good flavored, rich and sweet cream furnished by the patrons, and to have this cream taken under first class conditions to the creamery, at least three times a week, would materially aid in the improvement of the quality of the butter.

That part of buttermaking which is more directly the work of the creamery operator and manager is a very large one and is weak on many sides. We are not lacking so much in technical knowledge or instruction as we are in the intelligent application of principles we already know. If we are to keep a choice butter for home or export market in view, we must admit that our average creamery is lacking in such essential equipment as a pasteurizer and cooler, and has only an apology for a butter storage. We have too many poor creameries with an equipment that is not at all up to date. Of course, it can be argued with good reasoning, that the construction, equipment, and consistent operation of an ideal creamery may be a poor business venture, but this is not sufficient excuse for our common method of endeavoring to get sufficient cream to make a large quantity of medium grade butter at a minimum cost or maximum commission in manufacture. A creamery must have sufficient cream to make its operation practicable, but associated with this should be the rejection of poor cream and the handling of the remainder in the best possible manner. We owe this to our good patrons before we are reasonably entitled to their patronage. If we are going to improve the quality of our export butter we must prove ourselves greater masters of the essentials embodied in this improvement.

Sufficient work has been done in the churning of sweet pasteurized cream to demonstrate that the butter made by this method has an excellent keeping quality.

Good methods of work vary, but the following outline is good practice. The cream is pasteurized at 185 degrees and cooled to a temperature of 40 to 45 degrees if to be churned as soon as separated. This low temperature practically necessitates a cream cooler operated in connection with a mechanical refrigerating plant or by pumping through the cooler the brine from a tank containing cold brine or water and ice. As high as 30 per cent. of the good culture may be used to advantage. When the milk is inferior skim a very rich cream and use a high per cent. of culture. When the cream is to be held until the following day, add little or no culture if the quality of the milk is good; if the quality is not good, skim a rich cream and dilute with good whole milk and culture, or skim-milk and culture especially selected. Churning the cream the following morning will give a more exhaustive churning than if churned immediately after separating and cooling, and so low a temperature for solidifying the fat will not be necessary. As in ripened cream the same principles guide the churning operations, though special precautions should be taken to avoid churning too quickly. A cooling of the culture before adding it to the cold cream will prolong the churning period by making a lower average temperature of the contents of the churn.

It should be our aim to pasteurize all cream to be used in buttermaking. This will be beneficial in all cases when the highest quality of the butter is being considered, and will permit of a much lower cream acidity to produce an equally exhaustive churning. Keep the temperature of the cream at the pasteurizer up to 185 degrees.

The period of cream ripening is one of decomposition and should be under positive control. The production of high acid should be avoided in even pasteurized cream unless a higher flavor is needed for local or special market. Four-tenths of one per cent. acid is sufficient. In the handling of any cream, the use of an efficient cream cooler is very desirable. The absence of a modern cream cooler in our creameries is, season after season, causing excessive losses of fat in the buttermilk and decreased quality of the butter.

In unpasteurized cream as low an acidity as will produce an exhaustive churning should be used. This could be increased where a higher flavor is demanded or where an acid flavor will be less objectionable than a poor flavor already present. The temperature should be uniform throughout the cream, as the portions of the cream remaining at the higher temperature have their churnability increased both by the increased lactic acid development and decreased solidifying effect of the higher temperature, while the portions remaining at the lower temperature have churnability decreased both by the decreased lactic acid development and greater solidifying effect of the lower temperature upon the fat globules. Uneven ripening temperatures means extra losses in the buttermilk and uneven granules during churning. The resulting condition is really uneven amalgamation of the fat globules during the operation of churning. If an exhaustive churning of unpasteurized cream can be had below .55 per cent. acid do not exceed this amount.

Avoid extremes in the length of time for churning. From 30 to 45 minutes is good practice. Endeavor to get a balance of conditions from the amount in the churn, speed of the churn, quality of cream, etc., so as to have ample and uniform concussion of the contents. Do not churn very rich or thick cream in churns having internal projections or pockets that furnish a place for lodgment of the cream.

Avoid high and very low churning temperatures; a fairly low one is preferable. Endeavor to get body in the fat globules by using a low ripening temperature. A vigorous growing lactic acid culture will produce sufficient acid at a temperature of 50 degrees. Draw off the buttermilk as soon as it will readily separate. Having the granules small when the buttermilk is removed, thoroughly rinsing them, then adding sufficient water and increasing the size of granules to that of large corn is good practice. Endeavor to get angular granules and avoid very low or high temperatures of the wash water. Wash water very low in temperature makes a condition favorable for the production of mottles while the high temperature creates a condition demanding great skill. Having naturally firm granules, and using a fairly high temperature for the last wash water, are productive of greater overrun and is quite practicable under control conditions. Do not practice it if you are not in a position to counteract the risks entailed. In all cases, only wash water which is pure should be used. All doubtful water should be subjected to a chemical and bacteriological analysis before using.

The best salt obtainable should be purchased and care should be taken to store it in a dry place which is free from tainting odors. If preservative is used it should be evenly mixed with the salt. An ordinary flour sifter suits admirably for this purpose. Sift or spread the salt or salt and preservative onto the butter as evenly as possible, doing it in three or four applications, turning the butter each time. The best distribution in working, and the most economical use of salt is obtained by having a moist granule with a small amount of free wash water and relatively a small working area. After the butter has massed, open all faucets to permit of the ready escape of free brine.

The proper amount of working to be given to the butter will be best ascertained by observing the results of different amounts under the one system for successive days. We must secure an even distribution of the salt and expel an excess of free moisture. A slightly overworked condition of the butter is preferable to a mottled condition even if the grains be better in the latter.

All butter packages should be neat, strong and made from non-tainting material. Perfect cleanliness should be observed in lining and packing all boxes or tubs and in wrapping prints. The market to be supplied will largely determine the style of package and manner of packing Only the very best parchment paper should be used, and it should be cut while dry so as to finish neatly when the package is filled. Soak the parchment for twenty-four hours in a saturated solution of salt; if sufficient formalin is added to this brine to destroy mold, the incorporation of the mold spores will be prevented. Add small amounts of butter at a time to the package, in order that the packing may be more thoroughly done. Pack in considerably more than the requisite amount, and then, by means of a straight edge, cut out to a weight which will allow for ample shrinkage. The impressions of a fluted roller on this surface will relieve it of its plain and sometimes greasy appearance. Fold the parchment over the butter as neatly as possible. The preservation of the butter is best obtained by putting it into low temperature storage as quickly as possible.

Eternal vigilance is the price of keeping a creamery and its equipment in good condition. Dirt and conditions favoring its collection demand prompt and thorough attention. These are factors in the purchase of all creamery machinery and utensils. Machinery should be purchased subject to a test under practical conditions, and efficiency rather than first cost should be the guide in purchasing.

HAND SEPARATORS.

By Geo. R. Taylor.

The hand separator problem is one of the most important questions before the dairymen, and especially the creamerymen, of our country at the present time. When the whole milk system of buttermaking was in vogue, the buttermaker had control of nearly all the conditions which tend toward the production of a high grade product. The milk then had to be in a sweet condition when it was received at the creamery or it could not be separated. This being the case, the buttermaker had pure, sweet cream to work with, and he was held responsible, and justly so, if a first class product was not manufactured. With the general adoption of the cream-collecting system of buttermaking, however, a much different state of affairs exists. The patron of the creamery separates the cream from the milk, either with a hand separator or by other means. The cream is delivered at the creamery, once, twice, or three times a week, and owing to various causes, is too often received in a very poor condition. The buttermaker may then try to make a first class quality of butter, but will often meet with only a small measure of success. It is important, therefore, that the patron should understand how to operate a separator to get the best results, and also understand the principles to be observed in caring for the cream.

Some of the most potent causes of poor cream are:

1. Improper care of the cream after separation.
2. Having the separator in an impure atmosphere.
3. Carelessness in washing the separator, or neglecting to wash it each time after being used.
4. Skimming a cream too low in butter fat.

Carelessness or neglect in washing the separator, separating the milk in an impure atmosphere, or carelessness in caring for the cream are the common causes of bad flavors in the cream, and in each case the trouble may be easily overcome by a little extra care on the part of the person operating the separator.

A cream poor in milk fat, or one containing a large amount of skim-milk is objectionable for many reasons, both to the farmer and to the creamery man, and the separator agent who advocates the practice of skimming a thin cream and washing the . .parator once a day or only when convenient, is not working for the best interests of the dairy industry. Agents who advocate such a practice have only one object in view, and the machines which they are offering for sale are likely to be either separators that are hard to wash, or those that are not well adapted for skimming a cream containing a high percentage of fat, and intending purchasers should consider very carefully the merits claimed by these agents for their particular machine.

Thin cream contains a large amount of skim-milk which is valuable to the farmer for feeding purposes. It requires more water and ice for cooling, and in it the conditions are more favorable for the rapid development of lactic acid and bad flavors. The cost of delivering the cream at the creamery is greater on account of the larger quantity. The buttermaker has to supply extra vat room, and it is more difficult to get good results in churning.

When milk is set for cream to rise either in shallow pans or deep cans, the force of gravity compels the heavier portion to go to the bottom, and the cream being lighter rises to the top, and is separated more or less perfectly from the skim-milk. But when milk is delivered into a rapidly revolving separator bowl, the centrifugal force acts with much greater intensity. Separation takes place almost instantly and is much more perfect.

The hand separator has many advantages over the shallow pan and deep setting methods of creaming milk, and its disadvantages are comparatively few.

Some of the advantages are:

1. The loss of fat in the skim-milk is reduced to a minimum.

3. It saves the cost of utensils and the space required for their accommodation.

3. It gives a better and more uniform quality of cream and butter.

4. The richness of the cream can be easily regulated.

5. It saves labor in washing utensils and in the handling of ice for cooling purposes.

6. The skim-milk is in the best possible condition for feeding young stock.

The chief objections to the hand separator are its first cost and the labor of turning and washing the machine; but when we consider that the increased product made from the saving in loss of fat in skim-milk alone, over the best of other methods of creaming, to say nothing of its other advantages, amounts to from five to ten dollars per year for each cow, it will be seen that the separator will soon pay for itself. The labor of washing the machine is also a small consideration when compared with the labor of washing the utensils required for either the shallow pan or deep-setting methods.

The cost of a hand separator is from $50 to $150, according to the size and capacity, and they will skim from 150 to 700 pounds of milk per hour. A separator having a capacity of 450 pounds per hour is of sufficient size where from eight to ten cows are kept.

In choosing a separator it is advisable to select one with a capacity somewhat larger than is required for immediate use. The feed tap may then be slightly closed, and the skimming done with the separator running a little below its capacity. This makes a favorable condition for the separator to do close skimming, and also for the production of a rich cream which is so desirable at the present time. All, except the smallest sized machines, are so constructed that they may be connected with power and much labor may be saved in this way. The most common power in use is the tread power. It may be run by any farm animal with good satisfaction. A small gasoline engine is also a very efficient power where the separating room can be placed at a suitable distance from the barn, to avoid any possible danger of fire. There is also danger of tainting the cream from the odor of the gasoline.

There are many different makes of separators on the market at the present time, but which is the best it is impossible to say, as no one separator comprises within itself all the points of merit that the ideal might possess. The best separators might be described as those best suited to the special conditions under which they are to be used. It may be that the less capable of two separators is the better, for the reason that it may have advantages and conveniences which at first might seem of little importance, yet be of great value in the peculiar circumstances under which it is to be used. For example, the closest skimming separator may be more difficult to operate, more inconvenient to clean, or possess other disadvantages in its mechanism less desirable than a machine which skims less closely, and these diadvantages may more than counterbalance its closer skimming power. A hand separator may be considered to be doing good work, when, running at its full capacity, it will produce a cream testing over 30 per cent. fat, and leave not more than one-tenth of a per cent. (.1) of fat in the skim-milk, or a reading not extending over one space, in the graduated neck of a skim-milk test bottle.

The points of merit which a separator should possess are:

1. Simplicity and strength of construction.
2. Cheapness and durability.
3. Maximum capacity with minimum power required to turn.
4. Closeness of separation.
5. Desirable richness of cream.
6. Ease of cleaning.

With each separator is sent a book containing full directions for setting up, and operating the machine. This should be carefully read before removing the machine from the box. A suitable place for setting it up should then be chosen, care being taken to select one that is well ventilated, and where a pure atmosphere can at all times be assured. It is most convenient to have the separator in the barn, as it saves the labor of carrying the milk to the house and the skim-milk back to the barn, but the practice of allowing it to occupy a stall in the stable is very objectionable, on account of the injurious effect on the flavor of the cream, and injury to the machine due to dust and dirt getting into the bearings.

The frame should be fastened securely to a solid foundation, and the part of the frame containing the bowl should be perfectly level on top in all directions. A small quantity of quarter inch rubber packing, placed under the outside edge of the base or under the legs before fastening, improves the running of any separator.

Before the separator is started all parts should be thoroughly cleaned and all bearings well oiled. The oil-cups and oil-holes should be in good working condition. Special attention ought to be given to the oil that is used. When convenient, it is advisable to use the oil sold by the agent of the machine, but if not, any good separator oil will do. It should be rather thin, so as to give a clean drop, and be free from any tendency to gumminess when exposed to a very low temperature. It is a good practice to flush the bearings and oil-holes with coal oil once every week or ten days. This removes the thick oil and grit and adds greatly to the easy running of the machine.

Two or three minutes should be taken to get the speed up to the required rate which is usually stated on the crank of the machine. Sufficient water, at a temperature of about 110 degrees, should be added to to fill the bowl, to wet and warm the surface and prevent the cream from sticking. The milk should then be turned on full flow, and the feed pan kept well filled until the milk is all in. The speed should be kept well up, and as uniform as possible at all times to insure closeness of skimming and an even richness of cream.

In the use of a separator three things should be carefully watched, viz., the speed of the bowl, the temperature of the milk, and the feed of the milk to the bowl. With the same machine, and all other conditions the same, the greater loss of fat must be expected when the separator is not run up to the required speed, or when the milk is below a certain temperature, or when more than a certain amount of milk is run through in a given time.

Milk separates best when fresh or new, and at a temperature of 90 to 100 degrees F. Tests made with different hand separators with milk at temperatures below 80 degrees showed, in every case, a much greater loss of fat in the skim-milk, than when similar milk was separated at a temperature over 95 degrees F. Therefore, if for any reason, the milk has been allowed to cool below 85 degrees it should be heated again before separating if close skimming is desired. When the milk is all run through, the cream should be flushed from the bowl with a little warm water or skim-milk. The power may then be removed and the speed allowed to run down of its own accord. The bowl should not be stopped by applying a brake of any kind, unless provided by the manufacturer, as it injures the bearing and shortens the usefulness of the machine. All parts of the separator should then be thoroughly washed, first in tepid water, and afterwards scalded, then placed in a pure dry atmosphere until required for further use.

The richness of the cream may be regulated by the adjustment on the machine which will be either a cream, or a skim-milk screw. If the adjustment is by means of a cream screw, the cream may be made richer by turning the cream outlet towards the centre of the bowl, and thinner by turning it away from the centre or towards the outside.

In the case of adjustment by means of a skim-milk screw, the directions would be the reverse.

Other conditions which influence the richness of the cream are the speed of the bowl, and flow of milk into the bowl, and, to a certain extent, the temperature of the milk. High speed and a low feed give a rich cream, while a low speed with a regular or increased amount of feed will give a thin cream, and probably this accounts for the great variation in the cream tests from the same machine.

A low speed with a full feed of milk makes a very unfavorable condition for a separator to do good work, and should not be used as a means of lowering the test, as it is usually associated with a high loss of fat in the skim-milk.

The care of the cream is by no means the least important part of the work. As soon as the separating is completed the cream should be cooled immediately to as low a temperature as possible in the summer and to a temperature below 60 degrees 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 bad flavors in the cream and butter.

FARM BUTTER MAKING.

By Miss Laura Rose.

Every year less butter is being manufactured on the farm; and this is as it should be, for while I teach home-dairying, still I am a great advocate of co-operative dairying.

Good butter can be and is made on the farm, but from lack of skill, care, or improper surroundings or utensils, dairy butter very often lacks the fine flavor and body found in a No. 1 quality.

As civilization advances, conditions multiply. In a new country the milk and butter is apt to be better than that produced in a thickly settled district. This is owing to bacteria of an objectionable nature being less prevalent and as a result milk and its products are not so liable to contamination.

Cleanliness from the very start to the finish is the great essential in the art of making good butter, and too much stress cannot be laid upon its importance.

The Cow.

Farmers are far too well satisfied with the cows they keep. Were they their hired help they would not give them shelter another night. They would let them go for the simple reason that they did not earn their bread, let alone showing the smallest profit. We must, if we wish to make dairying pay, increase and improve the milk. A cow that is well fed and cared for should produce 6,000 pounds of milk containing 3.6 per cent. butter fat, or should make 250 pounds of butter per year. I would urge farmers to weigh the milk from each cow at least one day every month and test it for butter fat. This is the only accurate way of making comparisons and finding out what the herd is doing individually. The cow stable should be well lighted, well ventilated, and kept clean. Give the cows plenty of wholesome food. It is the poorest economy to stint the cows either in the matter of food or water. Also see that salt is always accessible to the cattle.

Milking.

There is no nicer place to milk cows than in a well-kept stable. Milk quietly, quickly, cleanly, and thoroughly. Cows do not like unnecessary noise or delay. Commence milking at the same hour night and morning, and milk the cows in the same order. Wipe the cow's flank and udder to prevent loose dirt and hairs falling into the milk. Do not wet the hands with milk. A practice to be recommended is rubbing a little vaseline on the hands. This keeps the teats in nice condition and overcomes the objection some have of milking with dry hands. Nothing tends more readily to drying up the milk flow than leaving a little milk in the udder.

Straining the Milk.

Remove the milk as soon as possible from the stable, and immediately strain through several thicknesses of cheese cloth. Place the cheese cloth over the bottom of the strainer, and secure it with an easily fitting tin hoop. The cloth must be removed and well washed after each time of using.

Creaming the Milk.

Shallow Pans. This method is the oldest, and is still used when but a few cows are kept or when ice cannot be secured or the supply has become exhausted. Tests of the skim-milk show that when the milk has been properly set and skimmed, the loss of butter-fat is no greater from the shallow pans than from creamers. The milk should be set in clean, bright tins, and should not exceed three inches in depth. It is most necessary that the milk room be clean and free from all odors, as milk so readily absorbs any taint that may be in the atmosphere. The temperature should range between 50 and 60 degrees. Avoid having the milk close to the wall or in a strong draught, so as not to have a leathery coat form over the cream, due to rapid evaporation. Skim before the milk thickens. Loosen, with a thin bladed knife, the cream from the sides of the pan. Lift the pan to the edge of the cream can, tilt it to allow a little of the skim milk to wet the edge of the pan, then with the aid of the knife, quickly glide the sheet of cream into the cream can.

Dilution System. Many devices have been put on the market for creaming milk by adding a certain percentage of cold water. We have tried several, and do not recommend any. There is danger of contaminating the cream by using impure water. It robs the cream of its flavor, and besides the loss of butter fat is usually heavier than when the deep cans are used. The skim-milk is too much diluted for feeding purposes.

Creamer. If the cream is raised by the deep setting system, the cans should be placed immediately in water the depth of the milk and the milk brought as soon as possible to 45 degrees or below, and held at that temperature. *Use plenty of ice.* It is economy to have ice always in the water, and just as necessary to use it in the winter as in summer. A water-tight box or barrel will do as effective work as an expensive cabinet creamer. We prefer a slant-bottom can, with a tap to draw off the milk. Having the slant carries away any sediment and permits all the skim-milk to be drawn off.

Cans without a tap should be skimmed with a funnel-shaped dipper, having a long straight handle and no wire around the rim. With a knife loosen the cream from the sides of the can, then wet the dipper in water or milk and lower, point first, into the can, allowing the cream to flow evenly into the dipper. Repeat until all the cream is removed. Avoid getting too much skim-milk with the cream.

Milk should always set twenty-four hours before the skim-milk is drawn off, and thirty-six hours in winter is even better. Milk allowed to stand only twelve hours before skimming will give a cream testing from 16 to 18 per cent. butter fat, while the skim-milk will test as high as from .6 to 1 per cent. Cream from milk allowed to stand twenty-four hours will test test from 18 to 22 per cent. butter fat, and the skim-milk from .25 to .35 per cent., or in other words we have in the latter case a richer cream and less loss in the skim-milk—two desirable conditions in the creaming of milk.

Cream Separators. A separate article in this bulletin is devoted to the hand separators; otherwise, much might be said in favor of this method of creaming milk. It certainly is the ideal way of obtaining the cream. A separator, even with only a small herd, pays, for it should mean less labor, better cream, and more of it.

Care and Ripening of Cream.

During the collection of cream for a churning, the cream can should stand in the coolest place in the cellar in summer, while in the winter it may be kept in a room where the temperature ranges between 50 and 60 degrees. The surrounding atmosphere should be clean and sweet. The can must always be covered. Have a tin stirrer which reaches to the bottom of the can and stir thoroughly, from the bottom to the top every time fresh cream is added.

Each time the can is emptied it should be well washed, scalded and put in the sunshine for several hours. In order to be able to do this, it is a good plan to have two cream cans.

When beginning to collect cream for a churning, add to your first skimming a culture or starter which you know has a clean, pleasant, sharp acid flavor and smell. This culture may consist of a pint or two of sour cream from your previous churning or the same amount of good-flavored skim-milk. The reason for adding the culture is that the bacteria which you know produces a fine flavored butter may take possession of the new cream before other germs which might prove objectionable gain control of it.

Another method is to hold the cream sweet until twenty-four hours before churning, then heat it to 65 degrees and add one pint of culture to every gallon of cream. In the evening cool to churning temperature or below, and hold at that temperature over night.

Separator cream should have the foam well stirred in, and by placing in cold water, should be quickly cooled to 60 degrees in winter and from 50 degrees to 55 degrees in summer. Stir the cream occasionally while cooling. It is most essential that this thorough and quick cooling be done before adding the cream to the cream can, otherwise separator cream cannot make choice butter.

Examine the cream, and when it has a smooth, glossy appearance, pours like molasses and has a pleasant acid taste and smell, it is in proper condition to churn. Churning should be done not less than twice a week in summer and three times in two weeks in winter.

To insure a good body in the butter have the cream lowered to churning temperature or below several hours previous to churning. It does no injury to raise the temperature to that desired, but when the temperature of the cream is lowered just before churning, the fat globules have not had time to harden and the result will be a soft, weak-textured butter.

To prevent loss of butter fat in the butter-milk, sweet cream should not be added during the last twelve hours before churning.

Perfectly sweet cream will churn in the same time as ripened cream and makes a mild creamy-flavored butter which is gaining in favor in the best markets. If the temperature of sweet cream is kept low, there is no excessive loss of butter in the butter-milk.

Complaints are sometimes made about a bitter flavor in cream. When held sweet for some time at a very low temperature this bitterness frequently develops. To overcome this difficulty, either pasteurize or get the cream started to sour.

For farm buttermaking we do not consider pasteurizing the cream necessary, but if bad flavors are found in the sweet cream it will to a great extent destroy them. To pasteurize, place the can holding the cream in a dish of hot water on the stove, and bring the cream to 160 degrees, and keep at that temperature for twenty minutes; then quickly cool to about 60 degrees. It is always necessary to add a culture to pasteurized cream if you wish to ripen it.

The Care of the Churn.

Before using, the churn should be scalded with boiling water and afterward rinsed with cold water. It is better and quicker to pour the water out than let it run through the bung hole. Floating dust will not then cling to the sides of the churn. After using, the churn should be rinsed down with hot water, thoroughly scalded with boiling water, then given a scouring with salt, followed by another rinsing with hot water. Wipe the outside, but do not touch the inside with a cloth. Never allow butter-milk or wash water to remain in the churn when not in use. Leave the plug out and the lid ajar, and keep in a cool place to prevent warping.

The worker, ladles, and butter-print may be prepared while the butter is draining. With a fibre brush, a dipper of water, and a little salt, give them a good scouring and cool well with cold water. After using remove any butter with hot water, again scour with salt, rinse with boiling water, and allow them to dry.

Churning.

Always strain the cream into the churn through a dipper with a perforated tin bottom. In winter add just sufficient butter color of a reliable brand to give a nice yellow tint. Do not depend on pouring it in, but count the drops for a small churning, allowing 3 or 4 drops to the pound of butter.

No definite temperature for churning can be given, but the necessity for the constant use of a thermometer must be emphasized.

Many conditions influence the temperature of the cream for churning such as the richness of the cream; the quantity in the churn; the feed and breed of the cow; the length of time the cows have been milking; the temperature of the room; and the speed of the churn. Aim to make conditions favorable to a low churning temperature as it insures a better butter and a more exhaustive churning.

Start with the churn about one-third full, which means not more than five gallons in a No. 3 churn, and regulate the churning temperature so as to have butter within from 20 to 30 minutes. That proper temperature can only be ascertained by past experience with similar cream.

I would suggest a range of temperatures for summer from 54 to 58 degrees and in winter from 58 to 64 degrees.

Cream that contains too much skim-milk and is too cold will foam. Never add hot water to the cream. It must be taken from the churn and heated by placing the can in a pan of hot water and stirring until the desired temperature is reached.

Poor cream often breaks but will not gather. Try churning slowly. If this does not overcome the difficulty the only remedy is to draw off part of the buttermilk to lessen the liquid.

Very rich cream is likely to paste or thicken in the churn, so that concussion ceases. Add enough water at the same temperature as the cream to dilute it so that it will drop.

When the churning is about completed, add a couple of quarts of water several degrees lower in temperature than the cream was. In the summer it may be quite cold. This floats the butter and allows the buttermilk to run off more freely. When the butter is the size of wheat grains it is sufficiently gathered. Look frequently at the inside of the churn lid, and when but few small specks are seen on it, the churning is usually finished. Watch the buttermilk as it runs through the strainer dipper, and if any butter comes with the first streams, a little more churning is necessary.

Washing the Butter.

When the buttermilk is drawn, rinse the butter with a little water and strain through cheese cloth into the churn as much water as there was cream. Temper the water in winter, having it from 48 to 56 degrees according to the conditions of the butter and the temperature of the room. In hot weather the wash water may be as cold as possible. Revolve the churn rapidly about a dozen times, and wash but once. We recommend washing butter twice if it has come very soft or has an objectionable flavor, or is going to be packed for winter use.

Salting the Butter.

Salt according to the demand of the market. If the butter is for immediate use and is salted on the worker 3-4 ounce per pound of butter is usually sufficient. If salting in the churn use an ounce, as not so much is incorporated in the butter. We strongly recommend salting in the churn, as by so doing butter free from streaks can be had with the least possible amount of working, but the churn must be without dashers, and the butter in firm granular form. The only difficulty in this method is gauging the amount of salt. Estimate the weight of butter from the last churning, then weigh the salt. Have the butter evenly spread over the bottom of the churn, sift on part of the salt, tilt the churn forward to cause the butter to lap over, sift on more salt, then tilt the churn backward and put on the remainder of the salt. Put on the lid and revolve the churn very slowly until the butter forms in several lumps. It may be taken out and immediately worked, but if possible it is much better to allow it to stand either in the churn or in a firkin, if the churn is in too warm a place, for two or three hours, and then give one working.

If salting on the worker, take the butter from the churn, weigh it, and allow $\frac{3}{4}$ ounce of salt per pound of butter. Spread the butter over the worker, sift the salt on evenly, fold the salt under and begin working.

Working the Butter.

For the farm dairy there is nothing nicer than the V-shaped lever butter-worker. It is not expensive and is a great saver of time and strength, besides preserving the grain of the butter.

Work by means of pressure only; avoid a sliding motion as it makes a greasy, salvy butter. Work sufficiently to expel the moisture and thoroughly distribute the salt. Any portion of the butter not reached by the salt will be light in color.

If the butter is very soft or very hard, work but slightly, allow it to stand and when at the proper firmness, give it a second working.

Printing the Butter.

The brick-shaped pound print is the most popular form in which to market butter. Finish the butter smoothly and press the print down into the butter until the mould is well filled. Cut with a ladle the surplus butter from the bottom. Wrap the print neatly in good parchment paper, which has been previously wet in clear, cold water. It is a good plan to have the paper stamped with the name of the farm or butter-maker. It is often the means of securing a choice trade. Be sure the print weighs a full pound or slightly over. The butter when wrapped in the wet paper should weigh full 16¼ ounces.

Keep the butter in a cool clean place and get it to the consumer as soon as possible.

Packed Butter.

When the butter is to be kept for winter use we advocate pasteurizing the cream and seeing that in every respect it is of No. 1 quality. Wash twice and salt heavier. Either allow it to stand in the churn for several hours after salting, or give it two workings. Pack in well glazed, thoroughly-scalded crocks; finish off to within ½ inch of the top. Cover with parchment paper and with a layer of moistened salt. Tie down with paper, and keep in a dark, cool place. If the salt on top dries, add water to it. It is better to keep the butter frozen if possible.

The Milk Pails and Pans.

Clean all tin dairy utensils by first rinsing in warm water, then clean inside and out with a brush and hot water in which a cleansing material such as washing soda is dissolved. Lastly rinse with plenty of boiling water and leave inverted in pure air and sunshine, when available, until wanted for use.

Applied Proverbs.

Praise the day at eventide, and the cow at the end of the year, if she then deserves it.

Children are the riches of the poor; but if you get them interested in the dairy they will help lift the mortgage from the farm.

The shoe knows whether the stocking has holes; the farmer *should know* where the leaks are that rob him of the profits from his dairy, and should set about mending them.

Cleanliness is next to godliness; this applies as much to the *cow stable* as to the *front parlor.*

It is hard for an empty sack to stand straight; but still harder for a lazy man to succeed in the dairy business.

We'll take the good will for the deed. Did you ever hear the cows say that when you neglected to properly feed and water them?

Penny wise and pound foolish is the woman who still uses old-fashioned, out-of-date dairy utensils.

'Tis good in every case you know
To have two strings unto your bow;
Some clucking hens and a brooding sow
Increase the profits from the dairy cow.