

milk, which is more than any cheese factory has done, at least in this part of the country, where they have to run under similar circumstances. It must also be remembered that the creamery can be run all the year round.

If the two branches of dairying are fairly and impartially represented, I am satisfied, and the country will soon be, too, that butter has quite as good a show as cheese.

CO. BRUCE, ONT.

M. MOYER.

Principles of Butter-Making.

Butter-making, so far as a knowledge of its principles is concerned, is still in its infancy; and there is no field of agricultural investigation which offers a wider scope for the ambitious experimenter. However, many important questions have recently been settled, a knowledge of which is required before you can intelligibly comprehend the answers to the numerous questions which we are almost daily receiving. By an understanding of the right basis or starting-point, our interrogators can easily reason out for themselves many problems which are constantly perplexing them.

Until recently many theories were indulged in concerning the fat globule, and each butter expert followed the system which most harmonized with his theories. Late microscopic investigations have settled many disputed points, and are destined to revolutionize the existing methods of manufacture. These discoveries are more or less in harmony with the numerous experiments which have been conducted in different countries.

It has long been known that the fat globule is encased in an albuminous envelope, and the theory was that this covering should be ruptured by violently churning and working, the broken membrane being severed from the globule and removed from the butter by washing. The apparatuses and temperatures employed were such as would best effect this result. It is now known that the membranous sac which encases the fat-layers of the globule can and should be preserved intact, and if broken the flavor and the keeping qualities of the butter are impaired. In fact a majority of the globules are not broken by working. This rupture may also cause the butter to turn white by exposing the innermost layer of the globule, which, being composed of stearine,—the same composition as beef tallow—is nauseous and white; but whiteness may also be caused by churning at too high a temperature, whereby the white caseinous substance in the cream adheres to the globules. The outer layers are composed of oils which give the butter its delicious flavor; but when the membrane is broken, and these oils become mixed with the hard, tallowy substance, the butter is then "grease." This condition being caused by violent churning and working, the latest practice is to churn gently, using a churn which will do the least violence to the globules, and to avoid working as much as possible.

EFFECTS OF TEMPERATURE.

It is also a pretty generally recognized fact amongst some of the highest dairy authorities that sudden and extreme changes of temperature injuriously affect the milk, cream and butter, as they favor the development of organic germs from contact with the atmosphere; so that ice in the dairy "must go," if the flavor

and keeping qualities of the butter are to be retained. There is, however, still a good deal of dispute about the keeping qualities of butter made by the different systems.

SEPARATING THE CREAM.

The understanding of this question also depends upon a knowledge of the fat globule. Of course the globules must be lighter than the milk, else they cannot rise. All other conditions being equal, the largest globules rise first, and some do not rise at all. Hence the larger the globules the better the cow as a butter producer. The Shorthorn and the Jersey give the largest globules; the Hereford and the Ayrshire the smallest, the other breeds being intermediate. The globules that rise last make the worst butter. The principle of separation by centrifugal force will now be readily understood. When milk is made to revolve rapidly in a cylindrical vessel, the globules, being specifically lighter than the milk, must move towards the centre; and the percentage of cream removed from the milk depends upon the speed of the separator. It has not been found profitable to make the velocity so great as to separate mostly all the globules from the milk; but considerably more can be profitably separated than by the setting systems.

The question of deep vs. shallow setting being dependent upon temperature, is more complicated. If two vessels, a deep and a shallow, are filled with milk, the temperature of both being the same, the globules will reach their journey's end sooner in the shallow vessel. But now let us consider the effect of temperature. When heat is applied to milk, the fats of the globules expand and become lighter more rapidly than the water and the other constituents of the milk, and the cream rises more slowly, the specific gravities being nearer alike, when the temperature is not changing. Water being a better conductor of heat than fats, the cream is somewhat behind the water of the milk in expanding or contracting, so that the specific gravity is less under a rising temperature, and greater under a falling temperature, there being little difference in the gravities of the milk and cream under the same temperature, and the rising of the cream then becomes very sluggish. From these facts it appears that the higher the temperature at which the milk is set, the less should be the depth; and the lower the temperature, the greater the depth.

Many facts have been ascertained by analysis and microscopic observations; but investigators, as a rule, are not satisfied with such tests—they must double the value and weight of the evidence by practical tests. When the practice corroborates the other evidences, the knowledge thus acquired is termed science; otherwise the term theory is used. The first experiments or observations may decide that a certain thing is so; but it usually requires the scrutiny of practice to obtain accurate figures with regard to it. By a proper understanding of the foregoing principles, you will readily be able to give a reason for most of the following

RULES FOR BUTTER MAKING:

1. The best churn is the one that will agitate most without pounding, at the same time creating a free current of air in the churn.

2. The cream should not be churned into a mass of butter, but the churning should cease when the butter gathers into small particles, say the size of apple-seed, so that the buttermilk can easily be separated from the fats by washing.

3. The butter should be thoroughly washed, and pure water or brine should be used. Working lowers the flavor and injures the keeping qualities.

4. Where cream is setting, the surface should not be exposed to an atmosphere much warmer than the cream.

5. The greatest percentage of cream can be got from milk that undergoes the greatest variation of temperature. Milk set at 90° and lowered to 60° will produce about the same quantity of cream as milk set at 70° and lowered to 40°, the variation in both cases being the same; but the former will produce better flavored butter. Farmers should therefore set their milk as warm as possible and let it cool to 50° or 55°, afterwards not allowing the temperature of the cream or butter to vary much from these figures.

6. When farmers use the skim-milk for feeding stock, the advantage of the system of separating the highest possible percentage of cream from the milk is greatly over-estimated.

7. More butter can be obtained from churning the milk than from any other system except the centrifugal.

8. A much larger percentage of cream can be obtained from newly calved than from old calved cows.

9. The number of pounds of milk required for a pound of butter varies from 20 to 30 according to the richness of the milk and the system of separation of the cream.

10. "Heavy milk" is a term applied to milk the cream of which rises slowly, leaving no distinct line of demarcation between the milk and the cream. Such cream is very thin. Heavy milk is produced by one or more of the following three causes: (1.) In some breeds, such as the Ayrshire, the fat globules are small and specifically heavy, so that they either rise slowly or not at all, and many rise only partially; (2.) In all breeds the milk becomes heavier as the milking period is prolonged, especially when the cow is in calf; (3.) All milks tend to become heavy when allowed to cool before setting.

11. If set at the same temperature, say 80° to 85°, milk set in ice will produce 10 to 15 per cent. more butter than when cooled with water to 50° Fahrenheit.

12. By centrifugal separation about 12 per cent. more butter can be produced than by cooling to near freezing point by ice, and about 30 per cent. more than by cooling to 50° with water.

13. Butter, if removed from the churn, without working while in small granules, can be preserved fresh and sweet in brine almost indefinitely.

The three requisites of Dairying—A dairy man, a dairy farm, and a dairy herd.

A dairyman in New York State feeds his skim and buttermilk to his cows, and declares that the same quantity of milk that it requires to make a pound of pork will make a pound of butter. Surely pigs in the dairy must now go.