Cheddar Cheese Making*

A Phase of Dairy Industry

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CHEDDAR cheese is the most popular cheese with English-speaking people. Its name is derived from a small village of that name in Somerset, England. In that district this cheese was made over 300 years ago. The system gradually spread to the principal British

by the late Mr. David Wilson about 1892, when at several factories the necessary plant was installed. A small quantity was exported and satisfactory prices obtained, up to \$14 per hundredweight; but it was not persevered with. Last season, again, a small quantity was exported with very encouraging results, over \$15.25 per hundredweight being realized for some makes. The quality was very favorably commented upon by the experts in the trade in England, which shows that the country and climate are thoroughly suitable for the industry. A large expansion in this branch of the dairying industry should therefore occur in the near future.

CHEESE AS AN ARTICLE OF DIET.

Cheese is highly nourishing, and is one of the staple articles of food of the masses in Great Britain, where the imports amount to over \$30,000,000.

Cheddar cheese, when properly made from sound milk of average composition, is of rich quality, perfect solidity, mellow or plastic, and of specially mild and pleasing flavor, reminding one of a pipe hazel nut. It will keep under proper conditions, and with continual improvement, from one to two years; or it may be consumed when three to four months old, and at the latter age is more digestible than most other makes of cheese.

The average analysis of matured cheddar cheese is as follows:

	Per cent.
Water	30.32
Fat	35.53
Casein	28.18
Salt, Ash, etc.....	5.97
	100.00

the casein and causes it to envelop the contents which are subsequently converted into cheese.

CHANGES DUE TO BACTERIA.

It is all important that some of the changes to which the solids of milk are subject should be understood.

Cheese-maker Taking the Acidity Test at the Coagulating Tank.

colonies. In the United States, in 1830, cheese was sold in the local markets at 5 cents to 8 cents per pound. From 1840 to 1850, the Americans began to ship it to Britain. In 1851 the factory system was inaugurated, and by 1866, 500 factories had been built. For the season ended September, 1859, 7,542 tons were exported. From that date the exports increased rapidly, and for a long time the Americans had the British market almost to themselves. Canada then entered into the business.

The original system was somewhat complicated, and it required a large amount of experience to produce a cheese of good quality. Even then troubles that puzzled the most experienced makers would affect the quality. The Canadian experts developed a modification of the system under which, by following fixed rules, more certain results are obtained and a more uniformly good article is produced. This is now known as the Canadian Cheddar system; and by it makers of limited knowledge are enabled to achieve greater success than was formerly possible by the most experienced under the American or "Stirred curd" system. The Canadian cheese trade soon grew to one of great proportions, and the quality was such that it commanded the highest prices. Owing to the rapid increase of population in the United States, the exports from that country have decreased till they have now little influence on the trade.

The system was introduced into New Zealand, but for many years the export trade was at a standstill, while the butter exports forged ahead. In 1907, however, owing to various reasons, the demand for cheese increased and uniformly good prices were obtainable.

Drawing Whey Off the Mat.

As the following figures show, the New Zealand cheese export trade was steadily developed:

NEW ZEALAND CHEESE EXPORTS.

1905	\$ 904,370
1906	1,325,420
1907	2,248,380
1908	3,961,590
1909	4,327,280
1910	5,928,520
1911	6,111,820

The Canadian system was introduced into Victoria

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Heating and Cooking the Curd.

Or roughly, about one-third fat, water, and casein respectively.

Although due, to some extent, to the butter fat which it contains, the peculiar mellow appearance and texture of choice cheddar are more largely the result of the breaking down which the casein or curd undergoes during ripening. The curd is hard and insoluble in water when first made, but by degrees it becomes softer and more soluble; or, to speak more correctly, gives rise, by the processes of fermentation, to products which are soluble in water. If cheese is consumed before this ripening process has developed, it is neither so wholesome nor nutritious as when properly ripened. The proper ripening of the cheese depends principally on the manufacturing process and the subsequent treatment of it while ripening.

MILK.

Milk is a very complex substance and is a perfect food. It will be sufficient to note its principal contents, which are as follows:

	Per cent.
Water	87.00
Fat	4.00
Casein	3.00
Sugar	4.75
Ash	.75
Albumin	.50
	100.00

The contents chiefly of value in the manufacture of cheese are the fat, casein, water and a little sugar and mineral matter. Nearly all the sugar and albumin, about half the ash, and a little fat, escape in the whey during the process of manufacture.

Cheese is made by the action of rennet, which is an extract of the stomach of the young calf. It coagulates

Cutting the Curd.

They are principally due to bacteria. While in the healthy udder, the milk is practically free from bacteria, but as soon as it leaves the udder it becomes inoculated by various kinds that are always present in the atmosphere.

Immediately these bacteria gain access to the milk they begin to develop very rapidly. Milk at the natural temperature of the body is a most suitable medium for their development. One form feeds on the sugar, the result of which is that lactic acid is produced. This is the natural souring or ripening of the milk; and, in cheese making, it is the adjustment of the various processes of manufacture to the development of the lactic acid that influences the matured product for good or ill. When proper precautions are taken with regard to cleanliness, the majority of germs that get into milk are of the class already mentioned, viz., those that produce lactic acid. When due attention is not paid to cleanliness, various filth germs get into the milk. These, feeding on the casein and other albuminoids, produce gases which form the pin holes and round holes in the curd and develop taints and bad flavors. A great variety of bacteria may get into the milk if proper care is not taken to prevent them. If they are subjected to high temperatures, say 130 deg. Fahr., and upwards, for a lengthy period, they will be destroyed. Low temperatures will check their development, so that by cooling the milk they are kept in check, and the development of acidity can be controlled by the cheesemaker.

The predominance of any particular class of germ in the milk has the influence of overpowering or keeping in check those that are in a minority; hence the use of pure cultures of the lactic acid bacillus which are

Milling the Curd.

known as starters. These starters are prepared from a pure culture supplied in a liquid form by the Department of Agriculture or from commercial cultures obtainable from the agents in the form of powder.

NECESSITY FOR CLEANLINESS.

As in all branches of dairying, cleanliness is of the greatest importance in cheese making. Sufficient care is not devoted to the raw material by those who milk the cows and handle the milk before it is delivered into the factory, and it is at this stage that it is more liable to contamination from careless and uncleanly habits.

The cows must be provided with a clean water sup-

ply. If the supply is obtainable from the open dam, this must be fenced so as to prevent the cows polluting it with their own droppings. The mud thus contaminated sticks to the udders, and it is almost impossible to prevent some of it finding its way into the bucket while milking.

It must be borne in mind that dung in any shape or form is the worst form of contamination to which milk is exposed. For this reason, the yards and sheds must be kept clean; and, particularly in the summer, dry cow dung must not be allowed to accumulate about the yards. The cow shed and milk room must be regularly limewashed.

The cows' udders must be washed or wiped with a damp cloth. This is especially necessary in the spring time, or when the animals have a full supply of succulent fodder, which has a laxative effect. Extra care is then necessary to prevent contamination.

The milkers' hands should be washed before milking each cow. For this purpose, water may be provided in a five or ten-gallon oil drum, with a tap. Dissolve some Condyl's crystals in the water. This will help to prevent the spread of sore teats or other troubles due to germ life.

Only well tinned utensils should be used. As the tin wears off, giving rise to a rusty appearance, they must be re-tinned or replaced by new ones. The utensils should be cleaned by first rinsing with cold or lukewarm water, and then thoroughly scrubbed with hot water in which soda has been dissolved in the proportion of about one-half pound to 10 gallons of water. Afterward scald with boiling water and soda, steam thoroughly, and place upside down to drain and dry. A cloth should never be used in cleaning the utensils—always use a brush.

CARE OF MILK.

The milk should be strained through a "Ulux" strainer, which consists of wire gauze, and wadding disk which is burnt after use. If butter cloth and wire strainer are used, take a fresh piece of butter cloth for each milking and double it.

The night's milk should be removed from the shed to a clean milk room and run over a cooler to remove the animal heat; the reduced temperature also checks the development of bacteria and prevents the milk becoming over-ripe.

Before the milk is emptied into the receiving or making vat, it is the duty of every maker to examine the milk as to its condition. Thorough work at the receiving platform places one on the high road to success in the labor that follows. While the milk is being received into the vat, it should be stirred gently at intervals to keep the cream from rising to the surface. Use the thermometer to ascertain the temperature of the milk. If over 70 deg. Fahr., do not apply the steam until you are sure that there is enough milk near at hand to fill the vat. If there is a suspicion that the milk is over-ripe, test is for acidity, as described below, or make a rennet test; if it proves to be over-ripe, the whole process must be hurried on to keep ahead of the acid. If, on the other hand, the milk is found to be fresh and sweet, a good starter must be used. Should there be any bad flavors evident, a good starter will assist in overcoming them.

STARTERS FOR CHEESE MAKING.

In preparing starters from commercial cultures for cheese making, it is essential that all vessels be washed and scrubbed in tepid water and soda and then thoroughly rinsed with hot water and soda, and sterilized with steam.

It is advisable to get the best milk obtainable and as fresh as possible from cows that have not advanced too far in their period of lactation. The milk should be strained through a Ulux strainer before putting it into the can or bucket in which it is scalded.

Stand the vessel in a trough of water heated by steam. Keep the water boiling slowly to prevent any water splashing into the milk. In this way the temperature of the milk is raised up to nearly boiling point (say 200 deg. Fahr.) and should be maintained at that temperature for half an hour, stirring occasionally with a clean sterilized rod.

Take the can out and strain the milk into a clean vessel, and wash the can first with cold water and then hot water and soda, and sterilize with steam.

Take one gallon of the scalded milk and cool down to 80 degrees, when the culture may be added, stirring it in thoroughly with a clean glass rod.

Cover the top of the vessel with a piece of clean cheese cloth that has been scalded and dried, to prevent any flies or dust getting in.

Set the can in a tub of water at a temperature of 78 degrees, giving the milk a stir for the first 5 hours at intervals and maintaining that temperature from 18 to 24 hours. The startline should be nicely thickened; skim off about 3 inches and discard it. Stir it up with a clean glass rod till it becomes like cream and keep back one pint to be used to start the second day's pasteurized milk.

The second propagation should be started at a lower temperature (about 180 degrees) and maintained at 70 degrees for the same period.

Test the acidity by using the acidimeter test, which should show 0.65 per cent. Keep back about 1½ pints to be added to third day's pasteurized milk.

The third propagation should be cooled down to from 65 to 70 degrees and kept at that degree from 18 to 24 hours. This propagation will be found sufficient to set the ordinary starter. The quantity to be used for the ordinary starter will depend on the acidity developed, which should not exceed 0.80 to 0.85 per cent.

Pressing the Cheese.

One per cent to 1½ per cent will be sufficient if the starter is mild to the sense of smell, clean and sharp to the palate, and firmly coagulated. If found to be over-ripe, use less.

It is a very important matter that the starter be kept covered and in a pure atmosphere. Before using a starter always reject one inch from the top of the starter which is not so good. The starter should be poured from one vessel to another until it becomes smooth and uniform. If it is found desirable to add the starter to the vat of milk after the temperature has been raised, mix the starter with an equal quantity of warm milk from the vat. After pouring from one bucket to another it may be put into the vat by straining it through cheese cloth so as to prevent the cold starter from curdling or forming into white lumps, causing mottled cheese.

A good clean flavored starter gives the desired flavor, aroma, and keeping quality required in cheese. A poor flavored one should never be used, as it spoils the flavor of the whole vat of milk.

THE RENNET TEST.

Heat a small quantity of milk in a dipper placed in hot water, raising the temperature to 84 degrees or 86 degrees. Take a 4-ounce glass measure of the milk and pour into an enamel mug, place in it a small chip or cork, pour in one drachm of rennet, and stir vigorously for 10 seconds with a clean teaspoon or a glass rod; then withdraw the spoon and watch when the

Dressing the Cheese.

chip stops. If the chip stops quickly, the milk is over-ripe.

THE ACIDIMETER OR TITRATION TEST.

The acidimeter or titration test is based on the fact that one cubic centimeter of decinormal solution of caustic soda will neutralize .009 gramme of lactic acid.

To make the test, put 10 cubic centimeters of the liquid to be tested in a white cup, and add two drops of phenolphthalein solution, which, by the production of a pale pink coloration, acts as an indicator of the point when neutralization of the acid by the soda takes place. Fill a burette graded in one-tenth of cubic centimeters with the soda solution, but not above the 0 mark. Note the point at which the solution in the burette stands; then turn the tap and allow the solution to run gradually into the milk, stirring with a glass rod all the time. Each drop of the solution produces a pink color, but when stirred it immediately disappears until the soda solution neutralizes the acid,

when a permanent pink coloration is produced. As soon as this point is reached note how far the liquid has run down the burette; and if it has dropped 22 spaces, equal to 2.2 cubic centimeters. The percentage of acid is calculated as follows:

$$\frac{2.2 \times 0.009 \times 100}{10} = 0.198 \text{—the percentage of lactic acid present.}$$

A quicker and simpler way of making the test is to take 9 cubic centimeters of the liquid to be tested, when the number of spaces of the soda solution used will indicate the percentage of acid present. For instance, say it takes 22 spaces to neutralize the acid, then

$$\frac{2.2 \times 0.009 \times 100}{9} = 0.22 \text{ per cent of acid.}$$

The temperature of the milk does not influence the titration test.

VARIOUS STAGES OF MANUFACTURE.

Commercial Starter.—A good starter is the foundation of cheese making, as it is composed almost entirely of lactic acid bacteria; and, in adding it to the milk, millions of desirable germs are introduced and help to crowd out the undesirable ones. Use from ½ to 1½ per cent, according to the sweetness of the milk.

Above all, never use whey for a starter. Sour whey always contains undesirable germs, and these will be transmitted from one day's milk to the next.

Heating the Milk.—The temperature of the whole milk should be raised to 84 degrees or 88 degrees, according to its richness. In spring, a lower setting temperature and a comparatively larger quantity of rennet should be used. As the season advances, and the milk gets richer, the setting temperature should be raised.

Testing Acidity of Milk.—The milk is now tested with the acidimeter test to ascertain its acidity. The acidities which give the best results are 0.22, 0.225, and 0.23, depending on the condition of the milk and the amount of starter used.

Coloring.—The coloring depends on the strength used; from 1 ounce to 1½ ounce to 1,000 pounds of milk gives the right color. It should be mixed in half a gallon of cold clean water, and gently stirred into the milk.

Rennet Test.—Before setting the milk, a rennet test should be made. From 18 to 20 seconds is the proper time for normal working milk. The time will vary with the season, condition of milk, and strength of rennet. The quantity of rennet used is from 3 ounces to 4 ounces per 1,000 pounds of milk, and it must be diluted with half a bucket of cold clean water to each vat before pouring into the whole vat of milk. The water delays the action of the rennet for a few seconds.

The rennet should be stirred into the milk with the curd rake or agitator for two to three minutes at a fairly fast rate; then slow down for two minutes so as to have the milk perfectly still before coagulation takes place. Withdraw the rake or blades of the agitator and skim off any dust or fat that may have accumulated on top of the milk. Put canvas cover over the top of the vat to keep the temperature from falling.

Coagulation.—Watch for the coagulation of the milk. If this occurs within ten minutes, the curd should be ready to cut in 35 minutes from the time the rennet was added to the vat; or the time it takes to thicken $\times 2\frac{1}{2}$ from the time it thickens, i. e., $10 \times 2\frac{1}{2} = 25$, + 10 = 35 minutes from the time rennet was added.

Cutting the Curd.—To ascertain when the curd is ready to cut, wet the forefinger and insert it carefully into the curd and then raise. If the curd breaks cleanly and shows clear whey it is ready for the knife.

The horizontal knife should be used first, lengthwise of the vat. The curd then keeps in place better and allows a more uniform cut to be made with the perpendicular knife. The latter is used crosswise and once lengthwise. The cubes should be even and not over three-eighths inch in size.

The curd should be stirred gently by hand for ten minutes and the curd adhering to the sides or bottom of the vat taken off before applying the curd rake or blades of the agitator.

Testing Acidity of Whey.—A test of the whey should be taken before turning on the steam so as to know how the acid is working. With some milks and some starters showing a test of 0.14 per cent, three-quarters of an hour from renneting will bring the curd on quite fast enough, while others, even at 0.15 or 0.16 per cent, may work too slowly in the same time.

Heating the Curd.—Steam should be applied through the medium of water under the vat, as there is less danger of scorching the curd. Turn the steam on slowly at first and gradually apply faster as the curd gets firmer. Stir constantly during the heating process, which should take from 40 to 45 minutes to raise the temperature to 98 or 100 degrees as the case may be.

After the curd is at the desired temperature, it should be stirred occasionally to keep it from matting and to insure even and thorough cooking.

Testing Acidity of Curd.—If the whey is showing 0.175 in two hours from setting the milk, remove the whey until the top of the curd may be seen; this checks the acidity from getting too far ahead. Mix the curd up by hand so as to get it nice, firm, springy, and elastic, so that when a handful is squeezed together it will fall apart readily on relaxing the pressure, before running the whey off.

If the curd is well cooked, allow from 0.195 to 0.22 per cent of acid before throwing the curd up on the racks in the vat.

Well cooked, curd requires very little stirring as the whey leaves it freely. It is of the greatest importance that the curd be cooked firmly, and that it contain sufficient acid before the whey is run off.

Racking Curd.—The curd racks are made in two-foot sections, from 4 to 6 inches in depth, to fit inside the vats. Tilt the vat so that the top end is about six inches higher than the bottom, and draw the curd downward. Put in the first section of rack and cover over with rack cloth. Dip enough curd on to the rack to make space for second rack. This process is continued till all the racks are in place.

Stir the curd gently and level it back 8 to 10 inches deep to mat. Test the acidity of the whey after racking; it should show from 0.285 to 0.30 per cent in 2½ to 3 hours from setting the milk.

Matting the Curd.—Put cover over the top of the curd and allow it to mat from 10 to 15 minutes; then cut in strips lengthwise and crosswise in 8 to 10-inch blocks and turn over. Repeat the process until the curd becomes "meaty," and when pulled apart it splits instead of breaking. At the last turn, place the curd on the bottom of the vat and remove cloths and racks before milling, which generally takes two hours from racking. The temperature of curd at this stage should be 94 degrees.

Milling Curd.—Knife mills should be used, giving a clean cut three-eighths inch to one-half inch in size. If smaller, they injure the curd, causing unnecessary loss of butter fat and spoiling the texture of the cheese.

Mellowing the Curd.—After the milling is completed, the curd should be turned over by hand, and covered to maintain the heat and prevent the curd from bleaching. Repeat the same process every 15 minutes for one hour after milling.

Testing Acidity of Curd.—Fifty minutes from milling make a small hole in the center of the curd, so that the moisture will gather sufficiently to allow a test to be made. Aim at 1 per cent of acidity, three hours after the curds are dry on the racks.

Turn the curd over by hand and cover up, repeating the previous process of mellowing. In half an hour the curd becomes soft and velvety, and exudes a moisture of half fat and whey testing 1.05 to 1.10 acidity. The curd is then ready to salt.

Salting the Curd.—The amount of salt to be added depends upon the moisture in the curd and upon the length of time for ripening. Moist curd requires more salt than quickly ripening cheese. The rate varies from 2½ to 3 pounds per 1,000 pounds of milk.

If the temperature of the curd is 88 degrees, let the water run from under the vat. The curd should be turned over and spread evenly over the bottom of the vat. Sieve half the salt on the curd and stir up thoroughly and evenly through the mass. The remainder should be put on and also well mixed.

Piling the Curd.—Pile the curd up in the center of the vat so as to allow the whey to escape. The temperature of the curd at this stage should not exceed 84 degrees. Cover the curd over for 20 minutes until the harsh feeling caused by the salt has disappeared; mix the curd up by hand and it will then be ready for the hoops.

Dressing Cheese Hoops.—In the bottom of the hoop place a clean cap cloth (hessian preferred). Use two cloths (seamless bandage). Wet the first cloth before putting it on, and do not have any on the bottom. Put the other cloth on and lap about 1 inch on the bottom of the hoop and cap cloth. When two cloths are used a silky skin is put on the cheese. The outside cloth is taken off in the morning and washed ready for the day's hoops.

Hooping the Curd.—The curd is now firmly packed into the hoops and weighed, and put into the press with the jointing of the inner hoops facing the gutter of the press.

Pressing the Cheese.—At first, the pressure should be applied gradually to the curd. When the whey starts to come away freely, stop screwing for 10 to 15 minutes; then screw up, repeating this process for one hour. A quarter of an hour before dressing the cheese, pour three or four buckets of water gently over the hoops at a temperature of 130 degrees, to assist in putting a good rind on it.

Dressing Cheese.—After about one hour has elapsed

the cheese should be removed from the press, and the operation known as dressing the cheese performed. This consists of trimming round the edge of the cheese, wetting the cap cloth with clean hot water, and pulling up the bandage and removing wrinkles so that the binding will lap one-half inch over the end. Wet the outer cap cloth and replace the cheese in the press, joining the inner hoops on the top. Pour three or four buckets of hot water on top of the hoops and gradually screw up fairly tightly. The maximum pressure is not put on until late at night.

The cheese should be turned in the hoops, end for end, and the outer bandage taken off in the morning, and any defects in appearance remedied. They are again returned to the press and allowed to remain in the hoops until they are required for the day's cheese. The outside bandage should be washed in hot water and spread over the top of the hoops to air and dry, so as to be ready for use when required.

After being taken from the press, the cheeses are removed to the maturing room to ripen.

Maturing.—The cheese should be turned every morning on the shelves in the maturing room, which should be well ventilated. The cheese shelves should be kept scrupulously clean and thoroughly washed at the end of the season with boiling water and washing soda. This keeps the cheese clean and helps to prevent mold. The floor also should be scrubbed and kept clean. Clean and neat cheese placed evenly on the shelves gives the room a nice appearance.

Hoops and presses should be washed thoroughly once a week, and cap cloths should be kept clean and sweet. The cheese vats, curd racks, curd cloths, etc., need special care in washing in order to keep them in first class condition. Curd racks should be left outside and well aired.

Keep the temperature down as much as possible during spells of hot weather, as overheated cheese loses flavor, discolors, and becomes bitter.

With cheese, as with everything else, every effort must be made to please the eye. Marketing cheese that are of unequal height or are lopsided, or the cloths of which are loose from some defect or carelessness in the process of making, is always unprofitable. Not only should the cheese be put up in a neat attractive form, but it should not come in contact with anything having a bad odor.

DAILY RECORD.

The cheese-maker should keep a careful record during the various stages of manufacture. A chart embodying the following list will be found very helpful:

1. Milk, pounds.
2. Acidity.
3. Fat test.
4. Starter used, per cent.
5. Temperature of milk before testing.
6. Color, ounces.
7. Rennet test.
8. Acid test.
9. Rennet added, ounces.
10. Temperature set at.
11. Time set.
12. Time stirred.
13. Time to coagulate.
14. Time to cut.
15. Acidity of whey after cutting.
16. Time heat applied.
17. Acid of whey in 1½ hours.
18. Temperature cooked to.
19. Time cooked.
20. Acid in 2 hours.
21. Acid in 2½ hours.
22. Hot iron test.
23. Run whey off top of curd.
24. Curd in whey, hours.
25. Acid of whey before racking.
26. Curd stirred dry on racks.
27. Acid of whey after piling.
28. Cut and turned in 15 minutes.
29. Left to mat, hours.
30. Time milled.
31. Time curd left.
32. Acid of whey one hour from milling.
33. Time curd left before salting.
34. Acid of whey when salted.
35. Temperature of curd when salted.
36. Amount of salt.
37. Time of hooping.
38. Temperature of curd when hooped.
39. Time hoops in press.
40. Time started pressure.
41. Time dressed.
42. Time full pressure.
43. Pounds of cheese.
44. Amount of cheese per pound of milk.
45. Weather conditions (temperature, humidity, etc.)

FAST WORKING CURDS HOW TO HANDLE.

During a spell of warm weather the milk, as a rule, arrives at the factory or dairy in a very unsatisfactory

condition. The heating should be so regulated as to have the desired setting temperature attained shortly after the last milk runs into the vat. A rennet test should be made before heating is completed by warming a sample up to the proper temperature. This indicates at once how far acidity has developed, and enables one to regulate the treatment accordingly. When milk is found to be working fast a lower setting temperature should be used, and a larger quantity of rennet added, so as to get the curd ready for the knife as soon as possible. At a lower setting temperature, acidity does not develop so fast. Cut the curd finer, giving an extra cut with the perpendicular knife.

The object is to get the pieces smaller so that they may expel their moisture more rapidly. When the curd gets a little firm, say 92 degrees, remove a portion of the whey in order to control the development of acid, and add 3 per cent of pure clean water at the same temperature as the whey.

In bad cases, all the whey can be removed down to the top of curd, and a second water added. This is found beneficial, as it checks the acid and allows a firm curd to be made before dipping on the racks.

GASSY CURDS.

The presence of gas is generally noticed by the slow ripening of the milk. Strong putrefactive fermentations (or taints) are also discovered as the result of examination at the receiving can and milk vat. In such cases, the milk should be ripened at a lower temperature, and more acidity allowed to develop before setting. Do not cut finely; aim at having the cubes larger so as to retain the moisture. Stir longer before turning on steam; heat slower than with ordinary curd. If very gassy, hold temperature a couple of degrees lower, say at 94 degrees, until the acidity begins to develop. This prevents the curd from getting too firm before the acidity is present. When, however, the acidity is coming on nicely, the temperature should be raised to 98 degrees so as to get the curd properly cooked before dipping.

Always allow more acid to develop in the curd before drawing off the whey; do not stir too dry. If well cooked, leave the curd on the bottom of the pan instead of racking. A shade more acid in the whey and more moisture left in the curd will assist in checking the gaseous fermentation of the latter. If the gas continues to check the acidity, and the curd is still working slowly, cut the curd in larger pieces than usual. These will retain the moisture and temperature better, and thereby aid development of acidity. If, on the other hand, too much moisture is present and acidity is developing too rapidly, cut the pieces smaller, mill earlier, and mature well before salting. When the curd has flattened out, all holes have disappeared, and the flavor is fairly clean, salt heavier than with ordinary curds. This will assist in retarding the effects of the bad flavor as the cheese ripens.

FAULTS IN CHEESE.

Acid Flavors in cheese are due to ripening the milk too much before adding the rennet, using too much starter and not firming the curd sufficiently before drawing off the whey. Prevent the development of too much acid in the milk before renneting. Of no account should sour milk be accepted from any supplier.

If the milk is found to be well advanced, keep back the starter till ready to add the rennet to the vat of milk; use very little (from ¼ to ½ per cent) according to the condition of the milk.

Rancid Flavors are due to filth germs caused through allowing cow manure and dust to gather in the cow-bails, and also by impure air where the milk is kept over-night in badly ventilated rooms. Utensils and straining cloths that have not been thoroughly washed and scalded, and bad flavored starters, should not be tolerated.

Bitter and Yeasty Curd are due to receiving milk in cans in which sour whey from dirty tanks is returned. All whey tanks should be constructed to allow whey to be carted away and the tank washed out thoroughly daily with hot water, and plenty of fresh air let in.

Whey that has been pasteurized is much better for feeding young calves and pigs, and does away with the sour disagreeable odor so hard to get out of the cans.

Weak Body and Open Texture are entirely due to faulty methods of manufacture, and there is no one else to blame but the cheese-maker. The body of the cheese is determined very largely by the condition of the curd at the time the whey is removed. If the curd at this stage is soft and tender, the probabilities are that the cheese will be short and tender in the body.

If the acidity is allowed to over-develop while the curd is in a soft condition, a more or less sour cheese will be the result. It is not the amount of acid in the curd at the time the whey is run off that indicates whether a cheese will be sour or not, but rather the condition of the curd as regards firmness when the acid develops.

Openness in the Cheese is due to not allowing the curd to mellow down sufficiently before adding the salt

and putting into press too soon. A sweet cheese is always open, because it resists the pressure and puffs and swells after removal from the press.

Mottled Coloring.—An uneven development of acid and moisture in the curd. This can be avoided by uniform cutting, heating and stirring, using three-eighths horizontal knife first lengthwise of the vat and then cutting with the three-eighths perpendicular knife crosswise of the vat and lengthwise. Mix the curd up by hand and then give it an extra cut lengthwise of the vat, giving a smaller cut which makes it much easier to get the curd firmed.

Starters should always be strained through a layer of cheese cloth and added to the vat of milk before the coloring.

The curd left over from the previous day should be placed in the corner of the vat after the day's curd has been piled up on the racks. The drippings from the curd will warm it up. Drain off the curd before milling, pull the curd into a heap, and salt apart. When hooping the fresh curd, put the stale in the bottom of a hoop.

The chief advantage of matting the curd is to improve the texture and body of the cheese. The curd

must be turned frequently on the racks in order to prevent the whey forming in pools on the curd.

The effects of salt on curd are to expel the moisture; to improve flavor, body and texture of the cheese; to retard ripening or curing and to add keeping quality to the cheese. If salt be applied to the cheese before it become velvety, the quality of the cheese is not so good.

A really fine cheddar cheese should have a clear pure silky and firm appearance when drawn by the trier. There should be no stickiness or pastiness on touching it; neither should there be any holes in the meat, or streakiness in the color. It should be pleasant to the eye, and sweet to the nose and the palate.

TRADE TERMS.

Flavor.—In common with other edible commodities, flavor is of the utmost importance in cheese. The flavor of high grade cheese is agreeable to the palate, is nutty, clean, and devoid of any bitter or objectionable after-taste.

Texture.—Perfect texture is shown when a plug or cut surface of the inside cheese presents a solid, compact appearance, free from breaks or holes.

Body.—This term refers to the consistency, firmness,

or substance of the cheese. Perfect body is indicated by its being solid, firm and smooth in consistency.

Coloring.—The color varies according to demand on the market.

EXPORT CRATE.

The cheese crate should be neat, strong and tight, the timber being well seasoned, and dressed both sides and ends. A further improvement in appearance is effected by bevelling the edges of the battens. Green timber should never be used, as it causes the rind to become softened, and is liable to impart a bad flavor to the cheese, and to occasion the development of mold. Care should be exercised to get the crates as nearly as possible the same size as the cheese, or, in other words, the cheese should be made of a uniform size to fit the crate.

When this is done, they look neater and are prevented from moving about. The packages also take up less space and unnecessary surplus weight is avoided.

The partition between the cheese should be securely nailed, and the ends of the crates bound with 14-gage pliable wire, with $\frac{1}{2}$ -inch staples, or galvanized iron hoop ($\frac{3}{4}$ inch).

Skis; Their Construction and Use

The Making of a Good Ski is a Delicate Task

In many mountainous regions, especially in the far north, the ground is so deeply buried in snow for weeks and months in winter that driving, riding and ordinary walking are impossible, and locomotion can be accomplished only with the aid of snow shoes. The principal types of these devices are the Canadian lattice snowshoe, which closely resembles a tennis racket, and the Norwegian snowshoe or ski, which is a long, narrow and slightly curved plank. The form and dimensions of the ski vary according to the particular use for which it is designed. In general, the length is approximately equal to the height to which the wearer can raise the tips of his fingers, and consequently ranges from $6\frac{1}{2}$ to $7\frac{1}{2}$ feet. The width varies from $2\frac{1}{2}$ to 4 inches at different points, and the thickness varies (inversely to the width) from one-half inch to $1\frac{1}{4}$ inches. Fig. 1 shows the plan and longitudinal and transverse vertical sections of a ski of the usual type. The upward curve of the front end is permanent, but the slight convexity of the after portion, on the crown of which the foot rests, is flattened in use by the weight of the body. The curve is determined by the elasticity of the wood and the weight of the wearer, so that the main part of the ski shall become perfectly straight under that weight. If the ski were made straight the wearer's weight would give it a concave form which would make locomotion impossible. A longitudinal groove in the under side molds the snow into the form of a rail, on which the ski glides, and which makes it easier to keep the two skis parallel in running or coasting. A mortise is chiseled transversely through the thickest part of the ski, to facilitate its attachment to the foot.

The construction of a good ski is not an easy task, for it involves a number of delicate problems. The following description of methods and details of construction is furnished by *La Nature*:

Skis intended for use in the mountains must be both strong and supple. These two qualities are associated in the wood of the ash, of which most good skis are made. Because of the high price of ash, many mountaineers substitute spruce or larch, which abound in the Alps. Skis are sometimes made of two kinds of wood, a heavy, close-grained species being employed for the lower, and a light wood for the upper part. Very hard and heavy oak is used for the bottoms of leaping skis. A ski made entirely of oak would be too heavy for use. White ash presents the best construction of the four desired qualities of elasticity, strength, lightness and moderate cost. The trees are felled in winter before the sap has started and are cut into planks about 8 feet long, $4\frac{1}{2}$ inches wide and $1\frac{1}{2}$ inches thick. Knots are carefully avoided and the planks are so cut that the grain of the wood will run obliquely downward from front to rear of the ski, as is indicated in Fig. 2. The planks are seasoned in the air for one year. The skis are then cut out with the aid of models and the bottom is planed to perfect smoothness. The desired curvature is usually obtained by soaking the ski in water and bending it with the hands or by pressing it in a mold. Dr. Pauleke advises the mountaineer to support the ski, in an oblique and inverted position, with its front end over a charcoal fire. A wet cloth is placed on the part to be bent, and the point of the ski is drawn downward by means of a cord until the desired curvature is obtained. The

cord is then fastened to a fixed object, the wet cloth is removed and the ski is allowed to dry over the fire. Fig. 3 shows how simply this operation can be performed with the aid of an ordinary sledge. The curvature of the after part of the ski is produced by a similar method.

At the normal military school at Briançon, in the Hautes Alpes, the wet planks are clamped between forms (Fig. 4) and are thus dried in a warm, well ventilated room or in a moderately heated oven. This process is expeditious, but is apt to cause brittleness.

In the Hagen ski factory which turns out 100 skis per day the ash planks, which have been kept one year in the storehouse, are soaked ten minutes in boiling water. This treatment makes the wood so pliable that it can be bent by hand on a form. The ski is allowed to dry in the air during two weeks, after which the final curvature is given to it by hand.

The desired curvature having been produced by any of these methods, the longitudinal groove and the transverse mortise are cut, and the ski is polished and varnished.

The problem of attaching the ski to the foot is much discussed and many different methods are employed. The attachment should be strong and simple and should assure easy and perfect control of the ski, without unduly restraining the freedom of the foot. Above all, it must be easy to adjust even with fingers stiffened by cold. It is also desirable to be able to disengage the foot quickly in emergencies to prevent breaking the ski or the leg.

One of the best and most generally employed devices is the Hintfeld attachment by means of iron lugs and a number of straps passing over the toe and around the sole and heel of the shoe, in a manner which will be made more intelligible by a glance at Fig. 5 than by any verbal description. The horizontal strap is provided with a lever buckle *B*, the operation of which is illustrated by Fig. 6. This buckle can be instantly unfastened and the foot can then be drawn out of the harness, which remains attached to the ski.

Persons who are not familiar with skis imagine that they are employed only for coasting, and that walking on a level is very difficult and ascending a slope quite impossible with such footgear. As a matter of fact Mont Blanc and many other lofty peaks have been scaled by ski runners. If the snow is in good condition a grade of 30 degrees can be ascended as rapidly on skis in winter as without them in summer, and in a long climb an average ascent of 1,000 or 1,200 feet per hour can be accomplished. On level ground five miles can easily be covered in an hour. In 1884 the Laplander Luorda traveled 136½ miles on skis in 21 hours and 22 minutes.

The ski runner, however, finds his greatest delight in coasting down a long steep slope. The joy of gliding as swiftly as a swallow, with every sense quickened to discover and avoid obstacles, cannot be imagined by one who has not experienced it.

This marvelous sport is becoming more and more popular in the French mountain country, although it is of very recent introduction. In Norway, skis have been employed in military operations since the year 1200, but it was not until the winter of 1901-1902 that the first experiments with skis were made by the French army. The employment of skis by both soldiers and civilians has increased rapidly since the opening of the Briançon Normal School in 1903 and the international ski contest on Mont Genevre in 1907.

Fig. 1. A Ski, in Plan, Elevation, and Cross-Section.

Fig. 5.—Hintfeld System of Attaching the Ski to the Foot.

Fig. 6.—The Lever Buckle, Open and Shut.

Fig. 4.—Shaping a Ski by Clamped Forms.