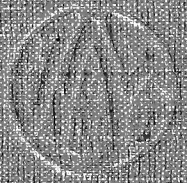
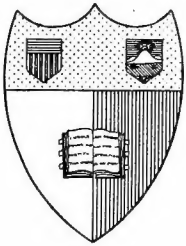
FARMERS' CYCLOPEDIA BOOK

DR. CHARLES E. ADRIANCE





FARMERS'
CLEAN MILK BOOK

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CLEAN MILK BOOK

BY

CHARLES EDWARD NORTH, M.D.

Director, North Public Health Bureau, New York City
Secretary, Commission on Milk Standards of the New York Milk Committee
Chairman, Mayor's Committee on Milk, City of New York, 1917

FIRST EDITION

NEW YORK
JOHN WILEY & SONS, INC.
LONDON: CHAPMAN & HALL, LIMITED
1918

PREFACE

THIS book shows why some milk contains millions of bacteria and how they get into it, and how easy it is to keep them out. It shows that the millionaire with his fancy barn has no monopoly on cleanliness, but that any farmer can produce milk which is just as clean as certified milk. It shows that the man himself is far more important than the dairy score card, and that hundreds of farmers in many dairy districts are now making a business success of producing clean milk.

I desire to make acknowledgment to the Clover Farms Company, New York City; The City Dairy Company, Baltimore, Md.; Abbott's Alderney Dairies, Philadelphia, Pa.; D. Whiting & Sons, Boston, Mass.; Tait Bros., Springfield, Mass.; The Rockdale Company, Rockdale, N. Y.; Borden's Farm Products Co., Inc., New York City; for many of the photographs and tabulations of bacterial tests which they have courteously permitted me to use in this book.

CONTENTS

CHAPTER I

THE MILK FACTORY

CHAPTER II

SELLING MILK

CHAPTER III

BACTERIA

CHAPTER IV

THE BACTERIAL TEST

CHAPTER V

MILK IN THE UDDER

CHAPTER VI

THE COW STABLE

CHAPTER VII

EQUIPMENT

CHAPTER VIII

CLEAN MILKING

CHAPTER IX

COOLING

CHAPTER X

STERILIZING

CHAPTER XI

RESULTS

CHAPTER XII

THE DAIRYMAN MORE IMPORTANT THAN THE DAIRY

CHAPTER XIII

THE DAIRY INSPECTOR

CHAPTER XIV

MILK TRADITIONS

Farmers' Clean Milk Book

CHAPTER I

THE MILK FACTORY

TRANSFORMING FARM PRODUCE INTO MILK

THE dairyman transforms farm produce into milk. Farm produce is raw material. The dairy barn is the milk factory. Dairy cows are machines. Milk is the finished product. Tons of corn, tons of hay, and tons of grain are transformed by dairy cows into pounds of milk.

The dairyman's raw material consists of farm produce and grain. The grain he can buy. The number of tons of farm produce and the kind of farm produce depends upon the land and the working of it.

The number of dairy cows the dairyman needs depends upon the number of tons of raw material to be transformed. Each stall in his dairy barn should have in it a first class machine capable

of producing the maximum quantity and quality of milk from a given amount of feed. The dairy barn is the dairyman's milk factory, and like the mill owner, he brings his raw material in one door and after passing it through the factory, takes his finished product out of another door.

LARGER DAIRIES

Volume of business and expense decide profit or loss. (Volume means quantity.) Dairy expenses must be borne by every quart of milk. A dairy producing only 10 quarts of milk makes each quart bear $\frac{1}{10}$ of the entire cost of operating the dairy. A dairy producing 200 quarts of milk makes each quart bear only $\frac{1}{200}$th of the entire cost of operation. The expense of operating a 200-quart dairy is not 20 times as great as the expense of operating a 10-quart dairy. The division of expenses among 200 quarts makes each quart carry a much smaller tax than where expenses are divided among only 10 quarts. A sufficient volume of milk is necessary to pay the cost of good dairy operations. Small business means loss, while large business means profit. Fifty acres of cultivated land supporting 15

milking cows producing at least 100 quarts of milk daily means a volume of business which may just pay expenses. A smaller business than this may mean a loss, unless dairying is incidental to other kinds of farming.

The advantage of the big dairy as compared with the small dairy is shown by the following table, which gives the cost of producing milk on 85 Connecticut farms arranged in groups according to the number of cows in the dairy herd.

EIGHTY-FIVE HERDS IN CONNECTICUT

(OF COWS AVERAGING OVER 6000 POUNDS EACH PER YEAR)

Number of Herds.	Cows in Herd.	Cost of Producing Milk per Quart. Cents.
13	7–10	5.92
45	10–20	5.45
21	20–30	4.97
6	30–40	4.65

From the above table it is clear that if farmers were receiving 5 cents a quart for milk, those dairymen with herds containing less than 20 cows would be losing money, while dairymen with herds containing more than 20 cows would make money.

The largest herds produced milk 1⅓ cents per quart cheaper than the smaller herds even though both herds contained the same kinds of cows.

BANKS BUY COWS FOR FARMERS

Many dairy barns contained empty stanchions. Farmers with land and buildings big enough to accommodate more cows often do not keep more cows because they cannot afford to buy them. In many states bankers have made arrangements to buy cows for such dairy farmers, taking notes, and payment for the same from the milk these cows produce. This is excellent business for the banks, because an increase in the cow population means increased bank deposits. It is good business for the farmer, because he immediately has a full-sized dairy herd which in a short time pays for itself out of the milk the cows produce.

The Plymouth County Trust Company, of Brockton, Mass., has during the past year and a half purchased thirteen car loads of cows, averaging twenty-five head to a car, for dairymen of that district. Numerous other banks in other states are doing the same thing.

LARGER PRODUCING COWS

Each stanchion should contain a cow which is a large producer of milk. Each cow must consume feed for her own use before she can use feed to produce milk. After she eats enough to maintain her body all extra feed goes into milk. For this reason the large-producing cow produces milk much cheaper than the small-producing cow.

Figures compiled by Professor Lockwood of Massachusetts Agricultural College from Massachusetts cows are as follows:

Production per Cow per Year.	Cost per Quart.
Less than 5500 lbs. . .	.0721
5501 to 7500 lbs.	.0624
Over 7500 lbs.	.0552

Professor White of Connecticut Agricultural College has compiled similar figures from dairy farms in Connecticut.

Production per Cow per Year.	Cost per Quart.
Under 4500 lbs.	.0702
4500 to 5500 lbs.	.0582
5500 to 6500 lbs.	.0560
6500 to 7500 lbs.	.0548
Over 7500 lbs.	.0474

The average cow producing milk for the New York City market produces between 4500 and 5000 pounds per year, which costs about 7 cents per quart. If produced by 6500-pound cows, this same milk would cost about $1\frac{1}{2}$ cents less per quart.

CHAPTER II

SELLING MILK

MEASURING MILK

THE laws of most states and cities describe milk as fluid drawn from the udders of dairy cows, to which nothing has been added, and from which nothing has been taken away, and which contains not less than 11.5 to 12 per cent solids, and not less than 3 to 3.5 per cent butter fat.

Milk must be measured either by volume or by weight. If by volume, the common measurement is the number of quarts or cans. This method of measuring milk is unfair, both to the dairyman and to the milk dealer, because it is inaccurate. Battered or dented cans and cans not full make correct measurement of milk by volume impossible.

The dairyman delivering milk in cans that are badly dented is cheating the milk dealer, and unfair to the dairyman equipped with good cans.

Measurement by weight by the use of a weigh can and scales is the only fair method of measuring milk. By the scales all milk delivered can be accurately weighed at once. All modern shipping stations are being equipped with weigh cans and scales for weighing all milk from each dairy farmer as it is received.

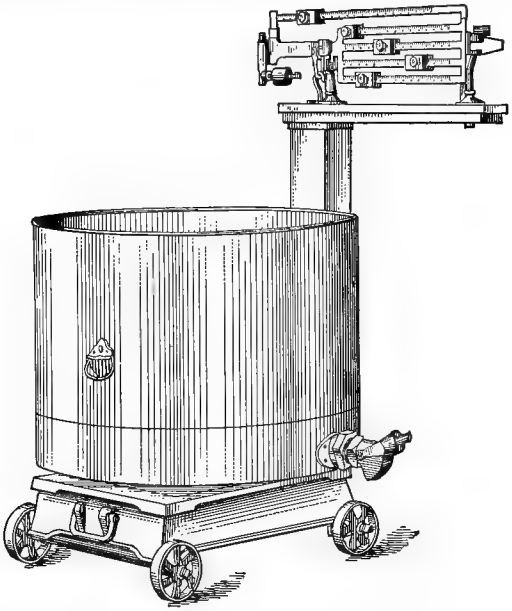
BATTERED MILK CAN

This can was built to hold 40 quarts of milk. Due to the dents it holds only 37½ quarts. A battered can is not a fair way to measure milk.

WEIGH CAN AND SCALES

All of the milk received from the farmer can be poured into the weigh can and correctly weighed by the scales. This is the only fair method of

measuring milk, both for the farmer and for the dealer, because it is the only accurate method.



SELLING BUTTER FAT

The dairy farmer whose cows produce rich milk expects to receive more money than the dairy farmer whose cows produce poor milk. Butter fat has its own price. If the legal standard is 3 per cent, and a dairy produces milk con-

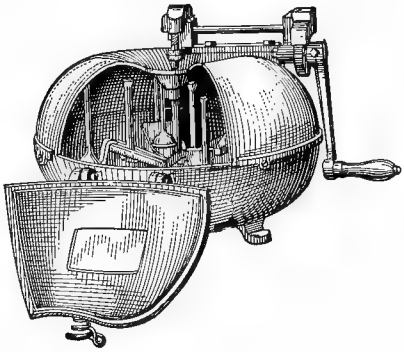
taining 4 per cent butter fat, the dairyman expects to receive the full market price for milk and a premium or extra price for butter fat equal to the value of the 1 per cent excess which his milk contains.

Butter fat is measured best by the Babcock test. Sulphuric acid added to milk makes the separation of butter fat easy when the mixture is whirled in a centrifugal machine. The separated fat appears as yellow oil in the neck of the glass bottle and the quantity can be easily read from graduated marks on the neck.

Fat tests may be made weekly or monthly. Disputes often occur between farmers and dealers regarding the fat tests. Changing cows changes the amount of fat in the mixed milk of the dairy. Removing cream from the top of the can for the house makes a big difference in the fat test of the the milk on that day. Where the farmer is honest, and the dealer is honest, disputes can always be settled by having the fat test made in the presence of both parties.

BABCOCK FAT TESTER

By this machine mixed milk or each cow's milk can be separately tested for fat.



BABCOCK TEST BOTTLE

The fat rises in the neck of this bottle as yellow oil, and the amount can be determined by reading from the marks on the neck the space which the fat occupies.

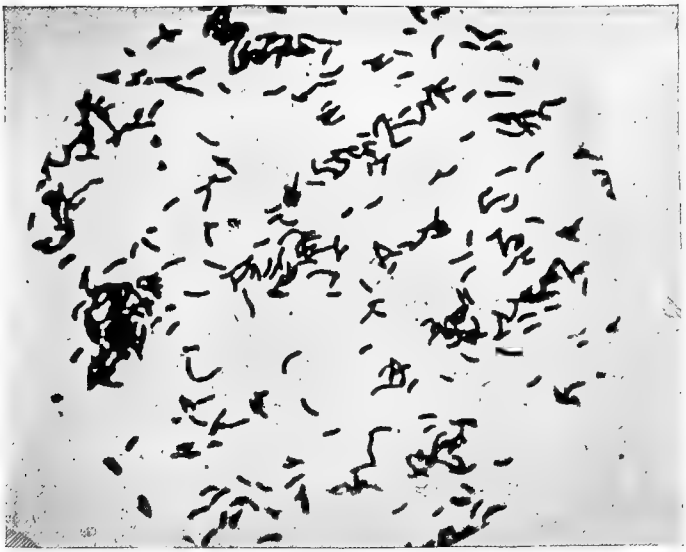
SELLING CLEANLINESS

This is something new. Cleanliness is something many dairymen have always possessed, but have heretofore been unable to sell. Milk buyers have not drawn any line between clean

milk and unclean milk, because they did not know how. Some milk drinkers prefer to drink clean milk. Cleanliness, therefore, has a market value. There would be a market for clean milk if it could be identified from the other kind.

Cleanliness costs money. It costs money to keep dairy utensils smooth and in good repair. It costs money to wash and sterilize. It costs money to brush and wash cows, and clean stables, and to wash milkers' hands. It costs money to milk carefully, and to cool milk.

At last a way has been found to measure cleanliness. This measurement consists of testing milk for bacteria.



CHOLERA BACILLI

These are small rods slightly curved. Each of these small rods is an individual germ. There are many other kinds of bacteria which look like these in shape, but which are entirely harmless.

CHAPTER III

BACTERIA

WHAT THEY ARE

THEY are vegetables. They are the smallest of all plants. Twenty-five thousand bacteria end to end would cover a distance of 1 inch. They are so small that it takes a powerful magnifying glass to see them. They have no roots and no leaves. Some of them are shaped like cucumbers, and others like oranges.

Most large plants, such as trees and corn and wheat, are harmless. A few are poisonous, such as poison ivy, mushrooms and sumach. Among bacteria there are hundreds of kinds entirely harmless, but a few are poisonous, such as typhoid, tuberculosis, sore throat and diphtheria. The poisonous bacteria have learned to grow in the warm and moist climate of human and animal bodies. There they make poisons which cause diseases known by their names.

WHERE THEY LIVE

Most bacteria grow out of doors on anything that is moist and that contains food, either animal or vegetable. All decay is the result of the growth of bacteria and moulds. Bacteria reduce all living things to the simple earthly elements of which they were formed.

Great numbers of bacteria are attached to all particles of decaying matter. Each speck of dust blown by the air is a tiny airship carrying a crew of living bacteria. Cow-feed and bedding are coated with bacteria which feed upon them. They follow feed into the intestines of the dairy cows and grow inside the cow in great numbers. The discharges from the intestines of dairy cows are filled with uncounted millions of bacteria. The dust of manure, the floor of the cow stable, and the manure on the flanks of dairy cows are loaded with intestinal bacteria.

Old milk inside of milk pails, milk cans, or on milk utensils, is the dwelling-place of enormous numbers of bacteria waiting to contaminate and injure any clean milk that may touch them.

HOW THEY GROW

Warm milk is one of the best places in the world to grow bacteria. It is so nourishing and digestible that nearly all kinds of bacteria find milk exactly suited to their taste. When particles of dust fall into milk, the crew of bacteria which they carry begin to multiply rapidly. Some feed on the sugar in milk and change it into acid, and this acid causes the milk to become sour. Others feed on curds and give milk a bad odor or make it decay.

Cold weather stops growth of plants. Cold stops the growth of bacteria. Where it is as cold as ice or ice-water, bacteria grow scarcely at all. Warm weather with a temperature of blood-heat makes bacteria grow most rapidly.

One germ will swell up, break in half, and in twenty-four hours double 48 times. If not interfered with, this means in forty-eight hours one germ would multiply itself to 281,474,976,710,656.

DISEASE FROM MILK

1. *Typhoid Fever* has destroyed the business of many dairy farmers. Typhoid in the farmer's family or in hired help sometimes gets into the

milk. The germs always escape from the sick person in the bowel discharges or in the urine. They may be carried by drainage into well-water and by the water into pails, cans, and strainers, or they may be carried by flies. Big epidemics of typhoid fever in cities have often been traced to milk from dairy farms where persons were sick with typhoid.

2. *Sore Throat and Scarlet Fever.* People used to think sore throat and scarlet fever were diseases sent by Providence to punish mankind. Now we know that they often are caused by bacteria in milk. Sore throat bacteria look like a chain of beads, and for this reason are named, "streptococcus," which is the Greek word for chain of beads. Sore udders of cows nearly always discharge bacteria like this in great numbers. Every epidemic of sore throat and scarlet fever which has ever been traced to its source has been found to have been caused by milk containing such germs. Sore throats in dairy employees or sore udders in dairy cows may cause big epidemics of sore throat among the persons to whom the milk is sold.

3. *Tuberculosis.* The examination in hospitals of many hundreds of tuberculous children shows

that 25 per cent are infected by the tuberculosis bacteria of cows. This means that cows carry these germs to children. Tuberculosis is common in cows. When the disease reaches the udder, the bacteria are discharged into the milk. A tuberculous cow also discharges large numbers of these bacteria from her bowels. Manure from tuberculous cows is dangerous and its dust spreads the disease.

4. *Diphtheria.* The bacteria of diphtheria grow well in milk. Diphtheria in the throats of the hired help on the dairy farm may get into milk through coughing or sneezing or from the milker's fingers. Many epidemics of diphtheria among milk drinkers have been caused in this way.

When dairy cows are diseased or when there is disease in the farmer's family or among the hired help, the whole business of a dairy farmer may be destroyed by the health authorities. Every dairyman must protect his business by quickly reporting disease when it occurs, so that the authorities can help him protect milk consumers and also save his business.

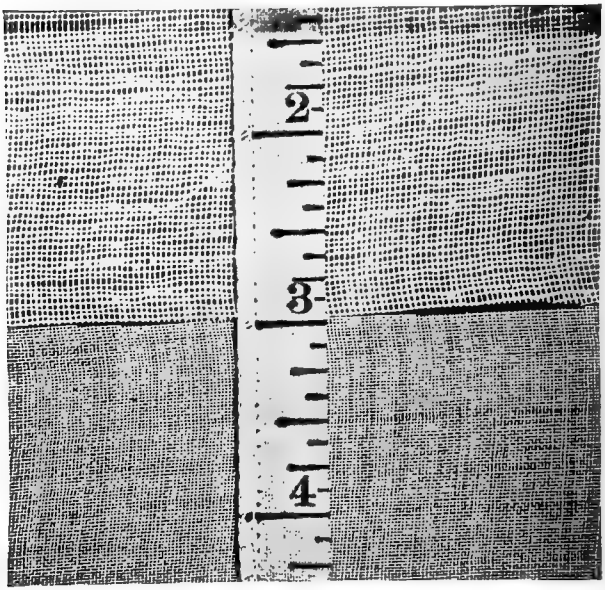
BACTERIA CANNOT BE FILTERED OUT

Dirt and bacteria travel together. Because the strainer removes dirt, some think it removes bacteria. The fact is that the finest strainer used by dairymen removes only the very coarse dirt, and leaves still in the milk all of the fine dirt. Bacteria are much smaller than even the finest dirt, and easily pass through the strainer with the milk.

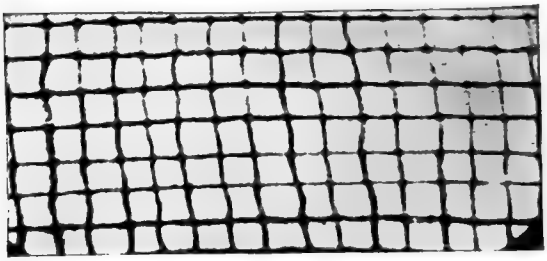
The cheese cloth or wire commonly used for straining is 32 meshes to the inch. The finest cheese cloth that can be purchased has 64 meshes to the inch. Under a magnifying glass the meshes of fine cheese cloth appear very large. Since it takes 25,000 bacteria to cover 1 inch in length, 400 bacteria could be placed in a row in the space between two threads of the finest cheese cloth, and through one of the square openings of such a cloth a regiment of 160,000 bacteria could march abreast.

Bacteria are much smaller than the drops of butter fat in milk, therefore a strainer fine enough to remove bacteria would also remove all of the butter fat, and allow only skim-milk to pass through.

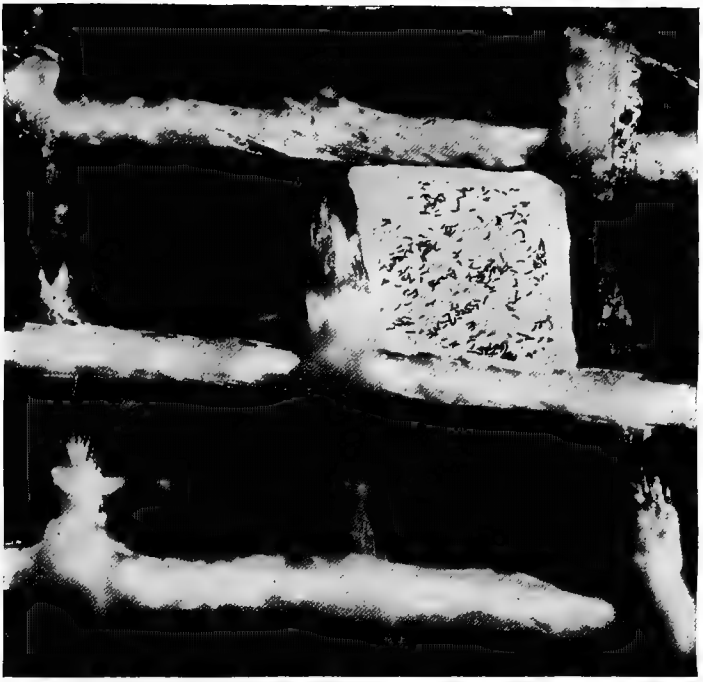
CHEESE CLOTH 32 MESHES TO THE INCH
(Upper half)



CHEESE CLOTH 64 MESHES TO THE INCH
(Lower half)



CHEESE CLOTH 64 MESHES TO THE INCH MAGNIFIED TEN TIMES



CHEESE CLOTH 64 MESHES TO THE INCH MAGNIFIED SEVENTY-FIVE TIMES

In this picture in the upper right hand corner are the same bacteria shown on the previous page. They are five times as large as they ought to be in correct proportion to the size of the meshes of the cheese cloth. Between the two threads, 400 of these bacteria could be arranged

in line, and a regiment of 160,000 of these germs could be pushed through one of the squares abreast. This shows clearly how the finest cheese cloth cannot possibly filter bacteria out of milk.

Dirty milk may look clean because it has been strained, but the large numbers of bacteria which pass through the filter will show by their presence that the milk was unclean.

The cleanliness of milk cannot be measured by the so-called "dirt test," which uses a strainer because milk may have been previously strained.

The test for bacteria is therefore the best possible way to measure the cleanliness of milk.

CHAPTER IV

THE BACTERIAL TEST

THE LABORATORY

TESTING milk for bacteria does not require the services of a college professor nor a laboratory equipped with expensive apparatus.

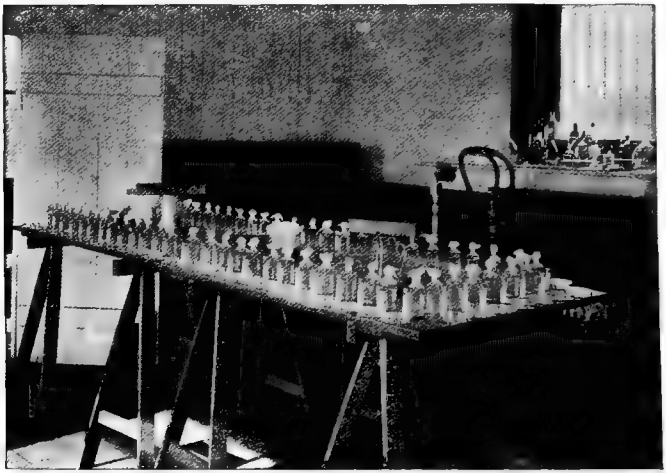
Any boy or girl with a high school education can learn how to make tests of milk for the numbers of bacteria by the "plate method" after six weeks' training. The laboratory operations are simple and very easy to understand. Accuracy and speed are necessary to make such tests available for the milk industry and for health authorities.

When such testing was done only in expensive laboratories by college professors the cost was too great to make such testing available for milk dealers and dairy farmers and the health authorities of small cities.

But at the present time bacterial tests of milk can be made by every milk dealer and by every

country village and town, because methods have been made so simple and have been so standardized that the work can be performed by any intelligent person after a few weeks' training.

The cost of the laboratory apparatus sufficient to test for bacteria 100 samples of milk daily need not be more than $250.



THE BACTERIAL TESTING LABORATORY

The laboratory equipment can be simple and cheap. It is mostly glassware. By properly arranging the work, a large number of samples can be tested at one time.

HOW THE BACTERIAL TEST IS MADE

Milk which is clean and fresh contains very small numbers of bacteria. Milk which is dirty or stale contains large numbers of bacteria. The human eye cannot see a single bacterium because it is too small, any more than the human eye can see a single grain of wheat in the distance. But just as the human eye can easily see a whole field of wheat growing, in like manner it is easy to see bacteria when they grow in large masses. One bacterium will multiply into a mass in one or two days big enough to be seen with the naked eye.

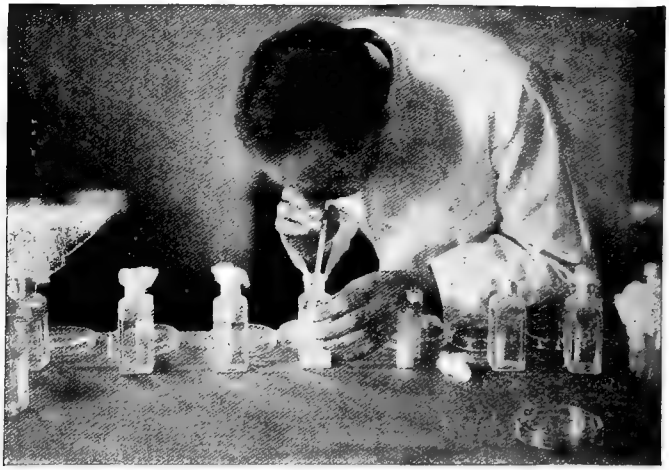
The bacterial test of milk as it is carried out in milk testing laboratories gives each of the bacteria in the milk a chance to produce its own mass of descendants, so that these masses may be separately counted.

The test is performed as follows:

(1) A sample of milk must be taken from the farmer's can into a glass bottle which contains no bacteria, because the bottle has been sterilized by baking in an oven. The milk must be transferred from the farmer's can to the sample bottle most carefully. The thumb or fingers or a dirty

dipper, or anything unsterilized which the milk touches will spoil the sample.

(2) The sample is kept ice-cold until tested, otherwise the bacteria will multiply.



DILUTING THE MILK WITH STERILE WATER

(3) In the laboratory exactly 1 cc. of milk (about a thimbleful) is drawn out of the sample with a glass tube and discharged into a bottle of sterilized water so as to make a dilution of 1 per cent. If the milk is believed to contain large numbers of bacteria, the dilution is made higher.

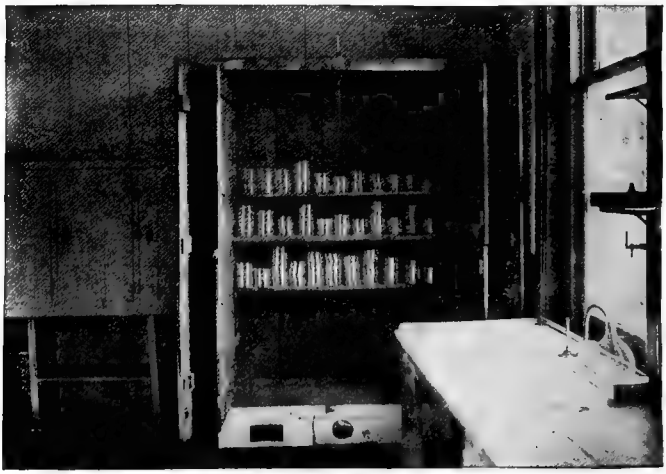
(4) Exactly 1 cc. (1 thimbleful) of this mixture of milk and water is drawn out of the dilution-bottle by another glass tube and discharged

DISCHARGING THE DILUTED MILK INTO A STERILE GLASS DISH

onto a flat glass dish having a cover. This dish has also been sterilized.

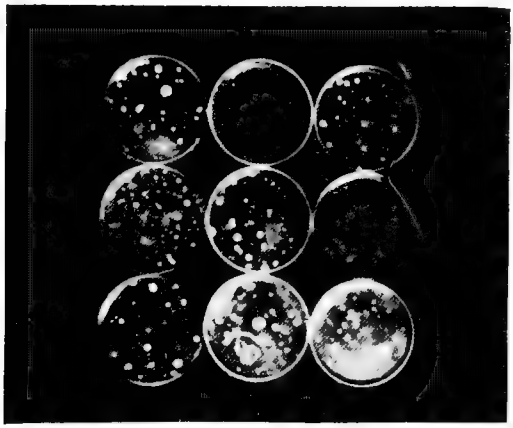
(5) Into the dish is then poured an exceedingly stiff jelly made from a Japanese sea-weed called agar. The jelly contains a little beef tea to furnish food for the bacteria. When spread out on the glass dish it hardens and all of the bacteria in the milk are glued fast.

POURING BEEF JELLY INTO GLASS DISH



GLASS DISHES IN INCUBATOR

(6) The dishes are put in an incubator where the temperature is the same as that used in hatching hens' eggs. They remain there for two days.



COLONIES OF BACTERIA

The jelly is perfectly clear at first. After two days there are developed white and gray spots on the jelly where the bacteria in the milk have grown into masses. Each germ has surrounded himself with millions of descendants, making a spot visible to the naked eye. It is easy to count these spots, and thus count the number of bacteria present in the milk sample. The

upper right-hand dish contains few spots, showing clean milk. The middle dish in the bottom row is gray with small spots like the sands on the sea-shore, showing very dirty milk.

CHAPTER V

MILK IN THE UDDER

MILK as it comes directly from healthy cows may contain no bacteria, but most cows give milk containing 200 or 300 bacteria per cc., which have found their way from outside into the ends of the teats. If handled carefully milk may pass through the dairy without the addition of bacteria. On the other hand, it may receive dirt from the cow's hide, the air of the barn, the milker's hands, the milking pail, strainer cloth, cooler, or cans, and in the end contain many millions of bacteria. In safeguarding milk from bacteria and dirt every step of the journey from the cow to the consumer must be protected by those methods which will prevent damage from outside sources.

ANIMAL MATTER IN MILK

Such protection must begin while the milk is still inside of the cow's udder. Farm produce

eaten by the dairy cow is changed in the cow's digestion into soft liquid material. This is absorbed by the circulation which carries it to the udder. The cow's udder is a large sponge filled with cavities, in the walls of which the blood tubes form a fine network. The surface of the cavities is like fine velvet made up of tiny particles of animal matter called cells. This velvet lining draws liquid nourishment from the circulation beneath, and transforms it into milk. Many of the tiny particles composing the velvet become so filled with milk material that they burst, and others are squeezed loose and fall off with the milk into the channels. The blood itself contains floating particles of solid material called white blood cells. They are round and soft like tiny drops of white jelly. These also work their way through the walls of the channels and fall into the milk. As a result, the milk which flows from the small channels of the udder into the large channels and finally reaches the teats carries with it considerable material which is shed from the lining of the udder, and which can easily be seen in milk under a magnifying glass.

The gray oval spaces in the picture are the

milk channels. They are cut across. The walls appear as white fibers. On the inside edge of the walls are numerous round balls, some white

Courtesy M. P. Ravenel.

SECTION ACROSS COW'S UDDER

and some black. These are the cells forming the velvet lining of the milk tubes. The white ones contain butter fat, and the black ones are

cells of animal matter. Some of these particles have broken off and are in the center of the milk channels, from which they will be discharged with the milk.

BACTERIA IN THE UDDER

When a cow lies down, dirt may be pushed into the ends of the teat, carrying with it bacteria. A scratch on the surface of the udder from a barbed-wire fence, or a wound from a bruise may become infected. Through such entrances, bacteria find their way into the interior of the udder and start an inflammation. It is nearly as common for a cow's udder to become inflamed as for a human being to have a cold in the head. The bacteria irritate the interior of the udder by the poisons which they produce. To offset this, the blood discharges enormous numbers of white blood cells supplied by nature to entangle the bacteria and carry them off. This white material is commonly called pus, and is often seen by the milker as thick or lumpy matter discharged with the milk. The bacteria commonly causing such udder inflammations may cause tonsilitis or septic sore throat in milk con-

sumers. The bacteria of tuberculosis may be discharged from the udder of a tuberculous cow in the same way.

The first step in clean milk production consists in regular examination of cows' udders to see if they are free from inflammation.

Dairy farmers must reject all milk which contains lumps, or is thick, or deposits gummy material on the milk strainer.

CHAPTER VI

THE COW STABLE

SANITARY AND UNSANITARY BARNS

A DAIRY barn includes accommodations for feeding, sleeping, drinking, the disposal of waste material, and often a yard for exercise. Cows are tied up by the neck in stanchions, in some parts of the country in the cellar of the barn, in other parts of the country on the second story. In one dairy district cows may stand in short rows running crosswise of the building in the same room with horses and mules. In another dairy district the cows may stand in long rows lengthwise of the building. Barns quickly become soiled by cow-feed, cow-bedding, and cow-manure. The air may be filled with dried dust from these sources. The cow's hide often becomes coated with material from the floor. The droppings of dust from the cow's

hide and from barn air into milking pails causes serious contamination of milk with dirt and bacteria.

Well constructed and sanitary barns are desirable because they reduce stable dust. Cement floors, iron stanchions, smooth and tight ceilings and walls, abundant windows, ventilating and drainage system, feed carriers, manure carriers, beds of cork brick, all these things are aids to sanitation, but are more expensive than most farmers can afford. The beautiful barns producing certified milk are some of them cow palaces, but after all the only thing such barns can accomplish is to reduce the quantity of stable dust.

Stable dust can be reduced in any barn by any farmer by extra care. Even the commonest barn with a dirt floor and rough walls can be kept free from excessive dust by the farmer who knows how.

But stable dust is of very small importance compared with other sources of contamination of milk. The barn itself is of small importance, and stable dust is of small importance compared with the damage to milk by direct droppings from the cow's hide into the milking pail, or damages

from unclean milking pails, milk cans, strainer cloths, and other utensils.

The care exercised by the farmer and his hired help in handling milk and milk utensils is of far greater importance than the dairy barn.

CHAPTER VII

EQUIPMENT

EXPENSIVE or fancy apparatus is not necessary for producing clean milk. The rank and file of dairy farmers can do good work with simple and cheap equipment. There are three primary dairy operations for which such utensils are required; namely, for milking, for cooling, and for sterilizing.

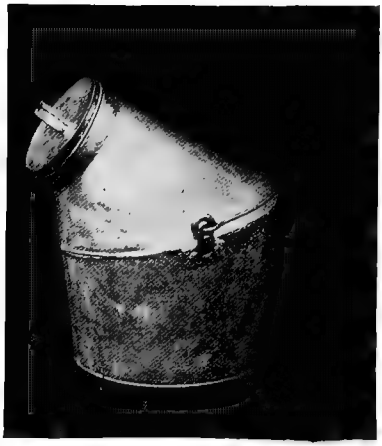
EQUIPMENT FOR MILKING

Brush and Wash Pail

Brushes such as are used on horses, and when necessary a curry comb, should be used to clean cows. Milk pails should not be used for wash pails. There should be a separate wash pail for washing cows.

Wash Cloths

Burlap makes a good wash cloth, because it is strong and coarse. Fine white cheese cloth or white towelling is best for wiping udders dry.



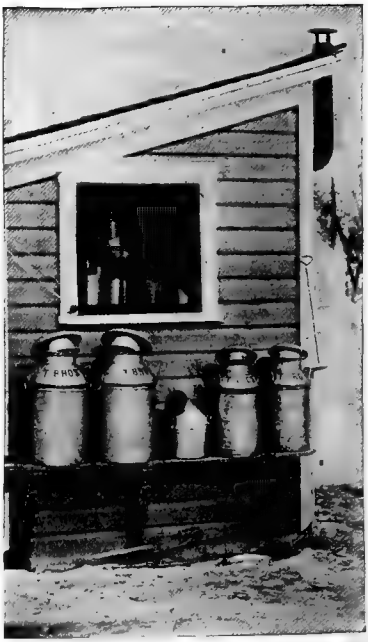
A slanting position reduces exposure to falling dust. A tin lid keeps the pail clean before it is used.

SMALL-MOUTHED MILKING PAIL

There are many types of small-mouthed pails with openings from 8 to 3 inches in diameter. A 5-inch opening is large enough for practical use by the majority of milkers.

MILK CANS WITH LIDS

There are several patterns of milk cans, such as the New England pattern, the Chicago pattern, and the New York pat-



tern. The New York can has a lid with a mushroom top. This is more sanitary than any other, because it does not collect dirt, dirty water, dirty ice, or old milk.

Strainers

The cleanest dairies use no strainers at all. The simplest and cheapest strainer is a piece of white cheese cloth which may be folded once and held in place on the mouth of the can by clothes pins, or tape, or a string, or a tin holder. A piece of white flannel or pieces of cotton may be used once and thrown away after each milking. Wire mesh strainers are much harder to keep clean than cloth, and should not be used.

SUMMARY

Cost of Milking Equipment

Brush for cows	.50
Wash pail for cows	.75
Wash cloths for cows	.05
Small-mouthed milking pail	2.00
Milk cans (each)	5.00
Strainer cloths (each)	.05
Holder for filter cloths	1.50
Total	$9.85

(The total cost will depend on the number of pails and cans used. There should be one pail for each milker, and cans sufficient for two milkings and for shipment.)

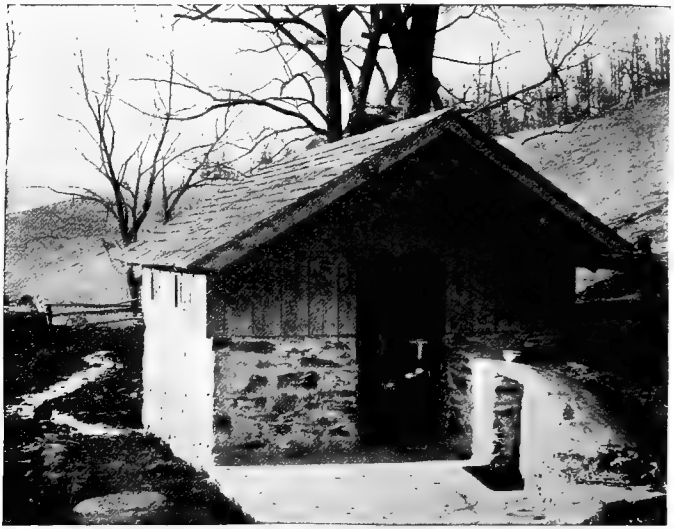
EQUIPMENT FOR COOLING

Ice Supply

The ice harvest is almost as important as the corn harvest for the dairyman.

In climates where natural ice is formed, every dairyman should have an ice house. At small expense an ice-house can be erected on any dairy farm. Often an old wagon-house or shed can be cheaply transformed by sheathing, and the use of saw dust, into an ice-house that will keep ice well. Most farm ice-houses are too small. The storage of ice in large quantities in tight, well-built houses prevents losses. The quantity of ice stored should be not less than 1 pound to each pound of milk for the period of hot weather

during which the ice must be used. An excess of 25 to 50 per cent must be added to allow for loss through melting.



Spring-water and Milk-house

Spring water should be protected from contamination. Cold running water is next best to ice-water for cooling. A well constructed milk-house, properly screened, is the safest place to keep milk.

Artesian Well and Milk-house

Where springs are not available, wells are necessary. The artesian well gives most protection to the purity of water. Water from the tank in the tower is not so cold as water pumped directly from the well into the milk-house. The milk-house can be conveniently located under the tower.

Cooling Tank

The cooling tank can be built of wood or cement or iron. They should be water-tight, and deep

enough to bring the water up around the necks of the cans, with an overflow that holds the water at the right level.

SHALLOW COOLING TANK

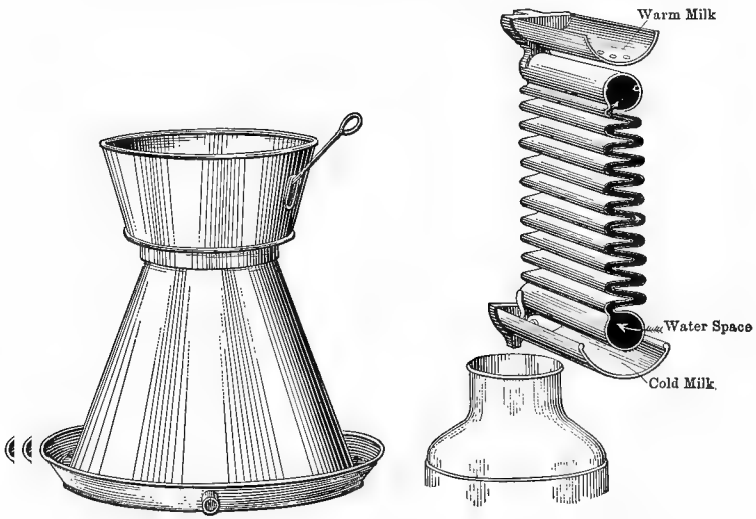
DEEPER COOLING TANK

Picture No. 1 shows a cooling tank of wood that is much too shallow. Night's milk in the upper half of the can cannot be kept cool.

Picture No. 2 shows a cooling tank of cement. Even this is not high enough to bring water around the neck of the can.

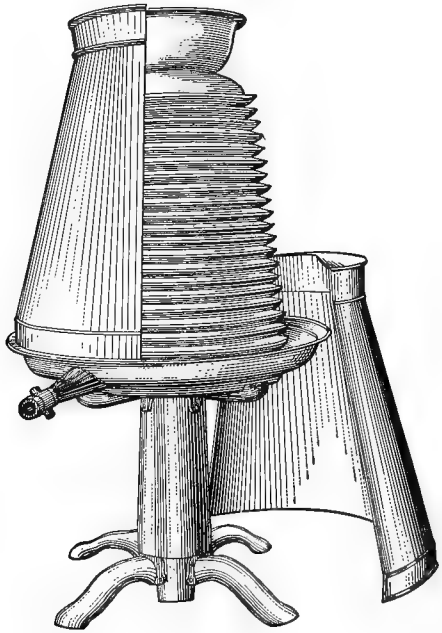
Open Coolers

The campaign for instantaneous cooling has led to the use of open coolers. All of these are



of tin, some of them conical in shape, and some corrugated, or made of horizontal pipes. They

all use cold water or ice-water on the inside, and the milk flows over the outside. Properly operated, they are very effective, especially where



large quantities of milk are to be cooled in a short time. The objection against them is that they are difficult to clean and sterilize properly. In small dairies such coolers are not so necessary as in large dairies. The small dairyman who has ice does not require an open cooler,

but can get first-class results without it. Where small dairymen have no ice and must depend only on spring water, the open cooler may be of assistance.

Stirring Rods

Where cooling water is not very cold, milk has to be stirred. This picture shows one stirring rod made out of a broom stick with a piece of board nailed across the end. This is very unsanitary, and such a rod should never be used, as it cannot be kept clean. The other rod in the picture is made of metal, covered with smooth tin. On the end of the rod is a small disc of metal. This can be washed and sterilized, and kept clean, and is a sanitary stirring rod. It must be kept in a clean place, and always scalded before using.

COST OF COOLING EQUIPMENT

Ice Supply. The cost varies according to the size of ice-house and convenience to ice-field.

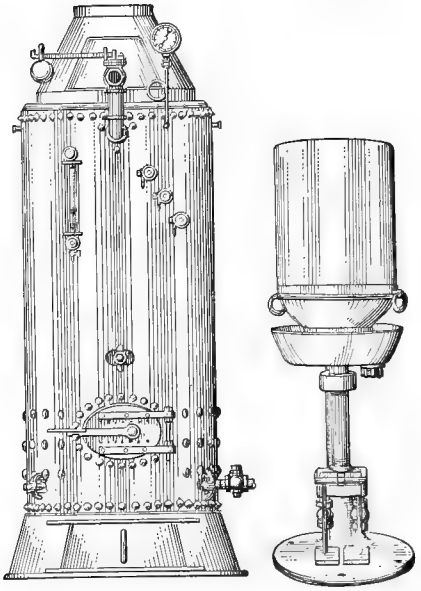
Water Supply. The water supply is necessary

for other farm purposes and therefore should not be charged entirely against the dairy.

Milk-house and Cooling Tank. A good milk-house with cement floors and cement cooling tank can be built for less than $100.00.

Stirring rod, of metal, 60 cents.

EQUIPMENT FOR STERILIZING



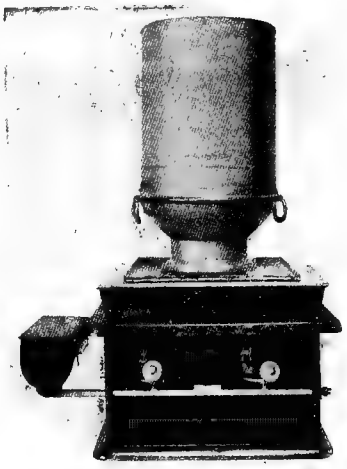
Steam Boiler and Sterilizer

In large dairies a steam boiler can be used to advantage. Steam in abundance can be used

for sterilizing, either in pressure sterilizers in which the cans, pails, and other small apparatus can be confined, or steam can be used through jets injected into cans, pails, etc. Only large dairies can afford to pay the cost of steam boilers.

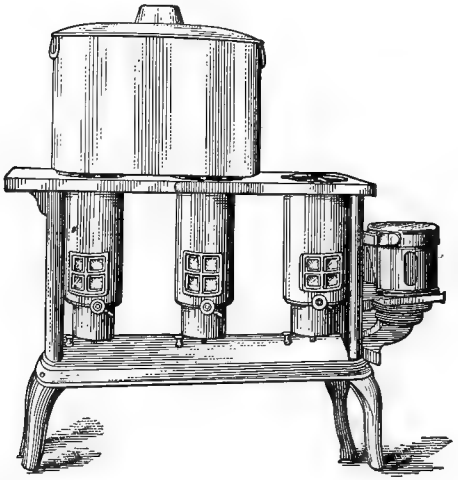
Cheapest Steam Sterilizer

The United States Department of Agriculture has designed a sterilizer consisting of a small kerosene stove upon which stands an ordinary roasting pan full of water, on top of which is placed a galvanized iron lid with a short jet which extends upward from the center. The water boiled in the roasting pan quickly creates steam, which ascends through the jet, and heats the can or pail placed upon it.



Boiling Water

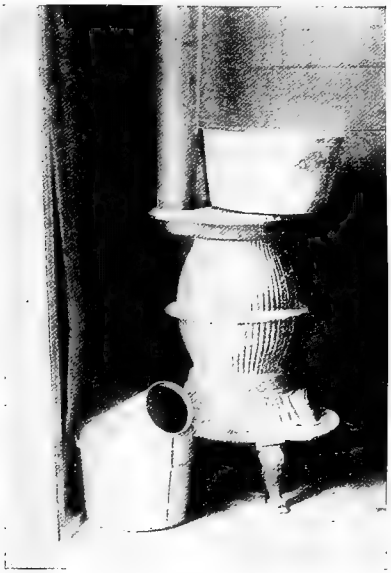
Kerosene Stove and Wash Boiler. Abundance of boiling water for sterilizing can be obtained by



the use of a kerosene stove with a large wash boiler upon it.

Hot Water Stove

Such a stove can be a small coal or wood stove. Every farm house is equipped with a kitchen



stove to which is attached a hot-water tank. The supply of hot water from such a tank is seldom sufficient. A wise dairyman will place pails or a wash boiler on top of the kitchen stove so as to insure sufficient hot water for sterilizing purposes.

Alkali Washing Powder

Washing soda or some of the alkali washing powders can be bought in packages from 1 pound to a barrel. They are far superior to soap in

removing curds and butter fat from tinware and from the meshes of a strainer. An 80-pound keg is a good size for small dairymen to buy, as the powder is much cheaper than in 1-pound packages.

Scrub Brushes

Good scrub brushes with thick stiff bristles shaped to get into the joints of cans and pails

are necessary to remove old milk or dirt sticking to the surfaces of the tin. They are much superior to any wash cloth. They can be bought at any dairy supply house. The brush with a long handle is desirable for washing milk cans.

Antiseptic for Milking Machines

The cleaning of milking machines requires not only treatment with alkali and brushes, but sterilization by antiseptic solutions. The best of these are solutions of chlorine. A number of preparations are on the market. Farmers can

make their own solutions by the use of bleaching powder. From a small quantity of powder a very large quantity of solution can be made. Such solutions should be freshly made for each milking and usually much stronger than directed on the commercial packages. They should be applied in warm water and only after all milk is removed by thorough cleaning.

COST OF EQUIPMENT FOR STERILIZING

A 20-H.P. steam boiler	$75.00
Home-made steam sterilizer (U. S. Dept. of Agriculture)	10.00
A kerosene stove with a wash boiler	10.00
Alkali washing powder in 1-lb. packages, per lb	.10
In kegs of 80 lb., per lb	.05
Scrub brushes (each)	.50
Antiseptic for milking machine in liquid form, per gallon	1.00
In powdered form, per lb. (1 lb. being sufficient to make 5 gallons of stock solution)	.10

Cold Water and Hot Water

Of all of the items in the above list of dairy equipment, there are two which stand out with such prominence that the others fade into comparative insignificance. These two things are cold water and hot water. The cold water supply for cooling, and the hot water supply for sterilizing, are by far the most important aids to the dairy farmer in producing clean milk. With an

abundance of cold water, and especially of ice-water, for cooling, and an abundance of boiling water for sterilizing, the success of the dairy farmer in producing clean milk is practically guaranteed.

On the other hand, that dairyman who is not equipped with cold water, and is not equipped with hot water, is almost certain to fail in his efforts to secure a sanitary product.

Cold water and hot water are the biggest things in the clean milk business.

CHAPTER VIII

CLEAN MILKING

THE equipment, after all, amounts to nothing if the dairyman by his own actions is unclean. What counts far more than equipment is the methods which the dairyman himself carries out at milking time and afterwards to prevent the contamination of milk with dirt and bacteria. His equipment may be good, but he may use it badly. On the other hand, his equipment may may be bad, but he may use it so well that he gets good results. There are several steps in the operation of drawing milk from the cow and taking care of it.

In a healthy udder, milk is safe from outside dirt and dust and bacteria. The clean dairyman must know how to transfer milk from the udder of a cow into a pail without damage to the milk. Clean milking includes the following steps:

STEP NO. 1. BRUSHING COWS

Cows fresh from a clean pasture may not need to be cleaned at all. If cleaning is necessary,

an old broom can be used to sweep coarse dirt from a cow's flanks. A curry-comb and brush will make cow's hair as shiny as a horse's. A piece of burlap, dry or slightly moist, may be used to clean the cow's sides and flanks.

STEP NO. 2. CLEANING UDDERS

The udder should be first brushed with a dry brush, then it should be washed with clean water

and dried with a clean cloth. Dirty water and a dirty cloth injure the udder and transfer dirt from cow to cow. Water and cloths must be changed often in washing udders in a large herd. Udders must be wiped dry.

STEP NO. 3. WASHING HANDS

Milk at times trickles over the fingers of even the best milkers. Milkers' hands must be carefully washed in soap and water and dried on a clean

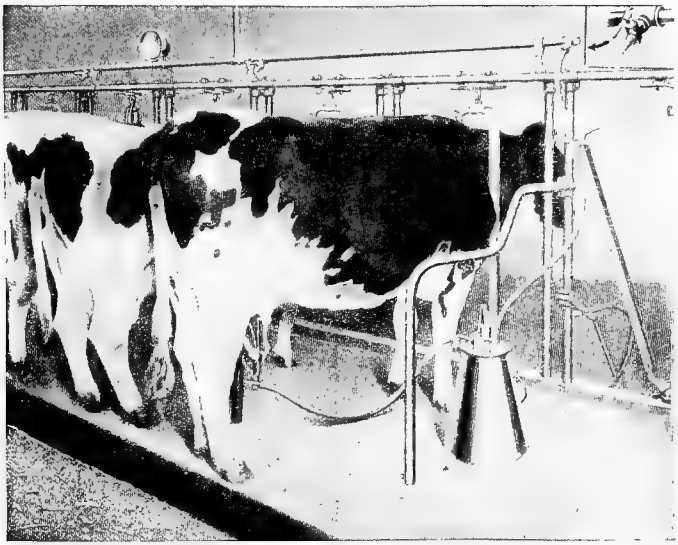
towel before milking. If moistened with milk, the hands should be again washed and dried. A dairy barn should be supplied with towels, soap, and water, so that milkers can easily wash their hands.

STEP NO. 4. MILKING INTO COVERED PAIL

Very clean cows in a very clean barn may be milked into open pails, or into closed pails, with

little difference in the contamination of milk by dust. But most barns are dusty. Nine-tenths of this dust can be kept out of the milk pail by a cover or hood which has an opening only large enough for convenient milking. Many farmers easily milk through a five-inch opening. Thousands of dairymen now use covered milking pails. Some hired men object to using covered pails, but a short trial always convinces them that their

objections are imaginary. Dairies where covered pails are used produce much cleaner milk than dairies using old-fashioned wide-mouthed pails.



STEP NO. 4a. MILKING BY MACHINE

Milk drawn from dairy cows through the tubes of a good milking machine is entirely protected against damage from the dirt of the cow, or the milker, or the stable.

The objection to the machine is that if it is not carefully cleaned and sterilized, it causes

immense damage to milk from the bacteria which grow in the old milk remaining in the machine. It is a serious business to clean a milking machine properly. It must be taken entirely apart twice daily, brushed with soda solution and sterilized with one of the chlorine sterilizing liquids. For a large herd, the machine is a much greater economy than for a small herd. Dairymen with small herds make better milk with covered pails and hand milking.

STEP NO. 5. STRAINING MILK

Clean milk needs no straining. Clean milk leaves no dirt on the strainer cloth. The cleanest dairymen use no strainers. Clean dairymen believe that strainers are needed only for dirty milk.

In dairies where strainers are necessary, the best strainer to use is a piece of white cheese cloth. New pieces of flannel or cotton which can be used once and then thrown away also may be accepted as good strainers. They save washing, but cost more.

CHAPTER IX

COOLING

ALL the dairyman's labor in raising farm produce, in raising cattle, in caring for and feeding dairy cows, in careful milking, goes for nothing if he allows the finished product for which he is to get cash to spoil through lack of proper cooling. Imperfect cooling means loss of quality through multiplication of bacteria. It may also mean entire loss of the product through spoilage. The best results are always secured through the use of ice.

GROWTH OF BACTERIA AT DIFFERENT TEMPERATURES

Night's milk kept below 50° shows practically no change the following morning. The growth of bacteria in milk at different temperatures during twenty-four hours is shown in the tabulation below.

BACTERIA PER CC.

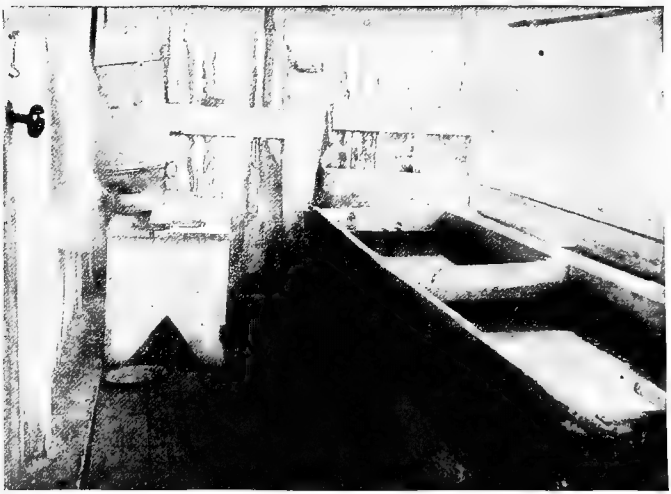
As Received	Cooled by	Tem.	12 Hrs.	15 Hrs.	18 Hrs.	21 Hrs.	24 Hrs.
4000	Ice water.....	38°	2,500	3,100	4,800	8,300	8,500
4000	Next to ice....	40	2,600	2,500	3,500	8,000	16,000
4000	Near ice.....	45	3,000	3,200	8,000	15,000	25,000
4000	In ice box.....	50	11,000	13,000	15,000	24,000	44,000
4000	Next to ice box.	55	18,000	18,000	24,000	70,000	73,000
4000	Running water	60	24,000	80,000	120,000	304,000	260,000
4000	Room temp...	65	330,000	1,400,000	5,000,000	15,000,000	40,000,000

(Note the big changes occur above 50° F.)

TANKS OF ICE WATER

Tanks of ice-water are the simplest and most effective form of farm cooling. They are built of cement or iron or wood. They should be deep enough to bring water up to the neck of

milk cans, and have an overflow at this level. They should also have a deep outlet, so that all the water can be drawn out and the tank cleansed. Galvanized iron tanks can be bought cheaply ready made for this purpose. One large cake of ice a day is usually sufficient for the average dairyman. In such tanks as this the bacteria in the night's milk will be no more numerous than the bacteria in morning's milk when delivered next morning.



TANKS OF RUNNING WATER

Some farm wells contain water as cold as 42°. Spring-water is likely to be warmer than well-

water. Farm springs may have temperatures in the summer time from 50° to 60°. Where water runs by gravity or through the operation of a pump, the temperature of the milk in such tanks can be kept as low as the lowest temperature of the water, and milk can be cooled without stirring.

TANKS OF STILL WATER

Where dairies have no running water and no ice, and must depend upon tanks which have been filled from a pump or a well, the best results can be secured by stirring the milk. Such stirring will bring milk to the temperature of the water in about half the time required to reach such a temperature if unstirred. Under these conditions, the stirring of night's milk is particularly necessary in summer time. Stirring rods should be of smooth metal and not of wood.

MORNING'S MILK AND NIGHT'S MILK

When the dairyman delivers milk for shipment once a day, and the time selected is the morning, morning's milk is twelve hours newer than night's milk. The cooling of night's milk is then far more important than the cooling of morning's

milk. Morning's milk can be delivered to a nearby shipping station within two or three hours ride of the dairy in good condition, even without any cooling at all, provided it is to be cooled at the shipping station. Night's milk, however, must be cooled on the farm if it is to be delivered in good condition.

IN WARM CLIMATES

Where there is no ice, and spring-water and well-water are not cool enough, dairymen have to deliver milk to the market twice daily. In many southern cities dairymen must make a morning delivery and an afternoon delivery of fresh milk to milk stations in towns and cities where it can be immediately retailed or properly cooled.

CHAPTER X

STERILIZING

THE most important sanitary process on the dairy farm is sterilizing. Milk utensils are commonly soiled with old milk or dirty water in which bacteria multiply enormously. Every surface milk touches when it leaves the dairy cow adds bacteria to it, if such surface is unsterilized. Pails, cans, coolers, tanks, vats, stirring rods, add enormous numbers of bacteria to milk if they have been soiled with milk left over from previous milking.

The strainer of wire or of cloth is without doubt the most dangerous weapon in the entire dairy industry, and responsible for more bacteria in milk than any other one thing.

The washing and sterilizing process consists of several important operations.

COLD WATER RINSE

Immediately after use a cold-water rinse should be applied to all utensils touched by milk, as

fresh milk is for the most part readily washed away by cold water. On no account should hot water be used at this stage, as it makes milk stick fast.

BRUSHING WITH ALKALI POWDER

The acid of sour milk is neutralized by the alkali in washing powder. The butter fat is changed into soap by alkali powder. For this reason, a washing powder containing soda removes dried curds and grease. Washing powder should be used in luke-warm water, and applied with a brush to cans, pails, tanks, and vats.

THE CLEAN RINSE

A most important operation is the clean rinse. This means the use of clean cold water or clean warm water to wash away all traces of soda or alkali powder after brushing. It should be used in abundance enough to give a thorough rinse.

STERILIZING BY STEAM

The purpose of sterilizing is to kill bacteria. Some bacteria are so tough that they are not killed by heat lower than the heat of boiling water. The most perfect sterilizing is done by steam in a metal sterilizer under several pounds pressure. Such sterilizers are beyond the reach of the average dairyman. A jet of steam will do good sterilizing if a can or pail is kept over it long enough, but a momentary application does not sterilize it.

STERILIZING BY BOILING WATER

Boiling water is the most important of all of the things the dairy farmer possesses. Boiling water in abundance will do more to make a success of the clean milk business than any other one thing. Most dairy farmers do not have enough boiling water.

Each milk can requires at least half a pailful of clean boiling water to properly sterilize its interior surface.

Pouring boiling water from can to can is ineffective. Each can and pail should have its own separate dose of fresh boiling water.

While milk cans for an entire day's milking may be washed and sterilized in the morning, milking pails must be washed and sterilized twice daily. After the night's milking such sterilization is just as important as after the morning's milking, yet many dairymen neglect to provide boiling water in the evening, and often fail to sterilize milking pails after night's milking.

It is a common thing for the fire in the kitchen stove of the farm house to go out in the afternoon, especially in the summer time. This commonly leads to neglect of sterilizing operations after the night's milking, so that pails and strainer cloths

are simply rinsed in cold water. This does not remove all of the milk on their surfaces and results in a growth of bacteria over night which often seriously contaminates the next morning's milk.

STERILIZING THE STRAINER

More good milk is spoiled by a bad strainer than in any other way.

The cleanest milk needs no straining at all. A strainer because of its mesh is far more dangerous than any other article of dairy equipment. The mesh catches dirt and bacteria.

A filtering cloth not thoroughly washed and not thoroughly sterilized breeds bacteria between milkings so that it hides many millions in its meshes. Cheese cloth is easier to wash and sterilize properly than any other kind of mesh.

The dairy farmer should have two pieces of cheese cloth large enough to use doubled once

over his milk cans. By having two such pieces they can both be washed and sterilized in the morning, giving him one cloth for the night's milking and the other for the following morning's milking. The advantage of washing and sterilizing both cloths in the morning is that the majority of dairy farmers find it inconvenient to do washing and sterilizing in the evening.

They should first be washed in a basin of cold water and alkali powder. Next they should be rinsed in clean cold water to get rid of the excess alkali. After this they must be boiled on the kitchen stove for at least thirty minutes in order to kill the bacteria, some of which have exceedingly hard shells, and are not killed by ordinary scalding. The cloths must then be hung up to dry in a clean place. Out of doors on a line over green grass in the sunlight is an ideal place for drying strainer cloths. In the winter time a line behind the kitchen stove is satisfactory if the room does not contain much dust. Farmers often fail to properly clean and sterilize filter cloths after the night's milking. As a result, night's milk may contain few bacteria, while morning's milk after passing through the unsterilized filter, contains many millions.

CHAPTER XI

THOUSANDS OF DAIRYMEN GETTING RESULTS

MILKING, cooling, and sterilizing; these are the big three. By practicing the methods of milking, cooling, and sterilizing before described, any dairyman can produce milk containing not more than a few hundred bacteria. Such results have been accomplished by many dairymen under practical commercial conditions.

This system has been tried out in a very definite way. The record of the work done by dairymen who have tried to produce clean milk by the use of these simple methods has not been accidental, but has been the result of well-laid plans under business condtions, with the object of proving beyond doubt that large volumes of clean milk can be produced at a very small additional cost above the regular market price. Large groups of farmers for a small advance in price have consented to cooperate in carrying out the simple sanitary methods specified. Such demonstrations

have been made at Homer, N. Y.; Sparks, Md.; Oxford, Pa.; Kelton, Pa.; Bridgewater, N. Y.; Fair Haven, Vt.; Wilton, N. H.; Rockdale, N. Y.; Bernardsville, N. J.; Bel Air, Md.; Oxford, N. Y.; and Brisben, N. Y.

PURITY MILK FARMS

These principles were first put into practice on a large scale in 1903 on the Purity Milk Farms near Pennington, N. J. For a whole year daily bacterial tests were made on milk from two barns separated by a distance of not more than 100 yards on the same farm.

$20,000 BARN

The first was a model sanitary cow-stable which, with its equipment, cost over $20,000.

The second was an old-fashioned cow-stable with no sanitary features, which cost not more than $400.

$400 BARN

The sanitary dairy house supplied sterilized cans and sterile covered milking pails for the old barn, which were carried there in a wheel-barrow. The milker did clean milking into small mouthed pails. When the first old barn proved able to produce clean milk other old barns in the neighborhhood joined the dairy and did the same thing. The

dairy house did the sterilizing and cooling for all.

BACTERIAL TESTS OF MILK AT PURITY MILK FARMS

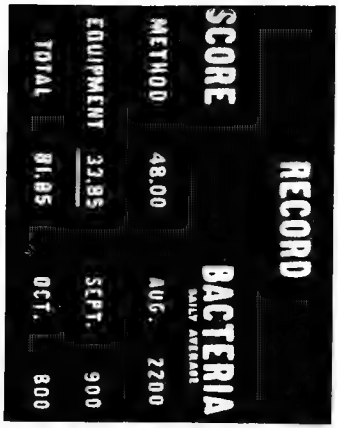
	Sanitary Barn.	Old Barn.
1903, September	660	1,950
October	354	331
November	287	425
December	505	457
1904, January	355	1,244
February	1,721	3,910
March	690	4,200
April	3,300	4,600
May	1,950	10,200
June	550	1,900
July	1,260	3,500
August	1,534	4,610
Average	1,097	3,102

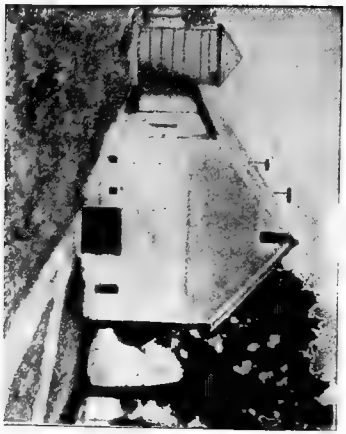
HOMER, NEW YORK

This system was established at Homer, in 1910. There were 71 dairy farms at this station producing an average of 10,000 quarts of milk daily. The majority of these farmers were able to produce milk containing less than 10,000 bacteria per cc., even in hot weather. This is shown

Farmer.	Bacteria per Cc.	
	A.M.	P.M.
Button, Ira	7200	7,100
Bartlett, Fred	600	8,600
Blair, W. H	1500	12,000
Cole, R. G	1400	7,300
Crouse, C. M	1200	1,200
Foster, Edw	5300	8,900
Foster, I. J	5400	9,600
Jones, Homer	2300	4,200
Klock, L. E	3000	4,200
Larrison, H	8600	7,400
McAuliffe, D	mixed	4,000
Moore Bros	7600	8,100
Niver, Ray	8900	9,400
O'Connor, Fred	4400	10,300
Quinlan Bros	6400	9,200
Ranney & Jones	4300	6,900
Rice, Frank	8100	10,300
Sellen, Dey	7200	3,100
Vinnedge, W	7800	8,600
Wilson, George	4600	5,100

(Highest outside temperature, 84° F.)





ONE OF THE HOMER DAIRIES AND ITS RECORD

by the reports made on samples tested by the New York City Department of Health in July, 1916.

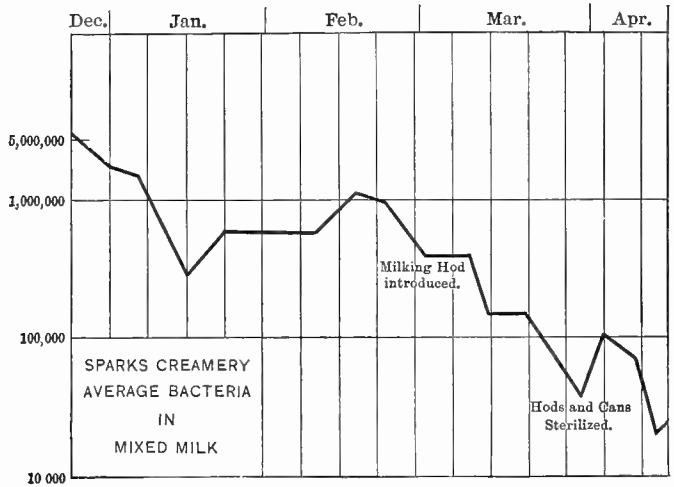
BACTERIA PER CC.

1914		1915		1916	
6800	900	3,100	4,500	900	9,600
1100	2100	2,300	12,500	1300	9,600
1600	4200	4,100	11,900	1300	1,500
3200	600	12,600	8,500	3900	9,300
1700	900	3,100	2,600	1300	8,700
3300	1200	800	5,300	2100	6,900
1700	1900	2,100	1,100	900	10,300
5200	1100	6,200	7,000	900	2,200
2800	1100	1,300	1,800	1300	1,400
		7,800	1,500	2100	2,900
		2,000	2,900	1000	4,600
		1,000	1,800	.....	2,900
		5,000	2,500		

SPARKS, MARYLAND

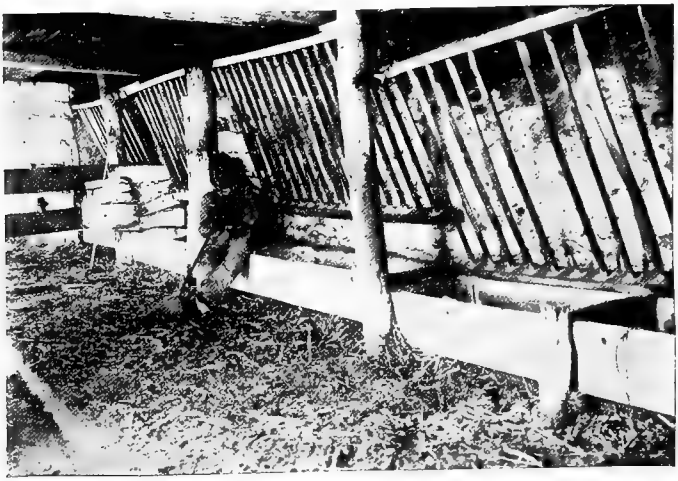
In 1913 this system of milk production was adopted by 28 dairy farmers bringing milk to a shipping station at Sparks, Md. This milk was shipped to Baltimore. In this territory the farmers were not equipped with ice, and were dependent upon spring-water for cooling.

The reduction in the bacteria in the mixed milk of all of the 28 farmers is shown by the chart below.



The above chart shows that even with the advantages of extremely cold weather in the winter months, the mixed milk of all farmers at the receiving station contained many millions of bacteria, but during March and April although the weather and spring-water were growing warmer, these farmers, by the adoption of sanitary methods, reduced the bacteria in the mixed milk at the shipping station to less than 50,000.

DAIRY BARN AT SPARKS, MD.



COW STABLE AT SPARKS, MD.

MILK FROM DAIRY OF JAMES B. ENSOR, SPARKS, MD.

BACTERIA PER CC.—1913.

December	*February*	*March*
12,000,000	1,500,000	118,000
6,000,000	1,000,000	520,000
7,500,000	790,000	173,000
	600,000	
January	1,100,000	*April*
	900,000	
6,600,000	1,100,000	300,000
1,000,000	1,200,000	180,000
2,080,000		79,000
1,380,000	*March*	120,000
1,120,000		87,000
1,040,000	960,000	41,000
1,900,000	870,000	47,000
1,500,000	780,000	34,000
560,000	560,000	78,000
500,000	590,000	32,000
650,000	360,000	
1,560,000	630,000	

(New methods adopted in April.)

OXFORD, PENNSYLVANIA

At Oxford, Pennsylvania, there is a large milk receiving station shipping milk to Philadelphia. Sixty-five out of the 98 dairy farmers patronizing this station undertook to produce clean milk in October, 1913, in return for financial premiums paid by the station for milk coming under the bacterial standards set by the station.

RECORD OF 65 DAIRY FARMERS' MIXED MILK, 1913. OXFORD, PA.

August	*October*	*November*	*December*
1,560,000	424,000	672,000	21,000
1,600,000	470,000	260,000	48,000
5,000,000	400,000	592,000	30,000
4,376,000	344,000	780,000	68,000
	250,000	547,000	27,000
September	456,000	272,000	30,000
	400,000	1,632,000	40,000
2,784,000	210,000	600,000	41,000
2,960,000	200,000	400,000	30,000
3,936,000	640,000	96,000	25,000
584,000	165,000	480,000	19,000
1,360,000	300,000	312,000	30,000
530,000	720,000	153,000	58,000
556,000	94,000	250,000	38,000
2,200,000	156,000	260,000	34,000
1,248,000	233,000	125,000	19,000
5,470,000	200,000	120,000	
1,440,000	149,000	90,000	
1,000,000	280,000	280,000	
1,480,000	.....	102,000	
382,000	.....	53,000	
1,160,000			
2,012,000			
1,400,000			
1,988,000			
270,000			

(New methods adopted in October.)

It is objected by some persons that the reduction in bacteria is due more to winter weather than to the cleanliness of the dairyman. To

offset this, there is given below a statement of the bacteria in the mixed milk of the Oxford farmers for August and September, 1913, before the clean milk system was adopted, and for August and September, 1917, four years after the clean milk system was adopted.

OXFORD, PA.—MIXED MILK

BACTERIA PER CC.

1913			1917		
August	26	1,560,000	August	8	100,000
	27	1,600,000		9	80,000
	28	5,000,000		10	84,000
	31	4,376,000		13	60,000
September	2	2,784,000		14	85,000
	3	2,960,000		15	100,000
	4	3,936,000		16	45,000
	7	584,000		17	70,000
	8	1,360,000		20	105,000
	9	530,000		21	80,000
	10	556,000		22	170,000
	11	2,200,000		23	150,000
	14	1,248,000		24	136,000
	15	5,470,000		27	180,000
	16	1,440,000		28	45,000
	17	1,000,000		29	90,000
	21	1,480,000		30	110,000
	22	382,000		31	114,000
	23	1,160,000	September	3	80,000
	24	2,102,000		4	80,000
	25	1,400,000		5	45,000
	28	1,988,000		6	25,000
	30	270,000		7	60,000

TYPICAL DAIRY FARM AT OXFORD, PENNSYLVANIA

COW STABLE, OXFORD, PA.

BACTERIAL RECORD OF JOHN BEYER, OXFORD, PA.

August.	September.	October.	November.	December.
2,200,000	920,000	12,000	6,000	5,000
24,000	101,000	20,000	22,000	28,000
1,120,000	704,000	21,000	15,000	6,000
160,000	123,000	20,000	43,000	6,000
690,000	74,000	8,000	4,000	17,000
	328,000	6,000	18,000	12,000
	50,000	20,000	25,000	4,000
	23,000	6,000	7,000	15,000
	16,000	4,000	16,000	25,000
	60,000	5,000	17,000	16,000
	2,459,000	19,000	14,000	
	60,000	6,000	40,000	
	15,000	3,000	2,000	

(New system adopted October.)

KELTON, PENNSYLVANIA

ONE OF THE 57 DAIRY FARMS AT KELTON, PA., SHIPPING SANITARY MILK TO PHILADELPHIA

DAIRY BARN AT KELTON, PA.

COW STABLE AT KELTON, PA.

BACTERIAL RECORD OF H. HACKMAN, KELTON, PA.

1916			1917	
March	*June*	*October*	*January*	*May*
12,000	12,900	20,000	2,000	80,000
7,000	20,000	23,000	5,000	32,700
9,000	5,000	21,000	1,300	17,000
7,000	*July*	48,000	3,000	4,000
8,000	7,000	18,000	1,200	130,000
36,000	25,000	20,000	4,000	25,000
April	300,000	23,000	2,000	75,000
3,000	360,000	40,000	1,200	15,000
80,000	25,000	50,000	*February*	*June*
9,000	240,000	*November*	2,500	9,000
17,000	15,000	40,000	3,000	115,000
4,000	15,000	48,000	4,000	20,000
16,000	*August*	24,000	5,000	120,000
20,000	23,000	40,000	1,000	60,000
16,000	1,000	50,000	3,300	7,000
May	27,000	22,000	18,000	10,000
6,800	10,000	20,000	*March*	*July*
24,000	20,000	9,000	4,000	16,000
8,900	10,000	4,000	4,800	7,000
24,000	17,000	*December*	9,000	10,000
16,000	15,000	16,000	20,000	20,000
12,000	*September*	4,000	10,000	16,000
23,000	16,000	2,000	6,000	5,000
14,000	17,000	1,400	2,400	16,000
16,000	5,000	2,000	160,000	20,000
24,000	18,000	2,100	4,700	12,000
16,000	24,000	1,500	*April*	*August*
June	24,000	4,000	2,200	20,000
48,000	14,000	.....	4,000	18,000
22,000	20,000	.....	8,000	7,000
23,000	24,000	.....	8,000	13,000
24,000	.....	.....	1,300	80,000
7,500	.....	.....	35,000	150,000
6,000	.....	.....	8,000	60,000
			100,000	35,000
				20,000

FAIR HAVEN, VERMONT

ONE OF THE 25 DAIRY FARMS PRODUCING SANITARY MILK AT FAIR HAVEN, VERMONT

BACTERIAL RECORD OF W. BUCKLEY, FAIR HAVEN, VT.

1916.				1917.
March	*June*	*August*	*October*	*January*
6,000,000	7,000	3,220	64,000	15,000
	18,500	1,200	3,000	4,000
April	58,000	14,000	2,500	9,000
560,000	42,000	10,500	2,800	17,000
80,000		14,000	26,000	19,000
250,000	*July*	3,000	45,000	
5,000,000	2,200	17,000	5,500	
	86,000	7,700	2,400	
June	70,000	5,000	6,300	
28,500	50,000	7,200	2,700	
490,000	28,000	6,900		
23,000	166,000	7,000	*November*	
130,000	67,000		8,900	
12,000	45,000	*September*	6,000	
3,000	67,000	4,400	20,000	
95,000	9,800	22,000	9,100	
10,200			24,000	
9,500	*August*	*October*	74,000	
5,400	5,200	3,600	45,000	
16,800	25,000	5,900	20,000	

WILTON, NEW HAMPSHIRE

ONE OF THE 38 FARMS PRODUCING SANITARY MILK NEAR WILTON, NEW HAMPSHIRE

DAIRY BARN, WILTON, N. H.

ENTRANCE TO SPRING AND MILK COOLING TANK UNDER PORCH OF HOUSE, WILTON, N. H.

BACTERIAL RECORD OF F. CUMMINGS, WILTON, N. H.

1916	1917			
October	*January*	*March*	*May*	*July*
37,000	5,900	1500	3,600	7,000
14,000	400	1900	3,500	1,000
	600	5900	4,800	5,000
November	1,800	400	5,500	2,000
19,000	1,500	2000	2,300	5,000
1,000	11,400	500	3,200	10,000
	700	5200	3,500	4,000
December	800	600		6,000
11,000	900	1900	*June*	
35,000			1,900	*August*
5,400	*February*	*April*	3,100	7,000
5,400	400	3400	11,600	1,000
900	2,200	1300	1,000	
3,800	200	2300	8,000	
3,100	1,400	4500	9,000	
500	1,300	5500	2,000	
900	2,200	9100		
		2600		

I am personally familiar with this dairy farm. Mr. Cummings has less than 10 cows. He does all the milk handling himself. His wife uses an abundance of boiling water, and carefully washes and sterilizes all milk utensils. The milk is cooled in the water of a very cold spring located in the ground under the front porch. Mr. Cummings illustrates the fact that it is possible to secure

milk with exceedingly small numbers of bacteria at all times of year, both winter and summer, without a fancy barn, or fancy equipment, but by exercising only the ordinary care that is easily within the power of any dairy farmer. The samples were taken from the cans at the railroad shipping station before shipment to Boston.

ROCKDALE, N. Y.

There is a large milk shipping station at Rockdale, N. Y., which ships milk to a well-known chain of dairy restaurants in New York City. The bacterial laboratory located in this station makes regular tests of all milk received from its patrons. The milk is cooled and shipped to New York City in a raw state in 40-quart cans. It is pasteurized by each of the dairy restaurants where it is received. Bacterial tests are regularly made from samples taken from the 40-quart cans on their arrival at the railroad terminal in Jersey City. The results of these tests are a most striking illustration of the high sanitary character of this raw milk after a railroad journey of 250 miles. Even though the samples are taken at the city railroad terminal, the milk compares

favorably with samples taken at some of the best country shipping stations.

BACTERIAL TESTS ON SAMPLES TAKEN FROM 40-QUART CANS ON THEIR ARRIVAL IN NEW YORK CITY OF THE MIXED RAW MILK OF 56 FARMERS AT ROCKDALE, N. Y., 250 MILES FROM NEW YORK CITY

January, 1917.	Feb., 1917.	March, 1917.	April, 1917.	May, 1917.	June, 1917.	July, 1917.	August, 1917.
74,000	8000	14,000	24,000	22,000	27,000	30,000	28,000
136,000	6600	11,200	12,000	20,000	42,000	55,000	32,000
67,000	4000	5,000	28,000	14,000	39,000	40,000	16,000
15,000	4700	1,000	16,000	40,000	34,000	48,000	221,000
7,000	5700	12,000	36,400	42,000	33,000	60,000	44,000
4,000	4800	18,000	28,000	22,000	16,000	52,000	28,000
	8200	16,000	13,200	25,000	27,000	62,000	87,000
	3900	14,500	7,000	42,000	39,000	47,000	62,000
		15,000	15,800	28,000	76,000	44,000	65,000
		10,000	10,000	30,000	27,000	74,000	121,000
		12,800	32,000	45,000	23,000	61,000	56,000
		10,500	20,000	26,000	34,000	70,000	85,000
Average							
50,000	5700	10,800	20,800	29,600	34,700	53,500	70,400

ONE OF THE 55 DAIRY FARMS PRODUCING MILK AT ROCKDALE, N. Y.

DAIRY BARN, ROCKDALE, N. Y.

COW STABLE, ROCKDALE, N. Y.

BACTERIAL RECORD OF FRANK SHEFF, ROCKDALE, N. Y.

1916	1917				
Sept.	*Nov.*	*Jan.*	*March*	*May*	*July*
21,000	3100	11,800	1,000	2,000	900
8,000	1300	1,100	800	2,000	10,000
3,000	7000	1,000	400	6,700	4,800
6,000	2200	1,400	1,100	2,700	1,800
1,100	4600	1,400	10,200	3,400	1,000
1,500	500	1,600	11,200	2,200	1,500
	1700	4,400	800	2,400	2,000
Oct.	1000	8,200	900	2,600	1,400
1,000	1200	1,000	8,900	1,300	15,600
1,100	1800		4,800	700	3,200
1,500	800	*Feb.*	4,700	1,100	14,000
12,000	1000	900	3,900		8,800
1,400		1,200		*June*	
10,800	*Dec.*	3,200	*April*	1,200	*Aug.*
1,200	3100	700	4,300	2,000	1,000
900	800	14,200	4,400	1,800	25,000
800	1000	1,400	4,100	1,200	1,700
1,400	1300	700	1,700	3,600	4,200
1,100	600	1,000	2,400	1,100	3,600
2,700	800	700	2,000	3,600	2,600
1,000	2000	800	1,900	10,800	1,600
	1100	7,600	4,400	2,500	5,000
	6200		3,400	9,000	1,000
	1300		2,800	1,000	1,500
	1100		3,400		900
	800		1,600		

OXFORD, N. Y.*

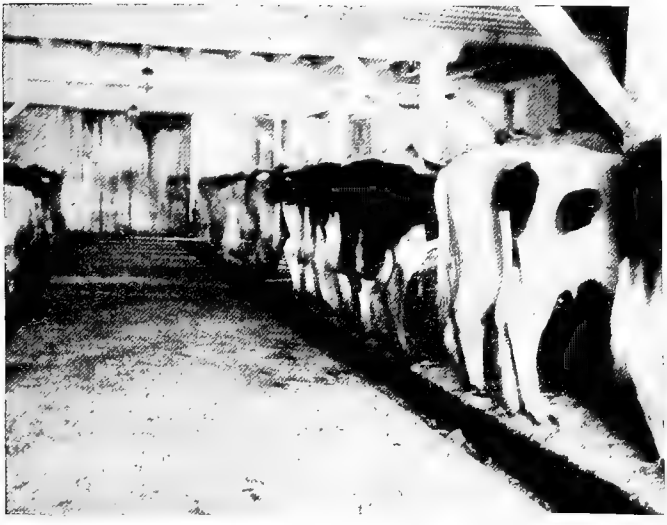
Work was begun in the summer of 1917 with 156 farmers at Oxford, N. Y., and 58 farmers at

DAIRY FARM, OXFORD, N. Y.

Brisben, N. Y., in laboratory testing and premium payments for the production of Grade A milk. Ninety per cent of these dairymen have already

* Oxford, N. Y., must not be confused with Oxford, Pa. Grade A milk is being produced for Philadelphia at Oxford, Pa., and for New York City at Oxford, N. Y.

been successful in keeping the bacteria in their milk below the required standards. As an example of their work, one typical dairy farm is selecetd.

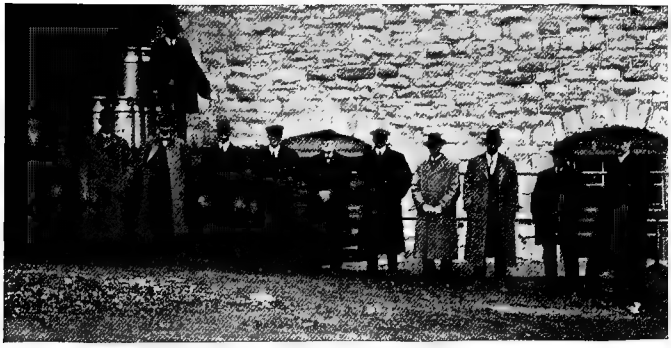


COW STABLE, OXFORD, N. Y.

BACTERIAL RECORD OF C. M. BALCOM, OXFORD, N. Y.

1917				1918	
July 9...	92,000	Nov. 1..	6,000	Jan. 4...	5,000
			4,000	7...	4,000
Aug. 1...	450,000	8..	6,000	10...	1,500
8...	65,000		6,000	12...	9,000
15...	24,000	15..	16,000	15...	2,300
24...	110,000		8,000	18...	2,700
28...	215,000	22..	9,000	22...	4,500
			15,000	23...	10,000
Sept. 6...	7,000				
13...	20,000	Dec. 3..	2,000	Feb. 1...	3,200
22...	110,000	6..	8,000	5...	5,800
		11..	9,000	8...	4,000
Oct. 3...	3,000	13..	8,000	11...	9,200
6...	6,000	15..	1,700	15...	12,500
8...	4,000	19...	6,000	19...	2,400
10...	2,500	22..	1,400		
15...	9,000	29..	2,800		
17...	3,000				
22...	1,000				
25	7,500				

CHAPTER XII



TEN OXFORD DAIRY FARMERS

THE DAIRYMAN MORE IMPORTANT THAN THE DAIRY

A DEMONSTRATION of the value of the dairyman himself as compared with the value of the dairy was carried out at Oxford and Kelton, Pa., in 1915. Ten dairy farmers at Oxford, Pa., who had learned how to produce clean milk agreed to make up a party to go to Kelton, Pa., to see

what kind of milk they could produce in dairy barns they had never before visited.

For six days before the date of this excursion, tests were made for the numbers of bacteria in the milk brought to the shipping station at Oxford by these 10 dairymen from their own dairy farms. The results are shown in the following tabulation:

BACTERIAL TESTS, OXFORD DAIRYMEN'S MILK

(On Oxford Dairies)

March 17 to April 5, Inclusive

Dairyman.	Test No. 1.	Test No. 2.	Test No. 3.	Test No. 4.	Test No. 5.	Test No. 6.
No. 1	13,000	13,000	21,000	4,000	21,000	20,000
2	7,000	13,000	23,000	4,000	60,000	18,000
3	4,000	19,000	25,000	8,000	24,000	17,000
4	20,000	8,000	21,000	11,000	19,000	23,000
5	15,000	4,000	16,000	7,000	22,000	18,000
6	6,000	20,000	19,000	24,000	22,000	25,000
7	10,000	20,000	26,000	22,000	12,000	11,000
8	21,000	9,000	9,000	15,000	11,000	22,000
9	10,000	22,000	23,000	12,000	21,000	13,000
10	20,000	15,000	24,000	16,000	29,000	80,000

At the same time a laboratory man had been sent ahead as an advance agent to the town of Kelton, Pa., where it was proposed to carry out

the experiment. The dairy farms at Kelton were a good average type of Pennsylvania dairies, but had never undertaken to produce milk containing small numbers of bacteria. Samples from all of the 56 dairies located there were taken by the bacteriologist, and from the number, 10 dairy farms were selected. The bacteria found in the milk of the Kelton dairies for five days before the date of the experiment are shown in the following tabulation:

BACTERIAL TESTS OF MILK PRODUCED ON KELTON DAIRIES

By Kelton Dairymen

March 29.	March 30.	April 1.	April 2.	April 3.	April 5.
1,200,000	1,160,000	60,000	60,000	57,000	1,830,000
		950,000	2,800,000	680,000	1,520,000
570,000	910,000	810,000	380,000	1,000,000	4,830,000
2,000,000	760,000	3,000,000	1,200,000	940,000	4,000,000
5,000,000	500,000	1,600,000	1,000,000	.....	1,450,000
290,000	1,100,000	600,000	3,000,000	2,600,000	3,600,000
1,400,000	.....	320,000	.....	8,000,000	60,000
11,000	9,000				
4,000,000	2,100,000	2,200,000	540,000	56,000	70,000
1,900,000	800,000	380,000	1,600,000	1,110,000	500,000

On the day appointed for the test, the 10 dairymen from the town of Oxford travelled by railroad from Oxford to Kelton, and were met at the station by 10 Kelton dairymen, with whom they

LEAVING OXFORD

were paired off. Each of the Kelton dairymen took with him to his dairy farm one of the Oxford dairymen. The Oxford man took complete charge of the milking operations of the afternoon's milking.

ARRIVING AT KELTON

OXFORD DAIRYMAN PAIRED OFF WITH KELTON DAIRYMAN

ONE OF THE KELTON DAIRIES

No changes whatever were made in the Kelton dairies. The Oxford men used the same barns, the same milk-houses, the same cows, the same milk cans, and the same spring-water for cooling purposes. They used the same sterilizing facilities, and milked the cows in the cow-stables without any attempt at cleaning the stables. Each Oxford dairyman brought with him his own covered milking pail. This was the only piece of apparatus which changed in any way the regular equipment of the Kelton dairies.

The Oxford dairymen were on the Kelton farms

not more than two hours in all. The milk they produced remained overnight on the farms, cooled only by spring-water. Samples for bacterial tests were not taken until the next morning, when the cans were brought to the Kelton railroad station.

The bacteria contained in the milk produced by the Oxford men compared with the bacteria in the milk produced by the Kelton men on these same farms are shown in the following tabulation:

BACTERIAL TESTS OF MILK PRODUCED ON KELTON DAIRIES

By Kelton Dairymen.	By Oxford Dairymen.
April 5	*April 6*
1,830,000	3,300
1,520,000	3,100
4,830,000	4,600
4,000,000	7,000
1,450,000	4,100
3,600,000	61,000
60,000	800
	2,500
70,000	1,600
500,000	5,600

The above results are almost too astounding to be believed, excepting by those who have actually been through such experiences as this. The truth of these figures can be so easily verified

by anyone who is sufficiently interested, to actually put into practice in an ordinary dairy the simple sanitary precautions previously outlined, that the figures can be accepted as not due in any way to accident or to any error of the laboratory but to correctly represent the facts. It is certainly true that a dairy farm producing milk containing millions of bacteria can in a single day at practically no expense change its methods so that the milk produced at the next milking will contain less than 10,000 bacteria per cc. All of this is because the factor which exceeds all others put together in importance is the dairyman himself.

CHAPTER XIII

THE DAIRY INSPECTOR

FARMERS OBJECT TO INSPECTION

Most dairy farmers object to the visits of the dairy inspector. City and state departments of health often send them to visit dairy farms. Some of them have had practical experience in dairying and some have not. The score cards which they use to score the cow-stable, milk-house, and utensils often greatly annoy the dairyman, because they emphasize details which seem to the dairyman to be unimportant. Cement floors, smooth walls, light and ventilation, iron stanchions, separate drinking troughs, the condition of the manure pile and the barnyard, are common subjects on which the dairy inspector gives the farmer advice and instructions.

The public is entitled to good, clean milk. The authorities ought to take action against dishonest dairymen who sell milk which is dirty or

adulterated. The farmers' objection to the dairy inspector is not on these grounds, but on the grounds that inspectors sometimes seem to emphasize things which have little to do with milk quality, and even disagree among themselves in a way that casts discredit on their judgment.

Every dairyman knows that success in the production and handling of clean milk depends most of all on the dairyman himself, and not on his buildings, nor their quipment. Careful milking depends on the dairyman. Careful washing and sterilization depend on the dairyman. Thorough cooling depends on the dairyman.

Every dairyman knows that no matter how good a barn and milk-house or their equipment may be, the milk produced on the premises can be greatly damaged through the carelessness and uncleanly habits of the hired man. One unclean strainer cloth can spoil the milk produced in a $25,000 dairy barn.

DAIRY SCORE CARDS

Dairy score cards have been used for a number of years by departments of health. Farmers often receive such cards, and they may be seen

nailed on the wall of the milk-house or of the dairy barn. They are the chief weapon of the dairy inspector. All score cards lay too much emphasis on surroundings and too little emphasis on milk.

The most popular score card has been one endorsed by federal authorities, often called the United States score card. Even in the hands of the most experienced and intelligent dairy inspectors, it is impossible by the use of this card to distinguish between the dairy producing unclean milk containing millions of bacteria, and the dairy producing sanitary milk containing a few hundred bacteria. The reason for this is that the United States score card fails to place the emphasis on the few things of most importance in clean milk production.

After all, the object of the dairyman and of the dairy inspector is to secure good milk, therefore a good score card should lay the emphasis on those things which chiefly affect the sanitary character of milk. Below is a new score card which aims to do this.

A NEW SCORE CARD

DAIRY SCORE CARD FOR PRODUCING SANITARY MILK

PROPOSED BY CHARLES E. NORTH, M.D.

(In this card it is assumed that no milk will be used from dairy cows which have any disease or have sore udders, and that dairy employees will be free from infectious diseases, and will not be carriers of disease germs. Veterinary supervision of cows and tuberculin testing, and medical inspection of employees are necessary where milk is to be sold in a raw state.)

PRIMARY FACTORS

EQUIPMENT (TOTAL 30)		METHODS (TOTAL 60)	
Milking			
Milking pails are of small mouth design, opening not exceeding 6 inches in diameter	3	Udders and teats of cows are clean before milking (washed and wiped properly (if necessary)	4
(Or opening larger, but less than half total area)	2	Milker's hands are clean and kept dry during milking	3
Milk pails are of metal, smooth, in good repair, and have all seams soldered flush	1	Small-mouthed milking pails only are used for milking	5
Milk cans are of metal, smooth, in good repair, and have all seams soldered flush	1	Milk is strained in a clean atmosphere through fine cheese cloth or cotton (or not strained at all)	2
Milk can lids are of metal, smooth, in good repair, and have all seams soldered flush	1		
Strainers are of fine cheese cloth (or of cotton, new for each milking), held in place by a good sanitary holder (no wire or metal strainers are used)	1		
Cooling			
Ice supply is sufficient for entire season estimate 1 lb. of ice sufficient for 1 lb. of milk	5	Milk house in sanitary condition	1
(Ice sufficient for 2 months)	3	Milk is cooled to below 50 F. within three hours after milking, and kept below 50°	15
(Ice sufficient for 1 month)	1	Or to below 55° F., and kept below	10
Water supply for cooling milk is pure, abundant, and cold.	2	Or to below 60° F., and kept below	5
Milk-house well located and constructed	1		
Cooling tanks of cement or metal or wood have capacity for milk cans and depth to bring water to neck of cans.	2		
(No open or exposed coolers are used except in protected milk room. If unprotected, subtract 1)			
Stirring rods are of smooth metal and in good condition. (If no stirring rods are used, allow 1)	1		

Sterilizing

Boiling water supply (or steam supply) for sterilizing is sufficient..... 8
Alkali washing powder is supplied..... 2
Scrub brushes for cleaning cans and pails are supplied.... 2

Utensils are rinsed with clean cold water immediately after using..... 2
Are scrubbed with solution of alkaline washing powder and are rinsed with clean water..... 3
Are sterilized with sufficient boiling water or steam (or in the case of milking machines with sufficient disinfectant). 15
Strainers are washed in alkali solution and boiled for at least thirty minutes (or no strainers are used)..... 10

SECONDARY FACTORS

EQUIPMENT (TOTAL 3.30)		METHODS (TOTAL 6.70)	
Cow stable (location and construction)	2.40	Cow stable (sanitary condition)	2.50
Cow stable (air and ventilation)	.40	Cow yard (sanitary)	.50
Cow stable (light)	.20	Cows (clean)	1.50
Privy (location and construction)	.30	Manure (removed)	.50
		Employees (clean)	.70
		Cow feed (sweet and clean)	.20
		Privy (sanitary condition)	.80

SUMMARY

Primary equipment	30
Primary methods	60
Secondary equipment	3.30
Secondary methods	6.70
Total	100.00

THE FAILURE OF SCORE CARDS

Even a card like this is an utter failure. In actual practice it has been used by some of the most experienced dairy inspectors in America, who not only could not agree sometimes within ten points of each other, but also found that the card did a great injustice to some farmers, because it failed to agree with the sanitary character of the milk produced.

We must put the score card in the same class with the strainer cloth. It is one of the most dangerous instruments in the dairy business. The score card above is shown mainly as a curiosity and not because it should be used. Health authorities are learning how to control milk without the use of score cards. They are coming at last to realize that milk consumers do not drink dairy barns, but drink milk. They are beginning to require only things of most sanitary importance and not things which have no effect on the milk.

NEW YORK CITY'S NEW MILK REGULATIONS

The Department of Health of the City of New York, after careful study of score cards, has de-

cided to discontinue their use and instead to make a few simple positive sanitary requirements for the dairy, and bacterial standards for the milk. These new regulations were published December, 1917. For Grade A milk, pasteurized, the requirements are as follows:

Sanitary Requirements for the Dairy

Cows physically examined.
Cow-stable properly constructed, lighted, ventilated, and clean.
Utensils properly washed and sterilized.
Water supply uncontaminated.
Milk-house provided and properly constructed, lighted, ventilated, and clean.
Cooling facilities for milk sufficient to maintain temperature of not more than 50°.
Milking must be with clean, dry hands.
Employees free from infection.

Standards for Milk

Raw milk shall not contain more than 200,000 bacteria per cc. in the city.
Raw milk shall not contain more than 100,000 bacteria per cc. in the country.

Pasteurized milk shall not contain more than 30,000 bacteria per cc. when delivered.

Pasteurized cream shall not contain more than 150,000 bacteria per cc. when delivered.

NOTE. These are extremely liberal bacterial standards compared with the small numbers of bacteria found in the milk of clean dairy farmers.

CHAPTER XIV

MILK TRADITIONS

TRADITIONS and superstitions have been handed down from father to son through generations of dairymen. These often prevent the farmer from accepting modern methods of dairy practice which are necessary to reduce the bacteria in his milk. Some of these beliefs are as follows:

SMOTHERED TASTE

Warm milk put into a can and covered with a tight lid, over night, will taste smothered. The smothered taste will appear unless milk is left uncovered so that the smother can escape. The truth is that the odor and taste are due to cow-manure which has fallen into milk from unclean cows or from dust in the stable air, or it is due to foul odors in the air of the stable itself. Clean milk can be put into cans with lids tightly on,

or into bottles tightly capped, while it is hot. It cannot have a smothered taste if it is clean. An open cooler will help get rid of this smothered taste in unclean milk.

QUICK COOLING AND SLOW COOLING

It is believed that bacteria grow so fast that milk must be cooled instantly to stop them. The truth is bacteria do not begin to grow until between three and four hours after milk is drawn from the cow. This is a great advantage to dairymen who have not a volume of milk sufficient to justify equipment with surface coolers. It is a serious thing for the small dairyman to feel that open coolers are necessary, for the reason that he is not equipped properly to wash and sterilize them. Small dairymen can cool milk best by placing it in cans and standing the cans in ice-water, or cold water. The numbers of bacteria at the end of three hours will be no greater than they were when milk was freshly drawn from the cow.

ANIMAL HEAT

Animal heat is supposed to be different from other kinds of heat. Some think animal heat

may smell or taste and is more difficult to remove from milk than stove heat. The fact is that animal heat is just heat. Animal heat is removed from milk by cooling of any kind. Animal heat will all escape from milk through the sides of a can or bottle when standing in cold water.

MIXING MORNING'S AND NIGHT'S MILK

There is supposed to be some mysterious chemical action that takes place between morning's milk and night's milk when they are mixed, which results in the rapid souring of the mixture. The mixture is supposed to sour much more rapidly than either the night's milk or the morning's milk would if left alone, consequently, dairymen keep morning's milk and night's milk separate. The truth is that souring of milk is the result of the growth of bacteria which produce lactic acid out of the milk sugar. If night's milk has been kept cold it stays sweet, because the bacteria do not grow in the cold. Warm morning's milk is sweet because it is fresh. Morning's milk will sour in a few hours if not cooled. If morning's milk is mixed with night's milk it

raises the temperature of the night's milk so that the mixture is warm enough to allow bacteria to grow. There is no reason why a farmer should not mix morning's and night's milk if he can keep them both cold. At the shipping station both morning's milk and night's milk are usually mixed by the milk dealer, because the dealer immediately cools the mixture and puts it through his pasteurizer. If milk is kept clean and kept cold, it makes little difference whether it is morning's milk or night's milk or a mixture of morning's milk and night's milk.

THUNDERSTORMS

It is believed by many that milk which was sweet before a thunderstorm will be sour after a thunderstorm, because of some influence, perhaps the influence of electricity on the milk. The truth is that the souring can be due only to lactic acid produced by the growth of lactic acid bacteria. These bacteria cannot grow well in cold milk. They will grow well when milk is not kept sufficiently cool. Since thunderstorms come in hot weather, and hot weather often interferes with the proper cooling of milk,

sour milk is frequently discovered on the same days that thunderstorms occur. On dairy farms where milk is cooled with ice, or ice-water, or cold water, thunderstorms come and go and are unable to sour the milk.

CHAPTER XV

DAIRY ARITHMETIC

The Farm

1 dairy farm	= 80 acres of cleared land	
80 acres of cleared land	= 20 acres hay	= 30 tons hay
	= 10 acres corn	= 100 tons ensilage
	= 40 acres pasture	= 40 tons green feed
	= 10 acres other crops	

The Cows

The above farm will support	20 extra cows, using 40 per cent of their feed for body building, and 60 per cent for milk	producing 8500 lb. milk per year each.
Or	27 fair cows, using 50 per cent of their feed for body building, and 50 per cent for milk	producing 5500 lb. milk per year each.
Or	35 poor cows, using 60 per cent of their feed for body building, and 40 per cent for milk	producing 3000 lb. milk per year each.

With hay at $15.00 per ton on the farm, ensilage and green feed at $5.00 per ton, and grain at

$50.00 per ton, the cost of producing milk in good, fair and poor cows is as follows:

Cow, No.	Lb. Milk per Year.	Quarts Milk per Year.	Quarts Milk per Day.	Cost of Food per Day, Cents.	Food per Day for Body-Building, Cents.	Food per Day for Milk Production, Cents.	Cost of Food per Quart of Milk, Cents.
1	8500	3953	11	40	16	24	3.66
2	5500	2558	7	29	14½	14½	4.14
3	3000	1348	3.7	23	14	9	6.21

THE PRODUCT

FARM PRODUCE IS THE RAW MATERIAL, COWS ARE THE MACHINES, MILK IS THE FINISHED PRODUCT

Farm Produce		Cows		Milk
30 tons hay 100 tons ensilage 40 tons green feed 35 tons grain	Passed through	20 extra cows or 27 fair cows or 35 poor cows	Will produce	170,000 lbs. or 148,500 lbs. or 105,000 lbs.

Collective Hauling

At eleven milk shipping stations in New York State, 453 farmers' wagons are used to haul 1181 40-quart cans of milk an average distance of 3 miles. Allowing only one horse and one man for each wagon and two hours as average time away from farm work the cost is per day as follows:

453 men, 2 hrs. at 30 c. per hr. . .	$ 271.80
453 horses 2 hrs. at 20 c. per hr. . .	181.20
Total cost per day	453.00
Total cost per year.	$165,458.25

One two-horse farmer's truck will carry thirty 40-quart cans of milk. It would require only 44 such trucks (allowing for some partly filled cans) to haul the 1181 cans hauled by the 453 wagons above. The cost of collective hauling by the 44 trucks would be:

44 men, $\frac{1}{2}$ day at $1.50	$ 66.00
44 teams, $\frac{1}{2}$ day at $2.50	110.0
Total cost per day	$ 176.00
Total cost per year	$ 64,284.00
Yearly saving	$101,174.25

COMPOSITION OF MILK

Normal Milk from Mixed Herds

Average of 3000 Samples, Snyder's "Chemistry of Dairying"

	Per Cent.	A Holstein Herd.	A Jersey Herd.
Water	87.50	87.61	84.59
Total solids	12.50	12.39	15.41
Fats	3.60	3.46	5.61
Solids not fat	8.90	8.93	9.80
Casein and albumen	3.40	3.39	3.91
Milk sugar	4.75	4.84	5.15
Ash	0.75	0.74	0.74

WEIGHTS AND MEASURES

1	quart	milk weighs	2.15 lb.
1	gallon	milk weighs	8.60 lb.
10	gallons	milk weigh	86 lb.
46.5	quarts	milk weigh	100 lb.

MILK PRICES

Per 100 Lb.	Per quart.	Per 8½ Qt.	Per 21½ Qt.	Per Gallon.	Per 10 Gal.
$1.00	.0215	.183	.462	.086	.86
$2.00	.043	.366	.924	.172	1.72
$2.50	.0537	.457	1.155	.215	2.15
$3.00	.0645	.549	1.386	.258	2.58
$3.50	.0752	.640	1.617	.301	3.01

CHAPTER XVI

ESSENTIALS FOR GRADE "A" MILK PRODUCTION

By Dr. Charles E. North

Primary Equipment		*Primary Methods*
Milk Pails (Small Mouth) Cans Strainers (Cheese Cloth)	**MILK-ING**	Cow's Udder Clean Clean, Dry Hands Milk in Small Mouth Pail Strain through Cheese Cloth
Ice Supply Cold Water Supply Cooling Tank Stirring Rod (Metal)	**COOL-ING**	Cool in cans in tanks of Ice-Water or Cold Water below 50 F. Stir night's milk (if necessary)
Boiling Water Supply Alkali Powder Scrub Brushes	**STERIL-IZING**	Wash Utensils with Brush and Alkali Powder Rinse with Clean Water Sterilize with Boiling Water