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A. D. MELVIN, CHIEF OF BUREAU.

SOME IMPORTANT FACTORS  
IN THE  
PRODUCTION OF SANITARY MILK.

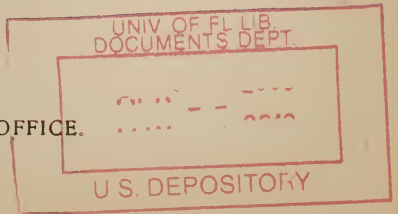
BY

ED. H. WEBSTER,  
*Chief of the Dairy Division.*

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# SOME IMPORTANT FACTORS IN THE PRODUCTION OF SANITARY MILK.

By ED. H. WEBSTER,  
*Chief of the Dairy Division.*

## INTRODUCTORY.

It is evident that in nature's scheme for the nourishment of the young milk was never intended to see the light of day, and if sucked from a normal, healthy gland it is the perfect food for the offspring. In this natural method of nourishment there is little possibility of contamination from outside sources. As soon as the artificial method of drawing milk is resorted to, however, there enters a whole set of conditions entirely new and different. The milk then comes in contact with the air, the vessel into which it is drawn, and with particles of dirt from many sources.

Milk properly drawn, from healthy cows, in clean surroundings, handled in a sanitary manner, and delivered to the consumer in a comparatively short time, is free from disease-producing organisms and is ideal as a food. The problem of securing clean milk—i. e., milk as near as possible to the condition as it exists in the udder—is the problem of dairy sanitation. To put it in another way, it is the problem of reducing contamination from all outside sources to the least possible factor. Few cows, however, are properly milked; many herds are not free from disease; many farmers understand but little of sanitary methods, and but a small proportion of the milk coming into any city of considerable size can be delivered to the consumer soon after milking.

## HOW MILK IS CONTAMINATED.

If the mere presence of solid particles of dirt so frequently found in the milk were the only damage wrought, the question would resolve itself into the simple operation of straining the milk or passing it through a clarifier. The presence of solid dirt is, however, an indication of much more serious conditions. Bacteriology teaches that every particle of dirt, whether it seems to the eye a source of contamination or not, carries with it great numbers of bacteria, and that milk at ordinary temperatures, 65° to 100° F., is an excellent medium for their growth, and most of the changes that take place in milk can be traced directly to such action. Neither straining nor clarifying will remove the bacteria from the milk; hence the necessity of keeping the dirt out, not straining it out.

From the act of milking to the final consumption of the milk the possibilities of contamination are many and varied in character. Everything that comes in direct contact with the milk may be a source of trouble, and many things may act indirectly and seriously affect the results desired.

Contamination usually begins with the act of milking. If the udder and flanks of the cow are covered with the dirt of the yard or stable the process of milking will dislodge a greater or less portion of this filth, causing it to fall into the pail. The amount of filth that may be on a cow will depend very much on the conditions of the stable yard and the floor, gutter, and bedding in the stables. (See figs. 21, 23, 25, and 27.)



FIG. 20.—Exterior of a model dairy barn.

As to the amount of filth that will get into the milk and its effect on the product, reports from the Illinois Experiment Station and the Storrs (Conn.) Experiment Station are here quoted:

The average weight of dirt which falls from muddy udders during milking is 90 times as great as that which falls from the same udders after washing, and when udders are slightly soiled it is 32 times as great.<sup>a</sup>

Wiping the flank and udder of the cow with a damp cloth just before milking is a very efficient method for reducing the number of bacteria which falls into the milk pail.<sup>b</sup>

<sup>a</sup> Illinois Experiment Station, Bulletin 84.

<sup>b</sup> Storrs Experiment Station, Bulletin 42.

An average of 13 experiments at the Storrs station showed the following results:

Bacteria in milk from unwiped udders per cubic centimeter-----	7, 058
Bacteria in milk from wiped udders per cubic centimeter-----	716
Decrease due to wiping-----	6, 342

The milker may not be cleanly in person or dress; he may have that most filthy of habits, milking with wet hands. The hands are usually wet by milking a few streams over them, and kept wet by repeating the operation from time to time. The filth on the udder will ooze out under and through the fingers and drip into the pail. This condition is frequently met in inspection work.



FIG. 21.—Insanitary barnyard. Manure and filth evident everywhere. It is impossible to keep cows clean in such surroundings.

Milkers too often wear clothing that has done duty for every other work about the farm. Such clothing may contain dirt from the hog pen, the chicken coop, the horse barn, or the swill barrel, and is entirely unfit to be worn during milking. A clean white milking suit has a twofold effect. It will not of itself contaminate the milk, and if the milker is required to keep such a suit clean he must of necessity keep everything with which he comes in contact clean.

The difference in results between different milkers working under the same conditions is strikingly illustrated by Stocking.<sup>a</sup> The average of 19 tests in which 2 milkers who had had no training in

<sup>a</sup> Storrs Experiment Station, Bulletin 42.

dairy sanitation and 1 milker who was a graduate of the Connecticut Agricultural College showed 17,105 bacteria per cubic centimeter for the untrained men and 2,455 for the trained man. The only difference between the men was the knowledge of what constituted contamination, gained by the college graduate, who was a student of bacteriology.

#### EDUCATION AND REGULATIONS.

This example well illustrates the difficulty encountered in securing clean milk by means of police regulations only. Education must go first, and the police authority should be used only in cases where the

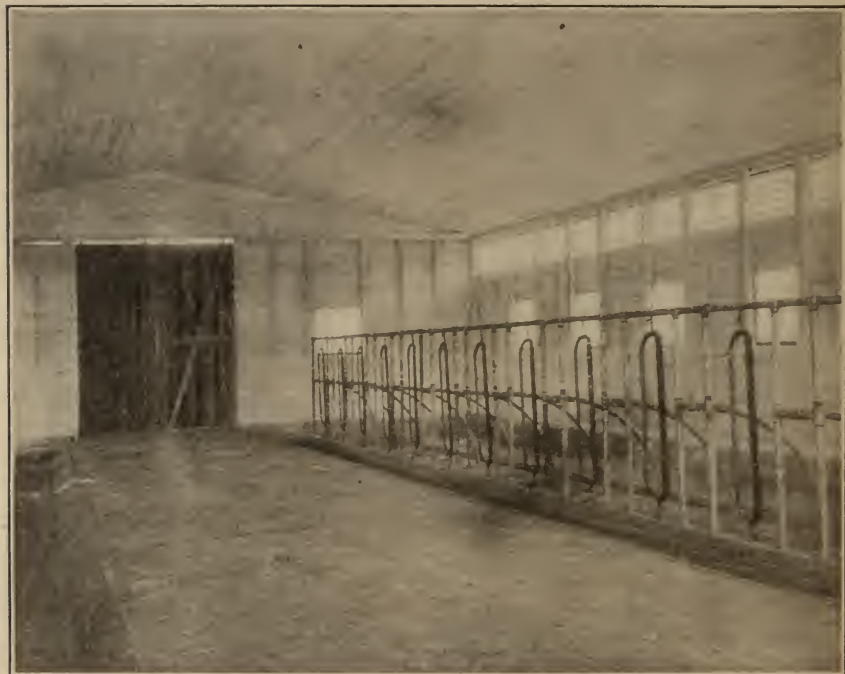


FIG. 22.—Interior of an inexpensive but good dairy stable. Well lighted and ventilated and easily kept clean.

dairyman persists in willfully disregarding sanitation when he knows better. But little improvement will come through regulations requiring clean cows, clean milkers, and clean methods of milking and of handling the milk unless the dairyman understands the object of such regulations and the effect they will have on his work. The officers in charge of inspection must be teachers first and policemen only when they find that the dairyman will not live up to the instructions given him and his knowledge of what is right.

Rules and regulations intended to correct evils often fail in their purpose because of injudicious administration on the part of health



officers, but much oftener from the fact that a man who is by nature filthy in his habits can not be legislated into cleanliness. If he is willing to drink at his own table milk which contains only a little cow dung, he takes it as an infringement of his personal rights and liberties if the authorities attempt to compel him to keep such material out of the milk that goes to his neighbors.

The illustrations accompanying this article are all made from photographs taken in the course of inspection work, and have been selected with a view to presenting a contrast between desirable and undesirable conditions of milk production. They show that more rigid inspection is absolutely necessary, that competent inspectors



FIG. 23.—Interior of an insanitary dairy stable. It is impossible to avoid contaminating milk drawn in such a place.

must be employed to instruct, and, where instruction is not sufficient, to demand a better state of affairs. Laws and ordinances must be strengthened and the public educated to demand clean milk from clean dairies.

One important item that must be borne in mind is the fact that to change these conditions must cause some expense to the producer, and the consumer must expect to foot the bills. A prominent veterinarian in Kansas City, Mo., recently said in regard to the milk supply of that city that the prevailing price of milk was based on a system which required only that the solid and coarsest dirt be strained out. If the consumer wanted milk that had been kept free from such contamination he would have to pay for the added cost of production.

## UTENSILS, EQUIPMENT, HOUSES, ETC.

The milk pail should be made so as to reduce to a minimum the amount of dirt and hair that can get into it during the operation of milking. The form with a wide top is in most common use and is most objectionable. The narrow top, in some form or other, will undoubtedly, in time, replace the wide top. Pails and all other vessels designed to hold milk should be seamless if possible, and where seams must occur, they should be flushed full and smooth with solder. There should be no place either inside or out that can not be reached with the brush in washing. Heavily tinned utensils are recognized



FIG. 24.—Clean cows in clean, comfortable, light, and airy stalls.

as the best for milk purposes. Wood, galvanized iron, or any material that is rough or porous is unfit for milk vessels.

No important part of the dairy work is so often neglected as the cleaning of the milk utensils. It can not be too strongly emphasized that dairy utensils must, after the milk is washed from the surface with warm water, be scalded with boiling water or steam. Nothing short of this will insure clean milk.

Milk after being drawn should be removed at once from the barn to a clean place for cooling. The milk house should be provided with an ample supply of hot and cold water, the necessary cooler, and other apparatus and supplies for handling milk. The surroundings

of the milk house should be neat and clean and the air at all times free from objectionable odors. Cement finish on the interior is better than wood, but success is due to the scrupulous cleanliness observed, and under these conditions the wood is unobjectionable.

#### CARING FOR THE MILK.

The bacterial content of milk at any time depends upon the age of the milk, the initial number of bacteria introduced through the processes of milking and handling, and the temperature at which the milk has been kept. Consequently clean milk, quick cooling, and short



FIG. 25.—Cows coated with filth in a dirty stable. Much of this filth gets into the milk.

time between milking and consumption are very important factors in securing pure milk. A careful survey of the milk supply of a number of cities indicates that not enough attention is paid to these factors by either producers, distributors, or inspection authorities. Milk should be cooled immediately and kept cool until it is consumed. Between the farm and the consumer often several agencies are employed. Hauling to the depot, holding at the shipping point, transportation on the cars, and the handling in the city milk plants are steps in the process of supplying a city that need intelligent and conscientious care

All that has been said about cleanliness, surroundings, and care in handling milk on the farm applies to the city plant where milk is received and distributed to the consumer. So far as insanitary surroundings are concerned, it is usually the smaller dealers who are the greatest offenders. They usually lack facilities for scalding or sterilizing bottles and utensils, and depend too much on the help of the family, often children, to wash bottles and utensils and do much of the work of the dairy.

#### DAIRY INSPECTION.

For an efficient system of dairy inspection it is recommended that there be an inspector for approximately every 100 dairy farms.



FIG. 26.—Milking cows under clean conditions.

These inspectors should be skilled in all subjects pertaining to the production and distribution of milk. Half of the inspectors should be skilled veterinarians, and the other half should have had training in a good dairy school or have had experience which would be the equivalent of such training.

Inspectors should devote their entire time to the work of inspection and should not be allowed to do outside work that in any way relates

to the business of inspection. There should be a chief inspector to supervise the work, and he should be responsible to the health officer. The health officer, or board of health, should have full power to make rules and regulations and enforce the same so as to safeguard the health of the community from a contaminated milk supply through either carelessness, ignorance, or malicious intent.

#### THE SCORE-CARD SYSTEM.

For the past two years the Dairy Division of the Bureau of Animal Industry has been making a thorough investigation of the city milk



FIG. 27.—Milking cows under filthy conditions with unavoidable contamination of milk.

supply of a large number of cities of the country with a view to establishing a system of inspection and reporting on dairies that would be complete, comprehensive, and meet the needs of the public in the improvement of the milk supply. Dr. W. C. Woodward, health officer of the District of Columbia, was the first to introduce a score-card system of reporting on dairies. A little later Prof. R. A. Pearson, of Cornell University, introduced a card for the same purpose. The cards had many good features, and if they had been generally adopted would have done much to improve the dairy conditions of the country.

The Department of Agriculture took up the work with the hope of extending the use of the score card and thereby promoting more thorough inspection. After three years' work, scoring several thousand dairies in all parts of the country, a score card has been adopted in a more or less modified form and has been introduced and used in about 60 of the larger cities of the country and in many smaller ones. The following is the form of the present card for farm dairies:

[United States Department of Agriculture, Bureau of Animal Industry, Dairy Division.]

SANITARY INSPECTION OF DAIRIES.

DAIRY SCORE CARD.

Owner or lessee of farm.....  
 Town..... State.....  
 Total number of cows..... Number milking.....  
 Quarts of milk produced daily..... Product is  
 sold at wholesale retail. Name and address of dealer to whom shipped  
 .....  
 Permit No. .... Date of inspection....., 190...  
 Remarks .....

(Signed) .....

*Inspector.*

[Back of card.]

DETAILED SCORE.

Equipment.	Score.		Methods.	Score.	
	Perfect.	Allowed.		Perfect.	Allowed.
<b>COWS.</b>			<b>COWS.</b>		
Condition.....	4	.....	Cleanliness.....	10	.....
Health (outward appearance).....	6	.....			
Comfort.....	4	.....	<b>STABLE.</b>		
Bedding.....	2	.....	Cleanliness.....	12	.....
Temperature of stable.....	1	.....			
Protected yard.....	1	.....	Floor.....	4	.....
Cubic feet of space per cow:			Walls.....	2	.....
Over 300, 2; over 400, 4; 500			Ceiling.....	2	.....
to 1,000, 6.....	6	.....	Ledges.....	1	.....
Feed.....	4	.....	Mangers and partitions.....	1	.....
Water.....	8	.....	Windows.....	1	.....
Clean.....	6	.....	No other animals in stable.....	1	.....
Fresh.....	2	.....			
<b>STABLE.</b>			Stable air.....	4	.....
Location.....	6	.....	Removal of manure.....	4	.....
Well drained.....	3	.....	To field or proper pit... 4		
Free from contaminating surroundings.....	3	.....	30 feet from stable..... 2		
Construction.....	10	.....	Cleanliness of stable yard.....	2	.....
Tight, sound floor.....	3	.....			
Gutter.....	1	.....	<b>MILK ROOM.</b>		
Stall, stanchion, tie.....	1	.....	Cleanliness.....	6	.....
Low-down manger.....	1	.....	Care and cleanliness of utensils.....	10	.....
Smooth, tight walls.....	1	.....	Inverted in pure air... 2		
Smooth, tight ceiling... 2			Clean (superficially)... 4		
Box stall.....	1	.....	Sterilized..... 4		
Light: 1 sq. ft. glass per cow; 2;			<b>MILKING.</b>		
2 sq. ft., 4; 3 sq. ft., 6; 4 sq. ft., 8; even distribution, 2... 10			Cleanliness.....	14	.....
Ventilation: Sliding windows, 2; hinged at bottom, 4; King system or muslin curtain, 8... 8			Clean, dry hands..... 4		
Stable yard (drainage)..... 2			Udders washed and dried..... 10		
<b>MILK ROOM.</b>			Cleaned with moist cloth..... 8		
Location.....	6	.....	Cleaned with dry cloth..... 4		
Convenience.....	2	.....	<b>CARE OF MILK.</b>		
Free from contaminating surroundings..... 4			Cooling.....	20	.....
Construction.....	4	.....	Removed from stable immediately after milking each cow and promptly cooled..... 10		
Floor.....	1.5	.....	Cooled to 50° F. or below 10		
Walls and ceilings.....	1	.....	51° to 55° F..... 8		
Light.....	.5	.....	56° to 60° F..... 6		
Ventilation.....	.5	.....	Storing.....	8	.....
Screens.....	.5	.....	Below 50° F..... 8		
Arrangement.....	2	.....	51° to 55° F..... 6		
Equipment.....	6	.....	56° to 60° F..... 4		
Hot water or steam.....	2	.....	Transportation.....	10	.....
Cooler.....	2	.....	Iced in summer..... 10		
Narrow-top milk pail... 1			Jacket or wet blanket in summer..... 8		
Other utensils.....	1	.....	Dry blanket..... 4		
Water supply for utensils..... 10			Covered wagon..... 2		
Clean.....	6	.....			
Convenient.....	2	.....			
Abundant.....	2	.....			
Milking suits.....	4	.....			
Total.....	100	.....	Total.....	100	.....

Score of methods.....multiplied by 2 = .....

Score of equipment.....multiplied by 1 = .....

Total.....divided by 3=.....final score.

NOTE.—Deductions may be made for exceptionally bad conditions.

NOTE.—If the herd has not been tuberculin tested within a year, the limit for the score will be 80.

The use of these cards enables a more perfect study of conditions to be made in any city. The results so reported are comparable and can be analyzed with greater ease and accuracy.

Perhaps not the least valuable part of the score-card system is the demand it makes for better and more competent inspectors. It has usually resulted in the dissatisfaction of inspectors with their previous work. The study of the premises in detail with the view to fixing the exact value of conditions requires better and more conscientious work. Wherever the system has failed—and but one or two such instances are known—this has been because the inspector did not relish the comparison of the results with his previous work.

A striking example of the improvement brought about by the score-card inspection system is given in the work of the Richmond, Va., board of health, as follows:

*Table showing percentage of dairy farms in various classes during the first twelve months of dairy inspection at Richmond, Va., May 1, 1907, to May 1, 1908.*

Class.	Percentage of all dairies inspected for the month which fell in each class.											
	1907.								1908.			
	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Scoring below 30. ....	13.8	26.5	3.9	4.0	.....	.....	.....	.....	.....	.....	.....	.....
Scoring between 30 and 40. ....	30.8	42.9	21.0	10.7	.....	.....	.....	.....	.....	.....	.....	.....
Scoring between 40 and 50. ....	26.2	22.4	38.2	29.4	40.0	23.7	14.8	15.8	2.8	.....	.....	.....
Scoring between 50 and 60. ....	13.8	8.2	22.4	33.3	45.0	35.6	45.9	36.8	11.3	13.6	6.8	5.7
Scoring between 60 and 70. ....	10.8	.....	13.2	22.6	12.5	33.9	29.5	23.6	35.2	44.1	39.8	34.3
Scoring between 70 and 80. ....	4.6	.....	1.3	.....	2.5	6.8	8.2	18.4	31.0	25.4	34.2	42.9
Scoring between 80 and 90. ....	.....	.....	.....	.....	.....	.....	1.6	5.4	19.7	16.9	19.2	17.1
Average of all scores for month. ....	41.5	36.4	47.5	50.5	51.4	57.0	58.4	60.5	70.4	69.6	71.5	72.0

The average increase in scores, as shown by the foregoing table, is 30.5 points, or 71 per cent.

#### FEATURES OF INSPECTION.

The routine of inspection should include (1) health of attendants, (2) health of the herd, (3) purity of the water supply, (4) methods of the dairyman, (5) facilities for producing pure milk, and (6) handling and transportation from farm to city.

These will be discussed briefly in the order given.

#### HEALTH OF ATTENDANTS.

Dr. John W. Trask, passed assistant surgeon in the United States Public Health and Marine-Hospital Service, says: <sup>a</sup>

During the last fifty years there has been piling up a mass of evidence which would seem to show that milk may receive from man the specific organisms of

<sup>a</sup> Bulletin 41, Hygienic Laboratory, United States Public Health and Marine-Hospital Service.



certain infectious diseases, and that these organisms may retain their virulence for some time and produce the disease in susceptible individuals drinking raw milk.

He lists over 500 epidemics which have been traced directly to milk as the medium through which they were spread. The distribution of milk from sources of such contamination is now absolutely prohibited by law in most cities, and yet in what city is the inspection so complete as to insure beyond any question of doubt that every milk producer obeys the law?



FIG. 28.—An inexpensive but clean dairy house. Milkers in clean white suits; pails and cans handled in a sanitary manner.

#### HEALTH OF THE HERD.

The health authorities and the consuming public are just beginning to awaken to the dangers of contamination of the milk supply through diseased cattle. It is unfortunate that the desire for the immediate dollar is in many dairymen greater than their desire to produce and distribute a pure and wholesome milk, though such milk will certainly in the end bring a greater profit. They attempt to hide any fact of sickness in their herds, at the expense of the health of the public. Dr. John R. Mohler, of the Bureau of Animal Industry, in the following recommendations to the Commissioners of the District of Columbia, points out what should be done in this connection:

Milk from cattle showing udder infection or anthrax, rabies, gastro-enteritis, septic conditions, or clinical symptoms of tuberculosis, shall not be utilized as human food, even though the milk be pasteurized.

All milk produced on dairy farms shall come from either tuberculin-tested cattle, which shall be retested at least once a year, or be subjected to pasteurization under the supervision of the health department in case the herd is not tuberculin tested.

#### PURITY OF WATER SUPPLY.

Even greater than the lack of interest in the health of the cows has been the lack of proper appreciation of the part that a polluted water supply on dairy farms may play in the health of the community. Yet in the great majority of cases trouble of this kind can be very readily overcome. As a result of a survey of 290 dairy



FIG. 29.—An undesirable dairy house. Cans exposed to contamination.

farms in Maryland and Virginia by the Bureau of Animal Industry, Dr. B. M. Bolton sums up this question as follows:

The results seem to show that there are comparatively few water supplies which are free from sanitary objections; but in spite of this fact it is nevertheless probable that in many cases the faults can be rectified. In fact, the faults have already been corrected in some cases where they were pointed out to the owners of the dairies. It would seem advisable in some cases to close up the source of supply, but in most cases all that would be necessary is to point out to the dairymen the sources of pollution and to give them instruction in regard to their avoidance.

To follow out these suggestions means the employment of inspectors competent to pass on the conditions of the water supply. There are too many inspectors employed who can not intelligently do this.

## METHODS OF DAIRYMEN.

The weakest point in the inspection system as ordinarily practiced is the inability of the inspector in most cases to be present at milking time. A dairyman's methods should be given at least twice as much weight as the ordinary facilities and utensils with which he works, and the methods to be criticised can be seen at their best or their worst only while the operation of milking is going on. It is the practice of the Dairy Division to score methods separately from equipment, and invariably the score is lower if the inspector sees the milking done than if he has to fill out this part of the card by questioning the owner or his helpers.



FIG. 30.—A tidy bottling room.

If a man has an inborn capacity or instinct to be clean, a little instruction will enable him to do satisfactory work; but if he is lacking in this quality it is very difficult to change his methods by any amount of instruction or police regulation. The contamination that enters milk because of this lack of the sense of common cleanliness is most serious. This disposition toward uncleanness is responsible for such practices as milking with filthy clothing and hands, filthy udders and flanks, wetting the hands with milk during milking, straining and aerating the milk in the stable, storing and shipping milk in cans that have not been properly washed and ster-

ilized, and many little practices which seem very small and of little importance in themselves, but add, each, their quota to the contamination of milk.

#### FACILITIES FOR PRODUCING PURE MILK.

The tools with which a man works can only to certain extent determine the fineness of his results. Good results are often obtained with poor tools. Yet the same results might be obtained much more readily if the tools were of the proper kind and fitted for the work.

Barns, stalls, floors, utensils, milk houses, conveniences in conveying and heating water, and all other accessories of the dairy may be



FIG. 31.—A bad place for handling milk.

so constructed and arranged that they require a great amount of labor to produce the desired results, or they may all be so contrived that the labor is easy and the results much more certain. While the mere matter of convenience is one mainly for the dairyman, the authorities should at least require adequate and sanitary equipment and facilities for the production of wholesome milk.

#### HANDLING AND TRANSPORTING MILK FROM FARM TO CITY.

The same element of doubt as to whether any inspection system can insure perfect work exists here as in the other processes under consideration, though perhaps to a lesser degree; yet there is the pos-

sibility that the milk will be exposed to unfavorable temperatures, delayed in transit, handled carelessly by employees, and delivered in a condition that renders it unfit for consumption as raw milk. These matters should, of course, be guarded against so far as possible by inspection.

#### THE CLASSIFICATION OF MILK.

It may be impossible for a farmer to meet the ideal conditions. Shall he, then, be compelled to discontinue his dairy? A city can not do without milk, and too rigid requirements of the ideal might easily cause a milk famine.

There are farmers who have the knowledge and the business ability to produce an article so superior that it may be sold as certified milk. Others are also careful in their work, and are so situated that they can produce a high class of milk free from any suspicion of disease organisms, but can not afford the expense attached to the production of certified milk. Each of these classes finds patrons willing to pay the extra cost of such production. As the consuming public becomes more enlightened on the subject, the demand for such milk will increase, as it should.

These classes of milk, however, are but a fraction of 1 per cent of the total milk demanded by a city. The vast proportion of producers are so situated, because of natural environment, personal handicap, or distance that they can not produce a milk which will meet the requirements of an ideal standard. To cut them off would deprive the city almost wholly of milk. This is the condition; what is the remedy? Dr. A. D. Melvin, Chief of the Bureau of Animal Industry, has proposed a system of classifying milk as follows: (1) Certified milk, (2) inspected milk, (3) pasteurized milk. Under this plan all milk of doubtful quality and not meeting the requirements of the first two classes would be rendered measurably safe by pasteurization under official supervision, and no milk not coming within one of the three classes would be allowed to be sold.<sup>a</sup>

#### PASTEURIZATION.

Let it be clearly understood that pasteurization is not recommended as a cure for all the ills of the milk business. No amount of pasteurization will make bad milk good. By destroying disease germs, however, pasteurization will render practically safe milk which would otherwise be dangerous to health; but the quality of the milk, as such, is not improved; rather the reverse is true.

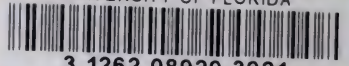
<sup>a</sup> The classification of milk is treated in a separate article by Doctor Melvin on page 179 of this volume.

Even with an efficient inspection system, as outlined above, it will not be possible for some time to obtain a sufficient supply of wholesome raw milk, and for this reason pasteurization is recommended as a temporary makeshift for dealing with milk of doubtful quality.

Pasteurization will not take the place of a careful and adequate inspection system. Such inspection system should eventually obviate the necessity for pasteurization, but this can not be accomplished until the consumer is willing to pay the increased cost of pure milk, nor until the producer works on a higher plane than the average do at present.



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