

THE GREAT BACTERIAL CONTAMINATION OF THE
MILK OF CITIES. CAN IT BE LESSENERD BY THE
ACTION OF HEALTH AUTHORITIES?

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It will be accepted that milk containing large numbers of bacteria, as well as the products of their growth, is less suitable for food than unpolluted milk. A bacteriological examination of the milk in great cities¹ generally will show that much of it in hot weather, and some of it at all seasons of the year, abounds in bacteria. Clinical experience also teaches that much of the milk in hot weather is unsuitable for food, especially for infants; because in them, owing to the rapidity with which the milk passes through the stomach, gastric digestion is almost no safeguard against the entrance of disturbing microorganisms into the intestines. Even pasteurization of milk charged with bacteria and their products does not restore it to its original condition, for the dead bodies of the bacteria and their toxins still remain. The changes in milk which are most deleterious being now known to be due to bacteria, it is theoretically conceded by all, that commercial cow's milk, the substitute for maternal milk, should be as nearly free as practicable from bacteria.

This being so, it seems strange that those who care for the health of communities, while striving so earnestly to protect milk from chemical adulteration, do nothing to compel or even encourage the farmer and shipper to supply milk free from excessive numbers of bacteria and their toxins. This neglect is probably due to the fact that Health

¹ According to Pakes, London milk contains over 3,000,000 bacteria per c.c. (*Lancet*, Feb. 3, 1900.)

Authorities have considered the practical difficulties too great to be overcome.

The investigations, the results of which are here given, were undertaken with the object of determining how much contamination necessarily takes place in milk during milking, and how much bacterial growth afterwards in its transit from the dairy to the city. The results show that it is perfectly practicable for the farmer and shipper, without appreciable increase of expense, to furnish commercial cow's milk with far less bacterial contamination than that now supplied.

From a careful study of the question, I think that the milk now consumed is unnecessarily contaminated and unwholesome, and that this is largely due to the present almost complete ignorance of persons, commercially interested, who do not appreciate the fact that bacteria arising from contamination by stable and barnyard dirt are capable, unless inhibited by cold (with the present allowance of time for transportation), of an enormous development which may render good milk utterly unfit for food. Although this study applies to the conditions existing in one city only, I hope that the facts brought out may be of general use.

The Source of New York Milk.

Nearly all the New York milk is transported to the city by railroads, most of it travelling a distance of 50 to 350 miles. The milk is delivered in the city about 2 a.m., consequently when it is shipped at a point distant 350 miles from New York it must start on its journey as early as 8 a.m. on the previous day. Under existing conditions the milk which reaches New York must, therefore, have been kept from 12 to 36 hours. Twelve hours more must elapse before the last of the milk is used. The milk is usually delivered at New York in 40-quart cans, or in quart jars. The dealers in the city have no control over the extent of bacterial growth which exists in their milk, though they may prevent further contamination and exclude further development by the application of cold.

The problem in New York and other cities of great size is, therefore, to furnish milk in a condition suitable for food after it has been kept from 24 to 48 hours. Milk even staler than 48 hours is now sold, but this is totally unnecessary and should not be allowed.

The present dangerous condition of the milk of great cities, especially in hot weather, arises partly from the fact that the great growth of the

cities has so widened the area from which milk is obtained. The cleanliness, cooling, and interval of time consumed in transportation, which sufficed for milk to be drunk in the neighbourhood, are utterly insufficient for milk which is consumed at a distance of 300 miles from the place of milking. The number of bacteria present in the milk of healthy cows, depends almost entirely on four things: (1) The original amount of germicidal substance in the milk; (2) The amount of bacterial contamination on or after milking; (3) The length of time which has elapsed since milking; (4) The temperature at which the milk has been kept. We have no control over the germicidal qualities of milk; but we can insure cleanliness in procuring milk. The degree to which milk is cooled and the length of time it is kept, can also be almost completely controlled.

There is an inexcusable lack of cleanliness in the methods of procuring milk and of care in sufficiently cooling and keeping it during its transportation. Even in the matter of sending milk to the railroad many farmers take twenty-four hours more than is necessary, keeping back one-half of their milk in order to save the trouble and expense of making more than one trip each day to the station. In considering what can be done to improve the New York milk supply, we may first note the comparatively small number of bacteria in milk which has been obtained and kept under suitable conditions, then the moderate number in milk which has been procured under ordinary dirty conditions, but which has been properly cooled and quickly transported, and finally the large number in the milk sold in New York under present conditions.

These data are given in the following observations:

I.

The number of bacteria present at the time of milking and 24, 48 and 72 hours afterwards in milk obtained and kept under correct conditions.

No preservatives were present in any of the following specimens.

TABLE I.

Milk obtained where every reasonable means was taken to insure cleanliness. The long hairs on the udder were clipped; the cows roughly cleaned and placed in clean barns before milking; the udders were wiped off just previous to milking; the hands of the men were washed and dried; the pails used had small (six-inch) openings, and were thoroughly cleaned and sterilized by steam before use. Milk cooled within one hour after milking to 45° F., and subsequently kept at that temperature. The first six specimens were obtained from individual cows; the last six from mixed milk as it flowed at different times from the cooler. Temperature of barns 55° F.

*Number of Bacteria in 1 c.c. of Milk¹.**From six individual cows.*

5 hrs. after milking	After 24 hrs.	After 48 hrs.	After 72 hrs.
500	700	12,500	Not counted
700	700	29,400	" "
19,900	5,200	24,200	" "
400	200	8,600	" "
900	1,600	12,700	" "
13,600	3,200	19,500	" "
Average 6,000	1,933	17,816	

From mixed milk of entire herd.

6,900	12,000	19,800	494,000
6,100	2,200	10,200	550,000
4,100	700	7,900	361,000
1,200	400	7,100	355,000
6,000	900	9,800	445,000
1,700	400	8,700	389,000
Average 4,333	2,766	10,583	329,000

Twenty-five samples taken separately from individual cows on another day and tested immediately averaged 4,550 bacteria per c.c. and 4,500 after 24 hours. These 25 specimens were kept at between 45° and 50° F.

II.

Milk taken during winter in well ventilated, fairly clean, but dusty barns. Visible dirt was cleaned off the hair about the udder before milking. Milker's hands were wiped off but not washed. Milk pails and cans were clean, but the straining cloths dusty. Milk cooled within two hours after milking to 45° F.

TABLE II.

Number of Bacteria in 1 c.c. of Milk.

At time of milking	After 24 hrs.	After 48 hrs.
12,000	14,000	57,000
13,000	20,000	65,000
21,500	31,000	106,000
Average 15,500	21,666	76,000

¹ Number of bacteria obtained from development of colonies in nutrient agar in Petri plates. The nutrient medium contained 2% peptone and 1.2% agar, and was faintly alkaline to litmus. One set of plates were usually left four days at about 20° C. and one set 24 hours at 37° C., and then 24 hours at 20° C. From 5 to 30% more colonies developed as a rule in the plates kept at room-temperature than in those kept for 24 hours at 37° C. The milk was diluted as desired with 100 or 10,000 parts of sterile water, and 1 c.c. of the diluted milk was added to 8 c.c. of melted nutrient agar. Plates containing over 1,000 colonies were found to be inaccurate, in that they gave too low totals. Apparently a considerable number of bacteria failed to develop colonies when too many were added to the nutrient agar. Nutrient gelatine was found to be more troublesome and not to yield more accurate results than nutrient agar.

III.

Milk taken from cows in ordinary barns. Ground covered thick with manure, the cows being more or less visibly dirty. The teats were cleaned slightly by running the unwashed hands over them once before milking. Pails and cans were thoroughly cleaned but not sterilized by heat. Milk cooled to 45° F. within two hours after milking.

TABLE III.

Bacteria in 1 c.c. of Milk.

Shortly after milking in warm weather	Shortly after milking in winter weather
18,800	11,500
18,800	11,600
21,200	17,800
22,000	18,900
51,200	19,900
51,200	20,200
Average 30,866	16,650
Average after 24 hrs. 48,000.	Average after 24 hrs. 31,000.
" " 48 hrs. 680,000.	" " 48 hrs. 210,000.

IV.

The condition of the average city milk is very different and is shown in the following tables.

The twenty samples were taken late in March by Inspectors of the Department of Health of New York City from cans of milk immediately upon their arrival in the city.

The temperature of the atmosphere averaged 50° F. during the previous 24 hours. The temperature of the milk when taken from the cans averaged 45° F. Much of this milk had been carried over 200 miles. From the time of its removal from the cans, which was at about 2 a.m., until its dilution in nutrient agar at 10 a.m. the milk was kept at about 45° F.

TABLE IV.

<i>From New York and Hudson River Railroad.</i>		<i>From Harlem Railroad.</i>	
No. of sample	No. of bacteria in 1 c.c.	No. of sample	No. of bacteria in 1 c.c.
50	35,200,000	48	6,200,000
51	13,000,000	49	2,200,000
52	2,500,000	50	15,000,000
53	1,400,000	51	70,000
54	200,000	52	80,000
55	600,000	53	320,000
56	2,500,000	54	5,000,000
57	100,000	55	140,000
58	3,700,000	56	25,000,000
59	135,000	57	52,000
Average per c.c.	5,933,500	Average per c.c.	5,406,200

It is interesting to note that while the average number of bacteria in the samples is very high, yet in nearly one-half of the specimens the number is low. The high figures were obtained from improperly handled milk.

V.

Milk as sold in the shops during the morning hours gave the following results:—

TABLE V.

Column *A* shows the number of bacteria per c.c. in 13 samples of milk supplied to the poorer tenement districts in midwinter. Average temperature of the milk 41° F. (highest 46°, lowest 38°).

Column *B* shows the corresponding number of bacteria in 10 samples taken from different dairy stores throughout the portion of the city inhabited by the more "well-to-do" classes in midwinter.

Column *C* gives corresponding figures for 5 samples from tenement districts early in September. Average temperature of the air during the preceding 24 hours, 78° F. Average temperature of samples 50° F.

Column *D* contains the results obtained early in September from milk sold in the "well-to-do" districts.

Number of Bacteria in 1 c.c. of Milk.

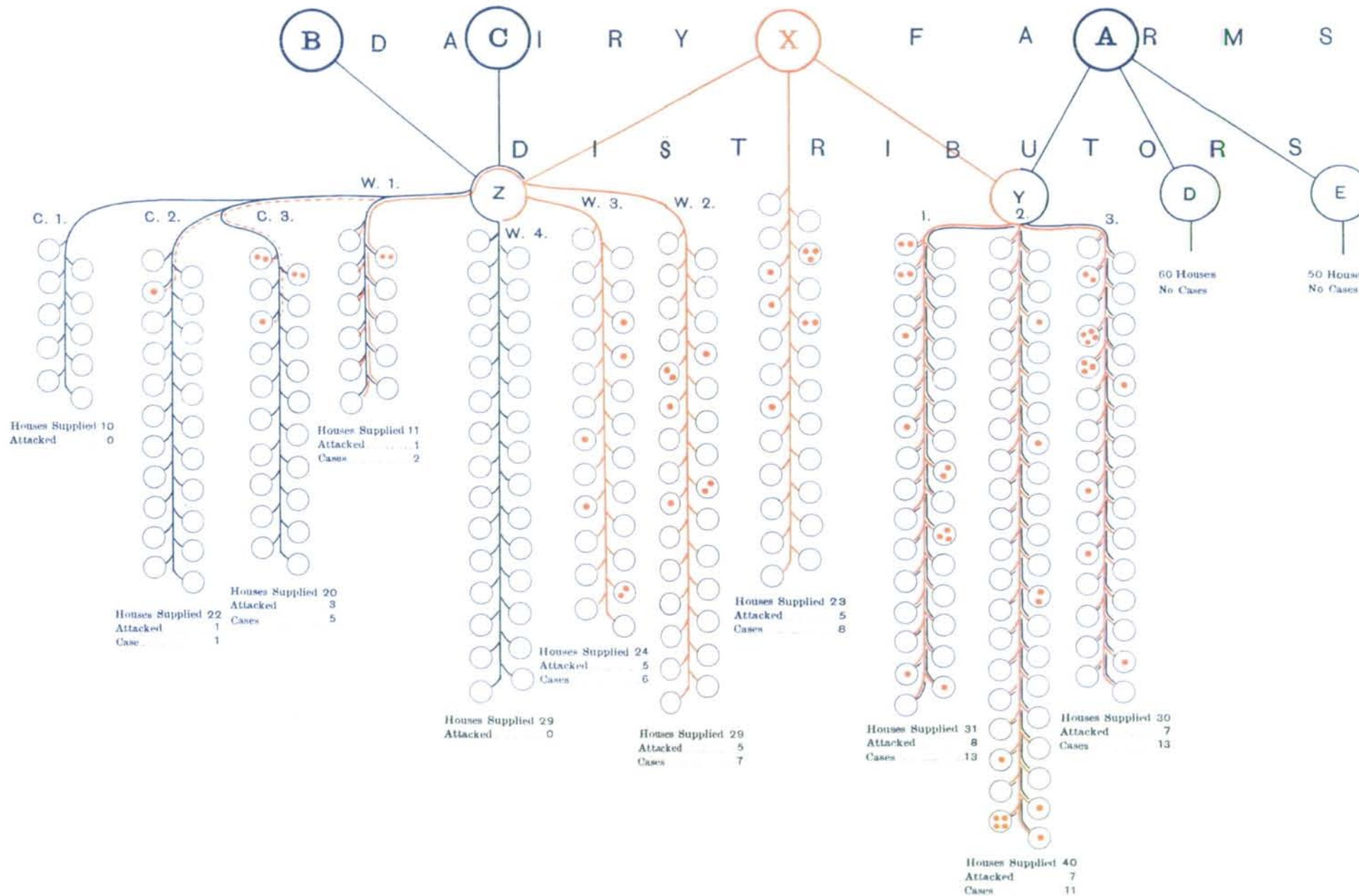
<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
110,000	30,000	5,600,000	80,000
140,000	30,000	6,100,000	192,000
140,000	60,000	15,910,000	355,000
145,000	60,000	16,320,000	480,000
175,000	70,000	31,888,000	4,200,000
280,000	155,000		
320,000	240,000		
560,000	560,000		
640,000	650,000		
1,200,000	1,420,000		
6,400,000			
5,100,000			
10,500,000			
Average 1,977,692	327,500	Average 15,163,600	1,061,400

While the above figures indicate that much of the milk sold in the better class stores is fair, even in summer, they show an appalling condition for most of that sold to the poorer classes—those who not only comprise the larger part of the population, but who are also compelled to keep their children in town during the hot weather.

It must be kept in mind that milk averaging 13,000,000 bacteria per c.c. will, when kept at the temperature common in the homes of the poor, soon contain very largely increased numbers and show its dangerous condition by turning sour and curdling.

CHART

Illustrating the Graphic Method of tracing the Distribution of Milk-carried Scarlet Fever applied to an Outbreak in Clifton, 1901.



Three Distributors supplying 269 houses.
42 houses attacked.—One house in every 6.4.

85 Other Milk Distributors supplied 6922 houses.
9 houses attacked.—One house in every 769.

A study of the present methods of handling milk makes it clear why so much of the milk contains excessive numbers of bacteria, and also fortunately how a great improvement can be effected by a few simple changes in the methods of handling milk.

*The Influence of Temperature upon the Rapidity of Bacterial
Multiplication in Milk.*

Few even of the well informed appreciate how great a difference a few degrees of temperature will make in the rate of bacterial multiplication. Milk rapidly and sufficiently cooled keeps almost unaltered for 36 hours, while milk insufficiently cooled deteriorates rapidly.

The majority of the bacteria met with in milk grow best at temperatures above 70° F., but they also multiply slowly even at 40° F.; thus of 60 species isolated by us, 42 developed good growths at the end of 7 days at 39° F. Our observations have shown that the bacteria slowly increase in numbers after the germicidal properties of the milk have disappeared, and the germs have become accustomed to the low temperature. In fact milk cannot be permanently preserved unaltered unless kept at 32° F. or less. The degree of cooling to which ordinary supplies of milk are subjected, differs greatly in various localities. Some farmers chill their milk rapidly, by means of pipe-coils over which the milk flows; others use deep wooden tanks filled with water into which the cans of milk are placed soon after milking. In winter these methods are very satisfactory, for the water runs into the pipes or tanks at about 38° F. In warmer weather they are unsatisfactory, unless ice is used, as the natural temperature of the water may be as high as 55° F. A considerable quantity of milk is not cooled at all at the farms. It is sent to the creamery or railroad after 2 to 6 hours, and is then more or less cooled. These few hours in summer, when the milk is left almost at blood heat, allow an enormous development of bacteria to take place as is shown in the table below.

TABLE VI.

Showing the development of bacteria in two samples of milk maintained at different temperatures for 24, 48 and 96 hours, respectively. The first sample of milk was obtained under the best conditions possible, the second in the usual way. When received, specimen No. 1 contained 3,000 bacteria per c.c., specimen No. 2 30,000 per c.c.

Temperature. Fahrenheit	Time which elapsed before making test			
	24 hrs.	48 hrs.	96 hrs.	168 hrs.
32°	2,400	2,100	1,850	1,400
	<i>30,000 *</i>	<i>27,000</i>	<i>24,000</i>	<i>19,000</i>
39°	2,500	3,600	218,000	4,200,000
	<i>38,000</i>	<i>56,000</i>	<i>4,300,000</i>	<i>38,000,000</i>
42°	2,600	3,600	500,000	
	<i>43,000</i>	<i>210,000</i>	<i>5,760,000</i>	
46°	3,100	12,000	1,480,000	
	<i>42,000</i>	<i>360,000</i>	<i>12,200,000</i>	
50°	11,600	540,000		
	<i>89,000</i>	<i>1,940,000</i>		
55°	18,800	3,400,000		
	<i>187,000</i>	<i>38,000,000</i>		
60°	180,000	28,000,000		
	<i>900,000</i>	<i>168,000,000</i>		
68°	450,000	25,000,000,000		
	<i>4,000,000</i>	<i>25,000,000,000</i>		
86°	1,400,000,000			
	<i>14,000,000,000</i>			
94°	25,000,000,000			
	<i>25,000,000,000</i>			

* The figures referring to tests of the second sample are printed in italics.

Observations on Bacterial Multiplication in Milk at 90° F., a temperature common in New York in Hot Summer Weather.

TABLE VII.

Number of Bacteria per 1 c.c.

	Milk I Fresh and of good quality	Milk II Fair quality from store	Milk III Bad quality from store
Original number	5,200	92,000	2,600,000
After 2 hrs.	8,400	184,000	4,220,000
„ 4 „	12,400	470,000	19,000,000
„ 6 „	68,500	1,260,000	39,000,000
„ 8 „	654,000	6,800,000	124,000,000

A sample of milk No. I. removed after 6 hours and cooled to 50° F. contained 145,000,000 at the end of 24 hours. Some of this milk which was kept cool from the beginning, contained but 12,800 bacteria per c.c. at the end of 24 hours.

Time Required for the Transportation of Milk from the Farm to the City.

On inspection of dairy-farms it is found that farmers make but slight attempts to hurry their milk to market, except perhaps in the very hottest weather.

Thus, if the milk-train leaves a town daily at 9 p.m. the farmer who finishes milking at 5 p.m., and cooling the milk by 6 p.m., does not send the milk to the station that evening, but waits until the next day, so that he can send the milk from the morning's milking at the same time, and save the trouble of an extra trip. Thus, instead of one-half of his milk being delivered at the city after 12 hours, 36 hours will have elapsed before it reaches the consumer. The same is true of farmers living at a greater distance from the city, who instead of getting their milk to the city after an interval of 24 and 36 hours, get it there after 48 and 36 hours, making it 60 and 48 hours old when it reaches the consumer. As the milk is usually only cooled to about 52° F. the immense development of bacteria permitted through this unnecessary addition of 24 hours to the shipping time is apparent. A glance at the previous table, as well as at the following figures, illustrates this.

Number of Bacteria present in Milk taken from cows in common dirty stalls, 24, 36 and 48 hours after milking. Milk cooled only to 52° F. three hours after milking and maintained at that Temperature.

TABLE VIII.

<i>Number of Bacteria per 1 c.c. of Milk.</i>				
After	3 hrs.	24 hrs.	36 hrs.*	48 hrs.
	21,200	70,000	350,000	1,600,000
	51,200	64,600	333,000	1,250,000
	18,300	61,000	305,000	1,400,000
	22,000	76,000	380,000	2,300,000
	51,200	64,000	320,000	1,280,000
	18,300	81,000	405,000	2,180,000
Average	30,366	69,433	348,833	1,668,333

* These figures at 36 hours are estimated from the test of one sample only.

By simply compelling the farmers within a radius of 100 miles from the city to send their afternoon's milk on the train of that evening, and those further off to send the morning's milk on the

morning train, a great decrease in the amount of bacteria would be obtained, since no milk would be delivered at a later time than 36 hours after milking.

The Degree of Cleanliness used in obtaining Milk and its Influence.

The present conditions under which much of the milk is obtained are not pleasant to consider. In winter, and to a less extent at other seasons of the year, the cows in many stables stand or lie down in stalls in the rear portion of which there is from one to four inches of manure and urine. When milked the hands of the milkers are not cleansed, nor are the under portions of the cows, only visible masses of manure adhering to the hair about the udder being removed. Some milkers even moisten their hands with milk, to lessen friction, and thus wash off the dirt of their hands and of the cow's teats into the milk in the pails. Some may regard it as an unnecessary refinement to ask that farmers should roughly clean the floors of their stalls once each day, that no sweeping should be done just before milking, and that the udders should be wiped with a clean damp cloth and the milkers should thoroughly wash and wipe their hands before commencing milking. The pails and cans should not only be carefully cleansed but afterwards scalded out with boiling water. The washing of the hands would lessen the number of ordinary filth bacteria in the milk, and diminish risk of transmitting to milk human infectious diseases like scarlet fever, diphtheria, and enteric fever, by the direct washing off of the disease germs from infected hands. It would also inculcate general ideas of the necessity of cleanliness and of the danger of transmitting disease through milk. The value of cleanliness in limiting the number of bacteria is demonstrated by the figures contained in the tables.

Summary and Conclusions.

Because of its location and its hairy covering the cow's udder is always more or less soiled with dirt and manure unless cleaned. On account of the position of the pail and the access of dust-laden air it is impossible to obtain milk by the usual methods without mingling with it a considerable number of bacteria. With suitable cleanliness, however, the number is far less than when filthy methods are used, there being no reason why fresh milk should contain in each c.c. on the

average, more than 12,000 bacteria in warm weather and 5,000 in cold weather. Such milk, if quickly cooled to 46° F., and kept at that temperature, will at the end of 36 hours contain on the average less than 50,000 bacteria per c.c., and if cooled to 40° F. will average less than its original number.

With only moderate cleanliness such as can be employed by any farmer without adding appreciably to his expense, namely, clean pails, straining cloths, cans or bottles, and hands, a fairly clean place for milking, and a decent condition of the cow's udder and the adjacent belly, milk when first drawn will not average in hot weather over 30,000, and in cold weather not over 25,000 bacteria per c.c. Such milk if cooled to and kept at 50° F., will not contain at the end of 24 hours over 100,000 bacteria per c.c. If kept at 40° F. the number of bacteria will not be over 100,000 after 48 hours.

If, however, the hands, cattle and barns are filthy, and the pails are not clean, the milk obtained under these conditions will, when taken from the pail, contain very large numbers of bacteria, even up to a million or more per c.c.

Freshly drawn milk contains a slight and variable amount of bactericidal substances which are capable of inhibiting bacterial growth. At temperatures under 50° F. these substances act efficiently unless the milk is filthy for from 12 to 24 hours, but at higher temperatures their effect is very soon completely exhausted, and the bacteria in such milk will then rapidly increase. Thus the bacteria in fresh milk which originally numbered 5,000 per c.c. decreased to 2,400 in the portion kept at 42° F. for 24 hours, but rose to 7,000 in that kept at 50° F., to 280,000 in that kept at 65° F., and to 12,500,000,000 in the portion kept at 95° F.

As we have seen, the milk in New York City is found on bacteriological examination to contain as a rule excessive numbers of bacteria. During the coldest weather the milk in the shops averages over 300,000 bacteria per c.c., during cool weather about 1,000,000, and during hot weather about 5,000,000. The milk in other large cities is from all accounts in about the same condition.

The above statement holds for milk sold at the ordinary shops, and not that of the best of the special dairies, where, as previously stated, the milk contains only from 10,000 to 30,000 bacteria according to the season of the year.

The question might be raised, Are even these enormous numbers of bacteria in milk during hot weather actually harmful? Here we

have only to refer to universal clinical experience, that a great number of children in cities sicken on the milk supplied in summer, that those put on milk which is sterile or contains few bacteria as a rule mend rapidly, while those kept on the impure milk continue ill or die.

Our knowledge is probably as yet insufficient to state just how many bacteria must accumulate to make them noticeably dangerous in milk. Some varieties are undoubtedly more harmful than others and we have no way of restricting the kinds that will fall into milk, except by enforcing cleanliness. We have also to consider that milk is not entirely used for some twelve hours after being purchased, and that during all this time bacteria are rapidly multiplying, especially where, as among the poor, no provision for cooling it is made. Slight changes in the milk which to one child would be harmless, would in another produce disturbances which might lead to serious disease. A safe conclusion is that no more bacterial contamination should be allowed than it is practical to avoid. Any intelligent farmer can use sufficient cleanliness and apply sufficient cold, with almost no increase in expense, to supply milk 24 to 36 hours old which will not contain in each c.c. over 50,000 to 100,000 bacteria, and no milk containing more bacteria should be sold.

The most deleterious changes which occur in milk during its transportation are now known not to be due to skimming off the cream, or to the addition of water, but to the changes produced in the milk by multiplication of bacteria. During this multiplication, acids, and distinctly poisonous bacterial products are added to the milk, to such an extent that much of it has become distinctly deleterious to infants and invalids. It is the duty of Health Authorities to prevent the sale of milk rendered unfit for use through excessive numbers of bacteria and their products.

The culture-tests to determine the number of bacteria present in any sample of milk require at least 48 hours, so that the sale of milk found impure cannot be prevented. It will, however, be the purpose of the authorities gradually to force the farmers and the middlemen to use cleanliness, cold and despatch in the handling of their milk, rather than to prevent the use of the small amount tested on any one day.

If the milk on the train or at the dealer's were found to contain excessive numbers of bacteria, the farmers would be cautioned and instructed to carry out the simple necessary rules, which would be furnished. If they failed to correct the evil, the Health Authorities

would, by refusing permits to the sellers, or in other ways, prevent the further sale of such milk. Thus the present lack of interest of dealers and farmers regarding the bacterial purity of their milk would be overcome.

If the authorities decide to establish a standard of bacterial purity for milk, what should it be?

We must recognize that much of the present impurity of milk in hot weather is due to the ignorance of the farmers and carriers, also that it will be well, if possible, to have their cordial co-operation in bettering the quality of the milk. It seems to the writer, therefore, that at first it would be more important to establish the principle that excessive bacterial multiplication in milk is harmful, and to get the co-operation of all those who deal with milk to do their best to limit this multiplication, than to fix any definite number of bacteria as the limit above which milk must be destroyed. Some figures, however, must be adopted by the authorities, even at first, beyond which milk cannot be allowed to be distributed. For the first year I think 500,000 per c.c. for milk entering New York and 1,000,000 per c.c. for milk delivered to the consumer might be a practical standard. If no milk worse than the above was brought in or distributed there would be a vast improvement over previous years, and, as a matter of fact, no dealer could afford to try and approach the limit, for if he did he would frequently go beyond it. Thus even by enforcing a standard allowing at least tenfold the number of bacteria which should be present in milk, a great improvement in our milk supply and a compulsory education of the farmer in the need of cleanliness, the preservative effect of cold, and a few of the elementary laws governing the transmission, the multiplication and the products of bacteria, would be secured. The difficulties which would be met with in distributing knowledge, in carrying out the tests, and in enforcing better methods would undoubtedly be great in cities of the size of London and New York: but the size of a city increases the need even more than the labour of the work; and wholesome, clean, unfermented milk is certainly of sufficient importance to make it worth while to undertake far more difficult tasks than this will prove to be.

On May 8th, 1901, the Department of Health of New York City adopted measures to prevent, after a reasonable time, the introduction into New York City of milk which contains unnecessary numbers of bacteria. It will be of great interest to watch the results of this action.

APPENDIX.

CIRCULAR OF INFORMATION FOR FARMERS RELATING TO
THE COLLECTION AND CARE OF MILK¹.*Issued by the Department of Health of New York City.*

The Department of Health of New York City has determined to adopt stringent measures against the introduction into New York of milk which contains an unnecessary and dangerous number of germs or bacteria.

The investigations of the Department have shown that under proper conditions and with reasonable care milk reaches the city in excellent condition, containing but a comparatively small number of germs. Where large numbers of germs are present in it, experience has shown that it is always the result of an unusual lack of cleanliness, or some serious defect in the methods of collection, handling, or care of the milk.

This circular is issued by the Department for the information of farmers and dairymen so that they may in their own interests observe those precautions which are necessary to preserve the milk in good condition and thus prevent its being condemned.

DIRECTIONS.

1st. The greater the cleanliness observed in collecting milk, the smaller will be the number of germs which drop into it.

2nd. The quicker the temperature of the milk is reduced and the lower it is kept the slower the growth of bacteria in it will be.

3rd. The quicker the milk is transported to the consumer the less time there is for the multiplication of germs and the better will be the condition of the milk when delivered.

*A Detailed Consideration of these three Factors which influence
the Condition of Milk.*

1st. **The Barns.** The barns should be kept clean, so that the cattle will not become filthy from lying in manure. If the cows are milked in the barns, no sweeping should be done a short time before milking, otherwise the dust raised, which is full of germs, will settle into the milk. If possible, a separate clean shed should be used for milking. The barns and the dairy building, if there is one, should be some distance from the dwelling house, to limit the danger of transmitting through the milk any contagious disease which may occur among the inmates of the house. Barns should be well ventilated and dry, so as to keep the cattle healthy.

2nd. **The Water.** The water used for cleaning the pails, cans, and for all other purposes in connection with the milk should be from a source at some

¹ This circular is to be distributed to all farmers who send milk to New York City.

distance from the house and barn, so that there shall be no danger of pollution by sewage.

3rd. The Cows. The majority of the germs which enter milk come from dirt which is shaken from the cow's udder and belly during milking. In order to have clean milk, it is necessary to prevent this; therefore previous to milking, the udder and the adjacent belly should be cleaned of dirt. All visible manure from these portions and from the tail should be removed, and the udder and the skin of the belly surrounding it should be wiped with a damp cloth. This largely prevents it from being shaken off during milking.

The milk should not be used from cows whose udders are diseased, or who are themselves unhealthy in any way.

4th. The Milkmen. All who come in contact with the cows or the milk should be free from contagious disease, and should not come in contact with any case of contagious disease, such as diphtheria, scarlet fever or measles. These and other diseases may be transmitted by the infection of the milk.

Before milking, the milkmen should thoroughly wash their hands with clean soap and water and dry them on a clean cloth, in order to remove all dirt and germs from them. This should be done after the cow's udder, belly and tail have been cleaned. Milkmen should never moisten their hands with milk, in order to lessen the friction in milking, as this tends to cause dirty milk to drip into the milk-pail.

5th. The Pails, Cans, Straining Sieves and Cloths. These should all be absolutely clean. They are very frequent sources of extensive contamination of the milk. They should all be cleaned immediately after use, first with lukewarm water, and then sterilized by being scalded with boiling water. After being thoroughly washed they should be placed upside down, to prevent dust falling into them, as this contains great numbers of germs. Straining sieves and cloths should be covered over to protect them from dust.

6th. Cooling. Milk should be cooled quickly to 45° F., or less. The simplest way is by placing the cans in a large wooden tank containing cold water. Except in winter, the water should be cooled and kept cold by the addition of ice, so as to be at 40° F., or less, and the cans should be immersed up to their necks and left to stand at least one hour, or until shipped to the creamery or train. If any milk in the cans stands at a level higher than the surrounding water, it is scarcely cooled at all for many hours.

The milk having been obtained in a cleanly manner and quickly cooled, should be delivered cold at the creamery or train. A full can of milk retains its cold for some time, but in summer should not be exposed to the warmth of the air for over one hour. If it is to be kept for a longer period at the station, some arrangements for keeping it cool must be made. Milk should never be allowed to stand in the sun.

7th. Transportation. Milk should be shipped to the city as quickly as possible. Many farmers hold the evening's or morning's milk over an entire day, to avoid the inconvenience of early delivery. This causes great injury to the milk. Dairymen have come to believe that as long as the milk is delivered in the city in such condition that it will remain sweet until delivered to the consumer, nothing more is required. Such milk when sold often contains enormous numbers of germs, is unwholesome, dangerous, and capable of causing much sickness and death, especially

in the summer. The high death-rate from diarrhoea among infants in the summer in the city is wholly due to such milk. Milk known to be over 36 hours old, or containing large and unnecessary numbers of germs, will not in future be allowed to enter New York.

The Transmission of Contagious Diseases through Milk.

No farmer or dairyman should allow any one who has a contagious disease, or who has been in contact with any person having scarlet fever, typhoid fever, measles, diphtheria, or consumption, to have access to the cattle, or to have any connection with the milk or milking, or with the milk utensils. Epidemics and outbreaks of contagious disease are often produced through the infection of the milk in this way, and if cases of disease in New York are traced to any dairyman, and proof is found that disease has been transmitted through negligence on his part, the Department of Health will take summary action in relation to this.