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Care of Dairy Utensils.

Cleanliness is the first law which should be observed by every man who in any way manufactures or handles dairy products. The real meaning of the term cleanliness or sanitation is to preserve or promote good health, be it of the individual or the public, hence any condition which will promote this end effectively should be established. The simpler these conditions can be made, the better. They need not be expensive or elaborate, and they certainly are within the reach of every dairyman. Inasmuch as the dairy industry is so important in influencing the health of the consumer, it is fitting that we pay special attention to the cleaning of utensils used in the dairy.

Unclean dairy utensils are among the greatest sources of contamination of milk. This contamination is due to the presence of undesirable bacteria. Some bacteria are useful and necessary in the art of causing such changes as the souring of milk and the ripening of cheese, all of which are processes produced by bacteria of a desirable kind.

The undesirable bacteria are those that produce taints in milk and which exist principally in filth lodged on the surface and in the crevices of dairy utensils. The amount of filth is an indication of the number of undesirable bacteria in the milk. These bacteria are minute organisms which have the power of multiplying very rapidly under favorable conditions.

The conditions most suited to their growth are food, warmth,

and moisture. Milk furnishes the required food for their growth. Bacteria are especially numerous in and around a dairy and get into the milk in many ways. Thousands of them are concealed in crevices that can barely be seen, and if they come in contact with milk they will increase many thousand fold within a short time and set up bad fermentations, which are familiar to all dairymen.

The real object of sanitation is to get rid of these undesirable germs. While it is a fact that some of them are harmless, still there are many which are harmful to human life, hence we must establish conditions by which we can destroy them effectively and without great expense.

The first requisite is to purchase dairy utensils that can be easily cleaned, which have smooth, hard and non-porous surfaces, and corners so made that they are easily accessible to a brush or cloth. Unnecessary corners and angles should be avoided.

Wooden utensils should never be used for receiving milk, as wood contains myriads of small pores which retain milk, making it impossible to clean such vessels thoroughly.

Glass and earthenware have sometimes been used and are very efficient, but, on account of their expensiveness, the ease with which they are broken and their great weight, they are impractical for dairy use.

Tinned metal complies most nearly with all requirements, and is the cheapest and most practical at the present time. However, the metal should be of good quality and heavily and smoothly tinned to avoid bare iron spots, which are liable to corrode and become rough, thus serving as breeding places for bacteria. It is not deemed wise to use galvanized iron, zinc or other rough surface metal.

All joints, corners, seams and crevices should be made smooth and filled entirely with solder. Pressed tin or seamless utensils are preferable from a sanitary standpoint. Milk pails in particular should have no corners so that there will be no places for bacteria to grow. Strainers and aerators should be made likewise, smooth and with as few projecting nut's, rods or braces as possible. Storing or delivery cans, dippers and other utensils must also comply with this rule. A new piece of strainer cloth should be used at each milking.

The principal things necessary for keeping utensils clean are hot water or steam, some alkali, a scrubbing-brush or a coarse cloth, combined with plenty of elbow-grease to make these agents effective. All utensils should be cleaned immediately after using.

The method for cleaning varies slightly according to what the utensils have contained. If they have been used for milk, they should first be rinsed with cold or luke-warm water so as to wash off the viscous albuminoids, which, if subjected to boiling water would coagulate and adhere firmly to the tin, thus becoming difficult to remove. They should then be thoroughly washed in hot water with some cleansing material, such as washing powders or caustic soda, in order to remove the grease. The water should be quite hot and the washing powders should not be used sparingly, for we too often find vessels where the grease has not been removed, but simply smeared over the tin. Caustics and washing powders are not only effective in cleaning the grease from utensils, but they also act as a means of destroying bacteria. Common soaps, and especially if perfumed, should be avoided. After the washing, utensils should be treated differently according to conditions. If steam is at hand, a thorough steaming should follow, steam being the cheapest and most effective agent for destroying germs in creameries, cheese factories, and large dairies. Since the production of steam requires a boiler, which is quite expensive for the average dairy farmer, it is necessary in his case to pursue a different course for destroying bacteria.

It has been found that a five or seven per cent solution of good fresh washing powder applied in hot water will make a good material for destroying germ life, provided the utensils are subjected to this solution for at least ten minutes, after which they should be rinsed in hot water and set away in the pure air to dry. The latter method requires more time to accomplish the same purpose than with steam, but is better adapted for farm use.

There are other methods for conveniently destroying bacteria on dairy utensils; they are, however, more expensive, but very effective. A practical way is to rinse the utensils, after they have been thoroughly washed in some alkali, with a hot solution containing six to twelve per cent borax. This solution also preserves the tin to a slight extent, but care must be taken not to get it into the milk.

Sunlight and pure air are the cheapest and most effective means of keeping the utensils pure and sanitary after they have been cleansed. Where these conditions do not exist it is then advisable to put them in a hot drying-room.

Old, unclean dish-cloths should never be used for wiping dairy utensils after they have been steamed or subjected to the hot washing solution, as the germs which are lodged in the cloth will be again distributed over the surface of the vessels, thus rein-

fecting them. If utensils must be wiped dry, it is always best to use a coarse linen cloth, which has previously been steamed or boiled.

Scrub-brushes are the best articles for use in cleaning dairy utensils. Coarse linen cloths may also be used, but they require more care in keeping them clean. The same methods for cleaning utensils should be followed for cleaning cloths.

EXPERIMENTS IN CLEANING SEPARATORS.

The hand cream separator is probably the most complicated piece of apparatus used in the dairy, and hence most likely to be the greatest source of contamination of milk. With this fact in view, and owing to the rapid increase of the use of farm cream separators, it was deemed necessary for this Station to carry on experiments to determine the extent of contamination which resulted from the several methods of treating the cream separators as advocated by separator agents and practiced by farmers.

The following experiments were conducted to demonstrate the relative cleanliness obtained by the various methods of (1) flushing out the bowl with water and (2) thoroughly washing cream separators. For this demonstration in the first experiment, three separators of average size and common use in this State were selected: An Alpha DeLaval, U. S., and Sharples, all 450-pound capacity machines. The test was made for six consecutive days, beginning January 18 and ending January 24, 1905. It is needless to mention that uncleanly conditions at that time of the year are not as disastrous in the dairy as they are in the warm summer months. Two gallons of 4 per cent milk were run through each separator at 85° F. at the same time every morning and evening during the test. After separating that amount of milk, separator No. 1 was thoroughly washed in the usual way; separator No. 2 was flushed out with two gallons of water at about 125° F.; separator No. 3 was first flushed out with one gallon of water at 125° F., and then flushed with one gallon of water and one-half pint of Standard washing powder in solution, then flushed out again with a gallon of the water at the same temperature, to remove the washing powder. Separators Nos. 2 and 3 were left standing in readiness for use the next time, while No. 1 was washed with bowl left apart and every part left exposed to air and ventilation. In the second experiment six different separators of average size and common use were tested — Iowa, National, Davis, Simplex, Empire, and Reid. Two gallons of 4 per cent milk at 85° F. were run through each machine every evening for six consecutive days, and the

bowls of each flushed with two gallons of water at 125°F. All of these separators were left in readiness for use until the following morning, when they were again used, two gallons of milk being run through each. They were then taken apart and thoroughly washed. So that the milk was run through clean separators every evening and through dirty ones every morning.

A sample of milk was taken from each separator every time they were used during the experiment, and a curd test and quantitative analysis of bacteria was made. The acidity of the milk was determined just before separating, the same milk being used for each separator.

A quantitative analysis of bacteria was also taken of the whole milk just before separating to ascertain the relative number of bacteria that are extracted from milk by centrifugal separators. The quantitative analyses of bacteria were obtained in the following way: One-tenth cubic centimeter of milk was drawn into a sterilized graduated pipette and transferred into a water blank test-tube containing .9 cubic centimeter of sterilized water. After shaking well, one-tenth cubic centimeter of this was transferred in the same way into a test-tube containing sterilized agar medium, well mixed, and poured into a petri dish. The solution then contained one one-hundredth cubic centimeter of milk, and the number of colonies that developed in each dish was therefore multiplied by 100 to obtain the average number of bacteria per cubic centimeter.

FIRST EXPERIMENT.

After making plates of each sample of milk as above indicated they were allowed to remain at ordinary temperature, 70° F., twenty-four hours and then placed in an incubator at 100° F. the same length of time, so as to give all germs whose optimum temperature varies a chance to develop. The table illustrates the results obtained.

Cuts 1, 2 and 3 are photographs of plates made from milk from separators Nos. 1, 2, and 3, respectively, on the sixth day of the experiment. Separator No. 1 decreased the number of bacteria in the milk by leaving large numbers of them in the dirt and slime in the bowl, while No. 2, which was only flushed with hot water, soon began to smell badly and at the end of the experiment was almost unbearable. Separator No. 3, which was flushed with hot water, washing-powder solution, and again with hot water, did not smell so badly nor get so dirty as No. 2, but the difference between them was slight.

METHOD OF CLEANING.

No. of Separator.	January.	Milk Temp., de-grees.	Per cent Acid.	Temp. Flush Water, Deg. F.	Method.	Av. No. Bacteria in Milk Before Separation, per c. c.	Av. No. Bacteria per c. c. After Separation.
No. I.	18 p. m.	85	.21	.....	Sterilized...	120,000	60,140
No. II.	18 p. m.	85	.21	120	Flush.....	120,000	66,220
No. III.	18 p. m.	85	.21	120	Powder*....	120,000	64,730
	18 a. m.	85	.24	.....	Sterilized...	342,000	246,840
No. I.	19 p. m.	85	.53	.....	Sterilized...	1,421,000	1,669,600
	19 a. m.	85	.24	120	Flush.....	342,000	2,135,000
No. II.	19 p. m.	85	.53	110	Flush.....	1,421,000	4,256,000
	19 a. m.	85	.24	120	Powder*....	342,000	2,100,000
No. III.	19 p. m.	85	.53	110	Powder*....	1,421,000	3,025,000
	19 a. m.	84	.19	.....	Sterilized...	173,000	112,060
No. I.	20 p. m.	85	.20	.....	Sterilized...	187,000	140,000
	20 a. m.	84	.19	120	Flush.....	173,000	4,880,000
No. II.	20 p. m.	85	.20	118	Flush.....	187,000	10,240,000
	20 a. m.	84	.19	120	Powder*....	173,000	3,500,000
No. III.	20 p. m.	85	.20	116	Powder*....	187,000	7,785,000
	20 a. m.	80	.19	.....	Sterilized...	100,000	76,000
No. I.	21 p. m.	80	.18	.....	Sterilized...	97,000	91,000
	21 a. m.	80	.19	115	Flush.....	100,000	4,128,000
No. II.	21 p. m.	80	.18	116	Flush.....	97,000	7,168,000
	21 a. m.	80	.19	115	Powder*....	100,000	3,964,000
No. III.	21 p. m.	80	.18	116	Powder*....	97,000	3,325,000
	21 a. m.	84	.24	.....	Sterilized...	150,000	88,000
No. I.	22 p. m.	85	.21	.....	Sterilized...	123,000	88,000
	22 a. m.	84	.24	120	Flush.....	150,000	5,120,000
No. II.	22 p. m.	85	.21	123	Flush.....	123,000	3,264,000
	22 a. m.	84	.24	120	Powder*....	150,000	2,688,000
No. III.	22 p. m.	85	.21	123	Powder*....	123,000	1,920,000
	22 a. m.	85	.24	.....	Sterilized...	175,000	137,000
No. I.	23 p. m.	85	.20	.....	Sterilized...	133,000	121,000
	23 a. m.	85	.24	125	Flush.....	175,000	2,412,000
No. II.	23 p. m.	85	.20	125	Flush.....	133,000	3,146,000
	23 a. m.	85	.24	125	Powder*....	175,000	3,641,000
No. III.	23 p. m.	85	.20	125	Powder*....	133,000	2,421,000
No. I.	24 a. m.	85	.21	.....	Sterilized...	76,000	64,000
No. II.	24 a. m.	85	.21	125	Flush.....	76,000	4,641,000
No. III.	24 a. m.	85	.21	125	Powder*....	76,000	1,421,000

* Amount of washing powder used, 1 pint to 8 pounds of water.

It will be noticed from the results in the table that the number of bacteria per c. c. of milk slightly diminished rather than increased toward the end of the experiment, especially in separator No. 2. This is due to the fact that the bacteria harboring in the bowl of the separator began to produce enzymes and lactic acid to such an extent as to prevent their rapid multiplication.

The milk used in this test varied in acidity from day to day, but was as near the average farm dairy milk as could be obtained. The higher the acidity the larger the number of bacteria. This would not hold true after milk had developed .9 per cent acidity, for most bacteria cannot grow in an acid medium. However, no milk was used with such a high per cent of acidity. When the experiment ended and the separator bowls were all taken apart, Nos. 2 and 3 immediately filled the room with a foul odor. A thick coat of slimy curd and dirt covered the entire inner surface of the bowls, cones, and plates. Several hours were required to thoroughly cleanse and sterilize them again. All parts of the bowls were badly rusted, and they could hardly be polished as

bright as they were before the experiment. Cuts Nos. 4, 5 and 6 represent photographs of the curd made from milk from each separator by the curd test. Glass pint jars were filled almost full of the milk, and a few drops of rennet added to each and well shaken. They were then left at 90° F, for eight to twelve hours and the curd examined. The curd from separator No. 1 was a natural smooth curd in every case, and had a clean taste and smell, while that of Nos. 2 and 3 developed a foul odor, round gas holes, and a rancid, bitter taste. Cuts 5 and 6 show very distinctly the round holes caused by gas-forming bacteria.

SECOND EXPERIMENT.

In this experiment, as previously outlined, seven different cream separators were used for six consecutive days beginning February 20 and ending February 26, 1905. During this time the weather varied in temperature from 30° to 60° F. The temperature of the creamery remained almost uniform, ranging from 60° to 70° F. At this temperature there would not be as rapid bacterial development as at 85° to 100° or average summer temperature.

The separators were thoroughly washed every morning after separating, but were only flushed out with warm water at night. This is a practice quite prevalent in many dairy communities at the present time.

The following table is an average of the number of bacteria per c. c. in the milk before and after separating, both morning and evening, for the entire six days.

	Average Acid.	Flushed Separators, A. M.	Clean Separators, P. M.
Separator No. 1—			
Before separating.....	2 per cent....	950,000	750,000
After separating.....	2 per cent....	3,280,000	575,000
Separator No. 2—			
Before separating.....	2 per cent....	675,000	410,000
After separating.....	2 per cent....	4,280,000	356,000
Separator No. 3—			
Before separating.....	2 per cent....	570,000	653,000
After separating.....	2 per cent....	5,355,000	570,000
Separator No. 3—			
Before separating.....		600,000	789,000
After separating.....		6,412,000	593,000
Separator No. 4—			
Before separating.....		782,000	813,000
After separating.....		5,384,000	695,000
Separator No. 5—			
Before separating.....		871,000	812,000
After separating.....		8,232,000	784,000
Separator No. 6—			
Before separating.....		773,000	542,000
After separating.....		6,987,000	487,000
Separator No. 7—			
Before separating.....		377,000	290,000
After separating.....		2,698,000	271,000

From this table we see there is a marked reduction in the number of bacteria in milk after being exposed to the centrifugal force of a clean cream separator. The case in slime and dirt that are forced from milk by this means carry out large numbers of bacteria. It will also be noticed that the milk from dirty or flushed separator bowls contains an additional number of bacteria, from two to eight million per c. c., showing that comparatively clean milk which comes in contact with the filth and slime of the separator bowl is readily contaminated with more bacteria than are thrown out by the centrifugal force. The purer the milk the easier the contamination. Cream delivered at the College creamery frequently has a taste or smell of dirty utensils or separators. Cream thus tainted is not so easily detected as tainted milk, on account of the larger per cent of fat present. Consequently, farmers who have been practicing the flushing method have been churning or delivering cream at creameries that can never be transformed into first-grade butter. Cut No. 7 is an average representative plate from one one-hundredth c. c. of the milk from clean separators. Cut No. 8 is an average of the plates made from one one-hundredth c. c. of milk from the flushed separators. Each dot represents a colony of bacteria which grew from a single individual.

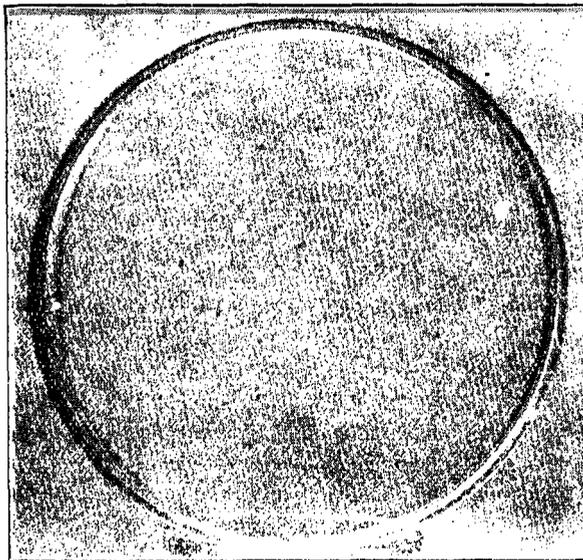
CONCLUSIONS.

1. A cream separator should be thoroughly washed every time after using. A brush should be used on every part and piece, using 5 per cent solution of borax or other good washing powder. Rinse in hot water, or steam if possible. They should then be left to dry while hot. Wiping with an ordinary clean cloth contaminates utensils with innumerable bacteria.
2. The bacterial contamination in milk is increased from three to five times by running it through a separator bowl which has been used and only flushed and left standing several hours. If only flushed while using for several days, the contamination increases several times more, and such milk would be likely to be detrimental if fed to calves.
3. The use of washing powder in flush water reduces the number of bacteria in the following batch of milk that is run through, and cleanses the separator more than hot water alone, but not sufficiently to warrant that method of cleaning.
4. The use of a cream separator that is thoroughly washed reduces the number of bacteria in milk one-fifth to one-fourth.
5. Improper cleaning is detrimental to a separator on account of the rust that accumulates on dirty or damp places. This may

shorten the life of the machine many months, depending on the degree of cleanliness employed.

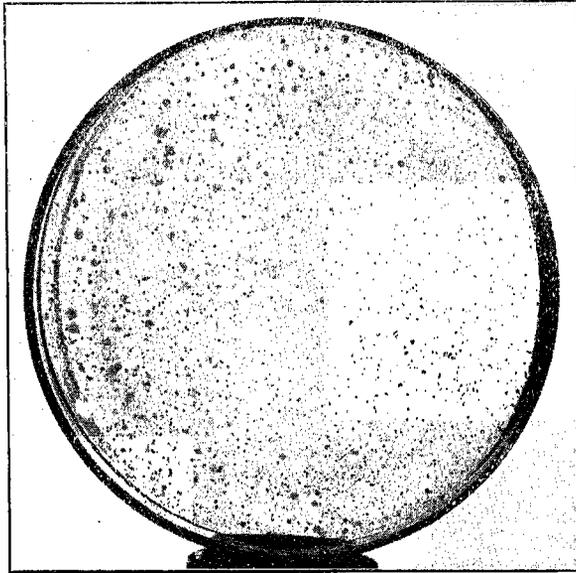
6. Running milk through a dirty separator is similar to running it through a dirty strainer, with all of the filth of the previous milking left in it from twelve to twenty-four hours. The millions of undesirable bacteria from the dirt, manure and slime lodged in the separator bowl spoil all the milk, to a greater or lesser degree, that passes through the machine.

7. When properly used, a cream separator is a clarifier and to a certain extent a purifier of milk, but when carelessly used it is a source of filth and contamination.

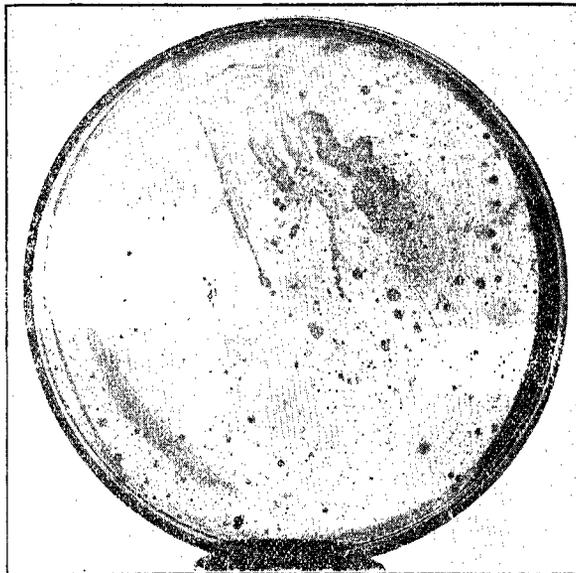


No. 1. Culture of $\frac{1}{16}$ cc. milk from sterilized separator.*

*Each dot represents a colony of bacteria which grew from a single individual

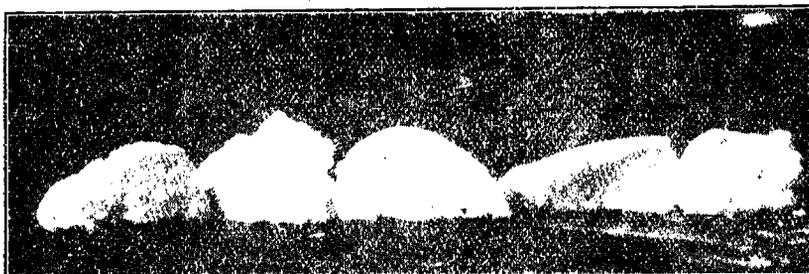


No. 2. Culture of $\frac{1}{16}$ cc. milk from separator which had been flushed with warm water only.*



No. 3. Culture of $\frac{1}{16}$ cc. milk from separator which had been flushed with hot water and washing powder.*

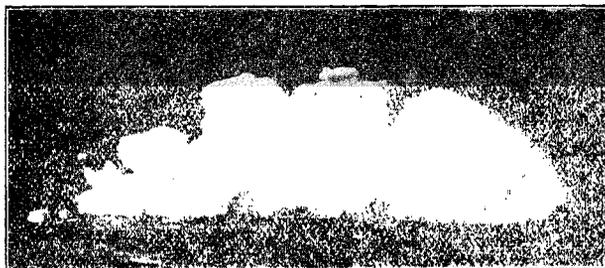
*Each dot represents a colony of bacteria which grew from a single individual.



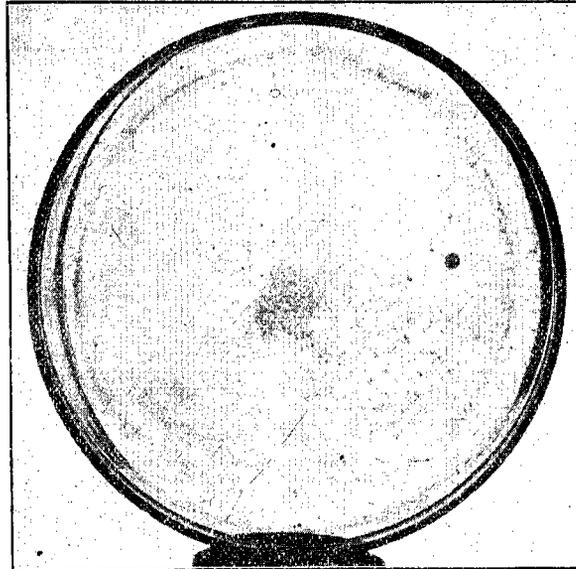
No. 4. Curd of milk from sterilized separator.



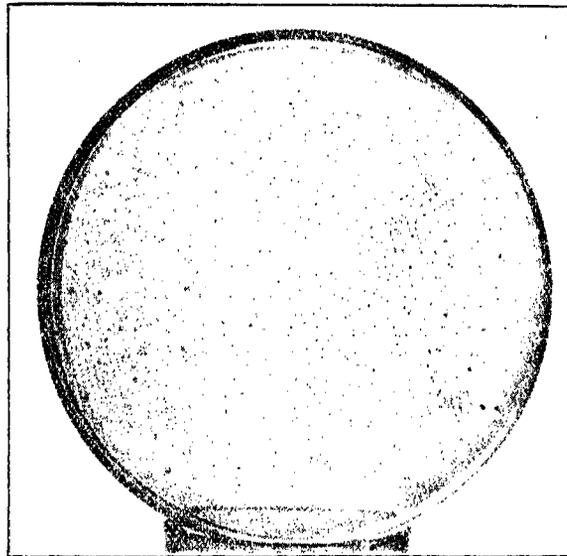
No. 5. Curd of milk from separator flushed with warm water.



No. 6. Curd of milk from separator flushed with warm water and washing powder.



No. 7. Culture of $\frac{1}{10}$ cc. milk from average sterilized separator.*



No. 8. Culture of $\frac{1}{10}$ cc. milk from average separator flushed once a day and sterilized once a day.*

*Each dot represents a colony of bacteria which grew from a single individual.