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Editorials

The opinions and ideas expressed in papers and editorials are those of the respective authors. The expressions of the Association are completely recorded in the transactions.

PUBLIC HEALTH SERVICE DISEASE REPORTS, 1948

YES, the Public Health Service annual "Outbreaks" report again: this time for 1948. And, by the way, that term *outbreak:* in no one of five dictionaries consulted is the word defined specifically as applying to an unusual prevalence of disease. In the medical tomes the word does not appear. The others, in almost identical general terms, define an outbreak as "a bursting forth; an eruption; a sudden or violent manifestation of harmful activity." Maybe the P.H.S. should speak to the dictionary people. Certainly common usage for more than 30 years should entitle outbreaks of disease to special recognition. Even "ain't" is in the dictionary.

Speaking of definitions, we still contend that one ill person, by any reasonable definition, constitutes a case of illness and not an outbreak. Yet we have them again in the food-borne list: five of them. But this time, as last year, one is so interesting and unusual as to fully justify its inclusion *as a case.* The story, this time, is a tragedy. Mr. R., of New Haven, Conn., "in honor of his birthday was invited to dine at the home of a friend in the company of several other friends. Eight persons enjoyed, as one course, raw clams with lemon and vinegar." The host, it seems, had dug the clams from New Haven harbor, at a point not far from a sewage treatment plant outlet. He had disregarded warning signs along the shore. As a result of eating 24 of the clams the guest of honor contracted typhoid fever and, later, died. This was the first recorded case of typhoid in New Haven in seven years and the first for the state in 1948.

But, to get down to business: here, again, is our "simple tabulation" of last year, with the outbreak figures for 1948 added. This is provided, as we said last year, "for purposes of rough comparison." Attention is called to the fact that outbreaks in which infection was *suspected* to have been conveyed through the specified vehicles are listed separately. In the Public Health Service tables they are still included in the outbreak totals.

NUMBER OF OUTBREAKS

	1944	1945	1946	1947	1948
Milk and milk products	36	24	12	17	13
Ditto suspected	5	5	6	5	4
Other foods	288	272	287	292	304
Ditto suspected	10	3	12	24	22
Water		20	25	20	16
Ditto suspected		6	7	4	5
Undetermined vehicles		12	6	27	10

MILK AND MILK PRODUCTS

Thirteen outbreaks: 11 gastroenteritis (listed as such or as food infection or poisoning); 1 bacillary dysentery; 1 typhoid fever. The picture is quite similar to that of 1947. The numbers of outbreaks have been remarkably—if not suspiciously—low. Three small outbreaks of food infection or poisoning were charged to cheese, in two instances apparently home-made. Home-made ice cream was credited with one.

Of the 9 outbreaks charged to milk (or, in one instance, cream) in 4 of gastroenteritis (by one name or another) pasteurized milk was involved. It was believed, in all four, that contamination occurred in handling after delivery. In one of these, a 3-case outbreak from New York City, the information as to how contamination occurred was too vague to be thoroughly convincing. The Big Town also reported another of 3 cases in which it was not indicated whether or not the milk was pasteurized or how contamination occurred.

The largest milk-borne outbreak was one of 165 cases of gastroenteritis in a school at Macon, Georgia. This was believed to have been a virus infection, a condition which had been prevailing generally in the city. "Several other schools had minor episodes"—presumably the same condition. Eighteen persons at the involved school had gastroenteritis, although they had not had the milk. Analysis, the report said, pointed to milk as the most likely vehicle "if any food was." The published evidence raises a question whether this outbreak should not have been in the "Suspected" list.

The one typhoid outbreak, 11 cases in a rural area in Ohio, was traced to a typhoid carrier selling raw milk in gallon jugs at the farm.

FOODS OTHER THAN MILK

The 304 outbreaks line up as follows:

Bacillary dystentery	1	Food poisoning	185
Botulism	7	Gastroenteritis	34
Chemical poisoning	5	Paratyphoid fever	1
Diarrhea	3	Streptococcus sore throat	1
Diphtheria	1	Trychinosis	14
Food infection	49	Typhoid fever	3

The botulism outbreaks were all charged to home-canned or home-cooked foods. One, at Beaver Falls, Pa., was labeled "Botulism (probably)" and attributed to scalloped potatoes. The only notable chemical poisoning outbreak, 48 cases in a prison at Frankfort, Ky., presented the sort of a prison story which is becoming familiar. An inmate cook, mad at a supervisor because of restrictions on his liberty, put soap powder in the Thanksgiving turkey dressing. Whether the supervisor got any of the dressing is not noted.

New York City reported the only outbreak of streptococcus sore throat. Three hundred ladies met in a Queens Borough hotel for an "organization luncheon"; 270, or 88 percent, became ill in from 5 to 57 hours. Three foods served were found heavily contaminated with Group A hemolytic streptococci. Three food handlers, including two waitresses and a baker who prepared the dessert, showed positive throats at the time of the investigation. One of the waitresses was ill the day before the luncheon. This outbreak, perhaps because of its unusual features, was the most adequately reported of any of the relatively large number, mostly minor, reported by New York City.

The total number of outbreaks reported as food infection, food poisoning, gastroenteritis, or diarrhea was 271. Of these New York City reported 29 percent. The picture was about as usual. In the food infections poultry dishes headed the list of vehicles, with turkey and turkey dressing well up in front. Other meat dishes came next, with ham mentioned twice. Cream-filled and other pastries ran a poor fifth. Salmonella were mentioned frequently.

In the food-poisoning class (185 outbreaks), however, poultry dishes ran third but with turkey and turkey dressing mentioned twelve times. Other meat dishes, nearly half of them ham, topped the list, with 71 outbreaks. In second position, here, were the cream-filled and other pastries.

Counting the food-poisoning outbreaks in which staphylococci were specified definitely or "Probably" and those in which they seemed to be indicated by the combinations of short "incubation" periods and reports of inadequate refrigeration, staphylococcus enterotoxin was responsible for a large majority. There was insufficient data to indicate whether albus or aureus predominated.

One of the largest outbreaks in this group was one of about 500 cases of food poisoning, "Prob. Staph.", in a Pennsylvania penitentiary. It was charged to Lebanon bologna. Incubation periods and other data on which conclusions might have been based were not given. Detroit reported a 7-case restaurant outbreak as due to *Staphylococcus aureus* and charged to "new dill pickles". Evidence pointing to the pickles as vehicle was not reported.

Upstate New York (exclusive of New York City) reported two sets of "repeat performances". Three separate outbreaks of gastroenteritis, 50, 31, and 19 cases, occurred a few months apart in a State hospital for epileptics. In a large children's camp in northeastern New York there were two outbreaks, 119 and 35 cases, a month apart. Information as to what was done, after the first outbreaks, to prevent recurrences would have been of interest.

WATER

Bacillary dysentery	1	Paratyphoid fever	1
Gastroenteritis	9	Typhoid fever	5

Public supplies were involved only twice. One of the gastroenteritis outbreaks was charged to an untreated housing development supply in New York State; the other, with 81 cases of typhoid fever, was attributed to an untreated surface supply in Porto Rico. A third, with 11 cases of bacillary dysentery, was in a home connected with a public supply but resulted from back syphonage from an improperly installed toilet bowl to the kitchen sink.

An outbreak of 6 cases of typhoid fever in 3 families at Amsterdam, N. Y., was shown to have been the result of contamination of private wells by sewage from a house in which there was a previously undiscovered typhoid carrier.

UNDETERMINED VEHICLES

Ten outbreaks: bacillary dysentery, 2; food poisoning and gastroenetritis, 6; paratyphoid, 1 and typhoid fever, 1.

GENERAL COMMENT

It is noticeable, as in previous years, that in a very considerable proportion of the listed outbreak reports, information given is insufficient to support the reported conclusions. This is more particularly true concerning the outbreaks listed as due to foods other than milk and milk products. This, of course, is not surprising and may be unavoidable.

So far as the outbreaks of food infection and poisoning are concerned, we are in a peculiar position. When we examine the reports we would like to feel that they were based on good epidemiology and were dependable. At the same time some experienced administrators, as mentioned last year, feel that in the investigation of "run of the mill" outbreaks of this class we have reached a point of diminishing returns. They feel that too much time has been given to them of late, at the expense of more important activities.

We sympathize with the Public Health Service people responsible for deciding which of the reported outbreaks shall go in the positive lists and which in the "Suspected" or "Undetermined". They have a difficult job and are doing it well. While, because of the inadequacies and uncertainties, our tabulations of included data have no statistical value, they do give rough, general pictures which may be helpful.

One slightly extraneous thought arises in this connection. Possibly in some other states, as in my own, many of these investigations are made by relatively inexperienced health department *trainees*, mostly medical. When they are assigned to such jobs, regardless of the importance of the outbreaks or what is to be done with the reports, they should be encouraged, assisted, and required to make efficient epidemiological investigations and adequate and dependable reports. Maybe that is being done now. We hope so. Anyway, we owe it to them as trainees, and even a few more really good reports would help to "brighten up" the good old P.H.S. annuals.

P. B. BROOKS

SOCIETY OF INDUSTRIAL MICROBIOLOGISTS

THE Society of Industrial Microbiologists is a new professional group, now in the process of organization. The president is Dr. Charles Thom, Port Jefferson, N. Y., before his retirement Principal Mycologist, Bureau of Plant Industry, U. S. Department of Agriculture. He is co-author of *A Manual of the Aspergilli*, 1945, and *A Manual of the Penicillia*, 1949. He is collaborator, Northern Regional Research Laboratory, at Peoria, Ill.

The secretary-treasurer is Dr. Charles Lyman Porter, Professor of Botany at Purdue University, West Lafayette, Ind., where he is also in charge of the courses in Industrial Mycology.

The Organization Committee includes the above two names, two more not yet appointed, and the following:

Dr. M. M. Baldwin, Battelle Memorial Institute, Columbus, Ohio.

Dr. Walter N. Ezekiel, Bureau of Ordnance, Department of the Navy, Washington, D. C.

Dr. W. L. White, Farlow Herbarium, Harvard University, Cambridge 38, Mass.

Dr. Porter points out that Microbiology as a science cuts across many other sciences including Bacteriology, Biochemistry, Biophysics, Algology, Mycology, and Zoology (especially Parasitology). The field is of tremendous interest not only to research workers in the universities but also to the research departments of many and varied industries. No one organization at present includes all of these diverse interests. There is need of a society that will cater to these various areas of industrial and scientific investigation; where ideas concerning techniques and developments may be discussed without feeling that the remarks are inappropriate for the group. The botanical, chemical, bacteriological, and zoological societies as now organized are too highly specialized in their interests for satisfactory microbiological conferences and programs.

"We are asking that all individuals interested in this sort of a society correspond with the Secretary-Treasurer of the organization. All those joining the Society during 1950 will be considered charter members. The dues are $2.00."

J. H. SHRADER

NEW PROBLEMS IN BIOCHEMICAL FOOD PRESERVATION

THE spectacular successes which have come from research in chemotherapy, then those in the quaternary ammonium detergents, and additionally in the antibiotics are directing attention to the fundamental factors that are involved in the effectiveness of food preservatives. These products may act through a number of avenues: physico-chemical effects on cell membranes; pH effects on enzymic action; reaction of functioning groups with enzyme constituents; competition of substrate and reagent for amino acids; destruction of the genetic systems of the microorganisms; build-up of katabolic inimical products; etc. The field is being made more complex by the increasing use of antibiotics.

The latter compounds, as applied to milk preservation, seem to be effective when used both therapeutically in the milking cow as well as by direct addition to the milk. Medical practice is highly conversant with the carry-over effects of drugs into mother's milk and thence ingested by the infant—sometimes with beneficial effects and sometimes not so good. The use of D.D.T. as an insecticide is now being discounted for use in dairy herds partly because of its carry-over into the milk.

Now comes penicillin. We know of no work published on its carry-over. However, in this present issue of this JOURNAL we publish a paper on the bactericidal properties of penicillin when directly added to milk. It appears to suppress the development of certain species under conditions which favor bacterial growth.

We publish this paper, not to encourage fraudulent use in evading pure food requirements, but in order to make the information available as a stimulus to further work in this field of applied biochemistry. We can expect that the increasing use of antibiotics will affect the bacterial content of milk. The imagination can picture attractive fields for exploration here.

J. H. SHRADER

SANITATION: A PROFESSIONAL ENTITY

SANITATION, in its broadest sense, means the establishment of environmental conditions favorable to health. Sanitary comes from the Latin, *sanitarus*, which means promoting health. Man, being the complicated biological mechanism that he is, must have the services of a large group of trained workers to promote health. He must have those trained in medicine such as the physician, psychiatrist, surgeon, and the many specialists in that field as well as the veterinarian. He needs the biologists such as the bacteriologist, parasitologist, entomologist, botanist, and zoologist. Likewise he needs those trained in the physical sciences such as the physicist, chemist—physical and biological. The engineers—chemical, mechanical, and sanitary—play an important role in the field of environmental sanitation such as water, sewage, ventilation, housing and the like. Then, there are the nutritionists and the nurses who can rightly lay claim to their contribution to promoting man's health. Last, but not least, has been the milk and food inspector, now known as the milk and food sanitarian. As a matter of fact, the practical sanitarian is the man who has actually put most of the health measures into effect and made principles workable.

In short, this whole business of sanitation has become a very broad subject comprehending a great many fields in the scientific, medical, technical, and engineering professions.

At the present time there are a dozen or more organizations whose members are active in some aspects of sanitation. Many of their activities overlap. Most of these workers belong to groups which have professional recognition in their respective specialties, as for example, bacteriologist, chemist, physician, engineer, and others. Each one of these fields is a professional unit, known as such everywhere, as for example, the American Chemical Society, the American Medical Association, etc.

We keep meeting the questions: what is a sanitarian? and what are his professional qualifications? The latter must be clarified and defined before professional qualifications can be formulated. The International Association of Milk and Food Sanitarians, Inc., does indeed require college degrees, but there are no definitions or subject requirements therefor. No educational institution, seeking to set up a curriculum to train sanitarians, has any authoritative basis for doing this.

We recognize the difficulty of finding a common denominator, so to speak, that would include bacteriologists, chemists, engineers, physicians, veterinarians, nurses, etc. However, we can if we want to. And since the sanitarians are the ones to be defined, we maintain that sanitarians as such should define the qualifications.

The International Association of Milk and Food Sanitarians, Inc., might very well sponsor a group meeting of sanitarians from various other organizations for the purpose of defining what a sanitarian is, and to consider the possibility of organizing a Sanitation Institute to cover the whole field of sanitation. Such an organization would be in a stronger position to "sell" sanitation than could any of the constituent groups. Moreover, it would have the resources to engage a full-time secretariate, publish its journals economically, promote sanitation-mindedness among the public, elevate professional standing of its members, foster the awarding of medals to eminent sanitarians—and in general assume adulthood as a professional entity.

FRED W. FABIAN AND J. H. SHRADER

THIRTY-SEVENTH ANNUAL MEETING, 1950, AT ATLANTIC CITY

The 37th Annual Convention of the International Association of Milk and Food Sanitarians will be held in Atlantic City on October 13th, 14th, 15th and 16th, with headquarters at the Dennis Hotel. Since this convention is scheduled during the end of the week preceding Dairy Industries Exposition sufficient rooms have been set aside for our group at the Dennis Hotel. Registration for rooms should be made directly with Mr. Wesler T. Keenan, Convention Manager of the Hotel.

The Program Committee is under the direction of Dr. K. G. Weckel, President Elect, University of Wisconsin, Madison, Wis.

Note that the convention runs for four days including Sunday, October 15th, and Monday, the 16th. The Executive Board felt that because of the large volume of association business, Constitutional Amendments, etc., which will consume considerable time, decided that Sunday, the 15th, would be a good day to carry on these discussions. The 16th is the start of the Dairy Show.

THE ROLE OF THE AIR LINE HOSE OF THE MILKING MACHINE IN THE CONTAMINATION OF MILK *

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THE prime objective of the dairy is the production of quality milk. To obtain a high grade product it is essential that milk be produced under conditions as nearly aseptic as possible. Every avenue of contamination must be effectively blocked so that a minimum number of bacteria enter the product throughout its course of travel from the udder of the cow to the consumer.

The need for proper cleaning and sanitizing of milking machines has been well established. The question of contamination of air lines as a source of bacteria in the milking machine has appeared repeatedly in discussion groups. It is generally agreed that air lines do become contaminated as any sanitarian has demonstrated by an examination of milking machine equipment on the farm. It is not generally agreed, however, that the contamination in the air lines enters the milk and causes marked increases in contamination.

In 1948 Domingo (1) built, in the laboratory, a duplicate of a barn vacuum pipe line installation to which various milking machines were connected and operated in a manner that would simulate actual milking conditions. Glass traps were placed at each stall cock and at the end of the vacuum line. With this equipment he was able to demonstrate the collection of liquid in the air lines and under certain conditions of operation the return of the liquid to the milk pails. He showed that the traps at the stall cocks collect the liquid and prevent its return to the milk pail.

Leber (2) in 1948 made a bacteriological study of milk produced on three farms equipped with milk traps invented by Domingo. These studies covered a period of nine months during which time daily microscopic and thermoduric counts of the milk were made. These data were compared with monthly microscopic and thermoduric counts obtained previously on the same producers over a period of nine months for two of them and six months for the other. He was unable to demonstrate that bacteriologically the milk had lower counts as a result of the traps on the air lines.

Because of the paucity of data on the controversial subject of air line contamination, a study was undertaken to determine whether the bacterial quality of the milk was affected. The need of such a study is clearly demonstrated by the fact that regulatory officials are already demanding remedial measures in the design of vacuum lines to avoid all possibilities of air line contamination.

Three areas were used and three city departments of health were invited to participate in the project. Due to overlapping of the milk sheds of each city it was possible to select farms supplying milk to each city in each of the three areas. This made it possible to obtain a more representative geographic sampling which would be more typical of the entire country.

Each milk sanitarian (one from each city) selected producers who had a

* Presented at the Thirty-sixth Annual Meeting of the INTERNATIONAL ASSOCIATION OF MILK & FOOD SANITARIANS, INC., Columbus, Ohio, October 20, 21, 22, 1949.

previous history of dirty air hose and high bacterial counts. For the initial sampling the sanitarian arrived at the farm before the morning milking so that he could make a complete inspection of the milking machines prior to milking. The farmer did his milking as usual without instructions from the sanitarian. The milking procedure was noted. Samples were collected from the milking machine pail after each cow was milked. Each sample was placed in a sterile plastic screw-cap test tube and immediately iced. A composite sample was also collected from the milk cans at the completion of the milking. Each unit on the farm was handled in the same manner. The samples were taken immediately to the laboratory for analysis.

These samples were the control group and represent, in general, the normal practice of the operator in cleaning and sanitizing his equipment and milking procedure. For convenience this sampling will be called Condition I.

Later in the day, the sanitarian returned to the farm to clean the milking machine. All parts, with the exception of the rubber air line, were carefully cleaned and sanitized with a quaternary ammonium compound. Any rubber parts which were not in good condition were replaced.

Just before the evening milking, the machines were again rinsed by the sanitarian with a quaternary ammonium sanitizer. At this milking the farmer was instructed to use a strip cup, wash and rinse the udder and teats with a quaternary ammonium sanitizer, and dip the inflations into a quaternary ammonium sanitizer before each milking. Under the direct supervision of the sanitarian, all sanitary precautions were observed except for the cleaning of the air line hose. Sampling procedures were the same as before. This second sampling is reported in Condition II.

The machines were again cleaned and sanitized as before by the sanitarian after the evening milking. The next morning, besides rinsing with a sanitizer, cleaning of the cows, etc., an air line hose which had been sterilized by moist heat under pressure was attached. The milking and sampling were done exactly as before. This third sampling is reported as Condition III.

The raw milk samples were tested by plating, using standard procedures.[3] Portions of each sample were laboratory pasteurized at 143° F. for 30 minutes, cooled, and plated to determine the thermoduric bacterial count.

Each dirty air line tube was brought to the laboratory for examination. The bacterial populations of the dirty air line tubes were obtained by pouring 20 ml. of sterile skim milk into the hose. The milk was worked through the full length of the tube by alternately lowering and raising the ends. The milk was then collected in a sterile container and checked for total and thermoduric bacterial counts.

The writers are well aware that this method of using milk as a rinse solution is not a good means of removing bacteria from the inner surfaces of the rubber tube. This method was selected because it was felt that the bacteria which might enter the pail would be more comparable to those obtained by a milk rinse rather than a saline or buffered water rinse. Undoubtedly the total bacterial population of the tubes would be much higher than those obtained. No attempt was made in this study to determine the total number of bacteria in the dirty tubes.

The sanitarian in each area selected farms, for test purposes, that previously had high bacterial counts and dirty air line hoses. Each farm presents a different picture as it pertains to all phases of the tests.

For example, Table 1 presents results on a farm using long tube milking machines where high total and thermoduric bacterial counts were obtained prior to cleaning by the sanitarian. After cleaning, the total and thermoduric bacterial counts were materially reduced. There was no apparent change in either the total or thermoduric bacterial counts as a result of substituting a sterile air line hose for a dirty one. This air line hose was very bady contaminated as demonstrated by the high bacterial counts.

TABLE 1.

BACTERIOLOGICAL DATA ON MILKING MACHINES (PRODUCER S-6-21-49) WITH VERY DIRTY AIR LINE HOSE

		Bacteria per ml					
		Condition I		Condition II		Condition III	
Sample	*Unit*	Raw	Pasteurized	Raw	Pasteurized	Raw	Pasteurized
1	A	68,000	14,000	5,500	530	700	80
2		102,000	2,800	2,500	180	4,000	30
3		163,000	38,000	4,000	410	1,200	50
4		32,000	17,000	240	390	210	220
5		337,000	47,000	960	500	730	390
Airline hose			1,365,000	37,000			
1	B	94,000	28,000	14,500	570	2,600	60
2		63,000	18,000	3,800	1,000	3,000	180
3		61,000	15,000	5,400	1,300	2,700	140
4		65,000	14,000	2,400	330	4,900	210
Airline hose			910,000	189,000			

Table 2 presents results on a farm where the short tube milking machines were carefully cleaned and sanitized but the air line hose were extremely dirty. It will be noted that the bacterial counts were approximately the same after thorough cleaning and sanitizing as before. Although the air line hose

TABLE 2.

BACTERIOLOGICAL DATA ON MILKING MACHINES (PRODUCER S-5-17-49) WITH VERY DIRTY AIR LINE HOSE

		Bacteria per ml					
		Condition I		Condition II		Condition III	
Sample	*Unit*	Raw	Pasteurized	Raw	Pasteurized	Raw	Pasteurized
1	A	7,000	220	5,700	20	1,200	100
2		2,400	360	4,200	15	700	9
3		2,100	90	1,700	20	800	19
4		1,700	120	1,300	6	2,900	6
5		2,000	30	1,300	10	2,400	4
6		6,700	60	12,000	1	12,000	70
7		4,400	70	1,900	6	L.A.	100
Airline hose			5,780,000	6,500			
1	B	14,900	160	1,600	1	1,700	50
2		5,200	50	2,400	170	4,500	50
3		2,200	50	1,600	8	1,200	50
Airline hose			3,000,000	3,700			

TABLE 3.

BACTERIAL POPULATIONS OF MILK OBTAINED FROM 44 MILKING MACHINES WITH DIRTY AIR LINE HOSE

Log. aver. of bacteria per ml.					
Condition I		Condition II		Condition III	
Raw	Pasteurized	Raw	Pasteurized	Raw	Pasteurized
21,400	470	3,000	40	2,900	25

were heavily contaminated with bacteria, there was no apparent change in bacterial counts of the milk when a sterile air line hose was used.

These two tables present data typical of many other producers. The data for 44 units, both long and short tubed machines, with dirty air line hoses were compiled. Due to the wide range of bacterial populations encountered, logarithmic averages were prepared. The data are presented in Table 3. It will be noted that the bacterial counts for both total and thermoduric bacteria are identical for Conditions II and III. These data show that in a check of 44 units, the presence of dirty air line hose did not influence the total or thermoduric bacterial counts. If contamination from the air line hose occurred frequently, an increase in the bacterial populations of the milk should be observed in Condition II where a clean machine with a dirty air line hose was used.

Ten units with very dirty air line hose were selected for further examination. The results from these are presented in Table 4. It will be noted that the average counts for Conditions II and III are practically the same. An examination of the individual units show no marked differences that could be charged to contamination coming from the contaminated air line hose.

In one instance the sanitarian deliberately introduced 10 ml. of milk into a dirty air line at the start of the milking and again added another 10 ml. portion after the third cow had been milked, without causing any significant change in the bacterial population of the milk.

The air line hose in most instances yielded high bacterial populations in spite of the fact that the method of determining the number was not planned to obtain total numbers present. The numbers of organisms removed are reported per milliliters of milk added to the air line hose (Table 5). Any marked movement of bacteria-laden liquid from the air line hose into the milk pail would be easily detected in practically every unit examined, due to the fact that the bacterial populations of the cleaned machines were extremely low; approximately 3,000 per milliliters.

If only small amounts of bacteria-laden liquid entered the milk pail, the numbers of bacteria introduced per milliliters of milk would be so small compared with a total count of 3,000 per milliliters that the effect on the total count would be insignificant even though the liquid carried populations of 1,000,000 bacteria per milliliters.

The results on all units tested arranged according to cities are reported in Table 6. It will be noted that in two of the three cities, the population

TABLE 4.

BACTERIAL POPULATIONS OF MILK OBTAINED FROM 10 MILKING MACHINES WITH VERY DIRTY AIRLINE HOSE

	Log. aver. of bacteria per ml.					
	Condition I		Condition II		Condition III	
Unit No.	Raw	Pasteurized	Raw	Pasteurized	Raw	Pasteurized
1	4,697	210	2,163	97	4,380	40
2	6,893	324	5,075	115	10,050	44
3	15,420	692	16,940	389	30,480	133
4	40,520	10	9,389	4	1,754	10
5	55,390	10	1,734	6	2,423	7
6	2,982	23	1,366	107	2,494	24
7	51,960	7,437	1,388	44	1,619	68
8	374,500	4,534	6,437	20	2,829	7
9	3,213	101	1,954	22	2,927	8
10	5,546	74	2,093	50	1,831	11
Log. av.	16,580	210	3,649	45	3,703	21

TABLE 5.

THE BACTERIAL POPULATIONS OF DIRTY AIR LINE HOSE

Bacteria per ml					
City D		City F		City S	
Raw	Pasteurized	Raw	Pasteurized	Raw	Pasteurized
11,300	140	78,000	50	5,800	20
1,200	L.A.	67,000	70	5,300	30
88,000	120	97,000	300	1,170,000	80
344,000	47,000	5,000	20	227,000	300
7,800,000	12,000	1,600	40	5,800,000	6,400
1,000	30	4,800	20	3,000,000	3,800
5,400	10	400	20	800	6
1,800,000	1,000	90,000	9,000	600	25
1,200,000	1,000	4,000	160	9,000	5,000
100,000	6,000	700	6	900,000	300,000
5,000	1,400	..	..	1,400,000	38,000
		..	..	900,000	200,000

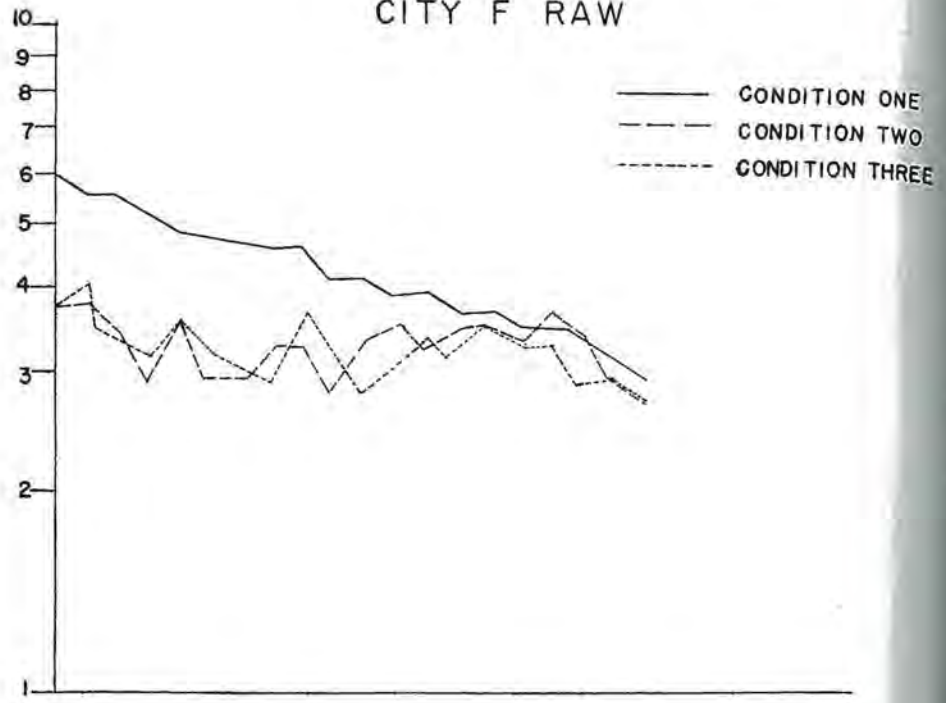
TABLE 6.

THE AVERAGE LOGARITHMIC BACTERIAL COUNTS OF MILKING MACHINES

		Bacteria per ml.					
	No.	Condition I		Condition II		Condition III	
Location	*Units*	Raw	Past.	Raw	Past.	Raw	Past.
City D	12	41,540	779	4,797	84	743	29
City F	20	21,360	452	2,262	30	1,956	24
City S	12	9,454	391	3,112	30	2,307	20
Total	44	21,410	508	2,970	37	1,558	24

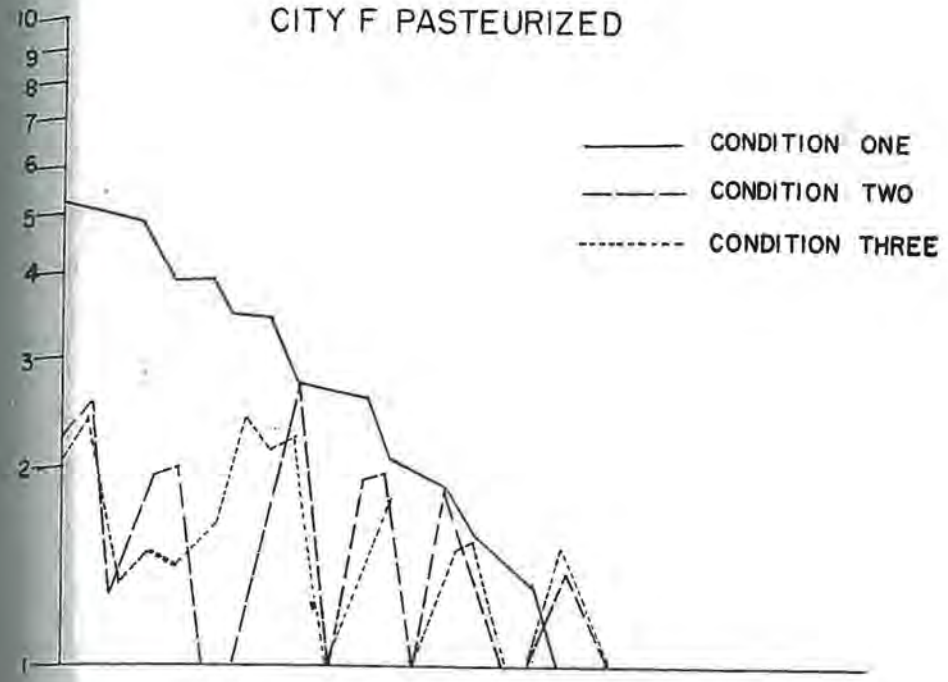
GRAPH I

CITY F RAW



GRAPH II

CITY F PASTEURIZED



in Condition III, where clean air lines were used, was slightly higher on an average than in Condition II.

The results are also shown in Graphs I-II for City F for both raw and pasteurized milk. The two curves for Condition II and III follow very closely for each unit. The results for the other two cities gave a similar picture.

The data for long tube and short tube machines were separated and compared. The data for each type of machine are shown in Graphs III and IV. The data for the two types of machines are practically identical, showing that the machine design does not cause any change in the bacterial picture.

Discussion

These studies were carried on over a period of three months and involved a total of 65 milking machines. All the farms selected for study represented "sanitary offenders" who were known to have dirty air line hose. On most of these farms the machines were poorly washed and seldom sanitized. The rubber inflation and tubes in most cases were in poor condition. In general the selected group represented the worst cross-section of milk producers that could be obtained in the areas studied.

All variables were carefully controlled in these studies by the sampling procedure in checking the same machine, before thorough cleaning, after thorough cleaning but retaining the dirty air line hose, and after thorough cleaning and installing a sterile air line hose. It would seem reasonable to believe that some of the 65 units examined would have shown the effect of a dirty air line hose, if contamination from this source does occur occasionally. No such cases were observed.

If, over a period of three months with this number of machines from known poor producers, we failed to reveal any significant contamination from dirty air line hoses, the problem is not particularly important and the need of traps on the machine or stall cock is not apparent.

The fact that contamination from air lines was not observed does not mean that air lines need not be maintained in a sanitary condition or that no attention need be paid to the vacuum lines. It is good practice to see that all parts of the milking machine are maintained in a sanitary condition. It is good practice to see that all air line hose are washed regularly. If air line hose are kept clean and the vacuum lines are properly installed and maintained, it is quite obvious that, even though air lines could cause contamination, there would be no trouble.

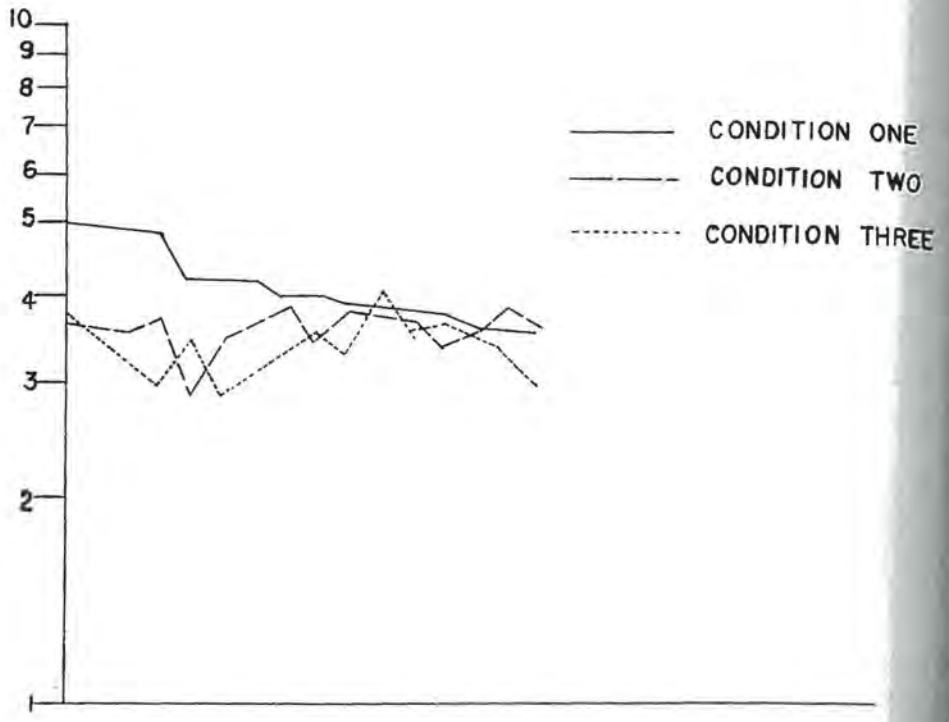
The whole problem resolves itself finally into good sanitation of the present equipment. The addition of further safeguards, such as traps on the machines or the stall cocks, instead of eliminating a source of contamination, probably would contribute by increasing the difficulties of proper cleaning and sanitizing of the equipment. The farmer who now fails to maintain his equipment in sanitary condition certainly would not improve the care of his equipment by the installation of more gadgets on the machines.

Conclusions

Contaminated air line hose did not cause any appreciable increase in the

GRAPH III

LONG TUBE MILKER RAW



bacterial population of milk collected in properly cleaned and sanitized milking machines.

It would seem that the production of quality milk depends upon good, sanitary milking practice. The installation of milk traps simply introduces a new cleaning operation.

ACKNOWLEDGMENTS

The writers wish to acknowledge the splendid cooperation of the Detroit, Flint, and Saginaw Health Departments, Babson Brothers, and De Laval Separator Company in making these studies possible.

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2. Leber, Henry. A Study of Milking Machine Traps at Three Farms. *22nd. Ann. Rept. N. Y. State Assoc. Milk Sanitarians,* p. 69 (1948).

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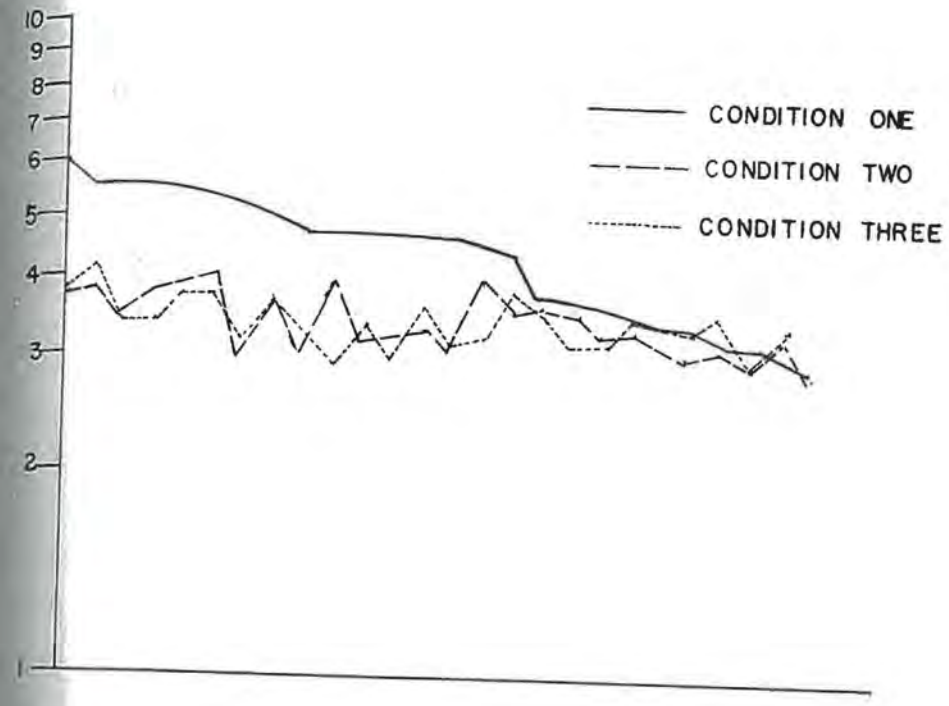
GRAPH IV

SHORT TUBE MILKER RAW



LOOSE HOUSING FOR DAIRY CATTLE *

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SOME ten years ago, Dr. Heizer, Chairman of our Dairy Husbandry Department at the University of Wisconsin and the writer started working on an idea. At that time, artificial insemination had been getting a very promising start. The proven sire program was in full swing and the Dairy Herd Improvement work had come back into full scale operation from the depression days. There still remained the fact that the average cow was good for about three lactation periods. Furthermore, the good cow with the large, full udder over half of the year was the most likely to be injured early in her production life. We had no trouble agreeing that if we could keep these good cows for brood cows over a long life span we would be able to develop cow families that would be invaluable to the dairy breeder. In fact, any good dairyman could profit by this advantage.

From the engineering point of view there were many reasons for developing the loose housing system. Barn fires are serious business, especially when one has the results of a lifetime of breeding securely locked in stalls and all his year's supply of feed stored overhead. Windstorm losses take their toll of high barns yearly. Deterioration, rot, and decay often weaken barn frames subjected to the extreme moisture and temperature variations. Barns are expensive and because of their great height are hard to build at low cost, partly because they are seldom erected with farm labor. Then, there were the mechanization possibilities for doing chores. Electric and mechanical energy can do work at odds of better than 100 to 1 when compared to human energy. Farm tractors equipped with self starter, lights, and rubber tires and carrying a mounted fork or scoop were scarcely used for chores except for pulling the manure spreader through the driveway of the barn. The question of individual feeding, milk weighing, records in a visible location over each cow, and appearance of the herd all lined up in stanchions were considered. To offset this we have the possibility of handling the entire herd as a unit. One has only to watch the feed mangers to see how well the feeding program is adjusted to the capacity of the herd. Likewise, he has only to watch the total quantity of milk produced at each milking to determine the response of the herd to feeding and management practices.

Finally, the problem of producing better milk offered a challenge. Would the milking parlor improve milking technique? Could clean milk be produced in a loose housing system? Could the cows be kept clean? Could the cows stand the cold temperatures and would they like to be outside? It was decided to set up a project and let the cows answer these questions themselves.

In setting up the project, a standard stanchion barn was planned as a check or control unit. This was known as A-Barn. A second barn of the loose-housing type was built for the test

* Contribution from the University of Wisconsin Agricultural Experiment Station, as a collaborator under North Central Regional Agricultural Experiment Station cooperative research project, entitled "Dairy Barn Research Project" and supported in part by funds made available by the Carnegie-Illinois Steel Corporation.

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according to the best information available at the time. This was known as C-Barn. A third insulated, loose-housing barn was built a little later, and this was called B-Barn. The project was made possible through an industrial fellowship by the Carnegie-Illinois Steel Corporation. Later, milking-parlor studies were added to the scope of the project and Regional Funds from the Agricultural Research and Marketing Act were made available.

The first three years, A- and C-barns were in operation. The test periods ran during the winter six months only. Herds of 17 cows were used, and results indicated little difference in production between the two barns. A-barn was operated as a warm stanchion barn while C-barn was operated as an open, non-insulated and cold shelter with the cows free to go outside as they wished. During this time a number of changes were made in C-barn. The fourth year B-barn was constructed so that only a short test period was used. In the next two years, B-barn was used as a warm, insulated shelter. It was not entirely satisfactory because of excessive moisture and lower production of the herd so it has been used as an open, cold barn the past two years. It was concluded that the warm manure pack and the insulated barn could only result in too much warmth and humidity for the comfort of the cows. After all, we were asking the cows what they preferred.

Data on A- and C-Barns have been tabulated and the data summarized for the past four years as per the tables below and on the next page.

From these data one might conclude that a loose-housing herd might be expected to perform on a par with a stanchion-barn herd and, if anything, a little better. Perhaps the herd health record is the most outstanding. These experiences have proven to be well founded as they have worked out in actual practice on the farms of cooperating dairymen.

DESIGN REQUIREMENTS

The work at the Dairy Barn Research Project has included the making of studies, observations, and adjustments which have made it possible to establish design requirements that insure satisfactory performance throughout. Many cooperating dairymen in the north central and eastern states who have had the pioneering spirit plus a full appreciation of the fine points

	A Barn			*C Barn*		
	No. cows affected	Prod. lag *	Serious †	No. cows affected	Prod. lag *	Serious †
A. Stiffness and lameness	18	8	2	0	0	0
B. Injured knees and hocks	8	3	2	0	0	0
C. Abscessed hocks—operated	3	2	2	0	0	0
D. Stepped on teats	11	4	6	0	0	0
E. Foot rot	8	3	0	3	0	0
F. Cow pox	3	0	0	3	0	0
G. Acetomemia	4	3	1	3	0	0
H. Metritis	1	0	0	0	0	0
I. Mastitis flaky milk	9	3	0	10	0	0
J. Mastitis flaky milk—chronic ‡	8	3	3	7	1	0
K. Mastitis—sub-acute	1	1	0	4	4	0
L. Mastitis—acute	7	7	6	1	0	0
M. Reproductive disorders	3	1	2	1	1	0
N. Off feed	6	5	0	4	2	1
O. Milk fever	1	1	0	0	0	0
P. Other injury	0	0	0	2	0	0

* Production lag means a noticeable drop in production for a short period of time.
† Injuries were considered serious when they had a lasting effect on the animal.
‡ Chronic mastitis not responding to treatment (usually staphylococcus infection).

	Outside	"A" Barn	"C" Barn
1. Temperature [4, a]	29.75° F.	54.78° F.	37.19° F.
2. Humidity [4, b]	72.46%	81.36%	78.19%
3. Manure pack temperature—ave. 3" from surface [4, b]	.....	.....	84.90° F.
4. Stall barn floor temperature—ave. [3, b]	.....	58.07° F.	.....
5. Labor comparisons [4, b]			
A. Actual summary of original time studies		100.0%	82.75%
B. Actual time plus time for cleaning C-barn loafing area, mechanically		100.0%	84.65%
C. Actual time plus time for cleaning C-barn loafing area by hand		100.0%	93.00%
6. Feed consumed (Cow day basis) [4, a]		100.0%	103.26%
A. Silage		100.0%	103.76%
B. Hay		100.0%	100.0%
C. Concentrates		100.0%	102.42%
D. Total T. D. N.			
7. Bedding (Cow day basis) [4, a]		7.68	12.39
Pounds per cow day		100.0%	161.33%
Percentage comparison			
8. Milk Production (4% F.C.M. Basis) [4, a]		100.0%	104.55%
A. On a total cow day basis		29.48	30.82
Actual pounds		100.0%	102.79%
B. On a milking cow day basis		35.10	36.08
Actual pounds			
C. Lbs. T.D.N. consumed per lb. F.C.M. (4%) produced		100.0%	97.98%
D. Cost per lb. 4% F.C.M. produced (Concentrates @ $60.00, Hay @ $20.00, Silage—⅓ hay cost.)		100.0%	97.44%
9. Bacterial Counts [a]			
A. Arithmetic average—counts taken at plant on pooled, raw milk [4]		4,340	7,136
B. Arithmetic average—counts taken at plant on pasteurized samples of pooled milk—check for thermoduric bacteria [3]		122	101
C. Average sediment tests—based on sediment standards of Wis. Dept. of Agr. on a 1, 2, 3, 4, basis, 1 being cleanest [3]		1.80	1.77
10. Cow weights—average lbs. gain per cow per test period [4, b]		13	49
11. Calves [a]		100.00%	88.32%
A. Gain per calf per day [4]		100.00%	85.37%
B. Lbs. T.D.N. consumed per lb. gain [4]		100.00%	71.36%
C. Lbs. Bedding/calf day [3]			
12. Herd Health (total cases) [3]			

[3] Comparable records covering 3 years (1946–49).
[4] Comparable records covering 4 years (1945–49).
[a] Figures shown are averages of totals for all test periods involved.
[b] Figures shown are averages of the yearly averages.

of dairy herd management have used these design requirements, and the reports have been so enthusiastic that one could scarcely believe them had he not experienced similar results on his own farm and with his own dairy herd. All of the things one might have hoped for seem to work out when the design requirements are met.

The following is a brief summary of the design requirements:

The Bedded Area

This open, cold, well-bedded manure pack should be in a separate building or a separate part of the total housing facility. It should be free of cross traffic, trampling, feeding, or holding area operations. Ample bedding storage at ground level or in a loft above will be best, and care will be needed to see that there will be bedding to spare at the start of each housing season. Remember, the colder the shed, as long as it is free of cross drafts and drifting snow, the less the bedding requirements will be on the basis of daily requirements.

The bedded area should be accessible for a tractor-mounted manure-loader. While trussed roofs eliminate posts, the cost can be reduced by using post construction where strict economy is required. An earth floor, graded well above outside ground level, is most desirable. Some window lighting in sheds not open to the south or east will be essential.

The bedded area, when managed as suggested will require 60 square feet or more per large Holstein cow as a minimum. Seventy to 80 square feet per cow will reduce bedding requirements. The bedded area is also a good place for the calf pens and young stock section. The amount of space and pens required will depend on how much young stock is to be raised. A hospital pen can also be provided or gates may be used to close off a corner of the bedded area for a temporary pen. Several barns have pens with removable partitions which permits the use of the tractor mounted manure loader to clean out the pens as well as the rest of the bedded area.

The Feeding Area

A clean, paved feeding area is a "must" if bedding requirements are to be held down to about 12 pounds per cow per day and if the cows are to be kept clean. When the feeding area was bedded, bacteria counts were erratic in the loose housing system, and the cows were often extremely dirty. The area required bedding three times a day and still punched up and remained so messy that the cows would most certainly get dirty if they lay down in this area. These observations were made where large Holstein cows in high production were housed and when they were being fed a well-balanced ration of hay, silage, and concentrates.

It is important that no hay or leftover roughages be thrown out or be permitted to be pulled out into the paved feeding area or the cows will lie down and get dirty. That is why the feed manger must be designed so that no feed can be worked out by the cows. The western type feeding fence with a plank front 27 inches high and a rail another 27 inches higher, works out very well whereas the slatted hay rack is a complete failure. One can mount the southern-type, short-milking stall, lever stanchion on this feeding fence if he wishes. The cows can then be held for the veterinarian making blood tests and if desired they can be fed concentrates before or after milking. Hay storage should be over or alongside the hay manger. For some installations, the feeding fence could be movable so it can be moved across the hay mow as the chopped or baled hay is fed out. For loose hay one would have to move the feeding fence from bent to bent down the length of the barn. The feeding space required per animal is about 30 inches where both hay and silage are fed at the same manger. For greater efficiency in feeding and housing space, hay can be fed

at one manger under roof, but in an open shed while silage is fed in feed bunks out in the barn yard or under another shed roof. By feeding hay and silage once a day and at the same time, the space per animal at the hay manger can be reduced to 18 inches and at the silage manger the same.

The paved feeding area is the proper place for the location of the water tank. It can be float controlled if the water is brought in from below. It can be banked in winter and it should have an overflow to a frostproof drain. A small tank is satisfactory.

The feeding area at least for herds of 20 cows or over should be accessible to a tractor-mounted scoop or scraper for cleaning along with the adjoining cattle yard. Cleaning should be done roughly once a week, if not daily, except when frozen.

The calves are sometimes housed under a part of the hay loft. The feeding area may often be used for the holding area where the cows can be concentrated and held ready for milking.

The hay storage and feeding area are best located together for convenience in feeding. A pole shed with a 30 foot width devoted to hay storage and 15 feet along the south or east sides used for a feeding area is one plan. In reconversion jobs, the old stanchion barn often serves for the feeding area because all the feed is located here and also because the head room is insufficient for the bedded area. Part of the old barn can be used for young stock and one end might be used for a milking parlor. Since the old barn is often too small to meet the greater floor area needs of loose housing, a separate building or lean-to of inexpensive construction can be used.

For both the bedded area and feeding area, pole sheds of creosoted poles set firmly and deep in the ground or arched or trussed roofed one story buildings may be built at moderate cost. The appearance and air of the loose housing area comes to be that of the sprawling, lazy but comfortable feeling of the ranch style house. This motif carried out in the design of all buildings will lead to a quiet and satisfying farmstead scene.

The Barnyard

The scene on the farm having loose housing will include cows out of doors in all seasons. A white board fence can add to the attractiveness of the roomy, concrete paved barn yard with a nearby sodded field of a few acres for the cows to bed down on when the weather gets warm and they prefer to spend the nights outside. This paved, well drained, cleaned, wind protected, barn yard should provide at least 100 and preferably 200 square feet of area per animal. It should be arranged for ease in cleaning, especially in the spring when the snow starts melting. At this time, a rollover scraper may be used to pull the thawing snow and manure out into a nearby field as the thawing progresses.

A good barn yard paving might consist of 4 inches of sand or gravel and a 4 inch slab of high quality concrete. Steel reinforcement and expansion joints are best but have often been omitted without serious results.

The Farm Milking Plant

Preferably a separate building built to the highest possible standards of cleanliness, the farm milking plant will house the elevated stall milking parlor, feed room, utility room, washroom, vestibule, and milk room. Of course, in developing a loose-housing system one can milk in, say, 8 or 10 stanchions separated from the rest of the barn. If this is done and concentrates are fed during milking, it is very important that a feed manger be built 18 inches off the floor so the cows will stand still while being milked.

The aim is that of having a strictly clean, sanitary, well lighted and ventilated, properly equipped place for milking the cows. Running water, hot and cold, some heat, proper floor drains, and the usual sanitary requirements can be met at moderate cost.

Here it is never necessary to milk the cows over a gutter full of manure. There should be no odors to contaminate the milk. Where well designed feed boxes are used, little feed is spilled on the floor and very little feed dust will show up in the filters. At least, for the small, one-man milking parlor, we hope the operator will be permitted to feed grain in the milking parlor and wash udders here before milking. Especially in the elevated stalls, it is possible to do the washing where one can see what he is doing. If he has warm running water he can do an exceptionally good job.

In the northern climate, often called Zone 1, the milking parlor may be operated without running water in the winter. The generous use of lime on the floor and the prompt removal of droppings seems to provide a satisfactory condition where the task of keeping pipes from freezing might work a hardship on the operator.

The elevated stall parlor makes the practice of good milking techniques possible. Here machine stripping and the manipulation of each quarter of the cow udder just before taking the machine off will result in quick, clean milking every time the herd is milked. Udder trouble can be drastically reduced through thorough practices when all milking operations are handy, effective and can be carried out in full view of the operator who is standing in a comfortable position.

All milking plants are designed so the milk can be carried or piped to the milk house and with the operators floor at the same elevation as the milk house floor if at all possible.

The number of milking stalls will depend upon the size of the herd and whether or not they are being fed while being milked. The number of operators also will affect the size. Good milking and the production of clean milk comes first; labor efficiency, milking time per cow, number of stalls and the number of units per operator are secondary. By having all controls handy and easy to operate, one can make time without hurrying. When the cows are fed while being milked, one might estimate a maximum of 8 cows per stall per hour under this plan of operation. One operator can use 3 stalls and one or two units quite effectively. The more times each stall can be used each milking, the less overhead each cow will be required to carry. Therefore, to be practical the smaller the herd, the smaller the milking parlor must be.

Special studies are being made on stall arrangements for milking parlors. Milking equipment is also under study. While all the results have not been tabulated it is evident that the cows should be routed directly through the parlor. The more concentrated the stalls, the shorter the walking distance and the better the controls are for the operator. The three stall "U" type parlor seems to work very well in every respect while for two operators the 4 stall "U" type parlor seems to show up very well. A report will be out in a short time on this work.

Milk quality studies have been intensified this year. The types of bacteria are being observed as well as the number. In the meantime, it would seem that one might safely conclude that high quality milk can be produced under loose housing for the dairy herd.

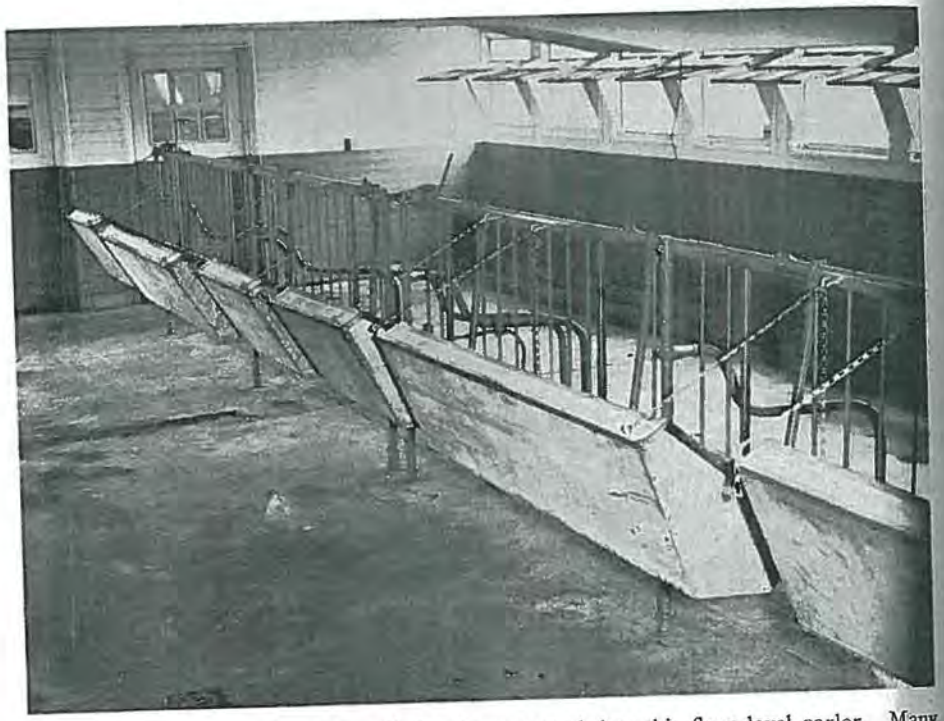
The Dairy Barn Research Project, located at the University of Wisconsin and carried on cooperatively through Agricultural Research and Marketing Act, Regional funds and through an industrial fellowship sponsored by the Carnegie-Illinois Steel Corporation. Since this picture was taken the barn lots have been paved.

During the winter the cows take advantage of most of the daylight hours out of doors; even on cloudy days there may be some beneficial solar radiation. Many dairy farmers feed silage in open feed bunks on the paved lot out of doors the year around in this climate. There has been no correlation between 4 percent fat corrected milk production and weather conditions.

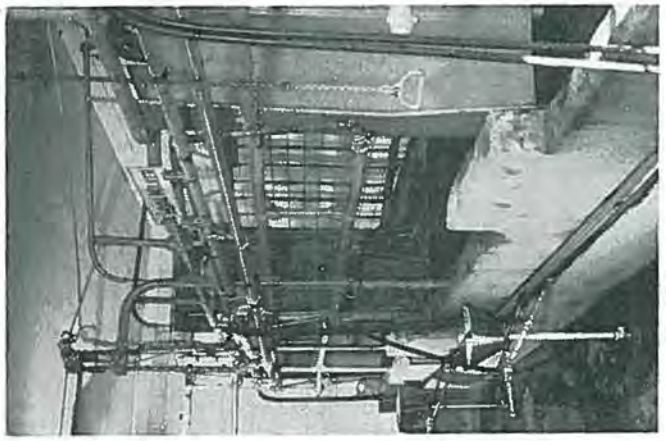
The cold, open, loose housing barn has temperatures from 8 to 10 degrees above outside temperature. The deep manure pack has a temperature of around 90° F. Comfort for the animals at these low temperatures seems to be adequate. Consider the bedded area as the bed room for cows to lie down. It should be bedded daily and no feeding or traffic lanes or holding of the animals on the bedded area should be permitted.

The tractor mounted manure loader quickly cleans the bedded area in this insulated loose housing barn that is now operated with a door open throughout the entire winter. Provision should be made for a depth of at least 3 feet of manure which should be cleaned out each spring. Hard earth floors are adequate for this building.

The control herd is held in the stanchion barn at the Dairy Barn Research Project. Stalls have partitions between them, are 4′ x 10″ wide and the stanchions are adjustable forward and backward so the cows can be stanchioned in a comfortable position. This barn is thoroughly insulated and has thermostatically controlled, electrically operated ventilating fans. In mild weather, windows are open for additional ventilation. This barn is known as "A" Barn.



The original milking parlor of 4 stalls has been expanded to this floor level parlor. Many dairymen could use this floor level parlor as a stepping stone toward the complete loose housing system with the elevated milking parlor stalls. Note the shape of the feed manger and its location so the cows can eat their feed while being milked without moving around and without spilling feed on the floor.



A typical milking parlor building on a farm of a cooperating farmer. Here one man with three milking stalls easily milks 24 cows an hour and follows the recommended practices for good milking technique.

At the Milking Parlor Research Laboratory at the Dairy Barn Research Project, various types of stall arrangement and milking parlor equipment have been under test for the past two summers. All equipment is portable including alleyway passages as well as the milking stalls. In one day the parlor can be completely changed to a different system. To date the U type, the chute type, the Montana type, and the tandem arrangements have been tested with 2, 3, and 4 stalls in operation with one man and two men milking and using either the bucket or releaser type milkers. The herd has been standardized. The milking operation has been standardized and two men have done all the milking.

THE APPLICATION OF QUATERNARY COMPOUNDS IN DAIRY SANITATION [1, 2]

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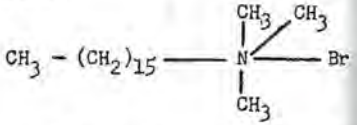
THIS discussion will deal primarily with the quaternary ammonium compounds from the standpoint of their application to the dairy industry. Much of the information and data cited apply as well to the problem of quaternaries for germicidal treatment in restaurant and tavern use. A number of reviews on the general subject of quaternaries have been published in recent years (1, 2, 3, 4). Therefore, a complete review of the various properties and their supporting research data will not be included in this report.

EARLY STUDIES ON QUATERNARIES

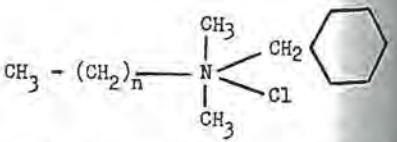
The history of the development of quaternaries presents an interesting example of how a valuable product may lie dormant for many years until it has the stimulus of commercial interest. The germicidal properties of the quaternaries were first observed in 1916 in this country by Jacobs and coworkers (5, 6, 7). They studied the relationship between the germicidal properties and structure of hexamethylenetetramine. In 1928 Hartmann and Kögi (8) synthesized a number of quaternaries and reported several of these to be germicidal. It was not until Domagk reported his studies in 1935, however, on the germicidal properties of the long chain aliphatic group (C_8H_{17} to $C_{18}H_{37}$) that their medical and industrial application appeared promising. Domagk worked with a number of quaternaries, the most important of which was Zephirol, an alkyl dimethyl benzyl ammonium chloride. Within a few years after Domagk reopened the quaternary field, a number of individuals and concerns in this country became interested in the compounds and, in the short period since then, an enormous volume of research has been carried out and published on the subject.

CHEMICAL STRUCTURE OF THE QUATERNARIES

According to Rahn and Van Eseltine the most commonly used quaternaries are: (1) cetyl trimethyl ammonium bromide, known as CTAB or Cetavlon; (2) alkyl dimethyl benzyl ammonium chloride known as Zephiran, Roccal, or BTC; (3) diisobutyl octyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride; and (4) cetyl pyridinium chloride. The chemical structures of these compounds are as follows:



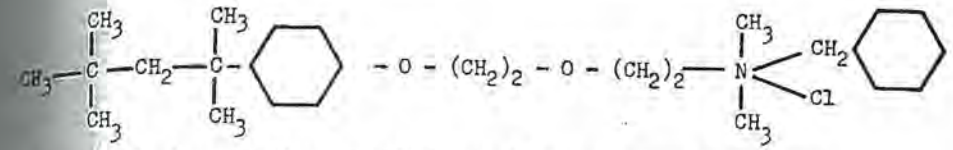
Cetyl trimethyl ammonium bromide



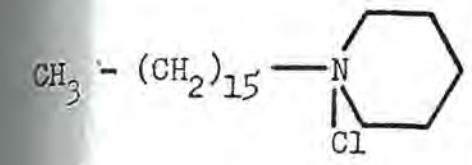
Alkyl dimethyl benzyl ammonium chloride

[1] Paper presented at the 13th Annual Klenzade Educational Seminar, Lake Delavan, Wisconsin, March 17–19, 1949.

[2] Published as Technical Paper No. 584 with the approval of the Director of the Oregon Agricultural Experiment Station. Contribution of the Department of Bacteriology.



Diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride



Cetyl pyridinium chloride

Of the compounds shown above, the most commonly used in the dairy industry at present probably are the alkyl dimethyl benzyl ammonium chloride and the diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride. There are numerous quaternary compounds employed for other purposes and still others to be synthesized, a number of which may show germicidal properties sufficient to enable their use for sanitation purposes. The entire quaternary field has undergone rapid growth and the next several years will undoubtedly see a number of important developments in new compounds and practical application of quaternaries for the dairy industry.

MECHANISM OF GERMICIDAL ACTION

In general it has been postulated that destruction of cells by quaternaries is due to inhibition of essential enzymes or enzyme systems, reaction with proteins of cells with consequent denaturation or irreversible damage of the cell membrane (1, 2, 3, 11). Contrary to results of earlier studies it has been reported that the activity of quaternaries against bacteria cannot be reversed by anions (12). The anion apparently only serves to save the organisms not already destroyed by neutralizing remaining quaternary.

Numerous reports have appeared on the subject of relationship of chemical structure to germicidal activity (see above reviews). An example of such a relationship is the effect of length of the alkyl chain on alkyl derivatives of quaternaries. The C_6, C_8, and C_{10} length chains provide less germicidal quaternaries. The C_{12}, C_{14}, and C_{16} lengths are most effective and at lengths of C_{18} the activity again decreases. The cetyl group appears to contribute markedly germicidal properties to compounds such as pyridines.

CHEMICAL METHODS FOR MEASURING QUATERNARY CONCENTRATION

A variety of chemical methods have been developed for determining concentration of quaternary compounds. Space does not permit discussion of all of them at this time. Brief reviews (9, 10) based primarily on available literature and trade reports have been published. However, an evaluation of the various methods based on laboratory and field trial and comparison apparently has not yet been published. Such surveys are in progress at the present time.

A study of application of quaternaries for dairy farm and plant use carried out in our laboratories during the past several years also included trials with the more promising methods available for determining quaternary concentration. It was apparent that no one method then developed satisfied the requirements for a rapid, accurate, and sensitive method. Consequently, preliminary studies included development of a new method for determining concentration of quaternary ammonium germicides (13, 14). Essentially the

method involves formation of a red precipitate on addition of 1 milliliter of quaternary solution to 1 milliliter of an eosin yellowish indicator, and subsequent titration to a colorless compound with a standardized anionic surface active agent.

This method now has been used and carefully studied in the field and laboratory for the past three years. It is inexpensive and as easy and simple to use as an ordinary acid-base titration. The color change from pink to white during titration is sharp and can be followed easily by an inexperienced operator. Results are also consistent from test to test. The method will accurately determine as little as 10 to 20 ppm of quaternary in solution in the lower range and up to 500 ppm in the higher range. An important feature of the method is that the same reagents and procedure can be employed for a simple field test and a highly sensitive laboratory method merely by substituting a microburette for the titration dropper bottle employed in the field kit. Therefore, both laboratory and fieldman can apply the same method and interpretation.

One disadvantage of all such methods is their inability to indicate the quantity of quaternary germicide free to act on microorganisms. This is of particular importance where contamination is encountered with anionic materials including detergents or proteins as in milk solids. Reaction of the quaternary with such substances results in a proportional reduction in germicidal action. In an attempt to overcome this deficiency of existing methods Gain and Lawrence (15) filtered the mixture of quaternary and inactivating agent through filter paper and found that the inhibited quaternary apparently was retained along with the inhibitor in most cases. Thus, a determination on the filtrate revealed the free quaternary. This method may prove effective with most but possibly not all inhibitors. As outlined, the Gain and Lawrence method lacks sensitivity for low concentrations of quaternary, and bacteriological studies correlating degree of inhibition and germicide strength by chemical determination are desirable. The principle possibly may be combined with other methods such as that outlined above (13, 14) to provide a more sensitive test.

The Gain and Lawrence method, as in some other procedures developed, is a turbidimetric test and is based on the addition of a precipitant for quaternary in the form of standardized horse serum. This is an advantage where colored solutions must be tested. However, as mentioned above, it is far less sensitive than certain titrimetric or colorimetric methods. Furthermore, the turbidimetric method cannot be applied to some turbid materials. The horse serum reagent is not stable over long periods and fresh material must be obtained at frequent intervals.

A field test for quaternaries based on Botwright's colorimetric titration using brom phenol blue as indicator has recently been reported (16). The method is simple and easy to use. However, it is designed only for determining relatively high concentrations such as 100 to 200 ppm. Tamol N, a condensed aryl sulfonic acid, has also been employed as a basis for a field test to determine whether quaternary solutions are of proper strength (3, 4).

BACTERIOLOGICAL METHODS FOR DETERMINING GERMICIDAL ACTIVITY

Almost every investigator of germicidal activity of quaternaries has condemned in some measure the standard Food and Drug Administration phenol coefficient method (17) for determining germicidal activity. In almost every case the investigator has then proceeded to develop a modification of the FDA method or in many cases an entirely new procedure. Consequently no attempt will be made here to review the numerous methods reported. For further details on methods see (1, 2, 3, 17, 18, 19, 20, 21, 22, 23). Obviously the best method is the one that comes nearest to indicating the germicidal effectiveness of a compound under the conditions encountered in the field.

A number of screening tests have been employed for hypochlorite and quaternary trials in our studies. These have included the FDA method, a modified Johns slide technique (22), the Weber and Black method (19), and a method employed as a routine control test in our laboratories (24, 25). This method involves addition of 1 milliliter of standardized suspension to 99 milliliter of germicide and transfer to inhibitor solution, followed by plating at desired intervals to determine percentage destruction. It was observed that the FDA method appeared to ascribe to quaternaries greater germicidal activity than they actually had, due presumably to bacteriostatic effect of small amounts of quaternary carried over to the subculture tube. This effect has been emphasized by a number of workers (26, 27, 28, 29).

One of the most significant contributions to the problem of test methods for germicidal activity has been the studies of inhibitors to stop germicidal or bacteriostatic action in subculture tubes following exposure of organisms to quaternaries. Studies showing inhibition of quaternaries by phospholipids (30) were followed by development of an inhibitor medium containing lecithin plus Tween 80 (Letheen). The Letheen medium has proven quite successful for this purpose (31). Others also reported include use of the sodium salt of Tamol N, a condensed aryl sulfonic acid, and suramin sodium, a sulfonic acid derivative (32, 33).

Another important development is the method of Weber and Black (19) developed to determine relative germicidal activity of either hypochlorite or quaternary compounds intended for dairy, food, restaurant, or tavern sanitation. This method involves the mixing of a standard suspension of test organisms with germicide and the transfer at desired intervals to inhibitor solution (thiosulfate or Letheen), then plating to determine percentage survival or time and concentration required for 100 percent destruction. The method can be used by any laboratory with the usual bacteriological equipment and can easily be modified to make it a more refined test method for the research laboratory. Our present studies also include two other techniques that more closely simulate actual dairy farm and plant operating conditions. One of these involves inoculation of stainless steel dishes, addition of germicide, removal of germicide at the desired interval, addition of inhibitor, brushing organisms from surface into inhibitor, and plating to determine percentage survival or destruction on the surface. The second method involves a similar technique applied to experimental stainless steel cheese vats in the dairy plant. It has been found that these methods more closely simulate use conditions and provide more information regarding performance of dairy germicides under operating conditions. In some instances differences quite pronounced in laboratory tests are less apparent under practical operating conditions.

FACTORS AFFECTING GERMICIDAL ACTIVITY OF QUATERNARY COMPOUNDS

Type of Compound. There is considerable variation in the different commercial quaternary compounds relative to rate of germicidal action (35, 36, 37). We have noted sufficient difference between compounds to suggest careful laboratory trials on a material before adopting it for general dairy farm or plant germicidal application. In some instances certain batches of one type of compound have varied somewhat in germicidal activity. Most manufac-

turers now endeavor to manufacture a consistently pure compound of maximum germicidal activity and in some instances the commercial product represents the purest form of the compound obtainable.

Type of Organism. As might be expected, bacterial spores are destroyed with considerable difficulty by quaternaries (1, 2, 38). One study has indicated a low germicidal but high bacteriostatic activity against thermoduric sporeformers isolated from milk cans (39).

The rate of germicidal action of quaternaries varies considerably with different species of nonspore-forming bacteria. In general, gram negative bacteria show greater resistance to quaternaries than gram positive nonspore-forming types (30, 35, 37, 40, 41, 42). One of the important gram negative types that frequently is difficult to remove from dairy equipment is *Escherichia coli*, the basis for presumptive tests for fecal contamination. This organism is usually present on pasteurized milk equipment where cleaning and germicidal treatment have been faulty. In general our studies indicate that fast-acting hypochlorites destroy *E. coli* more rapidly under sanitizing conditions employed for such equipment than do the quaternary compounds. *Pseudomonas fluorescens* and particularly *Pseudomonas aeruginosa* and *Serratia marcescens* are exceptionally resistant to quaternary action but relatively susceptible to hypochlorite. This is of particular significance where the so-called water bacteria of the *Pseudomonas* type must be totally destroyed in the plant sanitation program. Such forms may be responsible for serious defects in butter and may be the source of psychrophilic growth in pasteurized products such as milk and cream.

Effect of Temperature on Rate of Destruction. An increase in temperature of the germicidal solution invariably accelerates the destruction of organisms by a germicide. The effect is quite pronounced with hypochlorites (43); with spores of *Bacillus metiens* the killing time of a hypochlorite was reduced by 60 to 65 percent by a 10° C. rise in temperature. Reports of a number of investigators (37, 40, 44) indicate a definite increase in rate of germicidal activity with increase in temperature but the general accelerating effect on quaternaries is less than on hypochlorites. A point to bear in mind in general germicidal treatment of dairy equipment is that preparation of a germicidal solution with cold water direct from a well or water main may result in less efficient destruction than if a lukewarm water is employed. The noncorrosive effect of quaternaries may enable their incorporation in the hot water employed for destruction of coliform bacteria on equipment following the pasteurizer.

The quaternary would be less effective for this operation if cool or lukewarm water is used.

Effect of pH. The acceleration of rate of destruction by hypochlorite by lowering the pH is well known. However, most commercial hypochlorites are buffered to provide pH values from about 7.5 to 10.5 in use dilution since low pH values decrease stability of the compound. Most quaternaries appear to have weak buffering action and frequently shift in pH toward that of the water used to prepare the quaternary solution. Most reports indicate the alkyl dimethyl benzyl ammonium chloride type to show greatest activity in the alkaline range with definitely greater activity at pH 9.0 than at pH 7.0 (44, 45). Cetyl pyridinium chloride is an exception, showing as great germicidal action at pH 3.0 as at pH 10.0 (40). The diisobutyl phenoxy ethoxy compound (Hyamine 1622) has been reported to be more active in the acid range (44) but an examination of the data indicates that further trials should be carried out with this compound before drawing conclusions regarding its response to pH changes.

Potentiation of Quaternary Action. Some data, as yet unpublished, suggest the possibility of potentiation of some quaternaries by certain phosphates and perhaps other compounds in solutions prepared with distilled water.

Incompatible Materials. Certain compounds in the water used to prepare germicidal solutions may markedly reduce germicidal action of quaternary ammonium compounds (35, 37, 46). In some instances the inactivating effect may be sufficient to require four times the quaternary in hard water as is required in a soft natural water or distilled water. Of the ions present in most waters, calcium, magnesium, and iron have been shown to exert the most pronounced inactivating effect. One report (46) indicates complete inactivation of 200 ppm quaternary in presence of 10 ppm of ferric ionized iron. No inactivating effect has been observed with chlorides, sulfates, nitrates, and carbonates. Apparently the inactivating effect is not always proportional to the hardness of the water. Recent reports have suggested that use of sequestering agents for salts of hard water may at least partly overcome their inactivating effect. However, some phosphates used for sequestering hard water salts are not compatible with quaternaries. Tetrasodium pyrophosphate has been reported to be compatible and may be combined with quaternaries. Hypochlorites are not affected appreciably by hard water salts. The effect of certain ions in water is sufficiently serious so that any questionable waters should be subjected to tests to make certain that concentrations of quaternary to be used are sufficient for the desired destruction.

Anionic wetting agents and soaps exert a marked neutralizing effect on quaternaries. Consequently when quaternaries are used as a germicidal rinse following washing of equipment with anionic compounds, great care must be taken to remove all traces of the cleaner before applying the germicide. However, the non-ionic wetting agents now introduced into the dairy cleaning field do not inactivate quaternary ammonium compounds.

Effect of Organic Matter. Contrary to suggestions of some early reports, a number of investigators in recent years have shown quaternaries to be markedly inhibited by organic matter (1, 2, 4, 35, 47, 48, 49). Quaternaries appear to react readily with proteinaceous substances. Our studies have indicated some interesting comparisons between quaternaries and hypochlorites in the presence and absence of organic matter. As has been mentioned, the hypochlorites in most instances showed higher germicidal activity in the absence of organic matter. This superiority was quite pronounced with gram negative types like *E. coli* and *P. aeruginosa* and occurred in concentrations ranging from 25 to 200 ppm. When one percent sterile skim milk was added to provide organic matter, the quaternaries were more germicidal than hypochlorites in low concentrations; however, after the concentrations of germicide were increased, the recovery of germicidal activity by hypochlorites was rapid. This recovery usually occurred when the concentration was increased to about 100 to 200 ppm. In many instances the hypochlorites regained their superiority in rapid germicidal action when this threshold concentration was reached. Naturally this so-called threshold level is a function of the organic matter content in the germicidal solution and greater qualities of organic matter would interfere more seriously with hypochlorite than quaternary action. It has been shown in other studies (48) that the effect of low concentrations of organic matter on hypochlorites is less than was formerly believed.

The fat in whole milk should have a protective effect against quaternary action. It has been shown that bacteria

carrying a thin film of fat are protected from quaternary action (47). When quaternaries are applied to the skin they are believed to orient themselves in a film with the germicidal part of the molecule out (47). This would explain the phenomenon reported that when hands are dipped in one percent alkyl dimethyl benzyl ammonium chloride, a protective germicidal film is formed with viable bacteria underneath it (50).

Stability. One of the most remarkable properties of the quaternaries is their great stability in the absence of organic matter and other incompatible compounds. Their germicidal strength remains unchanged over many months in contrast to hypochlorites which gradually lose available chlorine under most conditions.

Toxicity. A number of trials during the past several years on laboratory animals have suggested that the toxicity of quaternary is relatively low (3). One report indicated that an alkyl dimethyl benzyl ammonium chloride caused no ill effect in white rats when a 10 percent solution was fed at the rate of 3 percent of the daily ration (52). Two reports from one laboratory indicate the toxic effect of quaternary on laboratory animals to be greater than that of other surface active agents (53, 54). In one of the studies alkyl dimethyl benzyl ammonium chloride was toxic in a concentration of 0.063 percent. There is some difference of opinion at the present time regarding the toxicity to human beings of low concentrations of quaternary that might be picked up by foods such as milk and milk products from utensils and equipment sanitized with them. Most of the work reported thus far suggests that the trace of quaternary that might be transferred to milk and milk products from sanitized equipment is not toxic to human beings. Investigations now under way should provide the necessary information about this problem. In their application for washing cows' udders and teats and rinsing hands the quaternaries have an advantage over hypochlorites since use of quaternaries results in less chapping of the skin surfaces (51). This is an observation frequently reported by herdsmen throughout the country. However, care should be employed in handling or applying concentrated quaternary solutions to skin surfaces since they may be quite irritating. It has been reported that application of a one percent cetyl trimethyl ammonium bromide ointment to cows' teats resulted in development of lesions with subsequent mastitis infection (75).

Corrosiveness. Quaternary solutions are considered noncorrosive to metals and alloys used for dairy equipment (41, 55, 56). This conclusion is based on trials involving long exposure periods with metals in contact with the quaternary solutions.

Odor and Flavor. Quaternary ammonium compounds usually are termed odorless. When components employed in their manufacture are sufficiently purified and synthesis of the final compound is carried out properly, the final product is relatively odorless in use dilution. In the past, some commercial compounds through use of poorly refined components, especially the long hydrocarbon chain, have imparted a disagreeable odor to utensils and equipment on which they were used. Some batches of a compound have shown variation in this respect. Care should therefore, be taken to test such products before employing them on a large scale for sanitation purposes.

Quaternaries impart a decidedly bitter taste to solutions or foods if present in sufficient concentration. This effect is noticeable when the quaternary concentration in milk reaches about 10 to 25 ppm and is quite pronounced at 50 ppm. Therefore, avoiding excessive contamination of milk and milk products with quaternaries is just as important as it is for hypochlorites.

Formation of Precipitates in Application of Quaternaries. A problem that has appeared rather frequently where quaternaries have been used for dairy sanitation purposes has been the formation of a brown precipitate, especially where milk comes in contact with quaternary on equipment surfaces. This precipitate, which may be quite gummy in nature, can usually be removed rather easily with warm water by brushing. Nevertheless, its occurrence is quite undesirable. It is believed to be due to a reaction between milk protein and quaternary compound but no report verifying this fact seems to have been published. There is some evidence indicating that excessive agitation or aeration or both may play a part in the precipitate formation. One of the pieces of dairy equipment reported as offering some difficulty in this respect is large surface coolers. In farm trials with detergent sanitizers containing essentially quaternary compound, nonionic wetting agent, and polyphosphates, we have found that removal of most of the milk film with water before application of the quaternary markedly reduces any tendency for formation of a brown precipitate.

Cost. To date there is no possibility of manufacturing quaternaries to sell as low as hypochlorites. In general, the cost runs at least twice as high as that of hypochlorites, and sometimes higher. An examination of the chemical structure of quaternaries and hypochlorites and the by-products available for hypochlorite manufacture explains the differences in cost of production. As volume of quaternary production increases, cost of the compounds undoubtedly will decrease.

DAIRY FARM SANITATION

For several years the quaternaries have been recommended for every possible sanitation operation on the farm. Many of the recommendations were made without benefit of research to evaluate such procedures. Subsequent investigation has supported some, but not all, claims.

Mastitis Sanitation. It has been shown that no significant difference in bacterial count of milk may be expected when warm water, hypochlorite, or quaternary solutions are used for washing udders prior to milking (57). This is to be expected since this washing operation merely removes excessive numbers of bacteria from the outside of the udder. Approximately an 80 percent reduction in numbers followed washing with 200 ppm quaternary and hypochlorite germicides (51). The quaternaries were considered preferable for this purpose because they avoided the chapping of hands and cows' teats encountered when warm water alone or hypochlorite solutions were used. It has been reported that about 30 cows can be washed before the germicidal potency of a 400 ppm quaternary solution is seriously impaired (58). Studies on teat cups have indicated a 99.7 percent destruction of *Streptococcus agalactiae* by soaking teat cups in a 400 ppm quaternary solution, using an extra teat cup assembly to allow treatment between cows (58). Others also have recommended quaternaries for this purpose (45, 56).

In our studies, 250 ppm quaternary ammonium chloride and hypochlorite solutions effected an average destruction of from 84 to 98 percent of *S. agalactiae* on teats of cows. On the basis of lack of skin irritation the quaternary was preferred. Destruction of *S. agalactiae* on teat cups, using a 3-second dipping in 250 ppm hypochlorite or quaternary solution, frequently exceeded 99 percent. Factors that resulted in more complete destruction of *S. agalactiae* on teat cups included: (1) Use of two successive germicidal rinses rather than a water and germicidal rinse, (2) use of a longer exposure period to germicide, (3) increasing concentration of germicide to 500 ppm, (4) use of teat cup inflations free of cracks and checks, and (5) a low initial

number of *S. agalactiae* on the teat cups to be treated.

General Farm Utensil and Milking Machine Sanitation. The general properties of quaternaries provide an indication of the operation where they should prove successful on farm equipment. Since hypochlorites show more rapid germicidal action in the absence of organic matter against a variety of common dairy organisms, they should be preferable for rapid germicidal treatment of clean equipment just before use. Quaternaries may also be employed for this purpose since their activity at 200 ppm strength is sufficient to destroy most of the organisms present (59, 62), but the fact remains that for this type of operation a hypochlorite may do a better germicidal job at a lower cost (60). Such rinsing before use may apply to pails, strainers, cans, stirrers, surface coolers, and milking machines. Where a farmer uses quaternary for washing cows' udders and treating teat cups, he may prefer to use it also for utensil sanitation.

One of the distinct advantages of quaternary compounds is their ability to form a bacteriostatic and bactericidal film on equipment surfaces. Thus, a piece of equipment may be treated with quaternary after cleaning and the film of germicide prevents growth and may actually decrease the numbers of bacteria on it while the equipment is idle. Our studies have indicated this to be an important factor where equipment surfaces remain in a moist state. However, where the equipment surface dries rapidly after cleaning and remains dry, treatment with quaternary results in no greater and sometimes in less destruction of bacteria than with a hypochlorite. The so-called film formation effect of quaternaries can be utilized to advantage with almost any type of equipment, either farm or plant.

Detergent Sanitizers. Incorporation of quaternary in a cleaner consisting of non-ionic wetting agent, polyphosphate, and other cleaner ingredients compatible with quaternaries represents one of the most important developments in the quaternary field. A number of workers have reported promising results with such preparations (61, 62). In an extensive farm trial using standard and various detergent sanitizer procedures, we have found that the type of compound and method of application greatly influence the effectiveness of the detergent sanitizers. In almost every case where detergent sanitizers were used the numbers of thermoduric bacteria were maintained at a low level even when numbers of other types, chiefly gram negative, increased. Thorough rinsing with cool or lukewarm water and thorough brushing were found essential for average conditions even though some farms consistently produced low bacterial count milk on a straight flush-wash procedure with no water rinse or brushing. The other factor, not stressed in previous studies, is that the cleaner ingredients in the detergent sanitizer probably are as important as the quaternary, and the first requirement for a detergent sanitizer is that it must be an excellent cleaner. If it is, a moderate germicidal and bacteriostatic action by the quaternary may destroy or prevent growth of most organisms present. Another requirement in the application of the detergent sanitizer is a periodic clean-up involving a complete disassembling of the milking machine and preferably soaking parts in an acid detergent to remove accumulated milk solids or precipitate that sometimes forms. Such a periodic clean-up materially increased the effectiveness of the detergent sanitizer in our trials. The actual washing procedure considered satisfactory included a rinse with water immediately after use, brushing with a warm detergent sanitizer solution without taking the teat cup assembly apart, racking or hanging up to dry with no further treatment, rinsing with water or germicide just before use, and finally, a weekly or biweekly thorough clean-up of milking machine equipment with an acid detergent.

DAIRY PLANT SANITATION

The same fundamental factors apply to germicidal treatment of both farm and plant equipment and consequently much of the above discussion concerning farm equipment pertains as well to the dairy plant. A number of general articles on application of quaternaries to dairy plant sanitation have been published (63, 64, 65, 66, 67).

Treatment of Farm Milk Cans. Marked reduction in numbers of bacteria in milk cans by treatment with quaternary as a spray or rinse has been reported (68, 69). In some trials reduction averaged 99.98 percent. It is common for milk cans to leave the milk plant with small amounts of moisture on the inside surface, or, in many instances, moisture may condense on the inner surface following cooling of the can. Since as long as 36 hours may elapse between washing and the time milk is again placed in the cans, there may be considered bacterial growth even in a relatively clean can. Therefore, quaternaries have usually been effective for treating cans following the washing treatment. Studies by Moseley (70) yielded the following average results on a large number of cans: Count per can immediately after leaving washer, 29,800; after 24 hours' storage, 42,490; cans from same washer after 24 hours' storage in moist state, 33,690,000; and cans treated with 200 ppm quaternary following washing, 4,690. An effective means of treating cans is by injecting a 200 ppm quaternary solution with the steam jet in the steam position. Hypochlorites are generally not satisfactory for this purpose.

General Equipment Sanitation. As in the case of farm equipment, if a rapid germicidal treatment is required just prior to use, there is no advantage in using a quaternary rather than a hypochlorite. As pointed out earlier, in some instances the hypochlorite may represent a less expensive, more efficient means of destroying organisms, particularly coliform or *Pseudomonas* species. However, in dairy plant equipment, where it is desired to prevent growth of bacteria while the moist equipment is idle, the parts can advantageously be rinsed or sprayed with 200 ppm quaternary. Similar recommendations have been given for tank trucks following cleaning. Frequently for such equipment the usual concentration of germicide may be doubled.

Other Applications in the Dairy Plant. Quaternary ammonium compounds have fungistatic properties in varying degree depending on the type of compound. In commercial plants mold growth on walls and ceilings has been checked by first thoroughly cleaning the surfaces with a dairy cleaner, then spraying or brushing on a strong (about 5000 ppm) hypochlorite solution, followed later by a quaternary solution of equivalent strength. Quaternaries in the form of sprays also have shown ability to deodorize storage rooms.

A number of workers have recommended quaternaries for the final germicidal treatment in bottle washers. Usually a hypochlorite is preferable for this purpose because of its more rapid germicidal action in absence of organic matter. A quaternary, however, might have an advantage for this step when bottles are stored for a considerable interval between washing and filling.

Quaternaries have also been suggested for treatment of butter wash water for destruction of water types of bacteria, chiefly *Pseudomonas* species. Again, the greater activity of hypochlorites for this form of organism gives them an advantage.

The quaternaries are not recommended for treatment of equipment or rooms in milk plants or cheese factories for bacteriophage destruction. One study (71) indicated quaternaries to be useful in isolating a bacteriophage for *E. coli* from mixtures of the organism

and phage. The quaternary was added to the mixture to destroy the organism, leaving the phage intact.

Adulteration of Milk with Quaternary. Several investigators have reported that quaternaries proved ineffective as a means of preserving milk or preventing spoilage (72, 73, 74). The common opinion is that since a bitter flavor appears at about 10 to 25 ppm of quaternary, the concentrations required for marked inhibition would be easily detected on examination of the milk. In milk intended for cheese making there may be more of a problem if adulteration occurs. Results of recent studies in our laboratory have shown some retardation of growth of *Streptococcus lactis* by 5 to 10 ppm quaternary added to milk when cultures were grown in milk under conditions simulating those in the cheese vat.

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THE FREEZING POINT OF RECONSTITUTED NON-FAT DRY MILK SOLIDS

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INTRODUCTION AND PREVIOUS WORK

THE practice of standardizing the fat test of whole milk, using reconstituted non-fat dry milk solids, has been considered a necessity or at least one solution to the problem of meeting volume demands during periods of low milk production. Regardless of the legality of such practice, one of the questions arising is whether it can be detected by analysis of the standardized milk. Experience shows that skillful blending of whole milk with a good quality reconstituted dry milk cannot be detected by organoleptic examination. The blended milk can, further, be prepared so that there is a perfect balance between fat and solids-not-fat.

The Evenson color test (4) is no longer reliable; methods of dehydrating milk have improved markedly over those employed in 1922. Tests involving the determination of heat treatments are no longer of value since the wider use of high temperature short time pasteurization of fluid milk and the improved processes of powder manufacture which employ low heat treatments.

On the theory that even a low heat process reconstituted powder would exhibit an abnormal refractive index, a few preliminary tests were made. The variations from normal milk were considered insignificant and these tests were discontinued. Partial destabilization of colloids or a change in solubility has been known to characterize certain powdered milks. Either of these and more particularly the latter should theoretically affect the freezing point. The freezing point of milk is generally thought to be its most constant physical property.

The purpose of this study was to determine whether the addition of reconstituted non-fat dry milk solids to whole milk has an effect on the freezing point of the resulting blend. A review of the literature did not reveal any data on the subject. The generally accepted average freezing point of normal milk is −0.550° C. Hortvet (5) and Bailey (6) give the ranges for normal milk as −0.534 to −0.562° C. and −0.530 to −0.566° C. respectively. Doan (3) found that the freezing point of skimmilk and cream are identical with that of the original whole milk. It would appear, then, that blending natural whole milk and cream or skimmilk in any ratio would not result in a freezing point differing from that of whole milk.

The Association of Official Agricultural Chemists (1) regards the freezing point of milk as determined by the Hortvet cryoscope, an official method for the detection of added water. Milk may be said to be definitely adulterated with water when by the Hortvet method there is more than a 3 percent addition expressed.

EXPERIMENTAL AND DISCUSSION

Three commercially manufactured samples of spray process non-fat dry milk were used in this study. The moisture content of each was determined by the toluene distillation method (2). The dry milks were reconstituted with distilled water at 80° F., to definite total solids levels. A Waring Blendor was used for the mixing. Normal whole milk with which

the reconstituted milks were blended, was obtained at the college dairy immediately after milking, was cooled to 41° F., and the freezing point determination made within three hours of milking time. Precautions were taken to avoid the addition of water. Freezing point determinations were made according to the procedure of the Association of Official Agricultural Chemists (1).

Nine samples of reconstituted non-fat dry milk were prepared; from each of the three powders, fluid skimmilks were made containing 9.0, 9.3, and 9.5 percent total solids. The freezing points of these nine samples are shown in Table 1.

TABLE 1

FREEZING POINTS (°C) OF THREE RECONSTITUTED NON-FAT DRY MILK SAMPLES

No.	*9% solids*	*9.3% solids*	*9.5% solids*
1	—0.536	—0.557	—0.570
2	—0.522	—0.540	—0.552
3	—0.527	—0.540	—0.548

The fresh whole milk had a freezing point of —0.550° C.

At the 9 percent solids level all three samples had a higher freezing point than that of normal whole milk. As the solid level increased from 9 percent the freezing points of all three reconstituted skimmilks decreased. Sample No. 1 showed a freezing point lower than that of normal whole milk when reconstituted to 9.3 percent solids. Samples No. 2 and 3 had freezing points approximately the same as that of whole milk when they were reconstituted to 9.5 percent solids.

Although the total solids content of the skimmilks before drying was not known, it is reasonable to assume that in all cases the fluid skimmilks were lower than 9.5 percent.

Table 2 shows the freezing points determined when each of the nine reconstituted non-fat powders was blended with whole milk at a 50-50 ratio. As the solid content of a blend increases, there is a direct lowering of its freezing point. When 9 percent solids in skimmilk was used in the blend there was a consistently higher freezing point and an appreciable percent of "calculated water added." Only in sample No. 2, however, did the "calculated water added" exceed 3 percent.

CONCLUSIONS

1. The freezing point determination does not detect a skimmilk which has been made by reconstituting non-fat dry milk solids to 9.3 percent solids.

It may detect one reconstituted to 9.0 percent solids if it is known that the reconstituted product has not been "watered."

3. If fresh normal whole milk is blended with reconstituted non-fat dry milk solids at a 50-50 ratio, the freezing point of the blend will be a normal value for whole milk if the reconstituted non-fat dry milk solids product is 9.3 percent solids.

4. The drying of skimmilk solids results in a decreased solubility of certain milk constituents or in some other manner raises the freezing point of the reconstituted product.

5. There is no difference between the freezing point of a freshly reconstituted non-fat dry milk and that of the milk held at 45° F. for forty-eight hours.

TABLE 2

THE EFFECT ON FREEZING POINT OF ADDING RECONSTITUTED NON-FAT DRY MILK SOLIDS TO FRESH NORMAL WHOLE MILK
WHOLE MILK —0.550° C.

No.	*Reconstituted solids (%)*	*Freezing point °C.***		*Percent added water (calculated)*
		Reconstituted N-F.D.M.S.	*50% whole 50% recon.*	
1	9.0	—0.536	—0.543	1.27
	9.3	—0.557	—0.553	....
	9.5	—0.570	—0.560	....
2	9.0	—0.522	—0.533*	3.09
	9.3	—0.540	—0.545	0.93
	9.5	—0.552	—0.551	....
3	9.0	—0.527	—0.538	2.18
	9.3	—0.540	—0.545	0.93
	9.5	—0.548	—0.549	0.18

* The only instance in which the arithmetic average of the freezing points of the blended whole and skim did not equal the one determined by test.

** Freezing points on the blends were repeated after 48 hours storage at 45° F. All were identical to those determined on the freshly blended samples.

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PENICILLIN AS AN ADJUNCT TO THE PRESERVATION OF QUALITY OF RAW AND PASTEURIZED MILK

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Penicillin is most effective against gram-positive bacteria, and most investigators agree that its action is most pronounced under conditions conducive to multiplication of susceptible organisms.

The main bacterial population of milk is composed of gram-positive species. It is logical to expect that penicillin could be used to advantage as an adjunct to the preservation of milk. Curran and Evans (1) showed that penicillin in low concentrations is sporostatic and sporocidal for a wide range of organisms, and they concluded that penicillin has no application in the preservation of milk. It would seem that their studies failed to exhaust the possibilities which penicillin might have as applied to the preservation of milk, and it was reasoned that since penicillin acts most effectively on growing (or metabolizing) organisms (2) this phenomenon could be utilized in controlling the increase in bacterial populations incident upon failure to attain or maintain proper cooling of the product.

A series of experiments were carried out to determine the bacterial growth inhibitory effect of penicillin in milk stored at various temperatures. The temperatures used were chosen to bring out maximum differences in response in order better to illustrate the principle under study. The results though not extensive are of obvious interest and are reported as an incentive for future work.

Methods

All plate cultures were made with saline dilutions of milk in Proteose-Tryptone agar to which was added 5 percent sterile skim milk (Difco). Plates were poured with 20 ml. of culture medium and contained less than 0.007 unit of penicillin per milliliter of medium, carried over in dilutions from the milks containing the standard 3-unit-per-milliliter quantity. Incubation of plate cultures was carried out at 34° C. and counts were made after 48 hours' incubation. Other details are recorded in connection with the experiments described.

Experimental

A sample of raw milk containing a count of 16,000 bacteria per ml. consisting mainly of cocci and sporulating aerobes was distributed in 20-ml. amounts in sterile tubes for storage at various temperatures. Duplicate tubes were prepared. To one tube of each pair 0.1 ml. of a penicillin solution was added to give a final concentration of 3 units of penicillin per milliliter. One tube containing no penicillin and one containing 3 units per milliliter was stored at the following temperatures, 7°, 13°, 27°, and 37° C. for 20 hours, after which they were plated. The results are shown in Table 1.

TABLE 1

Influence of Penicillin on the Growth of Bacteria in Raw Milk Kept for 20 Hours at Various Temperatures

	Storage temperatures °C.			
	7	13	27	37
Raw milk 16,000 bacteria per ml. No penicillin added.	5,600	40,000*	100,000*	innumerable*
Raw milk 16,000 bacteria per ml. Penicillin 3 units per ml. added.	5,280	2,750*	95,000†	innumerable†

* Pinpoint cocci
† —*P. pyocyaneous*

The data in Table 1 are of interest with respect to the growth of bacteria present in raw milk at various temperatures.

There is no significant difference in the counts of milk containing penicillin or not containing penicillin when the samples are stored at 7° C. Penicillin had a well defined bactericidal action as compared with the no penicillin control in the samples stored at 13° C. This was associated with growth at this temperature. In the raw milk control stored at 27° C. numerous "pin point" cocci developed, while in the penicillin-containing sample the growth of these types was suppressed. Considerable growth of penicillin-insensitive *Pseudomonas pyocyanea* occurred. The same course of events is seen in the samples stored at 37° C. Thus at the higher temperatures the penicillin-sensitive gram-positive cocci were inhibited while the gram-negative types multiplied.

A sample of raw milk containing 1,080 bacteria per milliliter was distributed in 20 ml. amounts in 10 sterile tubes. These were divided into groups of 5 tubes each and treated as follows: (A) no further treatment (raw milk control); (B) 0.1 ml. of penicillin solution added to give a final concentration of 3 units per milliliter of milk; (C) pasteurized at 58° C. for 30 minutes (pasteurized control); (D) penicillin added to a final concentration of 3 units

TABLE 2

Influence of Penicillin on the Growth of Bacteria in Raw and Pasteurized Milk Kept for 60 Hours at 17° and 27° C.

	Storage Temperatures							
	17° C.				27° C.			
	0 hr.	24 hrs.	48 hrs.	60 hrs.	0 hr.	24 hrs.	48 hrs.	60 hrs.
Raw milk, No penicillin added	1080	22,000	innum.	innum.	1080	140,440	innum.	innum.
Raw milk. Penicillin 3 units per ml. added	1080	1,030	1,760,000	"	1080	1,408	"	"
Pasteurized milk No penicillin added..	480	1,120	896,000	"	480	19,600	"	"
Units per ml. penicillin added then pasteurized	0	0	0	"	0	0	102,400	"
Pasteurized then penicillin added Units per ml.....	480	210	756,000	"	480	360	960	256,000

per milliliter and then pasteurized for 30 minutes; (E), pasteurized for 30 minutes, then penicillin added to a final concentration of 3 units per milliliter. After cooling all tubes to 17° C. one group of tubes was placed at 17° C., while the corresponding group was placed at 27° C. Plate cultures were made at zero hours from all tubes and after storage for 24, 48, and 60 hours at the two temperatures. The results are shown in Table 2.

It is seen in Table 2 that penicillin sharply retarded the growth of the bacteria in raw milk for at least 24 hours at both 17° and 27° C., although considerable growth took place in the interval between 24 and 48 hours.

A more decisive result was seen at both temperatures in the samples pasteurized with penicillin in it. This effect was most pronounced in the sample stored at 17° C. although it exerted a considerable restraining effect at 27° C. The increase in bacterial numbers in the raw and pasteurized milk containing penicillin was due to the presence of penicillin-resistant organisms since appropriate experiments showed that the penicillin content of the samples was not impaired.

The experiment is of practical significance as it clearly illustrates the ability of penicillin to inhibit thermoduric species for extended periods of time.

The preceding experiment was repeated using another sample of milk, with storage temperature of 7° and 17° C. Platings were made at zero, 72, and 96 hours. The results are shown in Table 3.

Table 3 shows the bacterial growth-restraining influence of penicillin in milk stored at 7° and 17° C. over a period of 96 hours. The beneficial influence of penicillin in raw and pasteurized milk is clearly shown and the restraint of development of a thermoduric flora is apparent.

It would appear from the data in Tables 2 and 3 that the efficiency of the pasteurization process is increased when this process is carried out on milk containing penicillin. In this regard it has been shown that heating cocci (50–60° C.) in the presence of penicillin increases the rate of killing of the organisms (3).

In comparing Table 2 and Table 3 it will be noted that penicillin had a more pronounced adverse effect on the

TABLE 3

INFLUENCE OF PENICILLIN ON THE GROWTH OF BACTERIA IN RAW AND PASTEURIZED MILK KEPT FOR 96 HOURS AT 7° AND 17° C.

	Storage Temperatures					
	7° C.			17° C.		
	0 hr.	72 hrs.	96 hrs.	0 hr.	72 hrs.	96 hrs.
Raw milk No penicillin added	3,600	256,000	innum.	3,600	innum.	innum.
Raw milk. Penicillin 3 units per ml. added	3,600	96,000	2,600	3,600	166.000	66,560
Pasteurized milk. No penicillin added	1,400	1,600	1,940	1,400	179,200	576,000
3 units per ml. penicillin added then pasteurized	440	1,140	80	440	500	180
Pasteurized then added 3 units per ml. of penicillin	1,400	1,140	100	1,400	380	180

flora of the milk used in the Table 3 experiment than in the previous experiment. This greater efficiency is doubtless due to the fact that the flora was composed of susceptible organisms in this instance.

Samples of pasteurized market milk from 3 dairies were obtained for study. Samples "O" and "N" may be regarded as milk of reasonably good quality while sample "R" was of a very poor grade. Duplicate tubes containing 20 ml. of the samples were set up for storage at 7° and 17° C. Penicillin was added to tubes of each sample group to a final concentration of 3 units per milliliter. Corresponding tubes without penicillin were carried as controls. All samples were plated at zero hours and after 72 hours of storage at 7° and 17° C. The results are shown in Table 4.

TABLE 4

INFLUENCE OF PENICILLIN ON THE GROWTH OF BACTERIA IN PASTEURIZED MILK KEPT FOR 72 AND 96 HOURS AT 7° AND 17° C.

		Storage Temperatures					
		7° C.			17° C.		
Samples of Pasteurized Milk		0 hr.	72 hrs.	96 hrs.	0 hr.	72 hrs.	96 hrs.
N	No penicillin added	160	440	.....	160	1,080	.....
	Penicillin 3 units per ml. added	160	220	.....	160	1,080	.....
O	No penicillin added	2,400	900	.....	2,400	60,000	.....
	Penicillin 3 units per ml. added	2,400	320	.....	2,400	680	.....
R	No penicillin added	1,280,000	6,912,000	innum.	1,280,000	10,240,000	innum.
	Penicillin 3 units per ml. added	1,280,000	2,304,000	800,000	1,280,000	800,000	124,800

Table 4 illustrates a number of points of interest. Sample "N" representing high grade pasteurized milk was not influenced by the presence of penicillin, little growth having occurred at either 7° or 17° C. over the test period of 72 hours in either the control or the penicillin-added sample. Some effect of penicillin action was seen on Sample "O," this being most pronounced at 17° C. at which temperature some multiplication of the population occurred. The flora of sample "R," containing numerous thermoduric bacteria, were found by differential count to consist mainly of spore-bearing aerobes and thermoduric cocci. In this sample an increase in the count occurred in the control, penicillin-free samples, at both 7° and 17° C. The addition of penicillin to this milk reduced the viable population in both test samples, the most pronounced effect occurring at the higher storage temperature.

DISCUSSION

The results described are in general what could be anticipated on the basis of what is known at the present time of the action of penicillin.

Translated into terms of practical operations it would not be expected that penicillin would be of any considerable benefit in high grade milk handled under good conditions and kept under adequate refrigeration. Bacterial multiplication does not occur to any marked extent in milk of this type, and since penicillin is active mainly against growing organisms it does not exert any effect. The experiments show that adding penicillin to milk as an adjunct to the maintenance of quality is important as a safeguard when proper cooling facilities are not operative. Bacterial multiplication occurs at elevated temperature and it is precisely under these conditions that

penicillin can exert its most pronounced effects. This is well illustrated in the various tables. Obviously the principle can be utilized in special instances such as for inhibiting bacterial multiplication in cream stored for ice cream manufacture, or for maintaining the quality of bulk milk being transported over long distances.

It will be noted in Tables 3 and 4 that an increase in bacterial numbers precedes the eventual decrease in samples containing penicillin. This phenomenon is not well understood but it is commonly seen in experiments in which the effect of penicillin on micrococcus populations is studied (4, 5, 6).

In general, the predominant flora of milk as produced in this country consists of gram-positive species and it is against these groups that penicillin is most active. It may be seen in Tables 1, 2, and 3 that the effect of penicillin in raw milk is less than in pasteurized milk. This is due to the presence in raw milk of penicillin-insensitive gram-negative organisms. Under the conditions existing in the average raw milk, penicillin can be expected to inhibit the gram-positive susceptible organisms but can have no effect on the gram-negative types. The result is the development of a selective culture of penicillin-insensitive bacteria in the milk. Such an occurrence is illustrated in the experiment shown in Table 1 where *P. pyocyanea* grew out in abundance in the sample containing penicillin. In other experiments not described, the slow, selective development of a coliform flora frequently occurred in raw milk containing no penicillin.

Striking results are obtained when penicillin is used in conjunction with pasteurization. This is ascribable to the destruction of coliforms and other penicillin-resistant types by pasteurization leaving a thermoduric flora which is largely susceptible to the action of penicillin.

It is not suggested that penicillin be utilized as a substitute for cleanliness or accepted sanitary practice, but it appears obvious that it may be advantageously employed as an aid in the maintenance of quality of certain dairy products and is worthy of further study in this respect.*

SUMMARY

Experiments are described showing the antibacterial action of penicillin (3 units per milliliter) on the viable count of milk handled in various ways under laboratory conditions. It is seen that penicillin can be used to suppress the development of certain species which comprise the milk flora under conditions which favor bacterial growth, and it is suggested that further studies be carried out to further elucidate the applications of the principle.

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* Footnote: It should be pointed out that penicillin can not be added to raw or pasteurized market milk offered for sale without the sanction of the proper regulatory bodies.

FAT DETERMINATIONS IN MILK

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SINCE 1890 when Doctor S. M. Babcock of the University of Wisconsin first published his procedure, the Babcock Method has been the test most commonly employed to determine the fat content in milk.

This method though recommended and accepted as the legal procedure in many states has numerous disadvantages. Sulfuric acid used as a reagent in the Babcock test often chars the sample. The neck of the Babcock bottle is small and unless care is observed, burns may be inflicted on the worker when pouring the acid. In this procedure several centrifugations must be carried out for each test. Cleaning of the test bottles is tedious and time consuming.

The technique suggested by Schain [1] eliminates the above mentioned disadvantages. This procedure depends upon the formation of a protein-detergent complex to break up the emulsion and thereby liberate the fat present in the mixture. We employed this method comparing it at the same time in all instances with the Babcock technique and in addition in eight instances with the Röese-Gottlieb technique. One hundred samples of milk (raw) and homogenized and plain (pasteurized) milks were examined.

MATERIALS

Solution A—A super-saturated solution of a fat dye was prepared by mixing oil red O in isopropyl alcohol. This was then added to a standardized nonionic detergent, polyoxyethylene sorbitan monolaurate in ethyl alcohol. The mixture was shaken well.

Solution B—This is a standardized anionic detergent, dioctyl sodium phosphate.

PROCEDURE

(1) A well mixed sample (17.5 ml.) of milk was placed in an official Babcock milk bottle.

(2) 7 ml. (or a standardized amount as found necessary) of solution A were added slowly and the mixture was shaken immediately to mix the contents thoroughly.

(3) 20 ml. of solution B were added without delay so that the last addition formed a layer at the bottom of the container. Care should be taken that milk and reagents are washed out of the neck of the test bottle. This is achieved by rotating the test bottle as each reagent is added.

(4) The container was then immersed in a water bath at 180° F (temperature is to be constant, though a 5° range is permissible). The water level in the bath should be at a height equal to that in the bottle.

(5) After exactly 5 minutes in the water bath, the bottle was removed, and distilled water or tap water (from the water bath) at 180° F was added until the fluid reached the top of the graduation in the neck of the flask.

The flask was set aside for 15 to 20 minutes. The percentage of fat was then read as in the Babcock technique. If any fat adheres to the side of the neck of the flask, it is cleared and the column of fat evened by adding from one to several drops of 1/N NaOH.

Forty samples of homogenized A milk, 27 of grade A milk, and 33 samples of raw milk, one hundred in all, were tested using in every instance the Babcock technique and the Schain method on each sample. For each type or grade of milk it was necessary to standardize the Schain technique against the Babcock method. This was accomplished by varying solution A until the fat percentage reading was exactly as that obtained by the Babcock technique.

The amount of solution A to be used as mentioned by Schain is 7 ml. In some instances we obtained a reading of 0.1 percent higher with this volume. Also by using less of solution A the reading may be increased, and if the amount of solution A is increased, the reading may be lower. We therefore standardized the technique for each type of milk so that the reading of the percentage of fat corresponded to the Babcock reading. We noted the amount of solution A required for each type of milk which gave us identical readings, and we always used that same volume throughout the testing of that particular type of milk. Under such conditions our readings corresponded exactly to the readings obtained by the Babcock method.

In our experience, the amount of solution A required for raw milks was 6.8 ml. instead of 7 ml. This adjustment accordingly was made in all instances when examining samples of raw milk. In the case of all pasteurized milk (plain and homogenized) the 7 ml. amount specified was satisfactory in practically all instances. The few exceptions were in cases where the fat content was 4 percent or higher; here the amount of solution A required was either 6.9 ml. or 6.8 ml., never a lower quantity.

Three samples of raw milk, three of homogenized A (pasteurized) and two of Grade A (pasteurized) milks, eight in all, were tested by the Schain technique, the Röese-Gottlieb method, and the Babcock method. All three readings for each sample were identical after the above mentioned adjustment with solution A was made.

Summary and Conclusions

The Schain technique for determining the fat content in milk (raw, pasteurized plain, or homogenized) was found to be simple, easy to perform, and required no extensive laboratory equipment. The possibility of either charring of the sample or acid burns with the reagent as may occur in the Babcock method is eliminated; one hundred different samples were examined. In all instances both the Babcock and the Schain methods were used. In 8 other instances the Röese-Gottlieb technique also was performed.

The test is carried out by thoroughly mixing the sample with solution A (oil red O in isopropyl alcohol with a nonionic detergent in ethyl alcohol) in a Babcock bottle. Reagent B (a standardized anionic detergent) is added immediately and without shaking; the mixture is placed in a water bath at 180° F for exactly 5 minutes. Water at 180° F is added to bring the liquid in the Babcock bottle to the graduated portion in the neck. After standing for ten to twenty minutes at room temperature, the percentage of fat is read. The fat layer is always clear and distinct, so that a reading can be made quickly, accurately and with ease.

Instead of using the stated amount (7 cc.) of solution A, it is necessary to standardize the Schain technique against each type of milk and determine at the beginning (only one test is necessary) the volume of solution A required so as to obtain identical findings (fat percentage readings) with either the Babcock or the Röese-Gottlieb methods.

The Schain technique in its present procedure cannot be used for fat determinations in buttermilk, creams, ice-cream, or other milk products. We are investigating whether modifications of the method may be useful for the latter.

Note: Since the presentation of the above, we have modified the technique, so that it can be performed with greater simplicity. Furthermore instead of using two solutions (A and B) and two operations, only one solution and one operation are used. In addition, our present technique can be used for fat determinations in buttermilk, creams (sour and sweet), butter, cheese, ice-cream and other milk products.
The use of other detergent mixtures has proven as satisfactory as the above.
These findings will be published shortly.

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Volume 13 May–June Number 3

A NATION-WIDE SANITATION PROGRAM*

Walter F. Snyder

Executive-Director, The National Sanitation Foundation, University of Michigan, Ann Arbor, Michigan

As one of the pioneer organizations in the field of food sanitation I want to congratulate the International Association of Milk and Food Sanitarians for splendid progress over the years. One has only to review the Journal of Milk and Food Technology to realize that this Association has developed into a strong, functioning organization in the milk and food field.

Progress in Sanitation

A study of the history and development of sanitation shows noteworthy progress in certain areas. No one can deny the success story of water and sewage; the United States is one of the few countries in the world where water from a public supply can be drunk without fear of disease. Pioneers in this field rightfully deserve respect and admiration for the splendid job they have accomplished.

The National Association of Sanitarians on the west coast has made marvelous progress in establishing recognition for the sanitarian as a professional worker in the field of public health sanitation. As you review this record it is apparent that years of hard work have been a prelude to great accomplishments. The Sanitarian's Association deserves praise and credit for their work. We should also give credit to the work of the Municipal Public Health Engineers, the Conference of State Sanitary Engineers, and other organizations in the field of sanitation, all of which have contributed to the sanitation story in the United States.

* Presented at Annual Meeting of The International Association of Milk and Food Sanitarians, October 20, 1949, Columbus, Ohio.

It would be very simple to go on and on describing in detail the many achievements of the International Association of Milk and Food Sanitarians, but, as time is something which runs out for all of us we must realize that when individuals and organizations dwell only upon past achievements, their period of dynamic progress is over. In order to plan sound programs for the future we must give credence to past accomplishments. However, the problem of today is a solution for the tomorrows.

Problem in Education

The American public cannot, or will not, extract from the scientific literature in the field of sanitation material which it can translate into a tangible sanitation story, understandable by lay people. The public needs and demands sanitation. It is entitled to know how this program affects and is affected by them. The public demands understandable facts—not detailed publications of technical data whose practical implication can be grasped only by specialists in the field of sanitation.

Is our program described in terms that are understandable by the Boy Scouts, the Girl Scouts, the Parents and Teachers Association? Is it a program in which they are eager to participate? The real strength of the program could be measured by the degree of understanding attained and the kind of action that *should* follow such understanding. Can our present program in sanitation stand up to such realistic tests? Would we be proud of the understanding our citizens have of sanitation? The answer is emphatically *NO!*

The ambitious individual or the ambitious group, in order to demonstrate leadership and to maintain leadership in the field of sanitation, must recognize the entire problem confronting us today. The many aspects of the question must be welded together as a whole into one story. Sanitation must be pulled together if we are to have a success story. Individual techniques, and isolation of certain groups, will not tend to build sanitation as a great part of American life. They will not demonstrate to the public the need for sanitation in establishing a better standard of living.

The public, in terms of the average family around the kitchen table, must have a clear-cut understanding of sanitation in terms of: What are you as a sanitarian doing which is of direct help to him and to his family? How does he, as an individual citizen, benefit by the sanitation program in his community? How does he fit into the program and exactly how does the program fit his needs? The need for public understanding is paramount; research in sanitation is of little value unless and until the practical value of the newer knowledge is put to work in the lives of individuals.

The sanitation field today offers an unlimited opportunity for leadership in the over-all picture of environmental sanitation; leadership in terms of making sanitation tangible to the average man and his family as it applies to his daily life.

Certainly sanitation is not an ordinance or a technique, an individual or a certain group. It is more than that, and the National Sanitation Foundation has suggested that sanitation is a way of man living with man, that "it is the quality of living that is expressed in the clean home, the clean farm, the clean business and industry, the clean neighborhood, the clean community. Being a way of life it must come from within the people; it is nourished by knowledge and grows as an obligation and an ideal in human relations."

One of the very basic elements which makes a city such as New York or Chicago possible is man's ability to live with man, and one of the first steps of man living with man is cleanliness, or sanitation. I do not plan to discuss the number of techniques which are involved in sanitation, but I would like to project our thinking into the future philosophy of sanitation.

Sanitation techniques, as tangible to man, are one thing, and sanitation as an important part of the average man's life in the center of the block is another. True, the techniques are all important to the sanitation worker and also to industry, but the public is not one bit interested in the details of sanitation. It is interested only from the viewpoint of how sanitation affects lives and living. This brings up an entirely different picture of sanitation. I mentioned leadership, and it is in this area of making sanitation tangible to the man in the center of the block that leadership is definitely needed. Some months ago the National Sanitation Foundation brought out seven areas in the field of sanitation which they thought needed more activity—those seven being: (1) trained personnel; (2) research in sanitation; (3) sanitation education; (4) National Sanitation Clinic; (5) testing laboratory; (6) publication; and (7) textbooks. In the third area of education, or public relations, we have developed some thinking which I would like to present at this time. It is our hope that the major emphasis on sanitation can be taken out of the negative area, that of rats, garbage cans, bacteria counts, etc., and placed on an educational approach or a positive approach. This approach can be centered around family activities and have the focal point of sanitation education not necessarily in the sick area of sanitation alone, but in the well area also, such a bringing to the attention of the school child as well as the adult the essentials and benefits of clean living manifested in the home, neighborhood and community.

New Positive Approach

In an effort to organize our thinking regarding this sanitation approach, we have divided our sanitation functions into what we call *curative* sanitation and *preventive* sanitation. In the curative area we think of a sick area of sanitation where treatment is needed because of a particular situation. We probably can list our control measures, our ordinances, techniques, laws, rules and regulations, and all that has to do with regulatory sanitation control in this area. This, perhaps, is where public health sanitation people have spent the greatest part of their time, and in this area is only a *small* part of the public.

The other side of our thinking deals with *preventive* sanitation which is educational for the *well* people of the community. These people constitute a larger percentage of the population, and they are a group that must understand our program, that must appreciate our program and must lend a hand to our entire sanitation effort if we are to have a balanced program in the community. This group includes, perhaps, the man who lives on Knob Hill in his ivory tower, and does not think sanitation is of real concern to him, and that sanitation laws, rules and regulations are written only for the man on the other side of the tracks. We feel that both curative and preventive sanitation must be practiced in order for our subject to be popular. The man in the well area certainly does not appreciate talking about rats, garbage cans, bacteria counts, or the negative side of sanitation. He will, however, respond to a positive approach when you tie up sanitation with his daily living in terms of beauty, cleanliness, morale, security, pride, dollar value, and social relationships.

The over-emphasis of the *negative* approach to sanitation and the *sick area* is a *liability*. Selling sanitation in the well area, using the positive approach and reaching the people outside of the sick area of sanitation is a real asset, not only to the profession, but to the betterment of community health. Sanitation workers over the years have been so handicapped by lack of funds and personnel and have had placed upon them such a tremendous responsibility of accomplishing results in the sick areas of sanitation that in many cases they have not had the opportunity to evaluate the good that can come to the sanitation worker by activities on the preventive side of sanitation in the so-called well area of people.

Let us not sell sanitation short! Let us look at the subject in its entirety and collect some of the assets that await us with this positive approach and talk to *all* the people instead of just a few. Sanitation in terms of rats, garbage cans, high bacteria counts, etc., is not appealing to any one. In fact, it is not hard to find health officers who are ashamed of the subject and do not have any particular interest in the field of sanitation. Sanitation as a way and means of a better American standard of living thought of in terms of beauty, security, social relationships, etc., is not only tangible to every citizen in the United States but can definitely be made part of his responsibility in society.

Illustrative Sanitation Program

Recently, through the cooperation of Mr. Clarence Klassen, State Sanitary Engineer of Illinois, we had the opportunity of trying this suggested positive approach of sanitation in a community. This positive approach was tried before luncheon clubs, and in two county health department units. Time will not permit me to go into detail regarding this experience, but I would like to cover the main happenings. As a result of talking to the luncheon clubs, front page newspaper stories and editorials appeared in the daily papers, pointing out that sanitation is a way of man living with man, that it is tangible to all of us, and that everyone had a responsibility in his or her community. Many times you have wished for front

page stories regarding a sanitation activity. In this case we had the front page stories without asking for them, and the newspaper pointed the finger to all of its readers emphasizing the benefits a sanitation program could bring them. The big difference in this approach was that we did not talk about rats, garbage cans, or dumps. We talked about sanitation in terms of *beauty, security, moral value, cleanliness* and *dollar value*. In the Springfield daily paper there appeared an editorial on moral sanitation. The approach to the county health department units was again the positive approach, the health commissioner taking the material over to the principal of the high school and the principal suggesting that the material was good as theme writing material in the English classes. Thus, themes were written in the high school on sanitation. The art classes picked up the posters and started to reproduce them; the Chamber of Commerce showed interest in a clean-up campaign, and as a result of making sanitation tangible to all the people in terms of their daily living habits, a clean-up campaign was started by the ministers of the town preaching in the pulpits on Sunday morning that "Sanitation Is Next to Godliness." Many in this group who are steeped in research activities may somewhat discount the value of this type of publicity. However, I am trying to emphasize the particular need for more understanding by the public of what we are trying to do. I am also urging that we make it possible for the public to participate in the field of sanitation. I think we must all admit that in order to have more financial support for sanitation we must have better public understanding of our programs. A positive approach to sanitation, making the subject pleasant for the people in the community to work with, will do much to turn the subject into a parlor story and not have it looked at as an undesirable subject for conversation.

New Emphasis

One might ask why we do not use the terms health and sanitation without bringing in other subjects such as beauty. We have found by surveying the public that they are not interested in garbage cans, even if they are clean. They are not interested in dumps or a sanitation fill method, even if kept the cleanest of clean. They are not interested in sewage disposal plants even if they are shrubbed from beginning to end. The public tells us that they just don't care to be associated with any subject which deals directly with *insanitary* conditions. Therefore, our attention was turned to a positive approach in sanitation, bringing to this bigger percentage of the population things that they themselves are reaching for every hour of their daily routine of living.

Beauty—It is hard to visualize a beautiful city, a beautiful home, or a beautiful person unless that city, home or person is clean, or sanitary. Beauty can definitely be linked to sanitation, and I am sure that the average man understands or has a meaning for the word beauty better than he has for the word sanitation.

Security—In the average home, the question of the family health, and particularly the health of the breadwinner of the family, is important so far as security for that family is concerned.

Cleanliness—Sanitation in the factory or in the home certainly can be definitely associated with security in terms of absenteeism in the plant and better living conditions in the home.

Dollar value—One has only to talk to the real estate man, not in terms of bacteria counts, but in terms of what happens to property values in a neighborhood when the neighborhood becomes dirty and insanitary.

Social relations—Public relations—a term that is very tangible to industry, organized groups, and to the individual. Nothing is more fundamental to better social relationships than cleanliness, and I would like to say that we have used the term "cleanliness" with the individual and the word "sanitation" in terms of the community. Cleanliness certainly is a word that is understood by industry and the public, and sanitation is a word with which they are very much confused. In many cases they associate sanitation only with the slum areas of the community.

We have had several meetings in Ann Arbor recently, and we have talked in great detail with a number of people from industry on how to help industry better understand sanitation programs in the United States. We are convinced that in thus presenting the positive side of the entire question of sanitation that industry is far more interested in sanitation than ever before, that they are more willing to participate in the program and that they associate it with themselves personally, and not just as an activity of their particular company.

We must not forget the need for proper ordinances in the field of sanitation and adequate research to bring forth the facts in the field. However, the question of a proper approach in selling, promoting or educating the public on the subject of sanitation is just as important as ordinances and research. Sanitation in the over-all public health picture is not something which is on the way out. The true benefits of a better American standard of living through sanitation have not even been touched as yet in this country. Sanitation has unlimited possibilities if you will only picture it as a way of life in true American fashion.

We must not forget the pioneer work that has been carried on in the early history of sanitation and the tremendous load which is being carried by the sanitation people today to have our country recognized as the most sanitation-conscious nation in the world. But we must look into the future and be honest about the responsibilities which face us in this field. We no longer have the challenge of typhoid, but we do have the challenge of stepping along with progress such as changing from the *mere absence of disease* to the *development of positive health*. Leadership must be shown by giving recognition to the entire field of environmental sanitation rather than to merely segments of it. The responsibility for the entire field of environmental sanitation will be accepted by some individuals and groups in this country. Certainly the public health sanitation people should face this responsibility which has been theirs for many years. We must realize also that the lay individual is interested, if only we will carry the story to him in terms that he can understand. While the problems in the sick area of sanitation must be answered, we owe it to ourselves to bring the sanitation story to all the people and reap the benefits which sanitation so rightfully deserves by having a preventive program of sanitation operating in the well areas of society.

Coordinated National Program

Why a nation-wide sanitation program? First to make sanitation tangible to the people, to encourage health agencies to lead sanitation towards uniformity, to change emphasis from the absence of disease to the presence of health; and second, to remove the present stigma that exists in the minds of people that sanitation is a law, that sanitation deals only with filth, that sanitation cannot be discussed in polite society; and third to bring to all people the thought that sanitation is a part of their daily living habits, and to present the positive values of a healthful environment. This program brings to the sanitarian recognition and the dignity that his profession rightfully deserves.

The sanitation personnel should not feel that sanitation is a minor activity of a health department. It can be a major one. Also, in presenting sanitation with a positive approach to all the people, every citizen in this country can be made conscious of the fact that sanitation is and should be an important part of his daily living habits. As the public realizes the importance of

sanitation, so will they realize the importance of monies in sanitation budgets. Sometimes we hesitate to mention the word salaries, but salaries are as important to the sanitation people as they are to any one else, and not until sanitation is recognized and respected by the public will the people in this profession be given proper recognition.

A nation-wide sanitation program should not only bring recognition to sanitation as a profession and the true worth of sanitation to the public, but it should also bring a uniformity in approach in the sanitation field.

Many of us have often heard the following rather similar questions posed:

(1) Is Sanitation a profession, and if it is, what are we doing to give it professional status?

(2) Are we so buried in techniques that we cannot see the forest for the trees?

(3) What is the status of the sanitarian in the eyes of the public? —of the official agency?

(4) What is the future of sanitation in this country, and what is the future of the sanitarian?

(5) Why is the sanitation budget in a good many instances not a major part of the health department budget, and why is the salary of the sanitarian lower than that of an electrical worker?

(6) What does the health officer in the local community really think of the sanitarian?

(7) How much does the public appreciate the subject of sanitation or know the relations it has to daily living habits?

Answers to many of these questions can be found in a nation-wide sanitation program, and the people in sanitation certainly owe it to themselves to take full advantage of the opportunities that the field of sanitation offers.

Following the pattern of many other organizations in this country, we suggest the positive approach of sanitation with the focal point of education in the home. Today in the United States we are living somewhat the same as the Indians who were here one hundred years ago. When filth and dirt around their wigwams got to the point where they could no longer stand it, they moved their wigwams to higher ground. Today, in this country, we are doing somewhat the same thing. We are still moving up on Knob Hill and we are somewhat proud to tell our friends that we do not live on the other side of the tracks but that we live in this new area. We then are moving away from filth the same as the Indians did one hundred years ago. Certainly we should make use of what we know—we should face the facts, and we should properly practice sanitation in all its ramifications, which means that all the people should be interested in sanitation. The only way that they can be interested is for them to understand it, and if they are to understand sanitation we must talk to them about sanitation in terms which they can understand.

The majority of people in the United States await an understandable story on this subject. We as sanitation people should answer that challenge and make sanitation tangible to everyone and again establish it as the backbone of public health. *Leadership is needed.* The challenge for a better American standard of living through sanitation awaits you as an individual, you as a sanitarian, and you as part of this great organization.

NEW BOOKS AND OTHER PUBLICATIONS

Laboratory Manual and Work Book in Microbiology of Foods, written and compiled by Fred W. Tanner. Published by the Garrard Press, Champaign, Illinois. 1950. 382 pages. $4.75.

This book assumes that the student possesses fundamental training in handling sterile equipment and materials. The various methods are written for advanced students of microbiology. Copious references are given to the literature, and many official methods are given in the form as originally published. "The student should see that his professional study and training has started." Indeed, the practicing food sanitarian and health officer will find the compilation useful. Many pictures illustrate microflora and apparatus, and there are useful descriptions of various types of spoilage and interpretations of data.

Each food is written up as a "unit". The pages are perforated for assembling in a ring-binder, thus facilitating the insertion of notes.

The Preface starts off with an excellent list of 16 journals and 67 reference books. The Contents run as follows: General (dealing with excerpts from the pertinent food acts, collection and preparation of samples, meaning of pH, and special apparatus and methods for Food Microbiology); Bacteria; Yeasts; Molds; Sanitation (dealing with bacteriological examination of drinking water, food containers, tableware, filth in foods, and sterility of liquids and solids); Milk; Milk Pasteurization; Butter; Cheese; Ice Cream; Miscellaneous Dairy Products; Eggs; Sugar and Starch; Flour and Bread; Meats; Sea Foods; Canned Foods (extensively treated); Tomato Products (40 pages); Frozen Foods (14 pages); Dried Foods; Nut Meats; Fruit Juices; and Spices, Flavorings, and Condiments.

The Market Milk Industry, by C. L. Roadhouse and J. L. Henderson. Second edition. Published by McGraw-Hill Book Co., New York, 1950. 171 figures. 134 tables. 716 pages. $3.75.

Since the first edition was published in 1941, important new developments in the milk industry are presented in the present book. These are particularly noticeable in new material on enzymes in milk, significance of important types of bacteria, *Brucella abortus,* mastitis, vermin control, tests on the grading and quality of milk, sanitary production, layout and operation of country milk-receiving stations, transportation of milk, 3-A standards for dairy equipment, milk-plant fat losses, processing costs, detergents and the washing of plant equipment, chemical sanitization, high-temperature short-time pasteurization and its control, electric pasteurization, vacreator, freezing of milk and cream, plastic cream, Yoghurt, homogenized milk, rehydrated dried whole milk, distribution problems and costs (1947), price of milk and milk plants, and other revisions in the light of newer knowledge, such as similarity of etiology of streptococcus (septic) sore throat with scarlet fever. References are included as late as 1948. The type has been reset and the format improved. The increased size is caused by greater pagination and a slightly smaller size.

"Have You Seen"

"Why Food Industry Sanitarians Must Perforce Train Pest Control Operators," Donald H. Little. *Food Technology,* **4,** No. 2, 69, 1950.

"Chemicals Introduced in the Processing of Foods," F. C. Bing. *American Journal Public Health,* **40,** No. 2, 156, 1950.

"The Sanitarian and the Milking Machine," T. R. Enright. *Milk Plant Monthly,* **39,** No. 2, 68, February, 1950.

"Quaternary Ammonium Compounds as Sterilizing Agents for Bacterial Spores," H. R. Curran and F. R. Evans. *Jr. Dairy Sci.*, 33, No. 1, 1, 1950.

"Staphylococcus Food Poisoning." G. M. Dack. *Bakers Digest*, 24, 1, 34, February 1950.

"Resolution 7, Chemical Substances in Foods." *Amer. Journal Public Health*, 40, No. 2, 229, 1950.

"A Test for Quaternary Ammonium Compounds in Milk and Detergent Sanitizers," D. D. Miller and P. R. Ellicker. *Circ. of Information 472*, January 1950. Oregon State College Agriculture Experiment Station, Corvallis, Oregon.

"Bakery Sanitation and the Flooring Problem," E. L. Holmes, *Bakers Weekly*, 146, No. 2, April 10, 1950.

Use of Vegetable Fat in Ice Cream

The Federal Security Agency has received a number of inquiries regarding proposals to market in interstate commerce a frozen product made in semblance of ice cream, but containing vegetable fats in complete or partial substitution for milk fat. It has been stated that the product is being currently manufactured in several States for distribution wholly within the borders of the State in which it is made.

This Agency regards products of this type, in which any vegetable fat is used as an ingredient, as adulterated within the meaning of the Federal Food, Drug, and Cosmetic Act, and therefore subject to action.

"A PREDICTION OF THINGS TO COME IN SANITATION" *

EDWARD W. MOORE

Associate Professor of Sanitary Chemistry, Harvard University

Future developments in sanitation will come from deductions based on scientific theories rather than, as in the past, accidental discoveries or experiments suggested by practice. The proportion of the national income spent on health and sanitation will increase. The public will demand clean water and food and, eventually, clean air. Expected developments in water supply are: improved palatability; reduction in corrosiveness; and extension of treatment for special objectives, such as the use of fluorides to control dental caries. In sewage and waste treatment, the expected developments lie in improved treatment methods and ultimate elimination of stream pollution. In food sanitation, control will be facilitated by increased use of frozen and dehydrated foods; increased mechanization, higher pay, and better insecticides and rodenticides will improve the serving of food. Reduction of air pollution and the control of air-borne disease offer the greatest field for advances in sanitation; opportunities almost as great lie in the study of housing by the sanitarian. However, these potential advances in the field might well be stifled or delayed by the increasing "administration-mindedness" of many people in it; administrative busy-work is encroaching too much on the time of productive people in the field.

* Abstract of paper read before Massachusetts Public Health Association, Boston, April 25, 1950.

New England Wastes Conference

A three-day New England Industrial Wastes Conference on June 26, 27, and 28, will be a feature of the 1950 Summer Session at the Massachusetts Institute of Technology.

The M.I.T. Department of Civil and Sanitary Engineering will be joined in sponsoring the event by the New England Council and the New England Sewage Works Association. Professors Rolf Eliassen and Clair N. Sawyer represent the M.I.T. sanitary engineering laboratories on the committee in charge of the conference.

Professor Walter H. Gale, Director of the M.I.T. Summer Session, described the conference as part of a broad series of summer activities scheduled at M.I.T. during 1950 to make the Institute's special facilities available to those in industry and technology who cannot participate in its regular program.

The Industrial Wastes Conference, according to Professor Eliassen, will be designed to bring together these three groups for discussion of water pollution and control problems:

1. Industrialists, representing management, chemical engineers, and sanitary engineers.

2. Representatives of stream pollution and water control agencies, including federal, regional, and state.

3. Research workers and consulting engineers concerned with industrial wastes and water supply problems.

In addition to general discussions of pollution abatement from the viewpoints of industry, control agencies, and municipalities, there will be symposia on the water and waste problems of specific New England industries, including pulp and paper, wool scouring, cotton and wool dyeing and finishing, metallurgy and metal working, *potato and milk processing*, and leather tanning.

A special symposium on future needs and developments will conclude the three-day gathering.

Soda Fountain and Luncheon Equipment
The National Sanitation Foundation

In accordance with recommendations formulated at the First National Sanitation Clinic, held at Ann Arbor in June 1948, the Soda Fountain Manufacturers Association set up a technical or engineering committee which has now written up specifications therfor in plain understandable language, with many line drawings. Copies of the booklet may be obtained, without cost, by writing to Mr. C. J. Palmer, Executive Secretary, Soda Fountain Manufacturers Association, 111 West Washington Street, Chicago 2, Illinois.

Official Placards in Restaurant Windows

"If you eat out, you'll soon be looking for placards in Los Angeles restaurant windows certifying that the places employ someone trained by the city health department in the art of keeping the food and premises clean."

That statement was made by Dr. George M. Uhl, city health officer, who, with Robert F. Callender, chairman of the Food Sanitation Advisory Committee, an organization of industry, labor, and health department representatives, has been awarding the placards to more than 1,000 local restaurants and public eating places.

JOURNAL of MILK and FOOD TECHNOLOGY

(including MILK AND FOOD SANITATION)

Official Publication of the

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Membership and Dues: Active membership in the Association is $3.00 per year, and Associate membership is $2.00 per year, including respectively all issues of the JOURNAL OF MILK AND FOOD TECHNOLOGY (including MILK AND FOOD SANITATION). All correspondence concerning membership in the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, including applications for membership, remittances for dues, failure to receive copies of the JOURNAL OF MILK AND FOOD TECHNOLOGY, and other such matters should be addressed to the Secretary of the Association, George A. West, 44 Marshall St., Rochester 2, N. Y.

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ASSOCIATION NEWS

Kansas Appoints Committee on Sanitary Procedure

The Kansas Association of Milk Sanitarians is the first affiliate of this Association to appoint a Committee on Sanitary Procedure to collaborate with the International Association's Committee on Sanitary Procedure, C. E. Abele, Chairman, as suggested in the Report of the Committee on Sanitary Procedure, 1949, this Journal, January-February issue, page 20. The members are: Ivan Van Nortwick, Chairman; Glen Merrill; Pascal Roniger; Frank Kelley; and Larry Green.

Molyneux Succeeds Appleby at Yonkers

City Manager Donald C. Wagner, of Yonkers, New York, has announced the provisional appointment of Mr. Gordon W. Molyneux of Bedford Hills, New York, as Supervising Milk and Food Sanitarian in charge of the Bureau of Milk and Food Sanitation in the Department of Health.

Mr. Molyneux is succeeding Dr. Aaron Appelby who resigned from this position on January 15, 1950, in order to enter private practice of Veterinary Medicine.

Report on Wisconsin Dairy Manufacturers' Conference March 23 and 24, 1950

Over 400 representatives from industry and governmental agencies attended the 1950 Dairy Manufacturers' Conference held at the University of Wisconsin on March 23rd and 24th.

On each day of the conference exhibits and demonstrations of various testing methods and research techniques were given by the graduate students of the Department of Dairy Industry.

Bound copies of the papers presented at the conference can be purchased by writing the Babcock Dairy Science Club, Department of Dairy Industry, University of Wisconsin.

Fellers to Receive Babcock Award

Dr. Carl R. Fellers, President of the Institute of Food Technologists and Chairman of the Department of Food Technology of the University of Massachusetts, has been selected as the 1950 recipient of the Babcock Award. This award consisting of a medal and a $1,000 honorarium has been provided by the Nutrition Foundation whose scientific director, Dr. Charles G. King, will make the presentation at a noon luncheon on May 22, 1950, of the Institute of Food Technologists' Decennial Conference at the Edgewater Beach Hotel in Chicago.

Aside from his long research career in the fields of food chemistry and bacteriology, he has been an active teacher of young food technologists.

Several hundred of his "boys" are now well distributed over the world in colleges, research institutes and in industry. At the present time 40 graduate students (15 foreign) are working in his department for advanced degrees. He is probably best known for his successful guidance and training of young food technologists.

He was one of the earliest investigators in the United States to show the importance of food processing to nutritive value and he has published about 40 papers in this field.

Fellers has been active in editorial work such as Abstractor of food chemistry journals for *Chemical Abstracts* since 1926 and serves on the Editorial Boards of *Food Research*, JOURNAL OF MILK & FOOD TECHNOLOGY, and *Quick Frozen Foods*. His home food preservation bulletins have been very widely distributed and used throughout New England in the interest of food conservation and better nutrition.

Fellers is a founder member of the Institute; Councilor 6 years; Secretary-Treasurer 1946–9; Chairman, Northeast Section 1949; and President of the Institute in 1949–50.

Smith Takes Charge Ohio Cream Quality Program

Mr. Charles T. Smith, manager of producer relations for a dairy products company at Cleveland, has just been appointed as an extension specialist in dairy technology to direct the the cream quality program in Ohio.

Mr. Smith graduated in dairy technology at Ohio State in 1933. Following graduation he worked for the Youngstown Sanitary Milk Company, and later as city chemist for the Steubenville health department. After serving a year as an instructor in the dairy technology department at Ohio State, he joined the Cleveland firm.

In his new post, Smith will work with farmer-producers and processors and handlers in improving the quality of Ohio produced cream. Mr. Fred Greiner, who has been in charge of this work, has resigned to accept a position with the Supreme Dairy, Alliance, Ohio.

INDUSTRIAL NOTES

Wyandotte Chemicals Corporation Releases New Dairy Plant Sanitation Film

"Dairy Plant Sanitation" is the title of the latest 35 mm. sound slide film that has been released by the Wyandotte Chemicals Corporation, manufacturers of specialized cleaning compounds for business and industry. The film is strictly educational—the sponsor's name being mentioned only on the title frame.

The film strip has a length of 60 frames and an accompanying sound transcription covering both sides of a 10" record. Time of showing is 20 minutes. The film is of interest to health officers, students, sanitarians, milk control officials, dairy plant owners and operators, and everyone who is interested in the processing of milk and other dairy foods.

Interested parties may write directly to the Advertising Department of Wyandotte Chemicals Corporation, Wyandotte, Michigan, for further information.

A frame from the Wyandotte Chemicals Sound Slide Film

National Dairy

Dr. Samuel M. Weisberg has been appointed Director of the Division of General Chemistry of National Dairy Research Laboratories, Inc., Oakdale, L. I., New York, effective January 3, 1950.

Dr. Lloyd K. Riggs was recently appointed Director of the newly formed Division of Nutrition and Biochemistry of National Dairy Research Laboratories, Inc., Oakdale, Long Island. Dr. Riggs, formerly the Director of Research (from 1936 to 1948) of Kraft Foods Company in Chicago, another subsidiary of National Dairy Products Corporation, transferred to the Oakdale Laboratories in 1948.

Sanborn Joins Nat. Aluminate Corp.

National Aluminate Corporation of Chicago, manufacturers of water treatment, slime control, and paper process chemicals, announces the addition to its staff of Dr. J. Raymond Sanborn, former Professor of Microbiology at Syracuse University. Dr. Sanborn became Technical Director of the company's Pulp and Paper Division on February 13, 1950.

At National Aluminate Dr. Sanborn will join Mr. H. E. Berg of the Pulp and Paper Division in assisting the company's field force in planning and establishing complete microbiological control programs for pulp and paper mills.

Dr. Sanborn is a member of the International Association of Milk and Food Sanitarians.

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