

NOVEMBER, 1961

Vol. 24

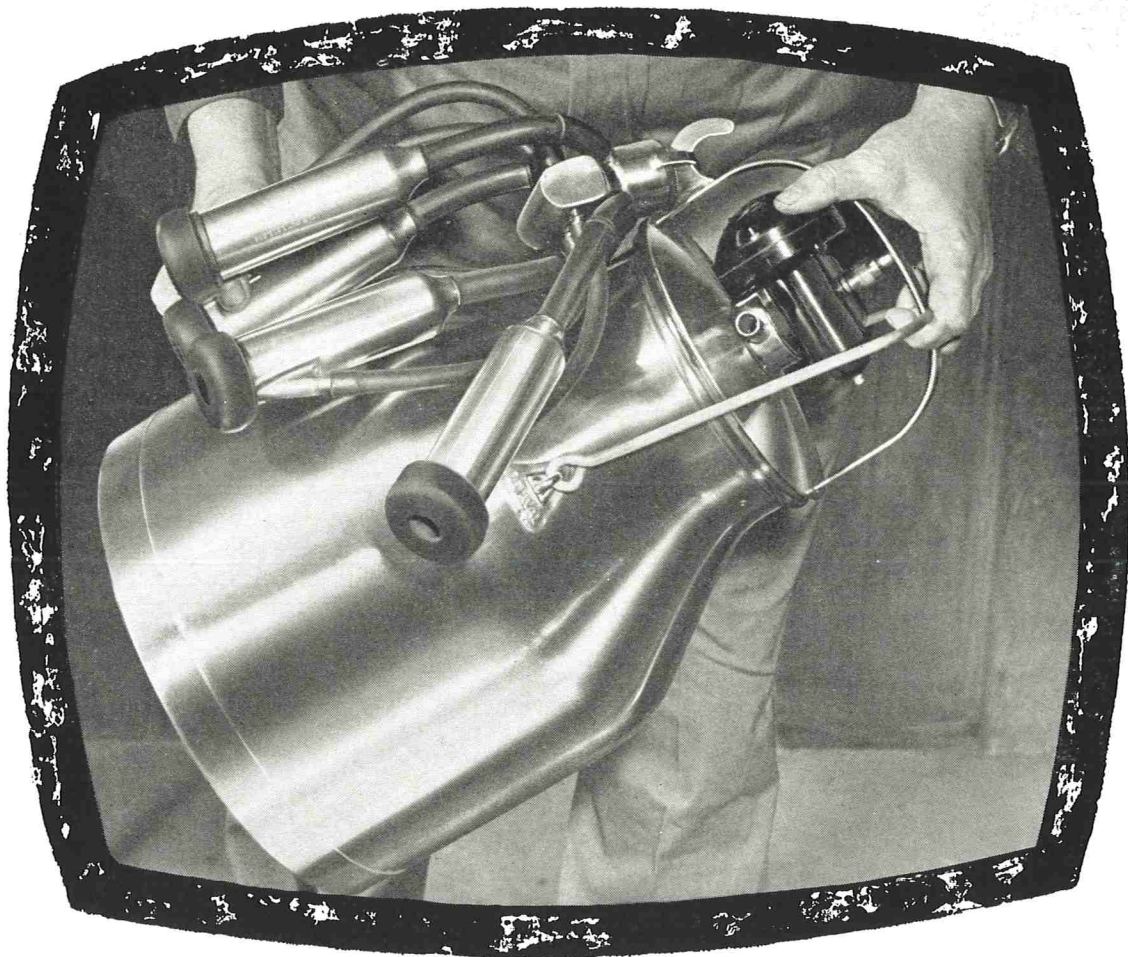
No. 11

Journal of

MILK and FOOD TECHNOLOGY

Official Publication

International Association of Milk and Food Sanitarians, Inc.



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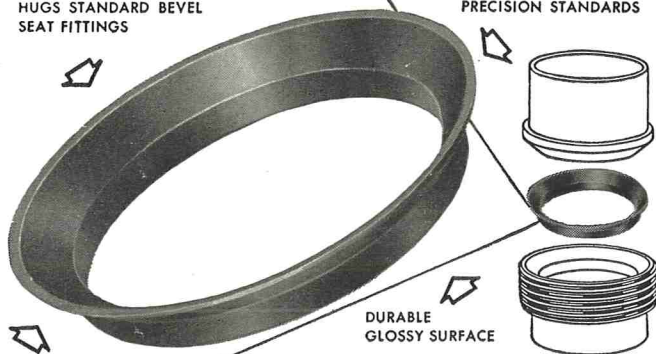
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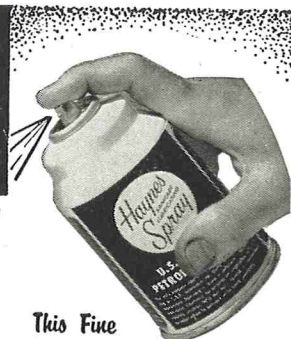
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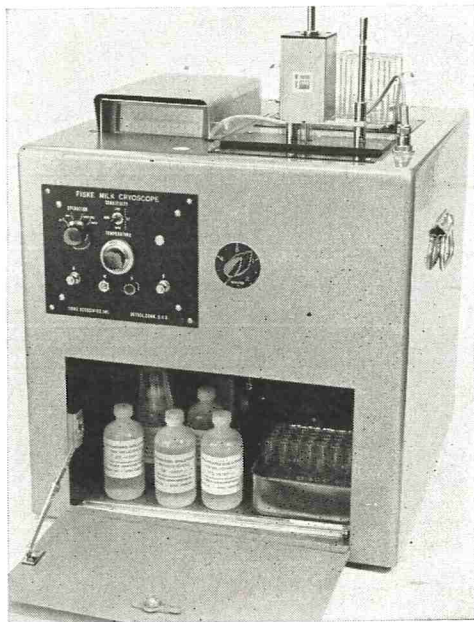
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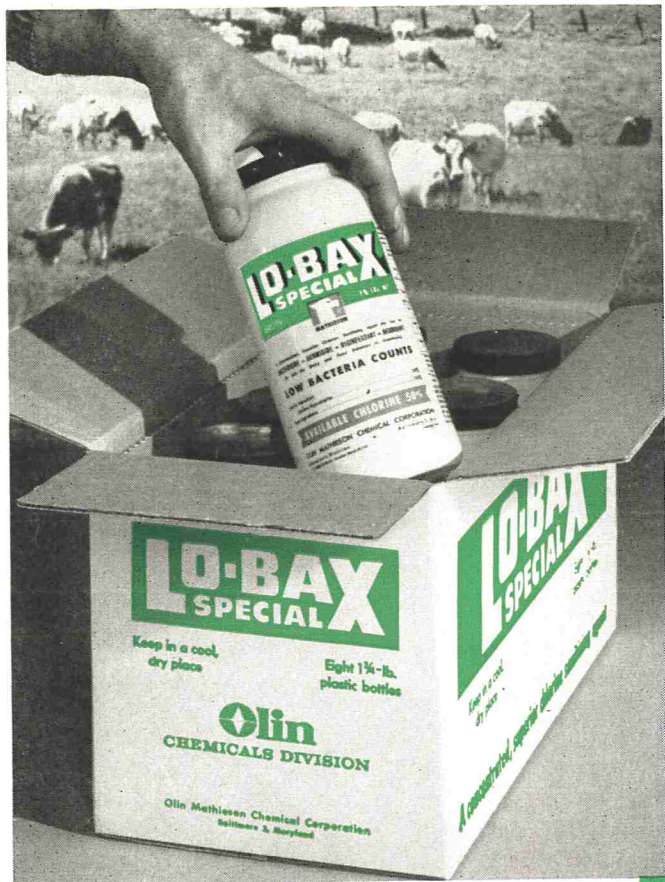
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The Journal of Milk and Food Technology is issued monthly beginning with the January number. Each volume comprises 12 numbers. Published by the International Association of Milk and Food Sanitarians, Inc., with executive officers of the Association, Blue Ridge Rd., P. O. Box 437, Shelbyville, Ind.

Entered as second class matter at the Post Office at Shelbyville, Ind., March 1952, under the Act on March 3, 1879.

EDITORIAL OFFICES: J. C. Olson, Jr., Associate Editor, Dept. Dairy Industry, University of Minn., St. Paul, Minn.; H. L. Thomasson, Managing Editor, P. O. Box 437 Shelbyville, Ind.

Manuscripts: Correspondence regarding manuscripts and other reading material should be addressed to J. C. Olson, Jr., Associate Editor, Dept. Dairy Industry, University of Minn., St. Paul, Minn.

"Instruction to Contributors" can be obtained from the Editor for the use of contributors of papers.

Journal of

MILK and FOOD TECHNOLOGY

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International Association of Milk and Food Sanitarians, Inc.

REG. U. S. PAT. OFF.

Vol. 24 November, 1961 No. 11

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Subscription Rates: One volume per year Individual non-members, Governmental and Commercial Organization subscription,

1 yr. \$8.00

Public and Educational Institution

Libraries, 1 yr. \$6.00

Single Copies \$1.00

Orders for Reprints: All orders for reprints

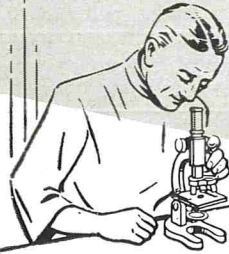
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Membership Dues: Membership in the International Association of Milk and Food Sanitarians, Inc., is \$7.00 per year, which includes annual subscription to the *Journal of Milk and Food Technology*. All correspondence regarding membership, remittances for dues, failure to receive copies of the journal, changes of address, and other such matters should be addressed to the Executive Secretary of the Association, H. L. Thomasson, Box 437, Shelbyville, Indiana.

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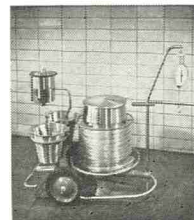
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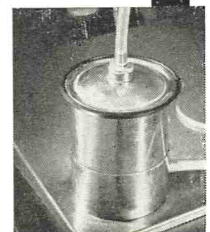
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EDITORIAL

Another Step Forward

The October 1961 issue of the *Journal* carried an announcement that merits editorial comment. We refer to the announcement by the Public Health Service that competitive examinations are to be held February 13, 14, and 15, 1962, for Sanitarians. Successful candidates will then be eligible for appointment to the commissioned (regular) corp of the Service.

At first glance this might be considered a routine announcement. It might be construed as the usual method of filling vacancies due to expansion or to take care of normal staff turnover. But this announcement has much more significance. The Public Health Service has recently reorganized the Sanitarian category to restrict its membership to the Professional Sanitarian. *It is the first time the Public Health Service has scheduled a separate examination for this newly organized category.* It is truly a step forward.

This did not come about over night. This is not a precipitous nor an emergency action. The announcement is the culmination of solid ground work laid over the past several years. Some realistic selling had to be done. And it was done. Some rather knotty problems had to be settled. And not the least of these was this. "What and who is a Sanitarian in the true sense of the term"? Coming as he does from many academic backgrounds, the answer was not easy to come by.

The proponents took the position that the professional Sanitarian is and must be science oriented. This was both right and logical. And when this point was settled, it also made the next step easier which was to set forth sound and definitive educational requirements. These spelled out, are as follows, and thus appear in the official announcement.

All Candidates must be United States citizens, and must possess (a) a master's degree in sanitary science and public health, or equivalent; or (b) an undergraduate degree with at least 50 semester or equivalent hours in the biological and physical sciences; plus a master's degree in public health, or a master's degree with major study in the biological and physical sciences, and in addition two years of creditable experience in the practice of environmental sanitation.

Some may say that this announcement is not as epoch making as the writer seems to suggest. Others will say the Public Health Service has employed professional Sanitarians for years. To the latter we would give a ready "yes." But we would hasten to add that the many successful sanitarians in the Service have not enjoyed quite as clear-cut professional recognition as have others of their fellow workers who fall into the several well known professional categories. This new pronouncement should, it would seem, help to bring about better recognition to those who by dedication and good work have helped to make this pronouncement a reality.

Two final points relevant to this particular issue need to be made. The first deals with the influence this announcement can have nationally. It should help to firm up the place, status, and educational qualifications of Sanitarians now employed or who may be employed later in state and local health agencies. Certainly it can be said that it sets some precise guide lines which may well be followed by civil service and other merit systems.

The second point is the challenge. While the writer has no intention of suggesting an exodus of qualified people from present state and local positions, it is sincerely hoped that the Service will be on the receiving end of a good many applications from a good many qualified professional sanitarians.

H. S. ADAMS

Indiana University School of Medicine
Indianapolis, Indiana

THE SANITARIAN-DIRECTOR RELATIONSHIP¹

JAMES F. SPEERS²

DeMoines-Polk County Health Department

Des Moines, Iowa

The health officer and the sanitarian both tend to be independent, strongly-motivated men. Differences in training, and in their location in the hierarchy of public health organization may easily create opportunities for conflict. Conflict occurs whenever director and sanitarian act on the basis of hiding or compensating for real or imagined personality defects. Conflict can be prevented by self-understanding and by understanding and respect for others. This brings about concrete program achievement, and job satisfaction for all.

"Sanitarian-Director Relationship" is a phrase which can be interpreted in a number of ways. It might include the relationships between staff and supervising sanitarians, staff sanitarians and the health officer, or supervising sanitarians and the health officer. For the purposes of this paper, discussion will be limited to the relationship between the health officer and the person immediately responsible to him, whether this man be a supervisor in a large department, or a staff sanitarian in a small one.

One question immediately comes to mind. Why is this topic worthy of discussion? Papers presented at annual meetings usually revolve around presentation of new developments in the field, or problems which are felt to exist. Since no new developments are apparent in this particular area, it may be assumed that those responsible for placing the topic on the agenda did so with the feeling that it is a problem area, at least on some occasions; and that the problems which do occur are sufficiently serious to affect operations adversely.

The problem now becomes one of searching out the causes of disturbance in the Sanitarian-Director relationship, and perhaps suggesting some preventive or corrective measures. One factor, and one factor alone, stands out as a basic cause of conflict between director and sanitarian. Whenever such conflict occurs it is because both parties to the conflict are human beings. If both parties were mechanical robots, with electronic computers for brains, and without feeling or emotion, all decisions would

be made on the basis of pure logic. The decisions might be wrong, because of inadequate or incorrect information, but they would never be in conflict.

Essentially, then, this problem is one of human relationships, and it is appropriate, insofar as possible, to begin our search for specific causes of conflict by determining what kind of people these two are. Obviously, such an attempt leads immediately to the possibility of error, since there is no such thing as a typical health officer, or a typical sanitarian. However, there are certain traits which tend to be more frequent in each of these occupations than in the public at large, and these are worthy of discussion.

What kind of a person is the health officer? First of all, he is a physician. This alone reveals certain facets of his personality. He is apt to be an individualist, with considerable dislike for working under more than very general supervision. His training as a physician probably did not make him this way, but it is very likely that he has chosen the field of medicine as one most likely to provide the kind of situation which will fit his personality. He is apt to be a person with strong motivations, whether or not these are apparent on the surface. Without such motivation, he would never have finished medical school, which is not an easy course of training.

One other point is very striking. The overwhelming majority of health officers did not choose public health as their speciality during their training period. Most have had more or less experience in other fields of medicine, and gone into public health work as a second choice. This probably is not because of any basic undesirable factor in public health work, but relates rather to the fact that public health is inadequately taught in most medical schools. Once working in the field, public health physicians are slightly more likely to express satisfaction with their work than are practitioners of internal medicine, for example (1).

The reasons for making a change from other branches of medicine to public health work are so varied as to defy classification. Often such changes are actually forced by circumstances, and the health officer originally enters the field with a "wait-and-see" attitude. However, among those who make the change voluntarily, or those who make it involuntarily and decide to remain, one factor tends to be of considerable importance. This factor is some-

¹Presented at the 48th Annual Meeting of the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, Inc., at Des Moines, Iowa, August 14-17, 1961.

²Director, Des Moines-Polk County Health Department, Des Moines, Iowa.

what difficult to define, but may be called the "obtaining of job satisfaction through opportunity to be of service to others."

In summary, then, the health officer may be characterized as a rather independent, strongly-motivated man, who has drifted into public health work, and remains there because of the satisfaction he receives from feeling that his work is directed toward leaving the world a little better than he found it.

What about the sanitarian? It will become apparent that these two have much in common. The earlier phases of training of the sanitarian are less easy to describe. The profession of the sanitarian is not as well defined as that of the physician, especially in the eye of the public. It is therefore unlikely, just as with the health officer, that the sanitarian moved directly into the field of public health as a first choice of occupation. In even a small department, one is apt to find former school teachers, salesmen, butchers, chemists, and morticians. Specific training may have been obtained through study at a school of public health, or through in-service training and experience.

While the sanitarian is not necessarily, by virtue of his training, so independent or strongly-motivated as the health officer, he is, by virtue of his choice of occupation, very likely to be so. The very nature of most sanitation work is such as to require considerable exercise of independent judgment. The environment in which the work is carried out, both from the physical standpoint, and from the standpoint of situations which develop in relations with his "clientele", is often sufficiently unpleasant to weed out rather rapidly the person without strong motivation. I believe that we may also credit the sanitarian with the strong feeling of satisfaction which comes from providing service to others. Sanitarians' salaries, on the average, are still not at a level which creates a large mob of applicants waiting to get in. In spite of this, we have a surprisingly low turnover in these positions. Most sanitarians (and health officers, too,) say very little about this aspect of job satisfaction, perhaps because it sounds a little Pollyannish. Nevertheless, the feeling is there.

In summary, the sanitarian may be characterized as a rather independent, strongly-motivated man, who has drifted into public health work, and remains there because of the satisfaction he receives from feeling that his work is directed toward leaving the world a little better than he found it. These, you will recall, are the same words used to describe the health officer. Light begins to dawn now on the reasons for conflict which sometimes occurs. When two independently-minded, strongly-motivated men

are thrown together, we have at that moment the elements of conflict, which need only a small difference of opinion to grow into a serious clash.

From whence may these small differences of opinion come? Usually from one of two things: The difference in training and knowledge of the two, or the difference in their location in the hierarchy of public health organization.

The training of the health officer (in public health, not in medicine) has been focused on the rather broad picture of public health work. He has been given considerable knowledge of needs and goals, and how to define them. His attention has been centered on inter-agency relationships within the community. His position is non-political, yet he is high enough in the hierarchy of city, county, or state government so that he is apt to be affected by, even though not involved in, political cross-currents. He is responsible, in addition to sanitation, for supervision of programs in nursing, health education, statistics, epidemiology, and perhaps several other fields. In each of these fields, he probably knows less than the department head in charge of the activity, (much as he hates to admit this fact). In sanitation, in particular, his knowledge is apt to be limited to a good knowledge of general principles, with perhaps a few details picked up in the course of working out specific problems, but practically no actual field sanitation experience.

The sanitarian is in quite a different situation. His training has been much more detailed and technical, although in a narrower field. His work revolves around laws and regulations, times and temperatures, cleanliness and uncleanness. Involvement in political matters is relatively rare, if we exclude internal politics of the department. On the other hand, he is much more concerned with the problem of direct supervision of staff personnel, being directly responsible for their activities, and directly concerned with their problems.

What kind of problems can these differences lead to? A great many examples can be formulated:

The health officer, being a generalist, may, relying on his knowledge of principles, ask for the performance of certain tasks which the supervising sanitarian has not the staff to supply. This can put the sanitarian in a most untenable position. He has to choose between short-cut which might reduce the quality of the service, elimination of other necessary programs, for which he may well be criticized, or explaining to the health officer why the program cannot be carried out as ordered. The latter step is, of course, the most logical, but is not always easy if the health officer himself is a man with strong opinions, who may construe the explanation as a

criticism of his plans, and therefore indirectly of his ability. The health officer in this situation sometimes pictures himself as shouting "Damn the torpedoes,—full speed ahead." It should be pointed out that this quotation made Admiral Farragut famous only because he was standing on the bridge at the time. A modern admiral who radioed the same message from the basement of the Pentagon to his battleships half-way around the world would be much less likely to go down in history.

Problems may arise along somewhat opposite lines, when the health officer orders the discontinuance or reduction of a program which the sanitarian feels is obtaining results. Here the health officer usually has a little more of the right on his side. Such reductions are usually the result of needs in other sections of the health department, which must be met even at the expense of existing programs. They may also be the result of political or semi-political considerations. However, the sanitarian may easily interpret the action as being a type of punishment, or an indication that the health officer does not feel he is doing a proper job. The health officer should, at this juncture, offer some sort of explanation, but it is not always easy to tell a man devoted to his own program that someone else's program is, even for the moment, a more important one.

The relationship between sanitarian and director comes under another type of strain whenever the health officer feels it necessary to reverse the decision of the sanitarian. This is, of course, his prerogative, but he may be right or wrong in exercising it. He may change the decision because of circumstances outside the realm of sanitation, of which only he is aware. On the other hand, he may be basing his decision on his own limited knowledge of sanitation, in which case he is quite likely to be wrong. In either case, the prestige of the sanitarian is apt to be damaged, to a degree depending on the amount of publicity with which the reversal of his decision has been made.

In view of the independent, strongly-motivated type of people under discussion, and the strains to which their different training and viewpoints subject their relationship, the question arises as to why open conflict is not more common than it is. The answer lies in the other facet of personality which is common to both the health officer and sanitarian—their dedication to service, and the satisfaction they obtain from it. The specific problems used as examples may be analyzed in more detail, as an illustration.

When the health officer asks for more than his staff can supply, the real conflict arises only when the sanitarian is afraid to explain the situation, per-

haps feeling that he will appear inadequate; or when the health officer, feeling that the explanation is really a criticism, refuses to listen.

Similarly, reduction or elimination of a program need not cause conflict. This arises only when the sanitarian interprets the action as a punishment, or a personal reflection on his ability; or when the health officer feels that he must protect his own feelings of inadequacy by acting the part of the king-emperor who need not deign to provide his subjects a simple explanation.

Even the more difficult problem of reversing a decision need not be a conflict-producing act. Only when the health officer acts without discussing the problem, in order to protect himself, and casts whatever stigma may be present on the sanitarian; or when the sanitarian interprets the reversal as casting aspersions on his intelligence or ability, and rejects all explanations offered, does a conflict result.

The common factor here is quite obvious. Whenever the director or the sanitarian, or both, act on the basis of hiding or compensating for their personal feelings of inferiority, or of building up their own ego, the seeds of conflict are sown, and sown in fertile personalities. Conversely, when each follows his true inclination, and bases his action on real program needs with full consideration of the rights and viewpoints of the other, the results will prove satisfying to both.

This kind of ideal relationship is easy to describe, but often not so easy to achieve, primarily because of the problem mentioned earlier. Both the director and the sanitarian are human beings. As such, they are bound to have feelings, prejudices, and reaction patterns which have been built up throughout all the years of their lives, and which cannot be shed like an overcoat during working hours.

The answer does not lie in the elimination of these feelings and prejudices. This is impossible. The answer *does* lie in learning to understand, and the first person for either sanitarian or director to understand is himself. This is a difficult task.

The difficulty can be illustrated by a simple experiment which can be performed by anyone responsible for filling out so-called "efficiency reports" for his subordinates. If the employees are asked to rate themselves, and this rating compared with that of the supervisor, it will be found almost without exception that the supervisor's rating is higher. We all tend to magnify our weaknesses, because we regard them as a threat to our self-esteem. As a result, we try—all too often—to cover up faults which do not really exist, and we create real problems by doing so. Understanding of oneself comes from self-evaluation. This means identification of ones

own weaknesses, correction of them when possible, but acceptance of them if not. It also means identification of strengths, and the courage to accept these as well.

Once this kind of self-acceptance is achieved, the health officer, knowing that his knowledge of sanitation techniques is very sketchy in spots, will not hesitate to ask his sanitarian for advice. The sanitarian, realizing that his viewpoint is somewhat less broad, will not hesitate to ask for help in fitting his program into the broader picture of health department activity.

The first, and most important, step has now been taken, but there is still another to be made. In addition to self-understanding, the sanitarian and the director must understand each other. Before any decision is made, or any action taken by either, he must consider how this will be interpreted from the viewpoint of the other, and modify it accordingly. If the contemplated action may be felt to be threatening by the other, it should be discussed with him beforehand, and a clear understanding of the factors involved should be reached. This step is actually not difficult, once the major step of self-understanding and self-acceptance has been reached. When each person needs no longer protect himself, or build up his own ego, protection and support of the other becomes easy—almost automatic—and leads to a spirit of cooperation which brings about concrete

results in the way of program achievement, thus providing satisfaction for all.

Obviously, this kind of Utopian relationship is seldom completely attained, but it can be approached, and attained in some degree. When this occurs, we are no longer dealing with a Sanitarian-Director relationship, or with the relationship of director to subordinate. We are dealing with a team, each with his specific job to do, but working in a spirit of understanding and cooperation, and dedicated to providing the best possible service to the community.

This paper may be summarized in two brief sentences. These may sound a bit like the close of a sermon. If so, it is because religion was expounding principles of human behavior long before psychology, sociology, and similar sciences were even thought of.

The sentences are these:

“Know Thyself” and

“Do unto others as you would have them do unto you.”

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THE INCIDENCE OF POTENTIALLY PATHOGENIC STAPHYLOCOCCI IN DAIRY PRODUCTS AT THE CONSUMER LEVEL. II. CHEESE¹

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(Received for publication June 18, 1961)

One hundred twenty-five samples of cheese, representing 20 varieties, were analyzed for the presence of staphylococci. Seventy-six percent of the samples contained staphylococci; 70.4% contained *Staphylococcus aureus* and 7.2% contained potentially pathogenic coagulase positive *Staphylococcus aureus*. The data indicate that the ratio of *Staphylococcus aureus* contamination is not the same for all varieties. A relationship exists between the presence of coliform organisms and *Staphylococcus aureus* in cheese.

Several instances of staphylococcal food poisoning attributed to dairy products have been reported (1, 3, 4, 6, 7). Epidemiological investigations implicated cheese in some of the outbreaks (1, 6, 7).

Many varieties of cheese made in this country and several imported varieties are manufactured from unpasteurized milk. The high incidence of staphylococcal infection in dairy cattle udders makes raw-milk cheese a possible disseminator of pathogenic staphylococci. In addition to the potential hazard of raw-milk cheese, a problem potentially more difficult is the manual handling of foreign-type cheeses during their manufacture. Staphylococci frequently are associated with infections about the hands, arms, face, nose and throat. Persons who manually handle cheese possibly may be carriers of coagulase positive staphylococci.

EXPERIMENTAL PROCEDURE

One hundred twenty-five samples of cheese, representing 20 varieties, were obtained from retail outlets in Kansas, Nebraska, and Missouri and held in their original wrappers at 30-40°F from collection until analysis were started.

The wrappers were removed and approximately 11 g of each sample of cheese was cut off, using a

sterile tongue depressor, and transferred to a sterile one pint Mason jar containing 99 ml of sterile water. The Mason jar was fitted with a sterile Oster Blender head and the contents mixed at high speed for five minutes.

One-half ml of the water-cheese mixture was transferred to plates of Tellurite-Glycine (TG) agar and *Staphylococcus* Medium No. 110 (S-110) agar, thus depositing approximately 0.05 g of cheese to each plate. One milliliter of the water-cheese mixture was transferred to 10 ml of an enrichment broth consisting of *Staphylococcus* Medium No. 110 minus the gelatin and agar. The enrichment broth containing the water-cheese mixture was incubated at 37°C for 24 hours after which aliquots were transferred to and incubated on TG and S-110 plates. These plates were designated TGE and S-110E, respectively, to differentiate between organisms obtained via the enrichment procedure and those obtained by direct plating.

The incubation time and temperature, as well as the determination of potential pathogenicity, bacteriophage typing and coliform counts were carried out as described earlier (5).

RESULTS

Data from the cheese studied are presented in Table 1.

Ninety-five of 125 samples examined (76.0%) contained staphylococci. Thirty-three of the samples contained *Staphylococcus epidermidis* (26.4%) and 88 samples contained *Staphylococcus aureus* (70.4%). Twenty-five samples (20.0%) contained both *Staphylococcus epidermidis* and *Staphylococcus aureus*. Coagulase positive staphylococci were isolated from samples of Cheddar, bondost, blue and brick cheese.

The 20 varieties of cheese samples were classified as very hard, hard, semi-soft and soft, using U. S. Department of Agriculture Handbook No. 54 (9), and into an additional classification covering all processed cheese varieties. A chi-square test indicated that the processed and very hard varieties had a lower ratio of *Staphylococcus aureus* than the other three variety classifications, the difference in ratio being significant at the .05 level.

¹Contribution No. 229, Department of Dairy Science, Kansas Agricultural Experiment Station, Manhattan; contribution No. 374, Department of Bacteriology, Kansas Agricultural Experiment Station, Manhattan; supported in part by research grant E-3157 from the National Institutes of Health, and the Public Health Service.

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TABLE 1—ISOLATIONS OF STAPHYLOCOCCI FROM CHEESE OBTAINED IN CONSUMER MARKETING CHANNELS.

Product	No. samples examined	Samples containing staphylococci ^a		Samples containing Staph. epid. ^b		Samples containing Staph. aureus		Samples containing both Staph. epid. and Staph. aureus		Samples containing coagulase positive staph.	No. of coagulase positive cultures isolated
		(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)		
Parmesan	1	0	0	0	0	0	0	0	0	0	
Romano	5	2	40.0	2	40.0	1	20.0	1	20.0	0	
Bergkase	3	2	66.7	1	33.3	2	66.7	1	33.3	0	
Cheddar	49	41	83.67	13	26.5	38	77.6	9	18.4	6	15
Colby	2	1	50.0	1	50.0	1	50.0	1	50.0	0	
Monterey Jack	1	1	100	0	0	1	100	0	0	0	
Provolone	4	4	100	3	75.0	3	75.0	2	50.0	0	
Swiss	2	2	100	1	50.0	2	100	1	50.0	0	
Blue	6	3	50.0	1	16.7	3	50.0	1	16.7	1	2
Bondost	1	1	100	1	100	1	100	1	100	1	5
Brick	4	4	100	0	0	4	100	0	0	1	2
Chantille	3	3	100	1	33.3	3	100	1	33.3	0	
Gouda	3	3	100	2	66.7	3	100	2	66.7	0	
Kuminost or											
Caraway	2	2	100	1	50.0	1	50.0	0	0	0	
Limburger	3	3	100	0	0	3	100	0	0	0	
Muenster	6	4	66.7	0	0	4	66.7	0	0	0	
Roquefort	2	1	50.0	0	0	1	50.0	0	0	0	
Camembert	1	0	0	0	0	0	0	0	0	0	
Mozzarella	6	6	100	2	33.3	6	100	2	33.3	0	
Processed	21	12	57.1	4	19.0	11	52.4	3	14.3	0	

^aStaphylococci differentiated from micrococci on the basis of anaerobic growth in glucose medium.

^b*Staphylococcus epidermidis* differentiated from *Staphylococcus aureus* on the basis of mannitol fermentation.

Table 2 presents the chi-square distribution of the data involving *Staphylococcus aureus*.

The within variety chi-square ($0.50 < p < 0.75$) shows the contamination with *Staphylococcus aureus* from sample to sample within the same variety group classification to be highly repeatable.

Table 3 presents pigmentation, hemolysins, bacteriophage patterns and lytic groups of the coagulase positive organisms. Contingency chi-squares between the presence of coliform organisms and *Staphylococcus aureus* were significant ($0.010 < p < 0.025$), indicating that a cheese containing coliform organisms may also contain *Staphylococcus aureus*, but that a cheese free of coliform contamination is less likely to contain *Staphylococcus aureus*.

DISCUSSION

The high percentage of samples containing *Staphylococcus aureus* (70.4%) and the 7.2% containing potentially pathogenic coagulase positive staphylococci is significant information for cheese manufacturers.

Of the nine samples containing coagulase positive staphylococci, seven yielded organisms with bacteriophage patterns that could be classified into lytic

group III. Anderson and Williams (2) point out that virtually all food poisoning strains belong to lytic group III. It has been reported that staphylococci producing outbreaks of enterotoxin food poisoning often could be attributed to organisms having a bacteriophage pattern of 6 and 47 (2). In this survey, bacteriophage pattern 6 and 47 occurred in samples of Cheddar, brick, and bondost cheese.

Some early studies on bacteriophage typing indicated that a great predominance of staphylococci isolated from milk, particularly that involving bovine mastitis, were lysed by bacteriophage 42D (2). Staphylococci having bacteriophage pattern 42D were isolated from one sample of Cheddar cheese.

Also of interest are the staphylococci isolated from

TABLE 2—CHI-SQUARE DISTRIBUTION OF *Staphylococcus aureus* IN CHEESE

Source	D/F	X ²	Significance
All varieties	19	27.6494	0.05 < P < 0.10
Grouped Varieties	4	14.2326	0.005 < P < 0.010
Processed vs. all others	1	3.9327	0.025 < P < 0.050
Very hard + Hard vs.			
Semi-soft + Soft	1	.5628	N.S.
Very hard vs. Hard	1	9.8007	P < .005
Semi-soft vs. Soft	1	.2741	N.S.
Within Variety	15	13.0791	N.S.

TABLE 3—CHARACTERIZATION OF COAGULASE POSITIVE STAPHYLOCOCCI ISOLATED FROM CHEESE

Cheese variety	Sample No.	Culture number	Isolation media	Pigmentation	Hemolysins	Bacteriophage pattern		Lytic group
						RTD ^a	Concentrated ^b	
Cheddar	H-4	450	GTE	orange	β 44A			Uncl. ^d
	H-4	451	110E	orange	β 7,75,44A			III & Uncl.
	H-4	452	GTE	orange	β		42D	IV.
	H-4	453	GT	orange	β		44A	Uncl.
	H-4	454	GT	orange	β		42D	IV.
	H-31	662	GTE	orange	β 6,42E,47,54,75,83(VA ₄)			III.
	H-18	593	110	orange	β		44A	Uncl.
	H-18	594	GT	orange	β		44A	Uncl.
	H-18	721	GTE	orange	β		N.T. ^c	
	H-58	669	GT	orange	β		80,53,77	I. and III.
	H-58	805	GTE	orange	β 45, 42D			III. & IV.
	H-58	806	110E	orange	β		80	I.
	H-71	632	GTE	orange	β		6,42E,54,83(VA ₄)	III.
	H-71	651	110E	orange	β 6,42E,54			III.
	H-116	810	110E	orange	β 44A			Uncl.
Blue	H-91	648	GTE	orange	β		80	I.
	H-91	652	GTE	orange	β		80,53	I. & III.
Brick	H-70	665	GTE	orange	β 55,6,7,42E,47,75,44A			II., III. & Uncl.
	H-70	666	110E	orange	β 3C,55,6,7,42E,47,75,44A			II., III. & Uncl.
Bondost	H-39	586	110	orange	β 55,6,7,42E,47,75,44A			II., III. & Uncl.
	H-39	590	GT	orange	β 55,6,7,42E,47,75,44A			II., III. & Uncl.
	H-39	588	GT	orange	β 55,6,7,42E,47,75,44A,54			II., III. & Uncl.
	H-39	718	GTE	orange	β 55,6,7,42E,75,44A			II., III. & Uncl.
	H-39	717	110E	orange	β 44A			Uncl.

^aRoutine Test Dilution^dTypable but have not been grouped^bRoutine Test Dilution x 1,000 β =Beta hemolysins^cNon-typable

both Cheddar and blue cheese being lysed by bacteriophage 80. This strain frequently has occurred during outbreaks of staphylococcal infections in hospitals (8).

Statistical analysis suggest that the ratio of *Staphylococcus aureus* contamination is higher in the hard, semi-soft and soft varieties of cheese than in the very hard and processed varieties. This is noteworthy in view of the absence of coagulase positive staphylococci from samples^d of cheese falling into the very hard or processed classification. However, the small sample size of very hard varieties may have influenced the outcome of the statistical analysis.

The relationship between the presence of coliform organisms and *Staphylococcus aureus* is of interest, especially considering the negative relationship found in a previous study of market milk and related products (5). The evidence here indicates that one finding coliform organisms present in a sample of cheese also would find staphylococci. However, one might find staphylococci without necessarily finding coliform organisms.

Staphylococci from cheese having bacteriophage types identical with those isolated from milk associated with bovine mastitis gives epidemiological sig-

nificance to cheese sold at the consumer level. If *Staphylococcus aureus* is present in cheese it may increase under conditions favorable to its growth. Not all strains of coagulase positive staphylococci are capable of enterotoxin production. However, they may be present in sufficient number to produce food poisoning unless proper care is exercised in the production and storage of the cheese.

The need to develop procedures and processing techniques for cheese production which would conclusively eliminate staphylococci from the finished product is forcibly demonstrated. A potential threat to the dairy industry in general and to the cheese manufacturing industry specifically exists so long as cheese, harboring coagulase positive staphylococci, is found in consumer channels.

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THE STATUS OF BACTERIOLOGICAL STANDARDS FOR FROZEN FOODS

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The growth in production and distribution of frozen precooked foods has focused the attention of the Food and Drug Administration and the Association of Food and Drug Officials of the United States upon these products. Concern about the microbiological content as related to production sanitation and proper handling during distribution to maintain product safety and quality has led to the development of the AFDOUS Frozen Food Code.

Establishment of bacteriological standards for frozen pot pies and dinners has been hampered by the lack of (a) sufficient data, (b) uniform methods, and (c) agreement upon criteria for such standards. Development of standards is complicated by variation in the nature of the products and processing techniques. When interpreted on the basis of factory inspection observations, bacteriological findings can be used to effect correction of insanitary conditions and practices.

In 1946, following World War II, the Food and Drug Administration decided to initiate field inspections and laboratory investigations of frozen precooked foods. We were aware that a considerable number of such products had become available to consumers during the war, generally on an unrationed basis. Complaints of poor quality were not uncommon and direct observations of some of the products were not reassuring. The inherent potential hazard from these products was commonly recognized.

Armed with a list of some 46 manufacturers in the New York City area alone, one of our bacteriologists with a District inspector started the rounds. They found four of the 46 plants still in operation, only two of which were still engaged in preparing frozen precooked foods to a limited extent. Inquiry of other Districts revealed the same story. The frozen precooked food industry had virtually disappeared.

You are aware of the phenomenal growth of the industry since 1950, and particularly since 1955. With regrowth of the industry and the increasing flow of

frozen precooked foods on the market, FDA began in a small way 10 years ago to study the microbiology of the products. One of our field bacteriologists made inspection observations in several plants and collected line samples of ingredients and finished products which revealed the effects of insanitary or unsatisfactory practices and conditions. As his work and the firm's own control studies continued, the practices improved and this was reflected in the bacteriological content of the finished products.

As new products continued to enter the market, and volume of production increased, FDA planned a comprehensive survey on the microbiology of frozen precooked foods as related to factory sanitation and practices. Funds, personnel and space became available in fiscal year 1957 and work was initiated in the early spring of 1958.

In 1956 and 1957 frozen precooked foods occupied the attention of the committee on Canned, Processed, and Frozen Foods of the Association of Food and Drug Officials of the United States. In the latter year, following open discussions with representatives of the National Association of Frozen Food Packers, a subcommittee was appointed and instructed to obtain information on (a) the bacteriology of frozen precooked foods as related to sanitation at the factory as the basis for possible development of bacterial limits for frozen food, and (b) the temperature conditions under which such products are handled at the retail and wholesale level. The NAFFP cooperated in these studies. FDA also agreed to participate and to make the results of the investigations available to the AFDOUS Committee, of which the writer is a member.

AFDOUS FROZEN FOOD CODE

At its 1958 meeting, the AFDOUS Committee

recommended that the Association develop a model frozen food code, which would cover all aspects of the production, storage, transportation and handling of frozen foods. The Association adopted the recommendation. Two sections, one on warehousing and transportation; the other on retail handling, were completed within a year and adopted in 1959. A basic requirement of the handling code was that frozen foods be maintained at 0°F at all times, though this was modified the following year to permit a 10°F tolerance above 0°F, under certain conditions. These, with other sections on plant layout and design, sanitary equipment, operating practices and in-plant freezing completed in 1960, were recently adopted by AFDOUS, subject to further editing by a special committee. The final code will be published in the January Bulletin of AFDOUS.

Following adoption of the first two sections of the code by AFDOUS in 1959, substantial industry opposition arose. Ultimately, a Frozen Food All-Industry Coordinating Committee was formed, comprised of representatives of the packing, transporting, warehousing, distributing, and retailing segments of the frozen food trade. This committee does not favor the code as a basis of regulatory control of the industry. It offers, instead, voluntary improvement programs by each segment. Recently, it has issued a voluntary industry code which, in effect, adopts the 0°F base, but provides gradually decreasing tolerances, starting with 15°F through 1962, 10°F in 1963 and 1964, and 5°F, thereafter. It has also conducted educational efforts towards improved handling of frozen foods in the industry.

PROGRESS OF MICROBIOLOGICAL STUDIES

In approaching the task of evaluating the microbial content of frozen precooked foods, the joint AFDOUS-industry committee agreed that the primary objective should be limited to frozen pot pies and dinners at the plant production level. Pot pies were specifically chosen for investigation because (a) published reports indicated they generally contained higher levels of bacteria than other products, (b) the manufacturing process is complex and the amount of handling after cooking of the components is maximal, and (c) the meat and poultry products included represent a large proportion of the total production of frozen precooked foods.

Industry consultants chose turkey pot pies as exemplary of these products and made studies in six plants with correlated line and finished product samples on three production days in each plant.

Two States carried out bacteriological studies on frozen precooked foods but could supply only limited data on pot pies.

Soon after FDA started its studies, the Poultry

Inspection Act was passed. Since meat and poultry products are exempt from the Food, Drug, and Cosmetic Act, to the extent of application of the Meat Inspection and Poultry Inspection Acts, these products were excluded from the FDA study.

Although the data obtained is interesting and useful, it has not been considered sufficiently extensive in amount or range to permit establishment of specific standards. There has been much discussion and debate about limits based upon these findings. There is rather general agreement that an aerobic plate count limit of 100,000 per gram can and ordinarily should be met, but disagreement about the fate of products which fail to meet such a standard and about the use of other indicator organism as a measure of bacteriological quality.

Meanwhile, little new data is being produced except, perhaps, within the industry. Methods of analyses employed by various laboratories differ and the immediate prospect of solution of the problem is dim.

For this reason the AFDOUS Committee has decided to refer this problem to a subcommittee of well-qualified microbiologists, under a broad charter to develop definitive recommendations on uniform methods of analysis and the interpretation of the microbiological findings obtained.

Earlier this year FDA published the findings of a survey of 63 producers of frozen precooked foods in 18 states (1). More than 3000 samples representing 81 frozen food items or their components were collected and examined. Although these findings reflect differences in sanitary conditions and practices in many cases, they also reflect the complexity of interpreting results without factory inspection observations to explain the significance of the findings. It is obvious that variations in basic manufacturing techniques influence the quantitative and qualitative results so that no single standard would be applicable to all products or, occasionally, to the same or closely related products. High counts may result from the addition of a raw component, such as grated raw cheese to a thoroughly cooked product, while low counts may reflect a severe final cook on products of poor sanitary history. The work is continuing.

Although our results are not sufficient to permit establishment of specific bacteriological limits for frozen precooked foods, FDA has started a regulatory program in this industry, based upon factory inspections with evaluation of sanitary conditions and practices by bacteriological methods, including examination of factory samples and finished products.

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THE SANITARY CONDITIONS OF A C-I-P FARM MILK PIPELINE AS INFLUENCED BY CLEANING SOLUTION TEMPERATURE^{1 2}

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(Received for publication July 15, 1961)

Studies were conducted on the bacteriological condition of a C-I-P farm milk pipeline. Test surfaces were examined by a swab and rinse technique at biweekly intervals throughout each of three 6-month test periods. The detergent solution temperatures were between 160 and 150°F. in the first test period which employed "booster" heating; 160°F. and down in the second test period; and 125°F. and down in the third test period.

Results of these studies indicated that the pipeline remained in a satisfactory bacteriological condition throughout each of the test periods and that the use of "booster" heating to maintain the temperature of the detergent solution at an elevated level was unnecessary. A raw milk of high quality was produced for a grade "A" market throughout the entire study.

In-place cleaning of farm milk pipelines has become an accepted practice on the modern dairy farm. While the procedures for cleaning and sanitizing these pipelines are somewhat similar in most areas, the regulations in some milksheds require supplementary heating of the detergent solution to maintain the temperature above a minimum level throughout the washing cycle. This additional heat treatment commonly is called "booster" heating. If the maintenance of a given temperature during the washing cycle is not necessary, then the use of "booster" heaters entails an unwarranted cost to the dairy farmer.

The present work was undertaken to evaluate the effect of the temperature of the detergent solution upon the bacteriological condition of a cleaned-in-place farm milk pipeline. An attempt has been made to ascertain a procedure which would provide a clean pipeline at minimal expense with special emphasis on hot water demands and original equipment costs.

METHODS

Utilized in this study was a 1½-in. stainless steel farm milk pipeline installed on a farm producing milk for a Grade "A" market. The line was 160 ft

long and made a complete circuit in a 24-cow stallion-type barn. The highest point in the pipeline was that most distant from the milk room. From this point the slope of the line to the milk room was one inch per 9 ft to insure adequate drainage. The milk was drawn by vacuum from the pipeline into a glass vacuum releaser jar equipped with an automatically controlled centrifugal pump to transfer the milk from the jar to the milk cooler. During the cleaning and sanitizing cycles the solutions used were drawn through the line in the same manner as the milk, except that they were transferred by the pump to the solution storage tank rather than to the bulk milk tank. The velocity of the solutions during the cleaning and sanitizing cycles was 7 ft per sec. The duration of each cycle as well as the strength of the cleaning and sanitizing solutions were controlled automatically to maintain uniformity throughout the experiment. The various solution temperatures were recorded by a recording thermometer. All electricity used for "booster" heating by the immersion heater in the solution storage tank was measured by a suitable electric meter. The cleaning agent was a liquid chlorinated-detergent used at a strength of 8 oz per 15 gal of water. An acid cleaner at a strength recommended by the supplier was used instead of the chlorinated-detergent on every fourth day. The cleaning and sanitizing cycles throughout the experiment were as follows:

Pre-wash Rinse: 15 gal of warm water (approx. 110°F) were drawn once through the pipeline and then discharged.

Wash: 15 gal of detergent solution were circulated for 22-24 min. The temperature of the detergent solution varied with the individual test period.

Rinse: 15 gal cold water (50-70°F) were drawn once through the pipeline and then discharged.

Sanitizing: 15 gal of a hypochlorite solution (110-115°F) containing 200 ppm available chlorine were circulated for 5 min just prior to milking.

The test periods were chosen so that the seasonal temperature extremes encountered in this climate

¹Published with the approval of the Director of the Wisconsin Agricultural Experiment Station.

²This research was supported in part by a grant from the Wisconsin Utilities Assoc.

would be included in each test period. The test periods were as follows:

Period A: January through July, 1959. The temperature of the detergent solution in the solution storage tank was approximately 158°F, (range 186-144°F) at the beginning of the wash cycle and from this point it fell to approximately 150°F, (range 184-136°F) where it was maintained by a 7500 watt electric immersion heater in the solution storage tank.

Period B: July, 1959 through January, 1960. The temperature of the detergent solution in the solution storage tank was approximately 161°F, (range 168-144°F) at the beginning of the wash cycle and from this point it was allowed to fall naturally until it reached approximately 99°F (range 122-82°F) by the end of the wash cycle.

Period C: January through July, 1960. The temperature of the detergent solution in the solution storage tank was approximately 125°F, (range 158-98°F) at the beginning of the wash cycle and from this point it was allowed to fall naturally until it reached approximately 93°F (range 122-82°F) by the end of the wash cycle.

The mean temperature for each cycle and the standard deviations of temperature observations have been shown in Table 1.

The possibility that organisms may increase in number or "build up" as the length of exposure to a treatment increased necessitated the use of a different test surface for each bacteriological examination. This was achieved by use of a series of one by four inch stainless steel test strips with a finish similar to that of the pipeline. Twenty-eight of these strips were attached to each of two stainless steel rods. The rods were inserted into each end of the pipeline. They held the test strips in a position parallel to the surface of the pipeline. These test surfaces closely resembled those described by Calbert (3). As the strips were removed for examination the vacancies on the rod were filled with new test strips thus eliminating the possibility of changing conditions due to the number of vacancies in the line. Each of the test strips examined during the experiment had approximately six-months of exposure in the pipeline. The fact that each test period had a less rigorous washing treatment than during the previous test period made this practice justifiable.

At regular two-week intervals, two test strips from each end of the line were removed aseptically and brought into the laboratory in sterile test tubes. At this time one test strip from each end of the line was given a sanitization treatment similar to the one it

TABLE 1—MEANS AND STANDARD DEVIATIONS OF DETERGENT SOLUTION TEMPERATURES IN THE STORAGE TANK.

Test period	Mean initial temperature (°F)	Standard deviation (°F)	Mean 22-24 min. temperature (°F)	Standard deviation (°F)
A	158	6.3	150	7.6
B	161	3.5	99	5.3
C	125	12.1	93	5.7

When the observed values are evenly distributed around the mean approximately 68% are within plus or minus one standard deviation, 95% are within plus or minus twice the standard deviation, and 99% are within plus or minus three times the standard deviation.

would have received prior to milking had it remained in the pipeline. Each sanitized and unsanitized test strip was transferred to a sterile test tube containing 25 ml of a 1-% peptone solution (7); then the entire surface of both sides of the test strip was swabbed 5 times with a sterile cotton swab. The test tube containing the test strip then was stoppered and shaken 40 times through a 6-in. arc. Then the strip was inverted and the process repeated. The strip was removed from the peptone solution and the cotton swab was broken off just above the cotton portion. The tube was then stoppered and shaken vigorously through a 6-in. arc with one hand, striking the palm of the other hand at the bottom of the arc, 50 times or until the swab disintegrated. The peptone solution was plated with standard plate count agar at the rate of 2 ml per petri dish until all the diluent had been plated. This swab and rinse technique was patterned after that described by Angelotti, *et al.* (2). The plates were incubated at 89.6°F (32°C) and counted after 72-hr incubation. The total number of colonies were recorded for each group of agar plates obtained from one test strip. This gave the bacterial count per 8 sq. in. of surface.

A bacterial count of less than 100 organisms per 8 sq. in. of sanitized surface was used as the microbiological standard in this experimental work. This was as recommended in the 10th Edition of *Standard Methods for the Examination of Dairy Products* (1), even though the combination swab and rinse technique used in this work should give a higher percentage recovery than the swab contact method. This was the case with the brush and rinse technique described by Hunter, *et al.* (5).

RESULTS

The results of the bacteriological examination of the test surfaces as well as the differences in the water heating costs are summarized in Table 2. The number of kilowatt-hours required to heat the water

TABLE 2—A SUMMARY OF THE RESULTS OF THE BACTERIOLOGICAL EXAMINATION OF THE STAINLESS STEEL TEST SURFACES AND THE ESTIMATED WATER HEATING COSTS.

	Test period A		Test period B		Test period C	
	Detergent solution at 150-160°F.		Detergent solution at 160°F. and down		Detergent solution at 125°F. and down	
	After washing	After sanitizing	After washing	After sanitizing	After washing	After sanitizing
Number of Samples ^a	34	16	26	28	34	37
Average bacterial count per sq. in.	14.9	4.8	35.8	13.3	234 ^b	8
Median bacterial count per 8 sq. in.	6	2	14	4	46	4
Log average of the bacterial count per sq. in.	7.9	2.8	15.6	6.3	57.4	4.1
Calculated water heating cost per year	\$142.35		\$ 89.06		\$ 62.78	

^aSamples were taken at biweekly intervals during the six month period.

^b8 of the 34 test strips examined had bacterial counts over 100 organisms per 8 sq. in.

was calculated by means of the formula outlined by Farrall (4). The cost of water heating was then calculated by multiplying the K.W.H. required by 1.1c. The cost of booster heating was calculated by multiplying the K.W.H. required by the regular electrical rate of 2.5c per K.W.H. These represented average rates prevalent in the rural area where this study was made. The depreciation costs for the booster heater were computed for a ten year period.

Test Period A: (Temperature Maintained at Approximately 150°F.)

The 34 test strips examined without being subjected to the sanitization treatment gave an average bacterial count of 14.9 organisms per 8 sq in. while the median bacterial count was 6 organisms per 8 sq in. and the logarithmic average was 7.9 organisms per 8 sq in. The 16 test strips that received the sanitization treatment had an average bacterial count of 4.8 organisms per 8 sq in. while the median count was 2 organisms per 8 sq in. and the logarithmic average was 2.8 organisms per 8 sq in.

Test Period B: (Detergent Solution Temperature Allowed to Fall Naturally From 160°F.)

The 26 test strips examined without being subjected to the sanitization treatment gave an average bacterial count of 35.8 organisms per 8 sq in., while the median bacterial count was 14 organisms per 8 sq in. and the logarithmic average was 15.6 organisms per 8 sq in. The 28 test strips that received the sanitization treatment had an average bacterial count of 13.3 organisms per 8 sq in., a median count of 4 organisms per 8 sq in. and a logarithmic average of 6.3 organisms per 8 sq in.

Test Period C: (Detergent Solution Temperature Allowed to Fall Naturally From 125°F.)

The 34 test strips examined without being sub-

jected to the sanitization treatment resulted in an average bacterial count of 234 organisms per 8 sq in. while the median count was 46 organisms per 8 sq in. and the logarithmic average was 57.4 organisms per 8 sq in. The 37 test strips that received the sanitization treatment had an average bacterial count of 8 organisms per 8 sq in., a median count of 4 organisms per 8 sq in. and a logarithmic average of 4.1 organisms per 8 sq in. It should be pointed out that more samples were taken during the first part of Period C than would normally be taken during the regular sampling interval of two weeks. This was done because the relative effectiveness of the low detergent solution temperature was unknown and to insure the maintenance of high quality raw milk it was felt that closer supervision was necessary.

The test strips removed from the pipeline throughout test Periods A, B and C appeared clean upon visual inspection with the exception of 3 samplings during test Period C when visible deposits could be detected. The deposit that occurred on one occasion was traced to the improper use of the acid detergent while the cause of the brownish fat-like deposits which occurred on two occasions was unexplained. These brownish fat-like deposits were accompanied by extremely high bacterial counts on the test strips examined without a sanitization treatment. However, the test strips which were examined after a sanitization treatment were found to be well below the recommended limit of 100 organisms per 8 sq in., although the deposit was still present after the sanitization treatment.

There appeared to be no difference in bacterial counts between ends of the pipeline nor did the atmospheric temperature in the milking barn affect the bacterial counts of the test strips throughout any of the test periods. It was also determined that

"build up," defined as a direct relationship of the number of organisms per test strip to the number of days exposure to treatment did not occur during any of the test periods.

A statistical analysis of the data obtained from the bacteriological examination of the tests strips which had not received a prior sanitization treatment was performed by means of Duncan's New Multiple Range Test (6). The logarithm of the bacterial count per test strip was used in the performance of this test to lessen the effect of a very few high bacterial counts on the final results. This gave a more realistic evaluation of the various test periods. The statistical comparison of the data from test Periods A, B and C demonstrated a significant difference between the results from test Period C and those from test Periods A or B. There was no significant difference between test Periods A and B. No statistical comparison was performed with the results obtained from the examination of the test strips which had received a previous sanitization treatment because the average bacterial count indicated that the pipeline was in excellent condition after sanitization throughout all the test periods.

A raw milk of high quality was produced throughout the entire course of the experiment and no significant change in milk quality occurred during any of the test periods. The Standard Plate Count of the milk averaged below 20,000 organisms per ml. during each of the test periods.

DISCUSSION

The development of more efficient detergents and of automatically controlled cycles has decreased the need for high temperature treatments which have been used in the past for cleaning farm milk pipelines. The results obtained here have indicated that under the conditions present "booster" heating of the detergent solution was unnecessary. This statement is supported by the fact that no significant difference in the number of organisms per test strip was found between test Period A and test Period B. The lower temperatures of the detergent solution used in test Period C produced results that were significantly different from those of test Periods A and B when the test strips were examined before a sanitization treatment. However, when the test

strips were examined after they had received a sanitization treatment there was no practical difference between the bacteriological condition of the test strips during test Periods A, B or C.

The use of automatically controlled cycles eliminates the possibility of wide daily variations in the cleaning and sanitizing procedures which could occur when these procedures are manually controlled. When the cleaning and sanitizing operation is started by pushing a button or throwing a switch the automatic controls take over the rest of the operation and the operator may be assured that the proper procedures are being followed and that no short-cuts are being taken in the cleaning and sanitizing operation.

It was concluded that "booster" heating of the detergent solutions to maintain the temperature above 140°F. was unnecessary. It was observed that the bacteriological condition of the pipeline was somewhat better when the hotter detergent solutions were used even though there was no practical difference in the bacteriological conditions after sanitization of the strips regardless of the temperature of the detergent solutions employed in this work. Also it was shown that a considerable savings in the cost of operation and original equipment could be realized by elimination of the use of "booster" heated detergent solutions.

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THE PASTEURIZATION OF CREAM, CHOCOLATE MILK AND ICE CREAM MIXES CONTAINING THE ORGANISM OF Q FEVER^{1 2}

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Under the conditions of this study the minimum recommended standard for the pasteurization of milk, of 145° F for 30 minutes and 161° F for 15 seconds is inadequate to eliminate viable *Coxiella burnetii* from cream and chocolate milk. However the standard for the pasteurization of these products of 150° F for 30 minutes and 166° F for 15 seconds suggested by the Assistant Surgeon General of the Public Health Service is adequate. It is recommended that this suggested standard become official and that half and half, cream and milk beverages with added sugar and flavor be pasteurized accordingly. Investigation of the minimum recommended standard for the pasteurization of ice cream mix revealed this standard to be adequate to inactivate *C. burnetii* from this type dairy product.

The organism of Q fever, *Coxiella burnetii*, is widely distributed throughout the world (1). Explosive outbreaks of the disease may occur in man and can often be traced to a common source of exposure. On the other hand, individual cases may occur sporadically in a community in which it is difficult to determine the origin of the infection. This rickettsia also infects many different species of animals and it has been suggested that the basic reservoir may be in wild animals with transmission from these species to our domestic animals and then to man (2, 3, 4, 5, 6). In the United States it has been shown that cows, sheep and goats are the important sources of infection for man (7).

The organism is shed in the milk of the infected animal and this vehicle provides one method whereby the rickettsiae may be transported to man's immediate environment (8, 9). Early in the study of Q fever it was found that *C. burnetii* could be isolated from milk pasteurized according to the standards

recommended at that time (10, 11). The hazard to the public health implied by this finding prompted an extensive investigation of the problem. This study (12, 13) demonstrated that 145° F. for 30 minutes and 161° F. for 15 seconds would inactivate *C. burnetii* in naturally infected milk with adequate margins of safety. These time-temperature points are incorporated in the presently recommended minimum standards for the pasteurization of milk by the vat and high-temperature short-time methods. At this time it was recognized that other dairy products containing more fat or having sugar or flavoring added often required greater heat treatment to destroy some microorganisms. Until these other products could be studied, the Assistant Surgeon General of the Public Health Service, in a letter to the State and Territorial Milk Control Authorities and to all concerned, dated July 16, 1956, suggested that a 5° F. increment in temperature be employed for the pasteurization of cream, half and half, flavored and skim milk beverages (13).

It is the purpose of this communication to present some observations on the effect of pasteurization of cream, chocolate milk and ice cream mixes containing the organism of Q fever. It was not the objective of this study to establish thermal regression curves for *C. burnetii* when contained in each product under study, but only to test the accepted and suggested standards recommended for their pasteurization.

MATERIALS AND METHODS

Since the rickettsiae of Q fever will not grow on artificial media and do not induce reliable symptoms or lesions in animals, the presence or absence of viable *C. burnetii* in the test samples is determined by the inoculation of guinea pigs and the testing of second passage animals for the appearance of complement-fixing antibodies. Methods for doing this were developed during the raw milk pasteurization study. Since these methods have been detailed elsewhere (13) only brief reference will be given to them here.

The Henzerling strain of *C. burnetii* was mixed with the dairy product being studied so that each

¹Presented at the 48th Annual Meeting of the International Association of Milk and Food Sanitarians Inc. on August 17, 1961, in Des Moines, Iowa.

²This study was supported by the Milk Industry Foundation, The International Association of Ice Cream Manufacturers and The Chocolate Milk Flavoring Association in cooperation with the Milk and Food Program of the U. S. Public Health Service and the Department of Public Health, School of Veterinary Medicine, University of California at Davis. The author wishes to acknowledge this support together with the aid given by members of The Dairy Industries Supply Association.

ml of the product contained 100,000 infectious guinea pig doses (IGPD). It had been previously ascertained that this was a realistic population to be used and one directly related to that encountered in raw milk delivered to the creamery. In each test the infectivity titer of the sample to be heated was determined.

The dairy product containing the rickettsiae was placed in a heat exchanger constructed of two, thin-walled metal cylinders, one inside the other. The inner cylinder, which was closed at either end, had diagonal vanes on its outer surface and was caused to spin by an electric motor. The outer cylinder contained a temperature sensing device on its inner surface. The test sample was placed in the space between the two cylinders which averaged about 3 mm. in width. During the test the outer cylinder was securely capped and effectively sealed the test sample within. The spinning inner cylinder was designed to keep the product in continuous flow over the surface of the outer cylinder and across the thermistor-actuated temperature sensing device. The test sample was heated by immersion of the heat-exchanger in a well-controlled hot water bath of large capacity and was cooled by rapid immersion in a large cold water tank kept near 36° F. The actual temperature of the dairy product was measured on a continuously recording potentiometer that was carefully calibrated before each test. In this way the temperature changes in the sample were recorded almost instantly and a permanent record of the heat-up, hold and cool-down curves made.

Time was measured mechanically on the same chart in juxtaposition to temperature. Since the heat-up and cool-down curves were recorded and could be measured in relation to time, the thermal inactivation occurring during these periods could be approximated. A corrected time was computed by adding to the measured holding time a factor representing the contribution of the heat-up and cool-down periods. In this way it is possible to present times at holding temperatures more closely approaching the instantaneous attainment of these temperatures. Burton's formula³ based on the pasteurization curve suggested for cream was used to calculate this factor for the heat treatment of cream and chocolate milk, while the formula based on the standard for pasteurizing ice cream mix was used for this type

product. The percentage lethality estimated to occur during heating and cooling is calculated in terms of the time at the holding temperature needed to accomplish the same percentage of mortality. This time, called the equivalent time-correction factor may then be added to the time at the holding temperature. Theoretically this method is not correct since the pasteurization standards upon which it was based do not represent the instantaneous-death time of *C. burnetii*. Since the error is relatively small, it is highly improbable that the temperatures and times so expressed could be achieved with less total heat treatment.

After heating, the test sample was inoculated in one ml. amounts into each of four guinea pigs by the intraperitoneal route. The animals were sacrificed after ten days, their spleens pooled and inoculated I.P. in one ml. amounts into each of six guinea pigs. These second passage animals were bled 30 days after inoculation. All guinea pigs were bled before inoculation and the pre- and postinoculation sera run in the same complement fixation test for antibodies to *C. burnetii*. A test was discarded and results not included in the data if any preinoculation blood showed fixation in the lowest dilution used (1:8). A test in which the preinoculation serum was negative and the postinoculation blood sample contained antibodies in a dilution of 1:32 or higher was considered as evidence that viable rickettsiae were in the heat treated sample. In the animal house normal, healthy guinea pigs were caged at random. The serum of none of these showed antibodies to *C. burnetii* when tested at intervals throughout the study.

The complement fixation test has been used in this laboratory for years. It is described in detail elsewhere (13). The antigen was a commercial preparation of the Nine Mile strain of *C. burnetii*. Two units of antigen, complement and sensitized sheep red blood cells are used in the test. Fixation is overnight at 4° C. Either a 3+ or 4+ fixation was considered positive, while partial fixation below the 3+ level was considered negative. The usual controls for the hemolytic system and for the anticomplementary effect of each unknown serum together with a titration of a known antiserum were included in each test.

Raw cream was obtained on the morning of each thermal resistance run from the University creamery. The percentage butterfat was determined and the product prepared for testing. Since no difference in the thermal resistance of *C. burnetii* when suspended in cream of 18, 24, and 40 per cent butterfat could be demonstrated, cream having a percentage of butterfat between 35 and 40% was used in this study.

The chocolate milk was made under the direction

³Burton's Formula $E = \sum \frac{\Delta t}{T\theta}$

where Δt = Time increments at a given temperature.

$T\theta$ = Time equivalent for pasteurization at that given temperature.

of the University creamery and was obtained fresh from them on the day of the test. This product was made according to a formula decided upon in conference between The Milk and Food Program, U. S. Public Health Service and the organizations supporting this study. It contained:

Milk Solids-not-Fat	-----	8.0%
Butterfat	-----	4.0%
Other Carbohydrates	-----	4.4%
(including cocoa)		
Stabilizer	-----	approx. 0.1%
Total Solids	-----	22.5%

The ice cream mixes to be tested were designed to cover the ranges of fat, sugar and solids-not-fat that might be encountered in commercial mixes. While this is a difficult problem, the formulae for ten different mixes were decided upon in conference between members of the Milk and Food program, U. S. Public Health Service and representatives of industry. The mixes were prepared under the direction of the ice cream specialist in the Department of Food Science and Technology, according to the formulae listed below:

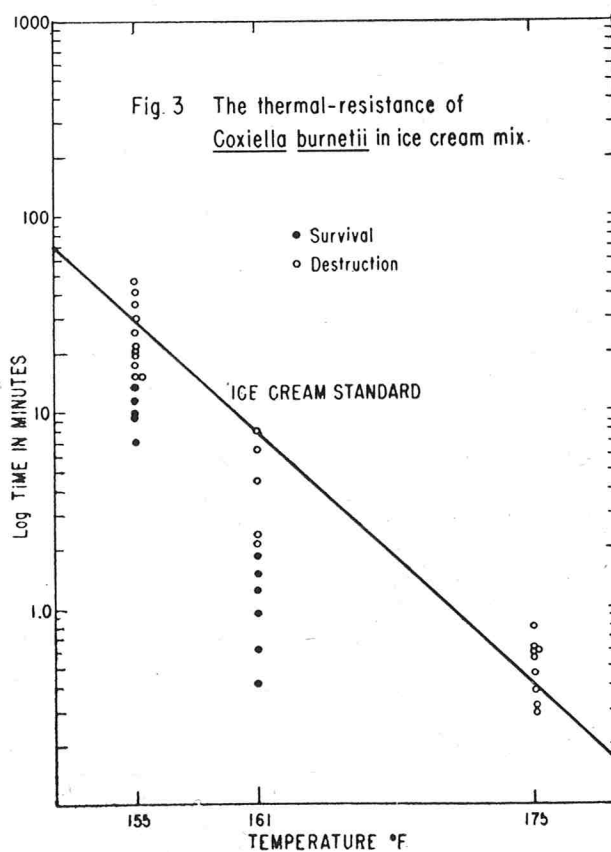
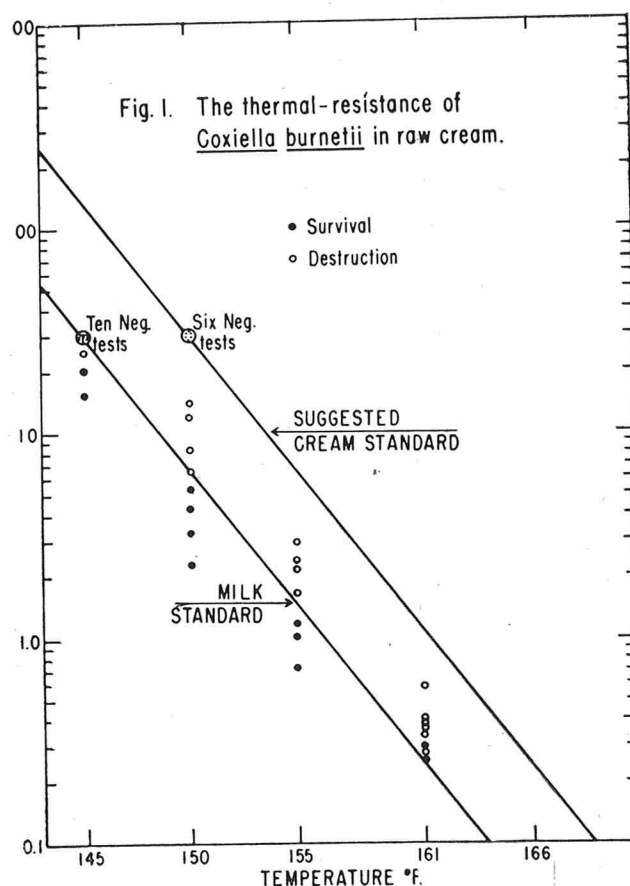
TABLE 1 — FORMULAE FOR ICE CREAM MIXES

Mix No.	Product	Fat (%)	S-N-F (%)	Sugar (%)	Stab. (%)	Egg (%)	Choc. (%)	Total solids (%)
1	Ice Milk	4	14	15	.25	-	-	33.25
2	Ice Cream	8	13	15	.35	-	-	36.35
3	Ice Cream	10	12	15	.25	-	-	37.25
4	Ice Cream	12	11	17	.25	-	-	40.25
5	Ice Cream	14	10	15	.25	-	-	39.25
6	Ice Cream	16	9	17	.25	-	-	42.25
7	Ice Cream	18	8	15	.25	-	-	41.25
8	Choc. Ice Cream	12	10	17	.25	-	2.5	41.75
9	Ice Cream Egg	16	9	17	.25	0.5	-	42.75
10	Sherbert	1	4	32	.50	-	-	37.50

RESULTS

In the phase of the study using cream as the medium in which the organism was suspended 42 time-temperature trials were made. The results of these trials are plotted in Figure 1 together with their relationship to the curve representing the standard recommended for the pasteurization of milk and that suggested for the pasteurization of cream. The closed circles indicate the survival of the organism, while open circles show destruction. Times are corrected to include the effect of the heating-up and cooling-down periods. While survival and destruction endpoints were not obtained in each run, the infectivity titrations of the samples before heating were of equal magnitude. Survival and destruction endpoints were determined in the same tests at 145° F. and 161° F.

In the studies of chocolate milk 20 time-tempera-



ture points were investigated and these are plotted on Figure 2 showing the relationship to the pasteurization standards. Open circles indicate the destruction of the organism while the closed circles show its survival and times include the value of the total heat treatment. In this phase of the study endpoints of survival and destruction were obtained in the same thermal-resistance trial conducted at each temperature, except at 165° F.

In Figure 3 are plotted the results of testing the effect of pasteurization of ice cream mixes. In this study 36 time-temperature combinations were run. And these are shown in relation to the recommended curve for the pasteurization of ice cream mix with survival and destruction at each point indicated. However an endpoint was only obtained in the same run at 155° F.

In Table 2 are listed the observed endpoints of survival and destruction together with the time-temperature point on the recommended or suggested curves for the pasteurization of milk, cream and ice cream mix. The times listed for cream and chocolate milk have been corrected for the percentage mortality occurring during heat-up and cool-down using Burton's formula based on the suggested curve for the pasteurization of cream, while the time correction for ice cream mix was estimated using the recommended ice cream standard as a base. The observed endpoints were obtained by subjecting like concentrations of *C. burnetii* to heat as determined by infectivity titrations run on an unheated portion of the sample. However both the survival and des-

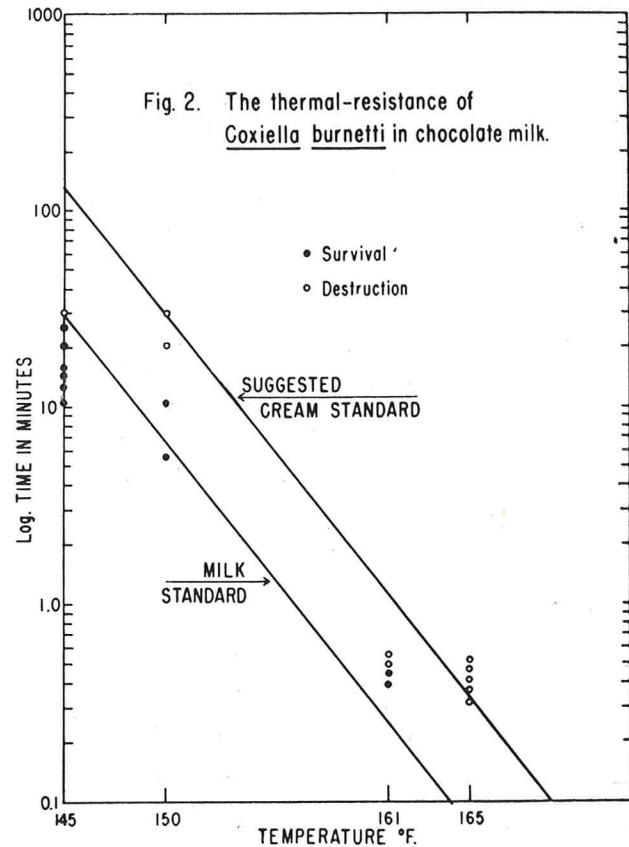
TABLE 2 — OBSERVED END POINTS OF SURVIVAL AND DESTRUCTION IN RELATION TO PASTEURIZATION STANDARDS

Type product	Temp. ^a ° F.	Time in minutes ^b		Standard		Time ^c Ice Cream
		Survival	Destruction	Milk	Cream	
Cream	145°	20.5	25.5	30.0	135.0	
	150	5.27	6.37	6.5	30.0	
	155	1.18*	1.64	1.5	6.7	
	161°	0.29	0.34	0.25	1.1	
Chocolate Milk	145°	25.7	30.7	30.0	135.0	
	150°	10.5	20.5	6.5	30.0	
	161°	0.44	0.49	0.25	1.1	
	165	—	0.31		0.34	
Ice Cream Mix	155°	13.8	15.8			30.0
	161	1.83	2.14			8.0
	175	—	0.29			0.42

^aThe observed end points of survival and destruction were obtained in the same test at the temperatures marked by an asterisk.

^bTime is corrected for the percentage mortality occurring during heat-up and cool-down.

^cTime points intercepting temperature on the recommended and suggested pasteurization curves.



truction endpoints were not obtained in the same trial unless marked by an asterisk.

DISCUSSION

The objectives of this study as stated earlier were to test the effectiveness of time-temperature points recommended or suggested for the pasteurization of cream, chocolate milk and ice cream mix by the vat and the high-temperature short-time methods when these products contained *C. burnetii*. It was not intended that the experiments be designed to provide the type data needed to construct thermal regression curves, nevertheless, it was possible to test a few intermediate points between the vat and HTST ranges. While the maximum time of survival and the minimum time for destruction of *C. burnetii* in these products was not determined in a single run in most cases, these times were relatively close in tests repeated at various intervals throughout the study.

It is revealed by inspection of Figures 1 and 2 that heating cream and chocolate milk according to the recommended minimum standards for the pasteurization of milk is not sufficient to eliminate the organism of Q fever from these products. However the standard suggested by the Assistant Surgeon General for the pasteurization of cream and milk

with added flavoring seems adequate.

In repeated trials near the suggested time and temperature points, survival of the organism was never demonstrated. These observations may be made again by inspection of the data listed in Table 2 and comparing the minimum time of destruction and the maximum time for survival of *C. burnetii* in cream and chocolate milk with the times for corresponding temperatures on the milk and suggested cream pasteurization curves. Since time is measured on the logarithmic scale, the magnitude of the difference between the observed end points and the times at corresponding temperatures on the two standard curves is relatively great.

At the present time the official minimum recommended standard for the pasteurization of cream and chocolate milk is the same as for the pasteurization of raw milk, or 145° F for 30 minutes and 161° F for 15 seconds. The results of this study indicate that the suggested standard of 150° F for 30 minutes and 161° F for 15 seconds is adequate for the pasteurization of cream of up to 40% butterfat and chocolate milk as constituted in this investigation. Therefore, it is recommended that this standard be made official for these beverages.

The effectiveness of the recommended standard for the pasteurization of ice cream mix of 155° F for 30 minutes and 175° F for 25 seconds was investigated. The results of this study are plotted in Figure 3 and listed in Table 2. Inspection of these data reveal that under the conditions of this study *C. burnetii* does not survive in ice cream mix pasteurized according to this standard.

The observations made in this study gain additional strength through the use of Burton's formula in the correction of time. This method estimates the percentage mortality occurring during heat-up and cool-down in equivalent units of time required to accomplish the same mortality at the holding temperature. This allows the equivalent time to be added to the time at the holding temperature. Because the error is relatively small over the temperature range studied, time at the holding temperature

may be measured as though the temperature was reached almost instantaneously. Practically this means that it is very highly improbable that any device could more quickly heat the test product to the holding temperature. Therefore, the variance in time needed to heat the product to the holding temperature in different types of heat exchangers can be ignored.

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FURTHER OBSERVATIONS OF PENICILLIN LEVELS IN MILK FOLLOWING INTRAMUSCULAR AND INTRAUTERINE ADMINISTRATION¹

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(Received for publication, May 31, 1961)*

Vaid et al. (4) reported on penicillin levels in milk following the parenteral administration of procaine penicillin G. Kendrick and Pier (3), using the Food and Drug Administration method as developed by Arret and Kirshbaum (1), were unable to detect the presence of inhibitory substances in the milk of cows following intrauterine infusion with 1,000,000 units of penicillin and 1.0 g of dihydrostreptomycin.

The observations presented in this paper represent a continuation of the study reported by Vaid *et al.* Additional observations are included on the presence of antibiotic residues in milk following the intrauterine administration of penicillin alone and with dihydrostreptomycin.

METHODS

A proprietary preparation containing equal amounts of benzathine penicillin G and procaine penicillin G in aqueous suspension was administered intramuscularly in a single dose, to a series of four lactating cows at the recommended rate of 4,000 μ /lb. of body weight.

Intrauterine infusion of penicillin was administered as follows: (a) two cows were given procaine penicillin G, oil base, 5,000 μ per pound of body weight; (b) three cows, 5,000 μ of procaine penicillin G, oil base and 5.5 mg of dihydrostreptomycin per pound of body weight; (c) three cows, procaine penicillin G aqueous suspension, 1,000,000 μ per cow; and (d) three cows, procaine penicillin G aqueous suspension 1,000,000 μ and 1.0 g dihydrostreptomycin per cow.

Samples of milk were collected from each cow before the administration of the penicillin and at each milking period after, up to and including 72 hours. The samples were held in the frozen state until they were analyzed for penicillin.

The plate-cylinder bio-assay method, (2) using *Sarcina lutea* ATTC strain 9341 as the test organism, was employed for the quantitative determination of penicillin.

TABLE 1—UNITS OF PENICILLIN PER MILLILITER OF MILK FOLLOWING INTRAMUSCULAR ADMINISTRATION OF BENZATHINE PENICILLIN G AND PROCAINE PENICILLIN G AQUEOUS SUSPENSION. SINGLE INJECTION OF 4000 μ /LB. OF BODY WEIGHT

Cow No.	Hours					
	0	12	24	36	48	60
452	0	0.031	0.005	0.017	0.	0
459	0	0.017	0.006	0.008	0.005	0
490	0	0.054	0.007	0.009	0.008	0
504	0	0.050	0.007	0.008	0.009	0
Average		0.038	0.006	0.011	0.005	0

RESULTS AND DISCUSSION

Intramuscular administration

Data showing penicillin levels in the milk following the intramuscular administration of the drug are presented in Table 1 and Figure 1. The horizontal broken line in Figure 1 at the 0.05 unit level represents the minimum working level of the 2½-hour Food and Drug Administration bio-assay method.

An average concentration of 0.038 units of penicillin per milliliter of milk was observed after 12 hours. At the 36-hour period, a second peak occurred at a concentration of 0.011 units. After that

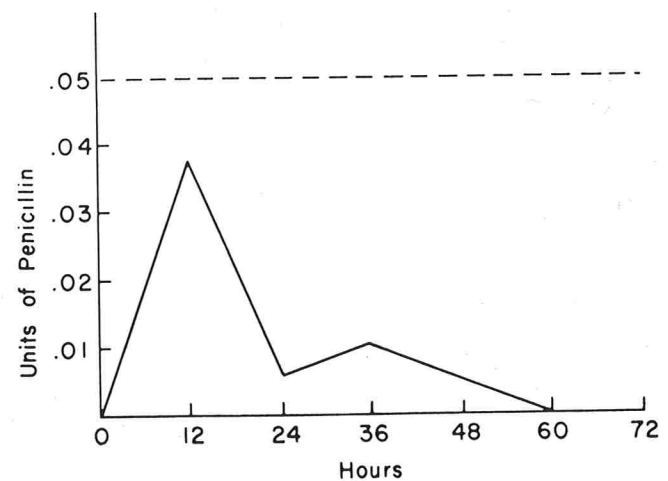


Figure 1—Penicillin levels in milk following the intramuscular injection of equal amounts of benzathine penicillin G and procaine penicillin G, aqueous suspension. Single injection of 4000 μ /lb. of body weight. Average of 4 cows.

¹Scientific paper No. 2116 Washington Agricultural Experiment Station, Pullman, Project 1499.

TABLE 2—UNITS OF PENICILLIN PER MILLILITER OF MILK FOLLOWING INTRAUTERINE INFUSION WITH PROCAINE PENICILLIN G.

Treatment	Cow No.	Hours						
		0	12	24	36	48	60	72
Procaine Penicillin G, oil base, 5000 μ /lb. of body weight	1	0	0.20	0.02	0.016	0.006	0	0
	2	0	0.04	0.006	0	0	0	0
Procaine Penicillin G, oil base, 5000 μ /lb. + 5.5 mg dihydrostrepto- mycin per lb of body weight	531	0	0.027	0.024	0.013	0	0	0
	2201	0	0.028	0.009	0.012	0.007	0	0
	3156	0	0.013	0.010	0.009	0	0	0
Procaine Penicillin G, aqueous, 1,000,000 μ	2218	0	0	0.006	0.010	0.007	0	0
	3135	0	0	0.006	0.006	0	0	0
	3185	0	0	0.008	0.008	0	0	0
Procaine G, aqueous, 1,000,000 μ + 1.0 g dihydrostreptomycin	404	0	0	0.007	0.008	0.009	0	0
	450	0	0	0.018	0.011	0	0	0
	462	0	0	0	0.009	0.009	0	0

the penicillin decreased and was not present in a detectable amount after 60 hours.

The more soluble procaine penicillin G in aqueous suspension accounted for the higher initial level of this drug in the milk at the 24-hour period, whereas the more slowly absorbed benzathine penicillin G was effective after this time.

The responses of the individual cows varied as shown by the concentration of penicillin in the milk. The highest concentration, 0.054 units per milliliter, occurred in the milk from cow 490. This amount of penicillin was barely within the working range of the Food and Drug Administration bio-assay method. No penicillin was detectable in the milk from any of the cows 60 hours after the administration of the drug.

Intrauterine infusion

Data showing penicillin levels in the milk following intrauterine infusion are presented in Table 2. With the exception of cow No. 1, penicillin levels in the milk, at all times, were less than 0.5 units per milliliter and would have escaped detection by the 2½-hour Food and Drug Administration bio-assay method (1). Milk from the cows receiving the larger dosages of penicillin showed the presence of this drug 12 hours after treatment, and it persisted up to 36 to 48 hours. Following treatment with 1,000,000 units of penicillin, the drug was not detectable in the milk until 24 hours after administra-

tion. Detectable amounts were present up to 36 to 48 hours.

Kendrick and Pier (3) concluded that it is not necessary to withhold milk following the intrauterine infusion of penicillin at the rate of 1,000,000 units per treatment. This conclusion was based on the use of the 2½-hour Food and Drug Administration bio-assay method which is the standard procedure of many regulatory agencies. Although the amount of penicillin present in milk following intrauterine administration may be of little or no significance, it can be detected by the more sensitive bio-assay method used in this study.

ACKNOWLEDGMENT

The author is grateful to Dr. R. E. Watts, currently Associate Animal Pathologist, College of Agriculture, The University of Arizona, for the administration of the antibiotics used in the intrauterine infusion experiments of this study.

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THE INACTIVATION OF BACTERIA IN MILK EXPOSED TO ULTRA-HIGH-PASTEURIZATION TEMPERATURES^{1 2}

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The advent of a new process in food processing such as ultra-high temperature (UHT) pasteurization must be motivated by one or more outstanding reasons. In the UHT pasteurization of milk, such reasons could generally be identified as those involving public health or economics. Since the level of the public's health and milk have been so closely related, a brief review of present milk pasteurization standards is in order.

Public health reasons, based on present knowledge and experience, could not justifiably be considered the basic need for moving to a more drastic method for pasteurizing milk. The present standards of 145°F for 30 minutes and 161°F for 15 seconds have been shown to be more than adequate to destroy any pathogenic bacteria which might be expected to occur in raw milk. In addition, these exposures destroy the faster growing types of bacteria which otherwise would cause quick spoilage of the milk. Thus, milk pasteurized by the foregoing heat treatments ensures the public's health and possesses an extended shelf-life under refrigeration.

Within the past ten years another pasteurization standard has been established as a result of the development of vacuum pasteurizers designed to operate at temperatures higher than those used previously. As a result of two independent research studies, a standard of 194°F with no specified holding time was established. Data showed, however, that the temperature of 194°F was maintained approximately 0.75 second. Obviously, this time was too short to be specified for routine control work. In establishing this standard, actually milk was not the product under study. The main objective of the research which led to the standard was to determine a pasteurization exposure for ice cream mix equivalent to 155°F for 30 minutes. Studies at the University of Illinois and at North Carolina College indicated that the 194°F for a steam injection process, such

as the Vacreator, was at least equivalent to 155°F for 30 minutes. The adoption of this standard for ice cream mix was *a priori* extended to milk for several reasons. These were: (a) bacteria in ice cream mix are more difficult to destroy than in milk, hence any treatment adequate for ice cream mix would be more adequate for whole milk; (b) there was not much need to use lower temperatures for milk since, in the use of equipment such as the Vacreator, a main objective was foreign flavor removal, and temperatures lower than 194°F were ineffective for this; (c) milk exposed to this treatment could not be marketed as cream-line milk, hence use of minimum heating to preserve creamline was of no concern. This new standard provided for what proved to be an extensive development of foreign flavor removal equipment, some of which accomplished pasteurization and flavor removal concomitantly.

The use of the higher pasteurization exposures demonstrated that along with foreign flavor improvement, bacterial counts were markedly lower than those obtained by the exposures of 143°F for 30 minutes or 161°F for 15 seconds. Only the most heat resistant types of bacteria would survive; i.e., bacilli and certain of the more hardy microbacteria and micrococci. The extended microbiological shelf-life was an advantage in addition to flavor improvement. Information so obtained was of much value when problems arose concerning extension of shelf-life and flavor of milk. Admittedly, our present problems appear destined to lead to development of sterile market milk.

Since motivation for the UHT pasteurization cannot be considered as concern over the public's health, explanation can be expected in the area of economics. A brief examination of the situation here is in order.

The trend in milk production and processing has been toward larger operations. This has been related to available labor and labor costs on one hand, and on the other to the effective utilization of specialized equipment and automation. The outcome has been the consolidation of production and processing into larger operations which can make effective and economical use of the specialized equipment. Consolidation, in turn, has resulted in longer distances which the raw and processed milk needs to be transported. Consequently, it has become necessary to

¹Presented to Milk Sanitation Administration training program, Communicable Disease Service, U. S. Public Health Service, Atlanta, February, 1960.

²Contribution from the Department of Food Science and Processing, North Carolina Agricultural Experiment Station, Raleigh, North Carolina. Published with the approval of the Director of Research as Paper No. 1326 of the Journal Series.

increase the shelflife of the raw and processed milk, and UHT pasteurization can make a definite contribution to the latter.

In obtaining a longer shelf-life of the processed milk, particularly if a sterile product is produced, certain other advantages become immediately recognizable. Examples of these are: (a) possible reduction of delivery costs, by less frequent home delivery; (b) bulk retail sales; (c) preservation of milk during peak seasons, or in areas of less costly production; and (d) less costly storage with refrigeration not needed.

The foregoing would lead us to conclude that economic considerations have provided the main motivation for developing UHT pasteurization. There is good reason to expect this process to increase in popularity. Bacteriological problems, however, connected with this means of processing will be considerably different from those which have been of chief concern to the dairy industry in the past.

Bacteriological studies of UHT pasteurized milk are relatively sparse in this country. Considerable more research has been done in England where sterilized milk has been produced for a longer time. However, the problems which have been encountered in England may be somewhat different from those which we will encounter. Their processing has generally involved an "in bottle" sterilization which results in an extended heat treatment that gives the milk a color and flavor (cooked) that probably would not be acceptable to the U. S. consumer. The discussion which follows will be an effort to review studies on UHT in this country and abroad, and to attempt a review of some fundamental bacteriological information which may resolve some of the practical problems which we anticipate.

Pasteurization at 206°F for 3 seconds has been shown³ to be much superior to pasteurization at 176°F for 16 seconds. In the former method the milk stored at 45°F had a count of only 3000/ml after 18 days, and had a shelf-life of 30 days. The milk pasteurized at 176°F had a count of 87,000,000/ml after 16 days. Thus, pasteurization at 206°F for 3 seconds, showed a remarkable extension of the shelf-life of the milk.

Another pasteurization exposure which has been used commercially in this country is 219° or 220°F for a 1 to 2-second hold. In fact, certain claims have been made that this is a magical pasteurization temperature, although no scientific data were given to substantiate such a claim. A shelf life of 3-4 weeks

under refrigeration appears to be quite possible with such a treatment. It is interesting to note, however, that an inquiry was directed to us by a company that was experiencing a faster spoilage of pasteurized milk when this treatment was used than when pasteurization at 195°F had been used. Bacteriological tests had indicated that a member of the genus *Bacillus* was the organism causing the spoilage. In such an instance, without benefit of personal observations, one can only speculate based on known fundamentals. Thus, it is known that heat often has an activating effect on spore germination. In the present problem it would seem that the increased heat was more active in effecting germination of the spores of the bacteria present in the milk. After bottling and delivery to customers, it is possible that the spores germinated reasonably rapidly, particularly if temperatures were not maintained sufficiently low, and resultant growth caused more rapid spoilage of the milk.

Another UHT exposure has been a 1-second hold at 232°F. It has been claimed that, with storage at 40°F, milk so pasteurized has been held 46 days, during which time the milk maintained an excellent flavor.

Still another pasteurization treatment which had been used is 285°F for 3 seconds. This has been used in some research at the University of Wisconsin, where studies have been made on a sterile 3 : 1 milk concentrate. In this process the product is heated to 285°F for 3 seconds before being condensed; after condensing it is again heated to 285°F for 3 seconds to sterilize; and then it is canned aseptically. This appears to give a sterile product. However, reports have indicated that there have been cases where spore-formers have survived. This has been attributed to errors in processing, although it has not been shown conclusively that the survivors were not resistant spores that survived the process.

Finally, there is a process for pasteurizing at 300°F with only instantaneous holding. The first commercial process using this exposure was developed in Switzerland, and is known as "uperization." There is also equipment being manufactured in this country by which pasteurization at 300°F can be accomplished. In this process the heating is accomplished by steam injection. Much of the initial cooling is accomplished by introducing the heated product into a vacuum chamber, which effects instantaneous cooling by vaporization of water. All the data on "uperized" milk indicate that the product is sterile. Apparently the 300°F, from what is known as the present time, will kill all of the organisms normally found in the milk, including the spore-forming bacteria.

³Personal communication from Dr. W. O. Kaufmann, Michigan State University.

The foregoing is a brief description of the very limited research on bacteriological problems connected with UHT pasteurization. Many of the difficulties which can be anticipated in the practical use of this means of processing milk, however, can be surmised from the research reported to date.

The microorganisms which will be the most difficult to destroy in UHT treatments will be the spore-forming bacteria. For instance, in processing evaporated milk, temperatures of 238°-245°F for a period of 14 to 18 minutes are required to destroy these microorganisms. Spores have been found which resist heating at 240°F for 3 hours! Infection of milk by such resistant forms would preclude sterilization of the product by any practical heat treatment. It is well known that resistance of different strains of sporeformers varies. Also the resistance of a given strain may vary as a result of: (a) variability in nutrients on which the culture grew forming its spores and; (b) the age of the spores, more resistance usually being present in older spores. Furthermore, the greater the number of spores present in a volume of medium the longer is the time required for sterilizing the medium. These factors make prediction of sterilization requirements for milk, under all conditions, indefinite and difficult. Normally, commercial sterilization requirements are based on exposures required to kill a test spore, of known high heat resistance, inoculated into the product under consideration.

In view of the variable resistance of bacterial spores, it might be presumed that the industry is faced with an unsolvable dilemma in efforts to produce sterile milk. Although absolute sterility may not be attainable, there is evidence that a state of "practical sterility" has been attained, and that this state is satisfactory for most situations. The term "practical sterility" is used to describe a situation wherein not all bacterial spores are killed, but the survivors are unable to grow and cause spoilage under most practical conditions. Such often is the case with evaporated milk. The inability of such surviving spores to germinate is not completely understood. Several factors are known to limit the ability of the survivors to grow, such as: (a) anaerobiosis in the container; (b) sufficiently low storage temperature (even with no refrigeration) since survivors seem to be primarily thermophilic and; (c) the formation of compounds during sterilization which are inhibitory to germination.

In accepting the situation of "practical sterility" one may wonder about the incidence of spoilage which may be expected. Temperature of storage will have much importance here. The French have found "sterile" milk to show actual sterility when

tested at 30°C; when tested at 55°C spoilage occurred in 1 to 50% of the cans. The English have indicated that a goal of no more than 0.1% spoilage should be expected. Of this spoilage 10% can be expected from UHT survivors and 90% from unsterile containers and contamination during filling. Evidence indicates that spoilage of "sterile" milk can, at the present time, be reduced most effectively by avoiding storage at high temperature; this means also that containers of milk should not be stacked until all of the heat used in processing has been dissipated.

There is reason to believe that results from current research may provide new means for preventing any UHT survivors, with no increased heat being required. For instance, it is known that heat shock will induce germination in many spores that otherwise might germinate slowly, if at all. Once germination has begun, the spores then can be killed with less heat than otherwise is required. The addition of antibiotics often reduces the heat required to kill spores; this certainly would not be a method of choice in the dairy industry. However, other materials known to induce spore germination are certain amino acids, certain intermediates in carbohydrate metabolism, and certain ions (Mn, Cl, NO_3 , PO_4). The heat resistance of spores seems to be directly related to their content of dipicolinic acid. Thus, if means are found to control the incorporation or release of this compound from spores, definite improvements in heat processing of foods can be made possible.

There are problems in addition to those of a bacteriological nature which should be considered in relation to UHT processing. One of these concerns inactivation of the various enzymes known to exist in milk. Failure to inactivate the enzymes would not conceivably result in any danger to the public's health. However, their activity could be very important to the shelf-life of sterilized milk. Many milk enzymes are inactivated by present pasteurization procedures (e.g., phosphatase, lipase, catalase), while others are not (protease, xanthine oxidase, peroxidase). The enzymes not inactivated would not be expected to show noticeable effects in pasteurized milk owing to unfavorable temperature in refrigerated storage. If these enzymes were not inactivated in sterile milk it may be possible for them to have adverse effects on the milk owing to its storage at room temperatures. Enzymes known to show reactivation after high heat treatment (e. g. phosphatase, peroxidase) might also be objectionable. Obviously, information is needed on the subject of enzyme inactivation in UHT pasteurization.

The production of a cooked flavor has been mini-

mized by the UHT treatments which use a very high temperature for an instantaneous holding period. Usually a definite cooked flavor is present immediately after processing, but dissipates completely in one or two days.

There have been problems with protein denaturation and separation in UHT processing. Current research, however, is expected to provide means for correcting this difficulty.

One of the greatest problems related to UHT processing is aseptic packaging. Heating of the product in the final container is undesirable as the heat treatment cannot be accomplished quickly enough to avoid an objectionable cooked flavor. Therefore, it is preferable to do the UHT pasteurization and cooling of the product in a continuous operation, and package the sterile product aseptically. The Martin aseptic canning system is commercially available in the U. S. Presumably other systems will be developed which will permit the use of containers other than cans. In addition to doing the packaging aseptically, means must be provided for sterilizing, and maintaining in a sterile condition, all equipment from the UHT heater to the final package. This will require procedures quite different and more stringent than those presently used for pasteurized milk.

This presentation has been an attempt to describe the present status in the processing of sterile milk by UHT methods. Problems already encountered and some which are anticipated have been described. The advantages inherent to marketing and distributing of sterile milk would indicate that it will be a

relatively short time until scientific ingenuity provides means for overcoming problems confronting the production of such a product.

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A COMPARISON OF TECHNIQUES FOR ASSESSING THE BACTERIOLOGICAL CONDITION OF MILKING MACHINES

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(Received for publication July 1, 1961)

As a yardstick for use in evaluating bacteriological tests for raw milk, a pulsating rinse technic was compared with a swab test for assessing the sanitary condition of milking machines. The latter test frequently failed to indicate conditions where gross contamination was revealed by the former. Because of the large dilution factor, milk drawn with heavily contaminated equipment may meet current bacteriological standards when examined fresh. After preliminary incubation at 12.8°C. for 18 hours, a much higher proportion of such milks can be detected.

The primary purpose of a bacteriological examination of a raw milk sample is to determine whether or not the milk has been produced and handled under sanitary conditions. The relative merits of various tests (standard plate count, direct microscopic count, methylene blue and resazurin reduction tests) have frequently been discussed, but comparisons of one with another fail to yield the information desired. What is needed is a suitable yardstick against which the various tests may be evaluated.

It is generally accepted that poorly cared for milking machines are the chief source of bacterial contamination of milk. Consequently, a procedure which adequately indicates their sanitary condition would appear to furnish a suitable measure or yardstick. Various methods have been employed, principally "static" rinses or swabbings. Smillie (7) stated "An accurate indication of the condition of the machine unit is provided by rinsing with 1,000 ml of sterile water which is given a few seconds contact with the rubbers before being drained into the milk pail for sampling." More recently the West of Scotland Agricultural College (6) has adopted a pulsating rinse technique, a modification of that described by Claydon (2). They report that results with it have correlated much better with counts on the milk than did those from a non-pulsating rinse; the latter was considered inferior to the swab test. For convenience we originally planned to use the swab test in farm survey studies, although it was realized that it would only remove bacteria on surfaces. Milker rubberware soon deteriorates in use; numerous fine cracks develop (Figure 1) and the rubber becomes porous.

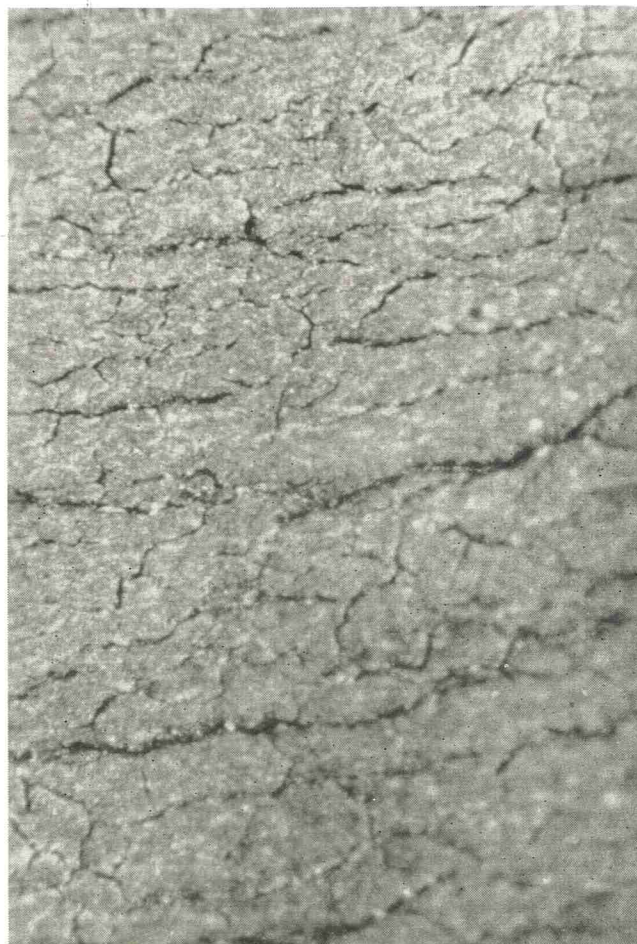


Figure 1—Photomicrograph of surface of a rubber inflation, magnified 65X. (Courtesy of T. J. Claydon, Kansas State University).

Bacteria hidden in cracks and crevices may escape detection by swabbing or "static" rinsing; however, when the inflation is flexed during milking many of these organisms are squeezed out and contaminate the milk. When we learned of the modified pulsating rinse, we conducted the studies reported in this paper to compare it with the swab test.

EXPERIMENTAL PROCEDURE

Three fieldmen of the Dairy Branch, Ontario De-

partment of Agriculture, were instructed in the procedures to be followed in obtaining samples. During February and March 1961 each of 29 farms shipping fluid milk to smaller towns in the Ottawa Valley was visited in the afternoon a short time before milking. A questionnaire form was completed for each farm and sent in along with the samples. The farmer was asked to sanitize his milking equipment in the usual manner. Each of the teatcups and the long milk tube on one or more units were then swabbed as thoroughly as possible without being inverted, following which a pulsating rinse with a sterile buffered rinse solution was carried out *on the same unit*. The procedure was as follows:

Supplies and Equipment

Sterile cotton swabs, each in 10 ml. sterile buffered rinse in screw-capped test tubes.

Sterile buffered rinse (8), 500 ml. in a wide-mouth jar.

Stand to hold teatcup cluster (Figure 2). Notched panel of $\frac{3}{4}$ -in. plywood; notches lined with $\frac{1}{4}$ -in. soft rubber tubing.

Hoffmann clamps, large—4 (for use with short-tube milkers).

Stopwatch or watch with second sweep.

Sterile dipper and sample bottle for milk sample.

Long Tube Milkers. Set up cluster on stand (Figure 2) to hold teatcups upright, start vacuum pump, connect machine, but *keep milk line valve closed!* Pour sterile buffered rinse solution into cluster to within one inch of tops of liners, and allow machine to pulsate for one minute. Then open valve and allow rinse solution to be sucked into pail, pouring any unused portion through teatcup. Swirl pail around to contact entire surface of milker bucket and pour rinse back into original container.

Short Tube Milkers. Set up teatcups on stand. Tighten Hoffmann clamp on each short milk tube, then pour sterile buffered rinse into each teatcup to one inch below top of liner. Connect to vacuum and pulsate for one minute, then loosen the clamps as quickly as possible and draw solution into pail. Shut off vacuum, swirl rinse around in milker bucket and return rinse to original container.

Representative samples of milk were obtained from either the bulk tank or the cans. (Bulk tanks were in use at 17 of the 29 farms.) Samples of both rinses and milk were to be cooled promptly to below 40°F. and maintained between 32°F. and 40°F. until analysed the same day or next day.

Laboratory Analysis

Samples were brought to the Ottawa Regional

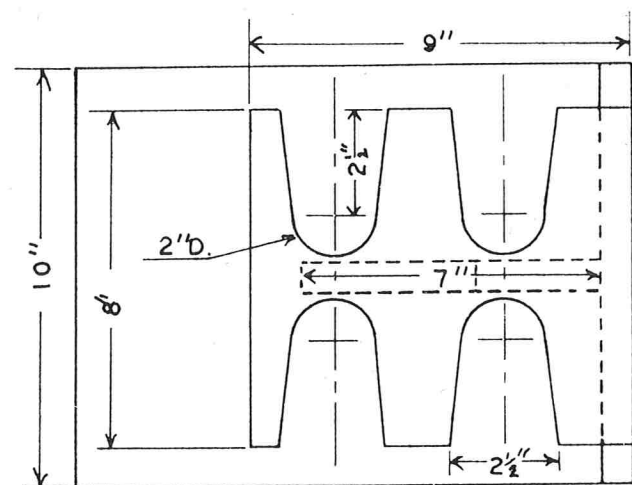
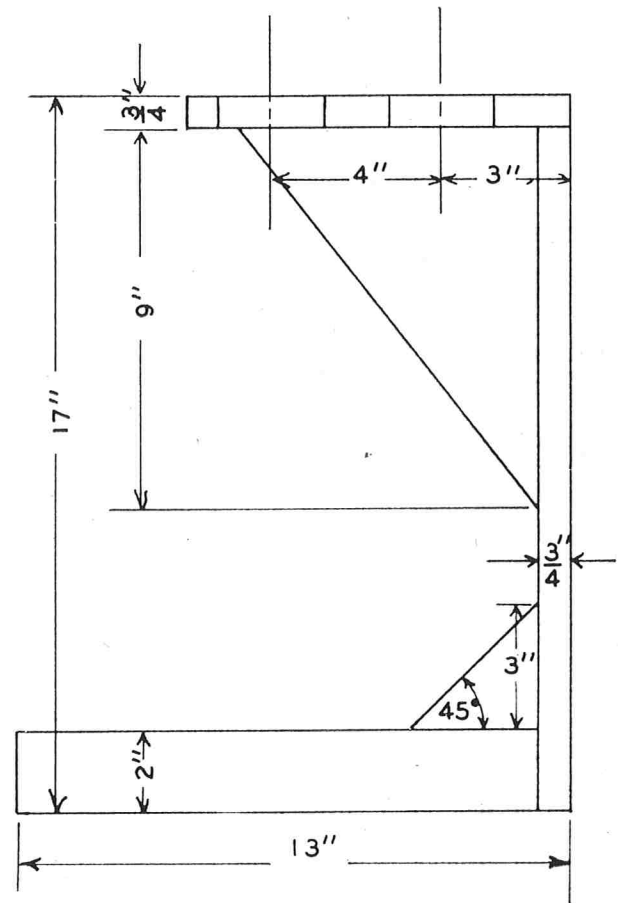


Figure 2—Stand to support teat-cup cluster during pulsating rinse.

Laboratory, Ontario Department of Health. There swab and pulsating rinses were analysed for standard plate count (SPC) and coliform count (8). Milk samples were analysed as follows:

(a) S.P.C. at 35°C.

TABLE 1—RESULTS OF BACTERIOLOGICAL TESTS APPLIED TO MILK AND TO SWABS AND RINSES OF MILKING MACHINES.

Farm No.	Milk							Lab. Past. count	Swab		Pulsating rinse	
	SPC		Resazurin red time (35°C)		Coliform count		SPC		Coliform count	SPC	Coliform count	
	A ^a	B ^b	A	B	A	B						
1	220,000	>30,000,000	2	1	23	>2,400	900	29,000,000	<3	3,500,000	<150	
2	75,000	>30,000,000	3	3	2	>2,400	600	750	<3	>150,000,000	1,200	
3	80,000	120,000	1 ^c	1 ^c	<1	<1	100	>30,000,000	<3	>150,000,000	<150	
4	13,000	210,000	5	2	1,100	2,400	300	60	<3	19,000,000	23,000	
5	100,000	290,000	5 ^c	4 ^c	<1	<1	1,500	390,000	<3	140,000,000	<150	
6	4,900	110,000	5 ^c	2 ^c	<1	23	100	260,000	<3	7,900,000	<150	
7	11,000	270,000	5	5	<1	2	1,800	250,000	<3	8,000,000	<150	
8	20,000	2,000,000	4	2	15	24	1,400	800	<3	4,500,000	180	
								LA ^d		25,000,000	1,200	
9	2,900	4,400	4	4	<1	<1	200	20,000	<3	590	<150	
10	2,800	3,900	4	4	<1	2	200	6,000	<3	6,000	<150	
11	7,200	6,000	3 ^c	3 ^c	<1	<1	1,700	1,100	<3	50,000,000	<150	
										8,400,000	<150	
12	14,000	26,000	4	4	<1	<1	2,000	5,300,000	<3	6,800,000	<150	
								No Swab		15,000,000	<150	
13	9,800	11,000	4 ^c	4 ^c	<1	<1	1,600	320,000	230	44,000	<150	
14	6,600	8,000	6+	6+	<1	<1	300	31,000	43	7,300,000	<150	
15	10,000	18,000	5 ^c	5 ^c	<1	<1	200	30,000	<3	13,000,000	23,000	
16	10,000	22,000	5	5	<1	<1	<100	10,000,000	<3	16,000,000	<150	
								11,000	<3	3,900,000	<150	
								29,000	<3	2,300,000	<150	
								19,000,000	<3	8,500,000	<150	

^aBefore P.I.

^bAfter P.I. at 55°F for 18 hrs.

^cLeucocyte count >800,000

^dLaboratory accident.

(b) Direct microscope clump count (DMCC) and leucocyte count

(c) Resazurin reduction at 35°C.

(d) Resazurin reduction at 25°C.

(e) Coliform (MPN) count (3 tubes per dilution)

(f) Laboratory pasteurization count

(g) Whiteside test

(h) Danish mastitis test¹

Portions of milk were also subjected to Preliminary Incubation (PI) (5) at 55°F (12.8°C) for 18 hrs., then all tests but f were repeated.

Farm Inspection Reports

Each farm was scored using the Farm Service Report of the Ontario Department of Agriculture. Each fieldman also reported on such relevant items as the condition and cleanliness of the inflations, pailhead gasket, shut-off valve, strainer, etc., as well as the method of cleaning and sanitizing the milker.

RESULTS AND DISCUSSION

It soon became evident that the contamination

from the milker units was much heavier than expected. Plates poured from the highest dilution of pulsating rinses, which were recorded as over 150,000,000 per unit, were frequently uncountable. Subsequently, rinses were plated at higher dilutions. Pulsation rinse counts per unit ranged from 590 to 2,300,000,000, and swab counts from 20 to 280,000,000. The marked differences reported by Smillie (7) for rinse counts from different units on the same farm were rarely encountered.

As it is not feasible to present complete data on all samples, a cross-section has been selected (Table 1) to illustrate the general trend of the findings. The counts for the swab and pulsating rinse tests represent the total number of organisms removed per unit. At several farms, e.g. Nos. 8, 11, 12, and 16, more than one milker unit was examined.

The chief impression gained from a study of the data is that the bacteriological examination of the milk frequently fails to reflect the sanitary condition of the milking equipment. In the top half of the Table 1, either the swab test or the pulsating rinse (or both) in every case indicated substantial contamination from the milking machine. Yet two of the eight milk samples gave counts of under 200,000

¹This is a gel test similar to the California Mastitis Test (4).

per ml following P.I., and three others were under 300,000 per ml. Only one milk sample (No. 4) had a high coliform count (1,100 per ml), and none had a laboratory pasteurized count over 1,800 per ml.

In the lower section, all farms showed low SPCs on milk both before and after P.I., yet several of these had high swab and/or pulsating rinse counts. Coliform counts on milk were uniformly low, but laboratory pasteurized counts were no lower than in the upper section.

The feature that really stands out in these results is the lack of agreement between the pulsating rinse test and the swab test. All eight farms in the top section of Table 1 showed high pulsating rinse counts, but only two of them were also high on the swab test. In the lower section, five of the eight had high pulsating rinse counts, but only two of these were also high by the swab test. Just how misleading the swab test can be is evident from Farm No. 2; the pulsating rinse test SPC showed over 150,000,000 with 1200 coliforms, yet the swab test SPC showed only 750, and less than 3 coliforms! The corresponding milk sample gave SPCs of 75,000 per ml before and over 30,000,000 per ml after P.I.

In a few instances the swab count was higher than that from the pulsating rinse. It is possible that the rubber surfaces were in excellent condition and the bacteria were mainly present on the surface. They might thus be largely removed by the swabbing, leaving relatively few to be washed off by the subsequent pulsating rinse.

One other feature brought out by these studies is the tremendous dilution effect. This seems the logical explanation for the low counts on milk samples even where the pulsating rinse counts exceeded 5,000,000 per unit. If we assume that each milker unit at one milking milks 10 lbs. of milk each from each of 10 cows, the contamination is distributed among 100 lbs or roughly 45,000 ml of milk. Thus the equipment could contribute 45 million organisms without increasing the count of the milk at one milking by 1,000 per ml!

These calculations suggest that fresh samples of well-cooled milk drawn by heavily contaminated milking equipment may still meet current bacteriological standards. Even the lower limit of 50,000 per ml for bulk milk (1, 3) is inadequate. If we take as generous a figure as 5,000 per ml. for aseptically drawn milk, up to 45,000 per ml of contaminants could be added before exceeding this limit. This would mean over 2 billion contaminants per 100 lbs of milk. Pulsating rinse counts even higher than this were encountered in these studies, with corresponding plate counts of the milk below 50,000 per ml. This is far in excess of the value, (1-5 million bacteria per

cluster) with this sampling technique (pulsating rinse), which Thomé and Leesment (9) regard as a reasonable goal. While the data show that PI fails to reflect all cases where there was substantial contamination from the milking equipment, it still shows up a number of cases which would escape detection where this step was omitted.

The results from the resazurin test (35°C) varied widely. In a number of cases early reduction of the sample before PI could be attributed to a high leucocyte count and positive reactions with the Whiteside and California Mastitis Tests. After PI, samples in the first group generally, but not always, showed more rapid reduction. It had been expected that incubation at 25°C might favor the growth of psychrophiles, but there was no evidence that these organisms were detected any more readily at the lower temperature. Furthermore, in most cases reduction was delayed by one to four hours, further limiting the usefulness of this modification.

In Britain, and especially in Scotland, the coliform count of raw milk is generally regarded as the most valuable indicator of sanitary milk production. Smillie (7) has reported that high counts most frequently arise from neglected milking machines. While this may be true, the data in Table 1 show that a unit may contribute over 150,000,000 organisms but less than 150 coliforms (none in 3 ml of 500-ml rinse). Furthermore, where the pulsating rinse test does show a moderately high coliform count (e.g., Farm 15) this may not be reflected in the count of the milk.

The tests for mastitic milk (leucocyte count, Whiteside and Danish) were run primarily to obtain an indication as to whether rapid resazurin reduction could be attributed to "abnormal" milk. Leucocyte counts in excess of 800,000 per ml. were obtained from 11 of 32 samples. As will be noted in Table 1, only 2 of 6 samples with counts above this limit reduced resazurin within 3 hours. A reasonable measure of agreement was noted in the results of the three "mastitis" tests (Table 2), although neither the Whiteside nor the Danish test showed as strong reaction to high leucocyte milks as would be expected.

TABLE 2.—COMPARISON OF RESULTS OF "MASTITIS" TESTS

No. of samples	Leucocyte Count	Whiteside Test Reaction				Danish Test Reaction			
		-	±	+	++	-	±	+	++
	(thousands)								
8	<250	6	2	0	0	6	2	0	0
10	250 - 500	6	1	2	1	4	4	2	0
3	500 - 750	1	2	0	0	1	2	0	0
7	750 -1,000	2	2	3	0	1	4	2	0
3	1,000 -2,000	0	1	1	1	0	2	0	1
1	<2,000	0	1	0	0	1	0	0	0

The limited value of the farm score cards in indicating sanitary conditions was again evident. In several cases farms with high scores had heavily contaminated milkers; e.g., Farm No. 2 scored 90 points. Others with much lower scores, e.g., Farm 10, with 78 points, had equipment in excellent shape.

CONCLUSIONS

The swab test for evaluating the sanitary condition of milker rubberware can be seriously misleading. The pulsating rinse test gives a much more reliable indication.

Because of the large dilution factor, milk drawn with heavily contaminated equipment may still meet current bacteriological standards when examined fresh. After preliminary incubation a much higher proportion—although not all—of such milks is detectable.

ACKNOWLEDGEMENTS

We wish to express our gratitude to Mr. J. M. Baker, Director of Dairying, Ontario Department of Agriculture, for co-operating in these studies; to Messrs. P. J. Bogaerts, A. E. Brasseur and K. C. Reynolds of the Dairy Branch for visiting the farms and obtaining the samples, and to Mr. E. Sahaneck

of the Ottawa Regional Laboratory, Ontario Provincial Department of Health, for conducting the analyses.

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NEWS AND EVENTS

TRAINING COURSE IN EPIDEMIOLOGY SCHEDULED

A multidiscipline course in *Principles of Epidemiology* will be offered at the U. S. Public Health Service's Communicable Disease Center, Atlanta, Georgia, January 15-19, 1962, as a part of the continuing program of the Center's Training Branch.

Designed to provide public health workers with a basic understanding of how epidemiological techniques can be used in an approach to the solution of problems in the preventable disease field, the course is offered for the following categories of public health personnel: physicians, dentists, veterinarians, nurses, laboratory workers, environmental health personnel and other members of the public health departments. Participants will be selected on the basis of professional education and experience and current responsibility in public health programs at all levels of government. Preference will be given to persons whose professional tasks involve the application of epidemiological procedures, and registrants will be expected to attend all sessions of the course.

Further information and application forms may be obtained from: Communicable Disease Center, Atlanta 22, Georgia, Attention: Chief, Training Branch.

FDA UNCOVERS SHORT WEIGHT IN PACKAGED FOODS

A different sort of weight from that which many overfed Americans have been concerned about has made news recently. This was the widely publicized seizures made by the Food and Drug Administration of allegedly short-weight packaged foods. Although in this area of enforcement the vigilance of inspectors is nothing new, what makes the recent drive particularly disturbing is the relatively large number of violations uncovered.

Industry explanations for this apparent rash of short weight packages mention occasional "bugs" in automatic filling lines, losses due to dehydration, variations in density of natural products like spices and condiments, difficulties in adapting existing equipment to packaging changes (e.g. stack packs), and so forth. Whatever the causes, the effect has been bad publicity for the food industry as a whole and has added grist to the mill for those who urge tighter government control over the manufacture and distribution of consumer goods.

The avoidance of occurrences such as this rests largely with industry itself. Though the percentage of short weights to the total tonnage produced is extremely low, and the number of firms involved

represents but a small fraction of those in the field, it nevertheless behooves everyone concerned to be aware of the fact that even with the most efficient filling machines and with the best care and diligence, variations in net weight (i.e. both shortages and overages) are bound to occur.

In-plant procedures for controlling the precision of fill, line by line, should be supplemented by occasional independent open market checks of net contents to avoid the possibility of internal bias and to reflect more accurately what the consumer receives (and the government inspector might pick up). Such independent surveys, conducted systematically and on a sufficiently large sampling, reveal not only the range of variation in net contents but the distribution around the average. By providing the statistical basis for establishing the minimum amount of overage necessary to insure legally acceptable compliance with declared net contents, an independent open market survey can pay for itself many times over.

Reprinted from Food and Drug Research, Sept. 1961.

DAIRY INDUSTRIES EXPOSITION SET FOR ATLANTIC CITY IN 1962

The 23rd Dairy Industries Exposition will be held in Atlantic City's Convention Hall, October 28 - November 2, 1962. This means the biennial giant American industrial shows will open on a Sunday afternoon, instead of the traditional Monday, and run through the following Friday.

The Milk Industry Foundation in 1962 will meet October 29 through 31. It will have its headquarters in the Hotel Dennis, with provision for additional rooms in the Shelburne and Marlboro-Blenheim hotels.

The International Association of Ice Cream Manufacturers will meet October 30 through November 2, and will have its headquarters at the Chalfonte-Haddon Hall hotel.

DISA members will have exclusive rights to rooms in the Traymore and Claridge hotels.

All hotel rooms and motel rooms in Atlantic City will be pooled in a Central Housing Bureau, and procedures for securing accommodations will be announced in the spring of 1962.

The International Association of Milk and Food Sanitarians will hold its 49th annual meeting just ahead of the Dairy Show. The IAMFS meeting is scheduled to be held in Philadelphia, Pa., October 25, 26 and 27. Headquarters will be the Ben Franklin Hotel. Members wishing to attend both functions can conveniently move on to Atlantic City for the Dairy Show which begins on October 28.

MICHIGAN MAKING PROGRESS IN BRUCELLOSIS CONTROL

Brucellosis in cattle is at an all-time low in the state through a program started in 1937 and operated jointly by the Michigan Department of Agriculture and the U. S. Department of Agriculture's Agricultural Research Service. Michigan's Agricultural Director G. S. McIntyre believes complete eradication of the disease is on the horizon if present progress continues. If funds are available to complete the work, a brucellosis-free state may be a reality by 1964.

Out of some 80,000 herds containing more than 1 1/2 million cattle there remain in Michigan only about 240 herds in which brucellosis is still a problem. These problem herds contain only about 3,700 cattle.

In order to stamp out brucellosis entirely a more stringent testing program has been inaugurated in the remaining 33 counties. This same program has been in operation in 50 northern counties since 1959 with gratifying results. The last 33 counties were recently placed under the program by the Michigan Commission of Agriculture.

The program calls for additional blood tests of infected herds at 30-day to 45-day intervals. When testing discloses infection in a herd, the infected animals are branded and slaughtered within 15 days. The rest of the herd is quarantined. This quarantine remains in effect until two successive retests at 30-day intervals fail to show reactors.

The program also provides for the retesting of suspect animals until their health status is approved. To insure the disease no longer exists in a herd, the program also provides as a precautionary measure another complete herd test 90 days later.

Coupled with this program of concentrated testing is strict enforcement of laws governing sale and movement of cattle and the protection afforded by calfhoo vaccination against brucellosis.

COW LEASING PLAN OPERATING IN WISCONSIN

A Wisconsin cattle dealer has started a cow renting business. Herman J. Schmitz of Monroe who has been a cattle dealer for twenty years started his cow rental business with an ad in the local paper. Schmitz claims a farmer can rent four cows for the cost of buying one. The rental term is one year and can be renewed. Response to the ad was surprising with orders for 200 cows received soon thereafter.

Rental fees are negotiated and the fee adjusted af-

ter the first year because the animal's production is then known. Schmitz figures that a good producing cow — between 8,000 and 10,000 pounds of milk a year — will give back only its purchase price in the first year. But by renting the animal, the farmer can recover his rental fee pay for the feed and housing and still have something left — maybe to rent another cow.

If the rented animal bears a calf, the renter can keep the offspring. Rental cows are purchased at auctions and from established herds. They are TB tested, brucellosis free and given a physical check. Schmitz points out that farm leasing is an age old practice. Now he's applying it to cows.

SPARTA DEVELOPS LARGE, LONGER-LASTING CELLULOSE UDDER CLOTH

Longer life has been built into an extra large cellulose udder cloth now being sold by Sparta Brush Company, Inc., Sparta, Wisconsin.

Called the Sparta "Kleen-Udder" Cellulose Cloth, No. 9500, its unusual strength results from a unique network of fiber screen which the manufacturer claims gives it three times longer life.

Measuring a full 10" x 11", the Sparta "Kleen-Udder" Cellulose Cloth can take squeezing, wringing and twisting and still bounce back into shape, reports the manufacturer. Its extreme absorbency quickly removes soil, manure and grime, yet stands up to repeated uses in all types of sanitizers including boiling hot solutions. The No. 9500 "Kleen-Udder" Cellulose Cloth is far softer than paper or cloth.

MASTITIC MILK MAY BE A SOURCE OF STAPHYLOCOCCI IN COLBY CHEESE

In recent years, "many cases of food poisoning attributed to enterotoxin produced by *Staphylococcus aureus* have been traced to cheese. Since a large amount of Colby cheese is made from raw milk, and because significant numbers of *S. aureus* have been found in raw milk, it seemed important to determine the viability of this organism in Colby cheese.

Vats of cheese were manufactured from raw milk of high and low standard plate count and inoculated with *S. aureus*, and from milk obtained from cows with subclinical staphylococcus mastitis. During cheese manufacture, the greatest increase in populations occurred in the cheese made from mastitic milk and at the end of 120 days storage this cheese had a greater percentage of surviving staphylococci than cheese made from milk inoculated with *S. aureus*,

indicating that staphylococcus organisms naturally present in the milk are better adapted to the cheese-making and storage environments, than the laboratory cultures inoculated into the milk. The maximum populations occurred in the curd when hooped or in the cheese when 1 day old and were high enough to cause the cheese to be a potential source of clinical levels of enterotoxin, regardless of decreases in populations during subsequent ripening.

High total counts in milk used for two vats of cheese did not seem to inhibit the staphylococci inoculated into the milk. The staphylococci in this cheese maintained a high population during the first 60 days of storage, and yielded a higher percentage of coagulase positive organisms for the entire 120 day storage period than the cheese made from low count milk.

G. C. Walker, L. G. Harmon and C. M. Stine, Michigan Agricultural Experiment Station, East Lansing: "Staphylococci in Colby Cheese."

USE ADVERTISING TO SELL AMERICA, SAYS DAIRY COMPANY EXECUTIVE

A revolutionary plan to use the power of advertising to sell American principles to Americans was proposed today to the American Association of Advertising Agencies by John L. Bricker, vice president of Foremost Daries, Inc.

In a talk to the Western Division meeting of the Association, which includes every major advertising agency in the nation, Bricker offered his plan as an antidote for the nihilism and uncertainty of the national and world situation.

The dairy company executive, representing one of the larger advertisers in the nation, suggested that one hour a week of prime television time be allocated by all networks to a program dedicated to the rebuilding of American purpose, honesty and integrity.

The visionary scheme would be supported, said Bricker, by the networks and the leading advertisers who have the greatest stake in a rebirth of American vitality.

Pointing out that advertisers and advertising people play an important part in the establishment of American standards, Bricker condemned the glut of westerns, gangster programs and other violence now offered on television together with "talking horses, skin-penetrating deodorants, headache pills, and filter cigarette come-ons."

Bricker told the gathered members of the advertising fraternity: "With all this time and talent and money, we should be able to promote one hour a week to combat the forces of greed, violence, selfishness and despair that seem to be so widespread in America today."

Pointing out that his was a specific proposal, Bricker said that it could be implemented immediately by agreement of ten men. The ten are President Kennedy, the presidents of ABC, NBC, and CBS, any top agency president and the presidents of the five largest advertisers in the country.

"This group," Bricker declared, "could put into motion programs that could begin to rebuild our American heritage."

Addressing himself directly to the individual members of the Association and warning them that the time is growing short, Bricker concluded with an appeal to advertising people to use the tools of communications to "make America and Americans a true example for the rest of the world."

THE NEW RADIATION TOLERANCE LEVELS

A most far-reaching development was the Sept. 28 release by the Federal Radiation Council of its new "radiation protection guides" setting range limits for strontium-90. Approved by President Kennedy and printed in the Federal Register of September 26, 1961, the new guides, however, also list tolerance levels for Iodine-131, Radium-226 and Strontium-89. Regarding strontium-90, the Council observed: "Studies by the staff of the Council indicate that observed concentrations of radioactive strontium in food and water do not result in concentrations in the skeleton (and consequently in radiation doses) as large as have been assumed in the past."

But the Council caution, with respect to Iodine-131: "However, concentrations of Iodine-131 in the diets of small children, particularly in milk, equal to those permitted under current (former) standards would lead to radiation doses to the child's thyroid which, in comparison with the general structure of current radiation protection standards, would be too high." The work of the Council aims at setting standards for fallout levels, so that automatically, according to reported levels, graded systems of action may be followed by the U.S. Public Health Service and other governmental agencies.

For strontium-90, if the average daily intake by the population is from 0 to 20 micromicrocuries per gram of calcium, then the fallout would be considered as being in *Range I*. If it is estimated from 20 to 200 micromicrocuries, then *Range II* would apply. From 200 to 2,000 micromicrocuries per day, *Range III* would have been entered. The estimates for Iodine-131 are: 0 to 100 micromicrocuries per day—*Range I*; 10 to 100 micromicrocuries—*Range II*; and 100 to 1,000 micromicrocuries—*Range III*. For each *Range*, there is suggested action. In general terms, *Range I* calls for regular surveillance such as USPHS

conducts now. *Range II* would call for more active surveillance and "routine control." *Range III*, if it persisted for a period of time judged hazardous, would call for highly intensified surveillance and prompt controls.

Range II surveillance must be "adequate to provide reasonable assurance that efforts being made to limit the release of radioactive materials to the environment are effective." It should be capable of determining variables in "time and location" of fallout, and to possibly study human reactions. *Range III* control—and it is at this point that Federal action could become relatively severe—would include whatever was necessary to reduce radiation exposure of the population to *Range II*. Such action might actually curb fallout exposure by the condemnation of certain food supplies, and similar actions such as the special control of water supplies.

What does it all mean to the dairy industry? In the opinion of the National Dairy Council, the *Range I, II, III* plan offers assurance that public health will be protected. *It also means maximum discretion by experts will be employed.* An over-riding view is that momentary rises in fallout need not be of continuing importance. Hence levels even in *Range III* must persist (at an annual rate) for counteraction to be called for. The upper limit of *Range II* (200 micromicrocuries for strontium-90 from all food and water) is considered an acceptable risk for a lifetime daily average. For administration and regulation, it is however obvious that averages for less than a lifetime must be used. The FRC suggests the use of annual averages.

One should not confuse the new tolerance levels with an earlier estimate that 33 micromicrocuries of strontium-90 per liter was a maximum permissible limit. That level was estimated for concentrations of strontium-90 within a given commodity (such as milk). The new standards for strontium-90 and the three other radionuclides, are "acceptable lifetime daily average levels from all sources"—in the case of strontium-90, from all foods and water. *This means any rise in milk radioactivity will be judged within a broad frame of reference.* Furthermore, the "range" concept eliminates arbitrary levels which, if exceeded, could cause arbitrary condemnation of supplies such as in the "cranberry incidence" two years ago.

There also will be confusion if persons attempt to equate strontium-90 levels in milk (as reported monthly by USPHS) with the new range levels. The milk levels can be compared with the former daily 33 micromicrocurie standard, but not with the new "all food and water" ranges. Perhaps this is the main point of the FRC's new "radiation protection guides"—to disallow singular and isolated judgment standards

which could call for superficially—considered and arbitrary action. One must laud the scope of consideration which the FRC suggests should be employed if radioactive levels ever point toward the possible condemnation of any food supplies. *Implying full assessment of the social, economic and nutritional well being of Americans (and denying capricious action of any kind), the FRC suggests as factors to be carefully weighed:*

- (1) Relative proportion of the total diet by weight represented by the item in question.
- (2) The importance of the particular item in nutrition and the availability of substitutes having the same nutritional properties, or perhaps stockpiles of uncontaminated food.
- (3) The availability of other possible control methods such as the removal of the radioactive material from the particular dietary item without affecting its quality.
- (4) The half-life of the radiocative material.
- (5) Other internal or external sources of radiation exposure to the same organ.
- (6) Relative contribution of other dietary items to the total daily intake of the nuclide.
- (7) Physical, chemical, and other factors affecting the relationship between intake and uptake of the nuclide.
- (8) The time and effort required to effect corrective action.

REPORT ON BOVINE LEPTOSPIROSIS STUDY

Results of a study on bovine leptospirosis in Ohio might alter the current disregard of the disease in cattle as a public health hazard, the Journal of the American Veterinary Medical Association reported.

The study of Drs. Paul R. Schnurrenberger, Richard A. Tjalma and Frederick H. Wentworth, and Mr. Howard E. Stegmiller was published in the Oct. 15 issue of the Journal.

A herdsman stands a good chance of being infected even if only one cow in a herd has one or more strains of leptospirosis, the team said. They cited as possible sources of infection the farm practice of drinking warm raw fresh milk, walking barefoot in barnyards and swimming in contaminated water. Even cleaning the barn or milking cows can be a source of infection.

The possibility that dogs may carry one strain (*Leptospira pomona*) was indicated in the report; further studies were suggested.

Three case studies — two herdsmen and a veterinarian — were described in the article. All had symptoms similar to influenza — weakness, fever up to 103 degrees, chills, aches, head and neck pains.

The team said their findings showed the symptoms of *L. pomona* in humans are like the classic description of European swineherd's disease — an influenza-like illness followed by meningal signs.

Treatment of the infected men with penicillin

cleared up the illness in about seven days; one herdsman, however, could not work for 28 days.

Abortions by cows were reported as a suspicious sign of leptospirosis in cattle; this event also leads to infection of humans treating or working with the cows.

STANDARDS FOR ICE CREAM FREEZERS, FILLERS AND SEALERS, AND RUBBER ARE COMPLETED BY 3-A COMMITTEES

Three new 3-A Sanitary Standards — one for Fillers and Sealers of Single Service Containers, and one for Batch and Continuous Ice Cream Freezers, and one for Rubber and Rubber-like Material — were completed at the regular semi-annual meeting of the 3-A Sanitary Standards Committee in Washington, D. C., October 2-5, 1961.

The 3-A Committees are composed of representatives of sanitarians and public health officials, dairy processors, and dairy equipment manufacturers. They meet twice a year to develop voluntary sanitary standards for dairy equipment and supplies. Generally speaking, equipment which conforms to 3-A Sanitary Standards is acceptable in health jurisdictions in most parts of the country.

Following completion of a standard, it must be signed by representatives of the conference participants, and then be published in *The Journal of Milk and Food Technology* prior to becoming effective. The standard for Fillers and Sealers of Single Service Containers was signed during the Washington meeting by the necessary signatories, and publication is expected very soon.

The standards for Ice Cream Freezers and for Rubber and Rubber-like Materials need further editorial review and polishing before being sent to the signatories. No further substantive action is required on them, however, and their publication is expected to follow that of the Filler standard after a short interval.

3-A Committee officials had given top priority to the standard for Rubber and Rubber-like Materials, as dairy equipment makes much use of these materials, and the general consensus was that its completion is a major contribution to milk sanitation. The new standard for Ice Cream Freezers applies only to factory-type freezers, and its completion had been awaited with much interest by regulatory sanitarians and industry alike.

Other tentative sanitary standards which were on the meeting agenda included those for Ice Cream and Cottage Cheese Fillers, Batch Pasteurizers, Air Under Pressure, Automatic Venders, Fittings, Pumps, Separators and Clarifiers, and Plastics. These were

considered by individual sub or task committees, and they will take their place on the agenda of the next 3-A Committees' meeting, tentatively scheduled for next spring in Madison, Wisconsin.

TEXAS ASSOCIATION TO UNDERTAKE CERTIFICATION OF SANITARIANS

The Texas Association of Sanitarians Governing Council at its August meeting directed President Curtis Posey to set in motion the Certification program for the Sanitarians of Texas. This program is *not* a substitution for registration legislation but rather an immediate effort to raise standards for Texas Sanitarians.

The highlights of this Certification Resolution are as follows:

- I. A six member Advisory Committee is to be appointed to draft and formulate requirements of eligibility; set up questions that are to be given in the various classifications of examination; recommend to Governing Board eligibility of each applicant; all actions to be passed on by Governing Board.
- II. Types of certificates to be issued will be three general classifications: Grade C; Grade B; and Grade A.
 - A. Grade C Certificate Qualifications:
 1. 1 year actual experience in the field of sanitation or experience equivalent thereto.
 2. A record of attendance at the association training school, the total instruction of which shall at least equal eight credit hours. (Hours in attendance at regular or called association or recognized health agency meeting may be approved for credit hours).
 - B. Grade B Certificate Qualifications:
 1. At least five years actual experience in the field of sanitation or experience equivalent thereto in the administration, supervisory or inspection in some field of sanitation.
 2. Same as under A-2 above.
 - C. Grade A Certificate Qualifications:
 1. At least ten years actual work in the field of sanitation.
 2. An applicant may offer in lieu of four of the ten years required in C-1 above

a B.S. Degree or equivalent from an accredited college or university with at least 18 semester hours work in physical, natural or biological science and/or public health.

This will incorporate members of the Texas Association of Sanitarians who are employed under the Merit System Council, Civil Service, Industry, and others who by nature of employment may qualify. Section 3 of the Resolution provides a "Grandfather" Clause exempting those from examination who apply within one (1) year.

Grade C and B Certificates are valid for 3 and 5 years respectively and may be renewed at a higher grade upon passing an examination.

If you have further questions, bring them to the Dallas meeting and maybe someone can answer them for you.

An Advisory Committee has been appointed, and plans are for the first meeting to be held in early October. It is hoped that by annual meeting time in Houston that Certification may be accomplished.

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MILK SUPPLY RATING OFFICERS ON CERTIFIED LIST

A total of 116 State employees in 42 State Departments of Health or Agriculture have been certified as rating officers whose ratings of milk pasteurization plants and their producing farms are acceptable, the Public Health Service announced today.

Ratings made by these officers are eligible for inclusion in "Sanitation Compliance Ratings of Interstate Milk Shippers" and/or "Milk Sanitation Honor Roll" published periodically by the Public Health Service.

Initial inclusion of each officer on the list, as well as his continuation on it, is predicated on standardization and evaluation of his inspections by representatives of the PHS Milk and Food Program. The evaluation assesses the rating officers' competency in applying standards and procedures of the Milk Ordinance and Code—1953 Recommendations of the Public Health Service.

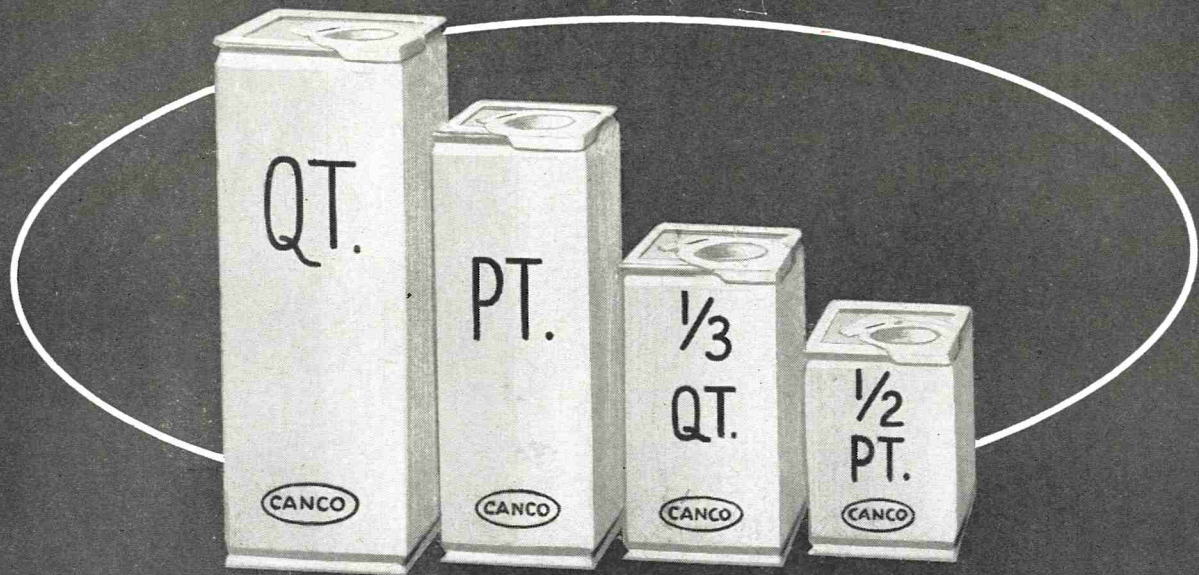
Names of the rating officers are:

State	State Rating Officers	Agency		
Alabama	R. C. Burkhardt Joseph F. Fail U. D. Franklin E. E. Herrmann G. R. Wright	SHD*		
Arkansas	Joe Hall W. D. Hamms	SHD		
California	Lee Biggs H. C. McCausland D. J. Radmacher H. J. Sartori Wendell C. Weaver O. M. Williams	SDA**		
Colorado	Eugene A. TeSelle Fred L. Vogt	SHD		
Delaware	Ward H. Meredith	SHD		
Florida	Samuel O. Noles Lewis W. Willis	SHD		
Georgia	Joel H. Adkins J. R. Culp Garnett H. DeHart	SHD		
Idaho	Charles J. Hammond	SHD		
Illinois	Enos Huffer Howard McGuire P. E. Riley	SHD		
Indiana	Verne Cavanaugh Wilbur G. Stevens Herbert H. Vaux James White	SHD		
Iowa	Harold A. Bayes Ray A. Belknap Richard E. Stedman	SHD		
Kansas	O. L. Honomichl Frank L. Kelley	SHD		
Kentucky	Joseph W. Durbin Louis E. Smith	SHD		
Louisiana	Jack Blanks Charles F. Miller Riley J. Richards	SHD		
Maryland	Alexander A. Pais	SHD		
Michigan	Robert R. Dalton Kenneth Feighner Mason I. Smith Kenneth Van Patten Frederick J. West	SHD SDA " "		
Minnesota	Orlowe M. Osten Leonard J. Waldock	SHD		
Mississippi	P. L. Bradshaw Jesse Olen May A. R. Russell Clinton Van Devender	SHD " " "		
Missouri	Erwin P. Gadd	SHD		
Montana	K. W. Conklin James R. Gray	SLSB***		
Nebraska	Charles W. Fahrenbach Harold Gammon	SHD		
Nevada	W. B. Hunter S. D. Mastroianni Sigvard J. Nielson	SHD " "		
New Hampshire	Richard J. Copson W. F. Oakman	SHD		
New Jersey	Calvin S. Tabler	SHD		
New Mexico	Grant R. Jones Tom W. Proctor	SHD		
New York	Nelson J. Hohl	SHD		
North Carolina	Ford P. Brendle Carson C. Foard E. E. King	SHD " "		
North Dakota	Everett Lobb Alfred B. Johnsgard	SHD		
Ohio	Ivan R. Baker Ned Baker Max L. Bunce O. Lynn Dennison Bernard M. Hull Richard Hunter Richard M. Martin Frank Slaton James E. Warfield Robert Zalahan	SHD " " " " " " " " " SDA		
Oklahoma	Glen W. Earley Berl I. Poe Hardy Watson	SHD " "		
Oregon	Joseph A. Gray Vergil N. Simmons Alvin E. Tesdal	SDA " "		
Pennsylvania	George W. Fouse John A. Ginck	SDA		
South Carolina	John D. Cagle E. M. Causey, Jr. W. W. Weston	SHD " "		
South Dakota	Charles Halloran	SHD		
Tennessee	Frank L. Cheney Glen C. Fulkerson Clifford Gully R. E. Maxwell M. R. Winfrey	SDA " " " "		
Texas	Sidney Allen Eddie Caraway Floyd N. Cobb W. W. Greer L. D. Kenney D. H. Price Kenneth L. Seaman	SHD " " " " " "		
Utah	Edgar M. Hayes Guy P. Stevens	SHD SDA		
Vermont	Wendell Carr	SDA		
Virginia	G. S. Kennedy C. B. Neblett	SHD "		
Washington	Roy J. Myklebust M. L. Strommer L. O. Tucker	SHD SDA SHD		
West Virginia	Richard A. Moats	SHD		
Wisconsin	Glen C. Drake Raymond W. Larson C. O. Widder	SHD " "		

*State Health Department

**State Department of Agriculture

***State Livestock Sanitary Board



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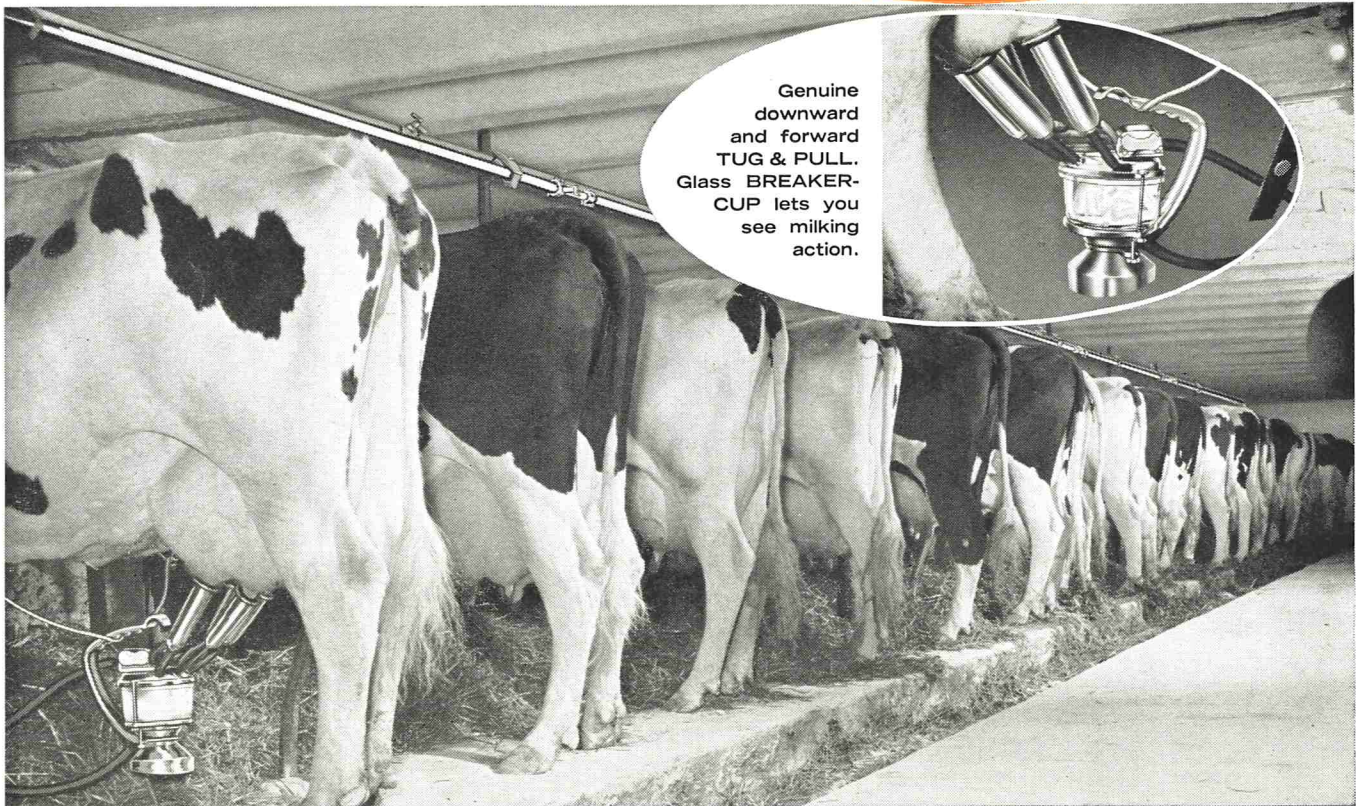
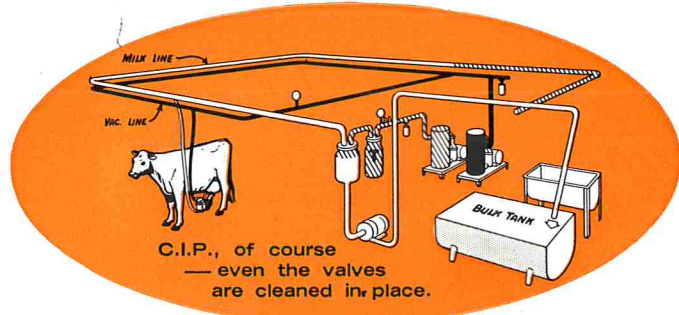
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