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August 17, 18, 19, 20, 1970
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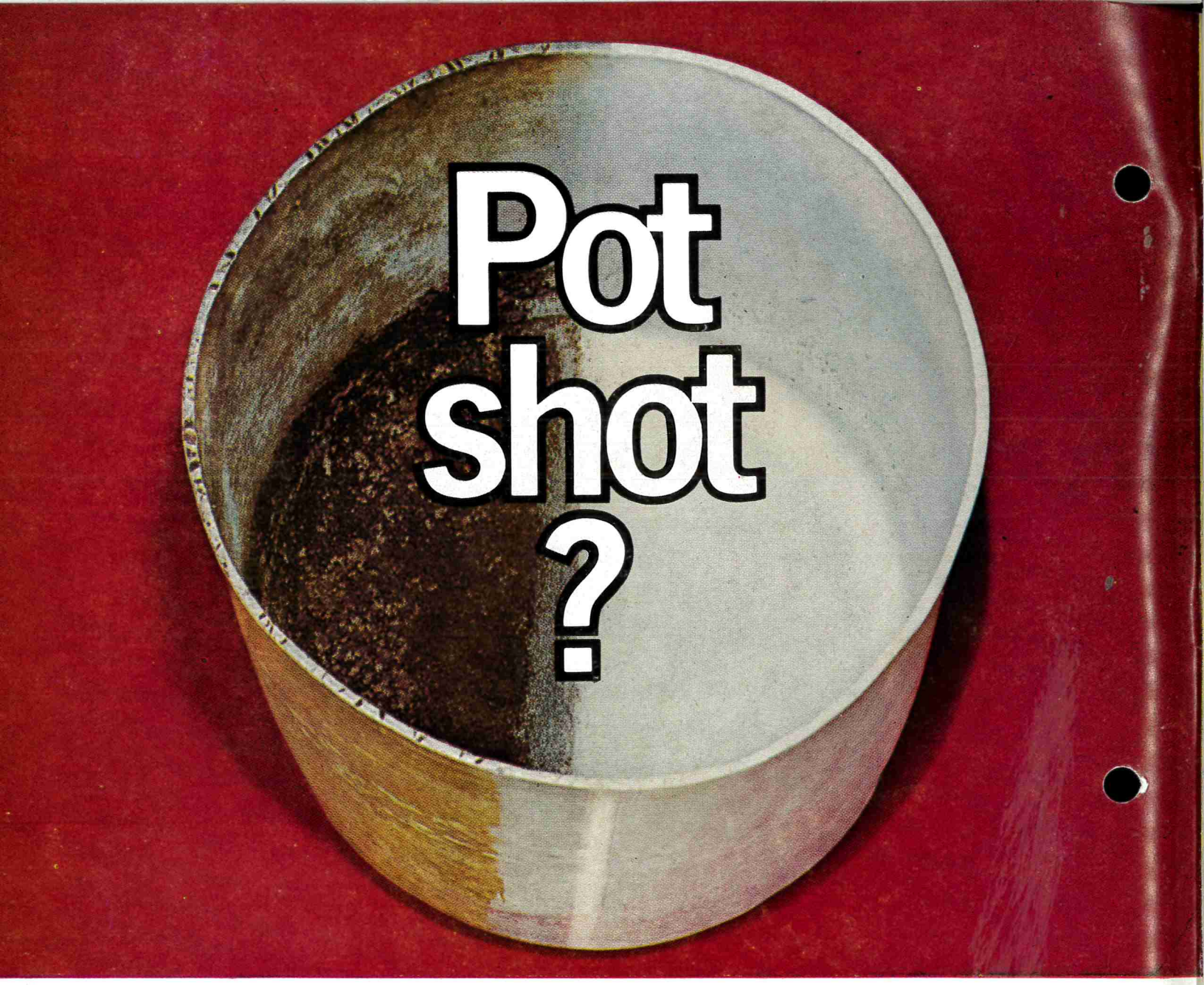

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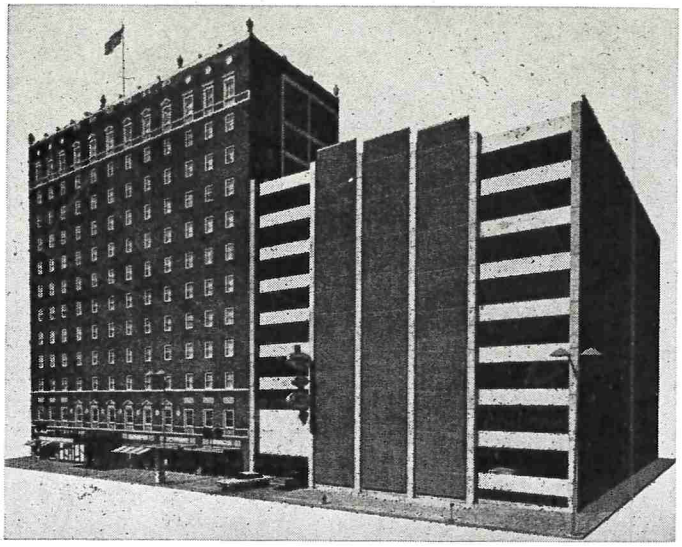

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EFFECT OF DILUTION BOTTLE MIXING METHODS ON PLATE COUNTS OF RAW-MILK BACTERIA[1]

C. N. Huhtanen[2], A. R. Brazis[3], W. L. Arledge[4], E. W. Cook[5], C. B. Donnelly[6], R. E. Ginn[7], J. N. Murphy[8], H. E. Randolph[9], E. L. Sing[10], and D. I. Thompson[11]

(Received for publication December 17, 1969)

Abstract

Forty-six raw milk samples were analyzed for plate counts at 32 C by eight different laboratories; each using three mixing procedures for the initial dilution. These were: five inversions in a 5 sec period, 15 inversions in a 15 sec period, and the "standard" method of twenty-five, 1 ft long, vertical cycles in a 7 sec period. The standard method gave the highest bacterial counts (71.1 x 10^3/ml average) the 15-15 method was second highest (60.4 x 10^3/ml average) and the 5-5 method was lowest (57.8 x 10^3/ml average). The standard method gave significantly higher ($P<0.01$) bacterial counts than the other two. The inversion methods were not significantly different from each other.

Tests of reproducibility (pooled average variances for each method) did not show any significant differences between mixing methods. There were significant differences in reproducibility between laboratories. There was evidence of interaction between mixing methods by samples and mixing methods by investigators.

Standard Methods (1) recommends a certain method of mixing dilution bottles for plating bacteria from milk. The method consists of twenty-five, 1 ft long, vertical cycles in a 7 sec period. Although the origin of the specific features of this method has been documented in the 4th edition of *Standard Methods* (1923) it differs considerably from that described in the original research article *(2)*. This method was believed to produce results of analyses which were more reproducible from laboratory to laboratory. The method is vigorous enough to be exhausting, especially for women, when large numbers of samples are being tested. The present study was undertaken to determine whether less vigorous mixing techniques would give results comparable to the "standard" method.

A blender procedure for mixing milk has been described by Wanser and Hartman *(9)*. They found an average increase in "total" plate count of 44% when either the raw milk or the initial dilution was blended for 30 sec to 1 min. This method would not be applicable to the routine study of large numbers of raw milk samples. Hartman and Huntsberger *(7)*, studied various factors influencing the microbial count of frozen foods, including the degree of mixing of dilution blanks. They found significant differences between workers and degree of shaking and also found a worker-shaking interaction. These effects were observed after a Waring blendor homogenization of the original frozen food.

The worker-to-worker reproducibility has been reported for split samples of egg salad by Messinger *(8)* and for milk by Donnelly et al. *(4, 5)*. The concept of using split samples is statistically sound since one great source of variation, between samples, is greatly reduced or eliminated. Split samples also are a great help in detecting "outliers" as shown by Donnelly et al. *(4, 5)*. The procedure used in this study was based on an analysis of variance for obtaining significant differences between mixing methods with each investigator choosing his own milk samples. This meant that the "between samples" variation would be larger than the split samples but this would be compensated for by analyzing more samples.

Materials and Methods

Mixing techniques

Eight different laboratories participated in this study. Each secured its own raw milk samples, usually from farm bulk tanks. The assay methods were those recommended by *Standard Methods (1)* with the exception of two methods of dilution bottle mixing. Three techniques were compared for their efficacy in enumerating raw-milk bacteria: the "standard" method of twenty-five, 1 ft long vertical cycles in 7 sec; five inversions in 5 sec (5-5 method); and 15 inversions in 15 sec

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[1]A contribution from the Subcommittee for the Examination of Milk and Milk Products, Applied Laboratory Methods Committee, International Association of Milk, Food, and Environmental Sanitarians, Inc.

[2]Eastern Utilization Research and Development Division, U. S. Dept. of Agriculture, Philadelphia, Pa. 19118 (Chairman of the Subcommittee).

[3]Food and Drug Administration, 1090 Tusculum Ave., Cincinnati, Ohio. 45226 (Chairman of the Applied Laboratory Methods Committee).

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[6]Food and Drug Administration, 1090 Tusculum Ave., Cincinnati, Ohio 45226.

[7]Quality Control Laboratory, 2274 Como Avenue West, St. Paul, Minn. 55108.

[8]Texas State Dept. of Health, Austin, Texas 78756.

[9]Department of Animal Science, Texas A and M University, College Station, Texas 77843.

[10]Moseley Laboratories, 3862 E. Washington St., Indianapolis, Ind. 46201.

[11]State Laboratory of Hygiene, 437 Henry Mall, Madison, Wis. 53706.

(15-15 method). These two inversion methods were selected for comparison with the standard method since they could be readily duplicated from laboratory to laboratory and were free of any significant fatigue factor when assaying large numbers of samples. The standard method is rather tiring for persons of limited physical endurance and is more likely to vary because of subjective factors such as length of stroke, duration of stroke, physical condition of the operator, etc. The time intervals of 5 and 15 sec were considered to be in an acceptable range for routine assay purposes.

Calculation of plate counts

Each method was replicated once and duplicate plates were usually poured. The total plate counts per ml raw milk were calculated from the 10^{-2} or 10^{-3} dilutions and usually the dilution showing a count between 30 and 300 colonies per plate was accepted. In some instances neither dilution fell completely in this range. In these situations the counts from a single dilution were used to avoid dilution errors. The total counts for the samples were transformed logarithmically to normalize the distributions and to ensure more nearly equal variances between the populations studied.

Statistical analyses

Generally accepted procedures for statistical evaluation were used to determine analyses variances. A missing value for one investigator was "synthesized" by a statistical formula *(3)*:

$$X = \frac{(k - 1)\ (t - 1)}{kB + tT - G}$$

where k is the number of blocks, t is the number of treatments, B is the total of all remaining observations in the block containing the missing observation, T is the total of remaining observations in the treatment containing the missing value, and G is the total sum of observations. The use of this synthetic observation necessitated a corresponding one degree of freedom reduction in total and error degrees of freedom in the analysis of variance table (Table 1).

The analysis of variance for determining the difference between treatments was performed using the average of two duplicate petri dishes for each replicate of the method, when duplicate plates were made by the investigator. The results of Investigator No. 2 were from single plates. Two analysts, each of whom counted the colonies on one set of duplicate plates, comprise the results reported for Investigator No. 5. These counts by the two analysts were combined for the statistical analysis. The results of Investigator No. 8 also were obtained by two analysts each of whom assayed different aliquots of the same milk samples using two replicates each and duplicate petri dishes. For samples 41 to 46 inclusive the analysis of variance of treatment effects was based on the results of Investigator No. 8, Analyst a.

The data were further analyzed to determine reproducibility between methods, investigators, samples, duplicate petri dishes, and replicate milk samples. These analyses were performed by calculating single degree-of-freedom variances between paired observations, pooling these variances, and dividing by the total number of degrees of freedom to obtain a pooled average variance. These pooled average variances were then tested by the null hypothesis against each other. All tests of significance were at the 1% level.

RESULTS AND DISCUSSION

Average counts for different mixing methods

Table 1 presents the arithmetic averages for investigators, samples, and treatments. The averages for samples were obtained by averaging over replicate milk samples and duplicate petri dishes for a

TABLE 1. AVERAGES OF BACTERIAL COUNTS OBTAINED BY THREE MIXING METHODS

Milk Sample No.	Investigator No.	Mixing method: 5-5[a] (X 10^{-3})	15-15[b] (X 10^{-3})	STD[c] (X 10^{-3})
1	1	47.8	61.0	57.5
2		18.3	19.7	18.8
3		52.2	48.2	64.2
4		88.5	86.8	84.8
5		55.8	45.0	40.8
6		53.0	51.8	65.5
Average: Investigator No. 1		52.6	52.1	55.3
7	2	6.70	7.60	13.2
8		4.10	5.00	4.70
9		76.0	58.5	120.0
10		15.0	21.1[d]	68.5
11		40.5	43.0	134.0
12		6.60	5.15	6.60
13		18.4	17.2	26.7
14		20.6	22.0	52.5
Average: Investigator No. 2		23.4	22.5	53.2
15	3	161.5	153.8	167.5
16		44.0	43.8	45.2
17		55.2	56.2	55.0
18		68.5	74.2	75.2
19		69.2	68.0	105.2
20		110.2	116.0	94.0
Average: Investigator No. 3		84.4	85.3	90.4
21	4	23.6	29.3	29.6
22		86.0	91.8	92.0
23		73.8	90.2	92.8
24		18.8	31.8	32.5
25		72.5	86.5	88.0
26		35.8	51.2	49.8
Average: Investigator No. 4		51.7	63.5	64.1
27	5	44.5	50.0	86.2
28		18.5	19.6	21.5
29		92.5	86.2	83.8
30		100.5	99.2	109.2
Average: Investigator No. 5		51.2	51.1	60.2
31	6	94.8	105.8	130.5
32		33.2	30.2	56.8
33		65.8	61.8	77.2
34		49.0	48.8	48.0
35		33.2	29.8	30.5
36		53.5	60.5	55.8
37		43.2	48.2	58.8
Average: Investigator No. 6		53.2	55.0	65.4
38	7	95.5	103.5	157.5
39		5.08	5.35	6.15
40		21.8	16.5	29.5
Average: Investigator No. 7		40.8	41.8	64.4
41	8	91.0	145.0	152.5
42		215.0	267.5	242.5
43		34.0	37.5	37.5
44		32.5	37.8	43.2
45		200.0	150.0	147.5
46		59.2	63.5	74.0
Average: Investigator No. 8		105.3	110.7	116.1
Average all investigators		58.81	61.99	72.46

[a]Five inversions in 5 sec.
[b]Fifteen inversions in 15 sec.
[c]Technique of *Standard Methods*.
[d]Based on one analysis; duplicate value missing.

TABLE 2. ANALYSIS OF VARIANCE SUMMARY[a]

Line No.	Source of variation	Degrees of freedom	Sum of squares	Mean square	F ratio	Significant $P<0.01$
A	Milk Samples	45	38.524582	0.856101	71.04	Yes
B	Investigators	7	13.646441	1.949492	2.98	No
C	Samples Within Investigators	38	24.878141	0.654688	282.92	Yes
D	Treatments	2	0.6058	0.3029	25.13	Yes
E	Standard vs 5-5 and 15-15	1	0.5788	0.5788	48.03	Yes
F	5-5 vs 15-15	1	0.0266	0.0266	2.21	No
G	Treatments Times Samples	90	1.498461	0.016650	7.19	Yes
H	Investigators Times Treatments	14	0.582598	0.041614	3.45	Yes
I	Investigators Times Standard vs Others	7	0.515226	0.073604	6.11	Yes
J	Investigators Times 5-5 vs 15-15	7	0.065028	0.009290	0.78	No
K	Treatments Times Samples/Investigators	76	0.915863	0.012051	5.21	Yes
L	Error	137	0.317034	0.0023141		
	Total	274	40.945877			

[a]The F values were derived from the following ratios: A/K, B/C, C/L, D/K, E/K, F/K, G/K, H/K, I/K, K/L, J/K

TABLE 3. POOLED SINGLE-DEGREE-OF-FREEDOM VARIANCES FOR TESTING HOMOGENEITY OF VARIANCES BETWEEN MIXING METHODS AND INVESTIGATORS[a]

Investigator number	5-5 method	df	15-15 method	df	Standard method	df	Average variance
1	0.0006301	(12)	0.0038649	(12)	0.0009321	(12)	0.0018090
3	0.0069768	(12)	0.0035150	(12)	0.0021674	(12)	0.0042197
4	0.0002650	(12)	0.0002235	(12)	0.0002990	(12)	0.0002625
6	0.0038067	(14)	0.0050020	(14)	0.0034715	(14)	0.0040934
7	0.0071378	(6)	0.0046374	(6)	0.0025987	(6)	0.0047913
8a	0.0061374	(12)	0.0022679	(12)	0.0048621	(10)	0.0043966
8b	0.0099628	(12)	0.0037494	(12)	0.0099592	(12)	0.0078905
Total		(80)		(80)		(78)	
Average Variance	0.0049881		0.0033229		0.0034700		0.0038621
F Value with average variance of 15-15 method the denominator	1.47[b]				1.1[b]		

[a]The above variances were obtained by calculating variances between duplicate plates, using logarithmically transformed colony counts.
[b]Not significantly different at 1% level.

total of four observations. An exception was the result of Investigator No. 2 where the figures represented replicate milk samples but only single plates. A value missing for Investigator No. 2 (sample 10) was "synthesized" by the technique reported above.

The standard method of mixing the dilution bottles gave the highest average counts; the 15-15 method was second highest and the 5-5 method was lowest. This table shows the great variations in average counts by mixing methods depending on the sample of milk analyzed and emphasizes the necessity of assaying a large enough number of samples to get meaningful results. The variability of the plate count method is illustrated by the results in this table where 10 of the 46 samples gave the highest counts using the 15-15 method. Eight of the 46 gave highest counts using the very gentle 5-5 method. These results are further analyzed below by analysis of variance techniques.

Investigator and sample variances

A summary of the different variances which might have been expected in an experiment of this type is shown in Table 2. The very large F ratio obtained for sample variances was not unexpected since raw milk samples are known to show great sample-to-sample variations in bacterial counts. There were no significant differences between investigators at the predetermined 1% level of significance (critical F ratio was 3.15). At a lower, 5% level of significance

the encountered ratio of mean squares of 2.98 would exceed the critical F ratio of 2.26. This indicated that the number of investigators used in this experiment was adequate and nearly optimal. If the F ratio for investigators had been very small, it might have indicated that too many investigators (or laboratories) had been used and were being "wasted."

Treatment variances

The F ratios of lines D, E, and F of Table 2 showed the treatment effects to be real and were shown to result from the higher values obtained by the standard method over the other two (line E, Table 2). The difference between the 5-5 and 15-15 methods was not significant, even at the 5% level of confidence. A study of many more samples might have shown a difference although this aspect of the problem was not important enough to warrant further consideration.

Interactions

The interactions investigated, lines G-K in Table 2, indicated that there were differences in the responses of different samples to the three mixing methods. The average values for bacterial counts from Table 1 also demonstrated this type of sample versus mixing method interaction, since not all milk samples tested gave the highest counts with the standard mixing technique. This could have been a reflection of the types of bacteria present in the milk samples. Chains of some strains of *Leuconostoc citrovorum,* for instance, were found by Goel and Marth *(6)* to be shortened when subjected to the standard shaking procedure. It is also possible that certain samples of milk contained higher amounts of agglutinins, perhaps as a result of recent udder infections—these agglutinated clumps of bacteria might show greater break-up than the normal bacterial masses in milk.

The potentially more serious interactions obtained from these studies showed that there was a highly significant difference between treatments depending on the particular investigator (line H). This indicated a possible "favoring" of one method over another. A further analysis of this "favoring" indicated that it was perhaps caused by an unconscious bias for the standard method over the other two inversion techniques (line I). These interactions, however, were completely accounted for in the statistical treatment and did not negate the conclusion that the standard method was superior to the inversion methods (line E).

Reproducibility of results of three mixing methods

An important consideration in developing new methods or in comparing one method with another is the difference in variation (reproducibility) between replicates of the methods under study. In the study reported here, these variances were determined by an analysis of the pooled and averaged variances of the three methods using the plate-to-plate differences within replicates as the source of variation. The results are shown in Table 3. The statistical null hypothesis of equal mean variances for the three methods was tested using the ratios:

$$\frac{\text{5-5 method average variance}}{\text{15-15 method average variance}}$$

and

$$\frac{\text{standard method average variance}}{\text{15-15 method average variance}}$$

A higher pooled variance was obtained with the 5-5 method; however, the F ratio of 1.47 for the 5-5 method average variance/15-15 method average variance did not exceed the critical F at the 1% level of significance. The ratio was significant at the 5% level.

It appeared therefore that the least vigorous mixing method of five inversions in 5 sec was the least reproducible between laboratories and that the other two methods were about equal.

Reproducibility between investigators

The primary purpose of this study was to investigate the effect of mixing methods on mean bacterial counts and on reproducibility between methods; however the data in Table 3 also show the pooled and averaged variances obtained for each investigator. These variances were all well within the variance of log plate counts suggested by Donnelly et al. *(4, 5),* of 0.012. The pooled variances of Table 3 show that there were great differences in precision between investigators (or laboratories, since the investigators, except 8a and 8b, were also in separate laboratories). The lowest average variance, 0.0002625, was attained by Investigator No. 4 while the highest, 0.0078905, was that of Investigator No. 8b. Investigator 8a, in the same laboratory as 8b, had a lower variance. Bartlett's and Cochran's tests for homogeneity of variances showed the between-investigator average variances to be significantly different. Inspection of the investigator average variances showed most of this difference to be due to the very low average variance of Investigator No. 4. The explanation for these variations in precision is not known but would be important, since it would be in the interest of all laboratories to adopt the procedures which would give the most reproducible results.

The wide range of precision between investigators does not necessarily negate the F test of the analysis of variance since the populations of interest were methods rather than investigators and because the F test is powerful enough to yield satisfactory results even with such widely differing population variances.

ACKNOWLEDGMENTS

The aid of Drs. S. M. Free and W. J. Westlake, Smith, Kline and French Laboratories, Philadelphia, Pennsylvania, for statistical consultation is gratefully acknowledged.

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A STATISTICIAN LOOKS AT GRADING BY ATTRIBUTES

(Part two of three parts)

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Grading is not new. For centuries, those who sold products of any description have "graded" these products into varying levels of quality. This grading of products might be very simple, or it might be quite complicated, but it has been felt to be an important aspect of marketing because the grade indicates the varying levels of value or price within a given product.

Grading historically has involved:

- Size—Such as sixpenny (2-inch) or tenpenny (3-inch) nails or "Extra Large" (27 ounces per dozen) or "Large" (24 ounces) eggs.
- Content—The medieval "assizes" of bread fized taxation and prices based on the quality-wheat content of the bread. And modern beef "yield" grades measure the expected yield of lean meat—or retail cuts—from a carcass.
- Appearance—More than a century ago, cotton was graded as "Good," "Middling," etc., the same terms used now for cotton classing. Grades for poultry and many fruits and vegetables today weigh heavily on appearance factors.
- Usability—The grades "U. S. Prime" and "U. S. Choice" refer to the tenderness and "eatability" of the beef or lamb graded—that is, they provide a guide as to how to use and cook the meat.

But regardless of what factor or factors are specifically being measured, the grading of products is still done much the same way as it's always been done. Someone examines the product—or a representative sample of the product—compares it with a standard sample or detailed descriptive standard, and judges the quality on how well the product matches the standard.

This is the process we call grading, a process which in the U. S. Department of Agriculture is a half-century old and is widely used and respected as vital in the marketing of agricultural products. But on an experimental basis, something new is being tried in grading.

This new approach is called "grading by attributes." It's a scientific statistically sound way of determining if a product meets specific standards, with minimum loss of time and maximum economy.

But to understand how the new system works, we must know something about the way grading is now being done—and has been done for many years. So let's take a typical example—grades for frozen asparagus.

The grader—a highly trained quality specialist, usually with a college degree—looks at a representative sample of the product. As he must weigh a number

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THE EFFECT OF GLYCOLS ADDED TO DISINFECTANT-DETERGENT SOLUTIONS UPON AEROSOLIZED TEST MICROORGANISMS

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ABSTRACT

Microorganisms that are aerosolized by high pressure cleaning methods are not appreciably affected by most disinfectant-detergent solutions when in this state. Since glycols are one of the few chemicals recognized as successful aerial disinfectants, it was suggested that the addition of certain glycols to these solutions would lower the concentration of suspended microorganisms. To test this possibility, triethylene and propylene glycol and lactic acid were added to phenolic disinfectant-detergent solutions. It was determined that there was no substantial reduction in the concentration of two aerosolized test microorganisms when the glycols were added. It is postulated that high relative humidities, 90% and above, are responsible for the failure of the glycols to reduce microorganism concentration during the high pressure spray application of the solution. Our findings indicate that the addition of glycols to disinfectant-detergent solutions for control of aerosolized microorganisms is not warranted.

Aerosols of viable microorganisms are generally produced during the cleaning of contaminated surfaces, especially if high pressure sprayers are used. Aerosols containing microorgansims are a potential threat to sterile procedures and, if pathogenic, a potential infection threat to susceptible animals and man. In a previous study *(1)* of microorganisms aerosolized by cleaning procedures, one of the authors noted that one of four phenolic disinfectants studied was much more effective in reducing numbers of airborne bacteria than were the other three. Since it contained a glycol as the most obviously different component, it was theorized that its specific activity resulted from the glycol. Glycols are recognized as one of the few successful aerial disinfectants and have been used for this purpose commercially.

This study was initiated to determine whether or not addition of certain glycols and related chemicals to disinfectant-detergent solutions would lower the concentration of airborne microorganisms in the immediate cleaning area during a spray cleaning procedure.

MATERIALS AND METHODS

Aerosol production

An 18-hr broth culture containing 8 x 10^8 *Serratia marcescens* ATCC 274 per ml and a broth suspension of *Escherichia coli* B T-3 bacteriophage containing 9 x 10^8 plaque-forming units per ml were used as test organisms. Aerosols of these microorganisms were generated by a DeVilbiss 841 nebulizer (DeVilbiss Co., Somerset, Pa.) at the rate of 1.5 ml per minute.

Aerosol sampling

Aerosol samples were collected with all-glass liquid impingers (AGI) (Ace Glass, Inc., Vineland, N. J.) at the rate of 12 liters of air per minute. Each impinger contained 10 ml of phenol red broth base containing 1% dextrose and 1% Tween 80.

Microorganism assay

Aerosol sampling fluids were assayed for S. *marcescens* and T-3 phage using standard methods and standard plate count agar for S. *marcescens* and an agar overlay method described by Songer et al. *(4)* for T-3 phage.

High pressure cleaner

A high pressure cleaning device (Kleen King, Britt, Iowa) with a nozzle pressure of 500 psi (35 kg/cm^2) and a flow rate of 6 liters per minute was used to apply the disinfectant-detergent solutions.

Disinfectant-detergent solutions

Three commercially available phenolic disinfectant-detergents referred to as A, B, and C were used. The brand and exact formulation of these disinfectant-detergents are irrelevant to this study. One per cent working solutions were prepared in 50 C tap water. Except where noted, 0.4% propylene and triethylene glycol and lactic acid were added to the solutions. This amount was considered the maximum that could be incorporated into a disinfectant-detergent concentrate. Lower concentrations of propylene glycol were used in one portion of the study for comparison purposes. The approximate quantity of glycol introduced into the air by the sprayer was determined indirectly from the assay of the air for Rhodamine B dye (Allied Chemical Corp., New York, N. Y.). The dye (.001%) was added to the disinfectant-detergent solution in two trials. The dye from the air was collected in AGI's and the fluid was assayed with a Turner Model 111 fluorometer (Turner Assoc., Palo Alto, Calif.). After spraying 25 liters of solution, the dye content was 0.013 μg/liter of air. This would indicate that the 0.4% glycol solution used would result in a 5.2 μg/liter concentration in the air. Glycol concentrations in the air of 40.0 μg/liter when vaporized by heat and 3.4 μg/liter when dispersed by nebulizer were calculated from the dispersion rate, room volume, and ventilation.

Room

The experiments were performed in a room having a 33.3 m^3 volume and a 3.3 m^3/minute ventilation rate. The temperature was maintained at 25 C. Relative humidity (RH) varied from 55 to 60%; however, it immediately rose to

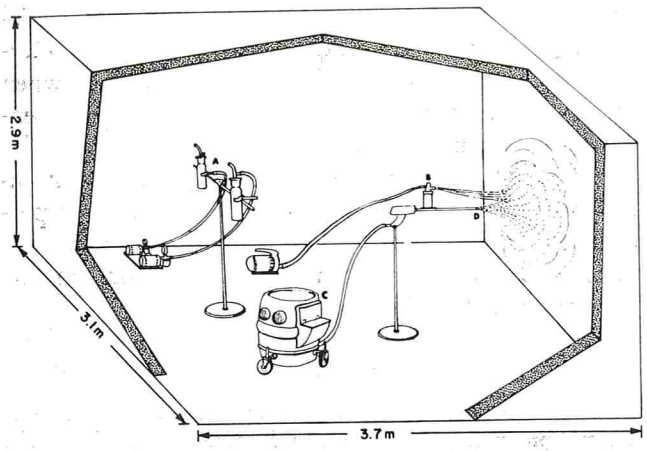

Figure 1. Arrangement of room showing relative position of the equipment used. A. All-glass impinger. B. Nebulizer. C. Sprayer. D. Sprayer nozzle.

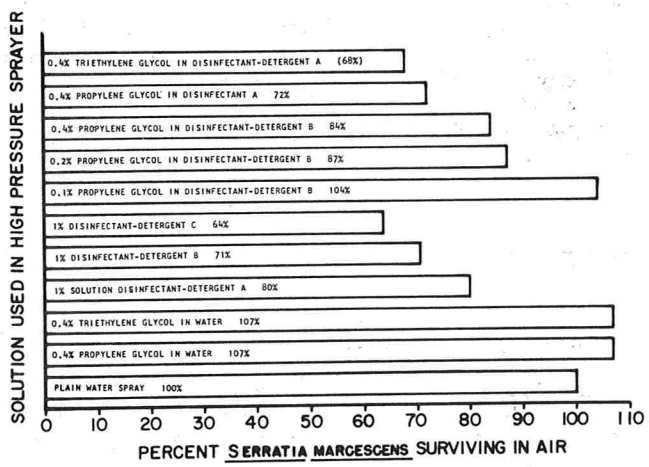

Figure 2. The effect of using different solutions in sprayer on the survivial in air of S. *marcescens*. Survival in the presence of water spray alone constitutes 100%. This corresponds to 2,000 ± 200 microorganisms per liter of air.

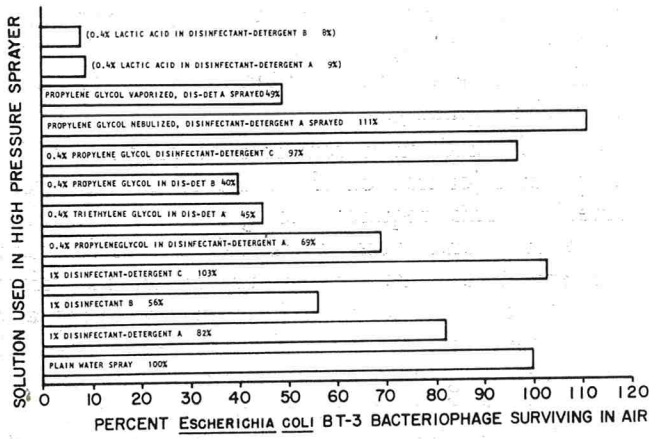

Figure 3. The effect of using different solutions on the survival in air of T-3 phage. Survival in the presence of water spray alone constitutes 100%. This corresponds to 620 ± 60 microorganisms per liter of air.

> 90% when the sprayer was started. Figure 1 shows the relative location and position of the equipment in the room. The sprayer nozzle was fixed 0.6 m from the wall and the samplers were placed 1.7 m from and facing toward the opposite wall.

The procedures furnishing first data were repeated 4 times. After reproducibility was assured, duplicate procedures were employed except for those involving lactic acid, nebulization, and heat vaporization of glycol which are results of a single set of duplicate samples.

RESULTS

The effectiveness of disinfectant-detergent solutions with and without glycols and lactic acid in reducing the number of airborne microorganisms are presented in Fig. 2 and 3.

As a basis for comparison, survival of airborne microorganisms exposed to plain water spray constituted 100% survival. The 100% survival baseline for *S. marcescens* was 2,000 ± 200 bacteria per liter of air and 620 ± 60 organisms for T-3 phage.

As shown in Fig. 2, 0.4% propylene and triethylene glycol added to water actually enhanced the survival of *S. marcescens* to 107% of that in a plain water spray. The disinfectant-detergent solutions A, B, and C without added glycol reduced the number of *S. marcescens*. A 1% solution of C was the most effective, reducing the number of surviving bacteria to 64%, followed by B with 71%, and A with 80% of the number in sprays of water. When 0.1, 0.2, and 0.4% propylene glycol were added to the disinfectant solution B, survival increased to 104%, 87%, and 84%, respectively. Higher concentrations of glycols were not considered practical.

A 1% solution of disinfectant A containing 0.4% propylene glycol or 0.4% triethylene glycol was only slightly more effective than the disinfectant alone. Eighty per cent of the airborne *S. marcescens* survived when disinfectant-detergent solution A was used. This was reduced to 72% with addition of propylene glycol and to 68% with triethylene glycol.

The results obtained using T-3 phage are shown in Fig. 3. The percentage of airborne T-3 phage surviving exposure to aerosols of 1% solutions of disinfectants A, B, and C were 82%, 56%, and 103%, respectively. One per cent solutions of disinfectant A, containing 0.4% propylene glycol and 0.4% triethylene glycol, reduced the viable T-3 phage to 69% and 45%, respectively. Surviving airborne T-3 phage were reduced to 40% when 0.4% propylene glycol was added to 1% disinfectant-detergent B, but only to 97% when added to disinfectant-detergent C.

When 3.4 μg of propylene glycol per liter of air was nebulized simultaneously with the spraying of a 1% solution of disinfectant-detergent A, the T-3 phage survival increased to 111%. When the concentration of propylene glycol was increased to 40

μg/liter of air by heat vaporization, T-3 phage was reduced to 49%.

Spraying with 1% solutions of disinfectant-detergents A and B containing 0.4% lactic acid resulted in T-3 phage survivals of 9% and 8%, respectively. This was the most effective additive tested.

DISCUSSION

The effective concentration of glycols and similar materials for aerial disinfection has been reported as 3.5-5.5 μg/liter of air. Glycols are most effective at 40-60% RH *(2, 5)*. In our studies, a glycol concentration of 5.2 μg/liter of air was generated from a solution of disinfectant-detergent and glycol with a high pressure sprayer. This technique was only slightly effective in reducing airborne microorganisms. During the procedure, the RH exceeded 90%. The high RH could possibly account for the failure of normally effective concentrations of glycols.

Shaw *(3)* found aerosolized lactic acid to be an effective aerial disinfectant at high RH. Our results would tend to confirm his findings.

From these studies, it is concluded that propylene and triethylene glycols are not effective as aerial disinfectants when incorporated into disinfectant-detergent solutions. The glycols are most effective when the RH is in the 40-60% range. The 90% RH encountered during spray cleaning would explain the poor performance of the glycols on reducing numbers of airborne microorganisms. The superior performance of a product in reducing numbers of airborne microorganisms would not depend on the glycol component.

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A STATISTICIAN LOOKS AT GRADING

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of quality factors before he assigns a grade, he assigns a numerical score to each factor and then totals them to see how the product measures up.

Traditionally, frozen asparagus of the top grade (U. S. Grade A) has to have a total score of at least 85 out of a possible 100 points, and also reach a certain score on each quality factor. The scoring system is based on four quality factors: color (20 points), uniformity of length (10 points), absence of defects (30 points), and character (tenderness, texture, and maturity) (40 points).

The grader examines each quality factor and assigns a score along a spectrum from "O" for the poorest to the top score (say "20" for color) for the best. This is a highly accurate and dependable method of grading but it falls short of the optimum in at least four ways:

1. It takes time for the grader to evaluate everything, weigh the scores, and assign a grade. (Not too much time, for grades do their work rapidly and accurately. But in this fast-paced marketing system, even a small saving in time can save money for the industry.)

2. It involves a considerable amount of subjective judgment on the part of the grader. Say the color for a sample of asparagus is not quite the "best" color for asparagus, does the grader give it a score of "17" (Grade A) or "16" (Grade B)? Only one point difference could make the difference of many dollars in value, and on a spectrum of 20 points, a difference of one point is mighty hard to distinguish.

3. It is primarily designed for stationary lot grading—but has been adapted to in-plant grading—where a grader examines the product as it comes down the production line and lets the plant adjust quality level during the manufacturing process. Since the bulk of grading has shifted to in-plant, it is desirable to have a grading system designed primarily for in-plant grading.

4. It is based on a container of product as the sample unit (or fraction of a container for large containers.) This requires the grader to remember special rules and make special calculations for each different sized container. It further has the effect of giving one a different look at quality during any given time of production—a "peek" when using small containers—a "glance" when using medium size containers—a "look" when using larger containers.

Attribute grading answers all these needs. Here's how it works.

We determine statistically what the levels of

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FEDERAL-STATE QUALITY PROGRAM FOR MANUFACTURING MILK[1]

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ABSTRACT

This paper describes the broad responsibilities carried out by USDA in the field of inspection, grading, specifications, standards, and quality assurance of manufacturing milk and manufactured milk products. Effectiveness of this work depends, in a large measure, on Federal-State cooperation and on close working relationships between State regulatory agencies and the industry. We believe that manufacturing milk from the great majority of farms meets the present acceptable quality level. However, some areas in the country lag in milk quality and some individual farmers in all areas are not doing their part to keep up with the rest of the Nation on milk quality.

The past year shows tremendous effort by many States to get needed legislation for quality and farm requirements for manufacturing milk. If your State didn't get legislation covering farm requirements, this is no excuse for delaying action on milk quality improvement. Consumer interests are insisting on action towards quality and wholesomeness of milk and dairy foods. We must move forward now on manufacturing milk quality.

United States dairy farmers sold about 117 billion lb of milk last year—50% of this total was used for production of manufactured dairy products, such as butter; cheese; ice cream; and condensed, sterilized, evaporated, and dry milks. It is not surprising, then, that quality standards and quality improvement programs for milk for manufacturing are popular topics for discussion. Also, it is interesting to note that only about 30% of the total milk sold by farmers is classified as milk for manufacturing. Surplus bottling grade milk makes up the difference in total amout used for manufacturing. And this "surplus" milk cannot be disregarded when we talk about quality improvement and protection of quality of the total supply of manufacturing milk.

The Dairy Division of the United States Department of Agriculture's (USDA) Consumer and Marketing Service has been a strong force in the development of quality standards and specifications. These standards and specifications are contained in three categories: *(a)* quality grade standards and Federal specifications; *(b)* specifications for dairy processing plants; and *(c)* standards recommended for adoption by State regulatory agencies.

[1]Presented at the Fifty-sixth Annual Meeting of the International Association of Milk Food, and Environmental Sanitarians, Inc., Louisville, Kentucky, August 17-21, 1969.

STANDARDS

Examples of quality standards are the U. S. Grades AA, A, and B for butter and Cheddar cheese, and U. S. Extra and Standard Grades for nonfat dry milk and dry whole milk. USDA grade standards for butter were first issued in 1919—over 50 years ago. As with all quality grade standards, the butter standards have been revised and tightened a number of times over the years taking into account general improvements in quality of milk and cream and manufacturing technology. Twenty-two Federal specifications for dairy products have been developed by USDA for the use of military and civilian agencies of the Federal Government and are available for use by the States and private institutions.

SPECIFICATIONS

In the second category are USDA's General Specifications for Dairy Processing Plants which have been in use since the mid-1950's. These specifications were issued in recognition of the importance of condition of plant and equipment, processing procedures, and sanitary practices in the keeping quality, wholesomeness, and uniformity of the finished products. The latest revision of these specifications was published in the *Federal Register* in 1967 and serves as the basis for inspection and approval of plants for USDA inspection and grading services.

USE OF STANDARDS AND SPECIFICATIONS

How are the grade standards and plant specifications used?

USDA's inspection and grading services on products and plant inspections are for voluntary use and fees are charged to cover costs. The services are available for use nationwide under a master Federal-State cooperative agreement. A total of 43 State agencies have signed this agreement; 42 of the 43 are Departments of Agriculture.

In fiscal year 1969, 3.8 billion lb of manufactured dairy products were officially inspected or graded. There were 5,400 dairy plant inspections. More than 1,400 dairy manufacturing plants are currently approved as meeting the requirements of the General Specifications.

These 1,400 plants account for over 75% of the U. S. production of butter, Cheddar cheese, evaporated milk, sweetened condensed milk, and dry milk. Their names and locations are included in a list published quarterly by USDA entitled *Dairy Plants Surveyed and Approved for USDA Grading Service.* The list gives recognition to processors of manufactured dairy products in much the same way as the listing of fluid milk plants in the publication *Sanitation Compliance and Enforcement Ratings of Interstate Milk Shippers.*

In order to maintain USDA approval all plants are inspected at least twice a year, except dry milk plants which are inspected 4 times a year.

STANDARDS FOR STATE ADOPTION

USDA's third category of standards includes those recommended for adoption by State regulatory agencies. There are two at present: (*a*) Recommended Standards for the Manufacture of Frozen Desserts for Adoption by State Regulatory Agencies, published in June 1968; and (*b*) Minimum Standards for Milk for Manufacturing Purposes and Its Production and Processing Recommended for Adoption by State Regulatory Agencies, published in 1963.

All of the USDA inspection and grading and standardization work as well as development and publication of the standards recommended for adoption by State agencies is authorized by the Agricultural Marketing Act of 1946. The Act authorizes and directs the Secretary of Agriculture ". . . to develop and improve standards of quality . . . and recommend and demonstrate such standards in order to encourage uniformity and consistency in commercial practices."

STANDARDS AND FARM REQUIREMENTS FOR MANUFACTURING MILK

Looking back over the past year we see a good deal of activity by Federal and State agencies and others concerning quality standards and farm requirements for manufacturing milk.

A working group of representatives from the Dairy Division of USDA's Consumer and Marketing Service, the U. S. Public Health Service, and the Food and Drug Administration agreed upon a set of proposed quality and farm requirements for manufacturing milk. We believe you will be interested in knowing that these requirements are essentially the same as those contained in the 1963 Minimum Standards for Manufacturing Milk Recommended for Adoption by State Agencies, except for changes as follows: (*a*) farm water supply (the requirements of the applicable State regulatory authorities will be used as the basis for approving water supplies) (*b*) quality requirements for milk (the methylene blue test as a recommended test for classifying milk has been deleted; Class 2 (acceptable) milk from individual producers will be reduced from 3 million direct microscopic clump count per milliliter to 1 million, 3 years after adoption of the standard; the comparable resazurin reduction times for 1 million DMCC milk will be: can milk—not less than 2 hrs; and bulk milk —not less than 3 hrs; and the detailed program of the National Mastitis Council for detection of abnormal milk is included).

From the outset of our discussions with the U. S. Public Health Service and the Food and Drug Administration, there was good agreement on the need for improvement in quality of manufacturing milk and for more attention to farm requirements. We are not certain at this time what will be the next action to be taken on these proposed standards. If we proceed toward a revision of the USDA Recommended Standards for Milk for Manufacturing, we will need to first issue a proposal in order to obtain views and comments from State authorities and from the industry.

In the past 9 months members of Dairy Division met with State regulatory officials in 26 States. At these meetings we reviewed with State officials the existing State laws and regulations for manufacturing milk and compared them with the USDA Minimum Standards Recommended for State Adoption. We discussed the present status of milk quality and farm facilities, and the steps that would be necessary to bring milk quality and farm requirements to the level of the recommended standards. Also, we considered reasonable and meaningful timetables to accomplish the established goals. Coordination among the States was discussed too—particularly as it involves application of quality standards and farm requirements for producers whose milk is shipped across State lines. We participated in several regional meetings of States to assist State officials with this problem.

I will not attempt to review the hard work done in the past year by many of the individual States to obtain needed changes or new laws and regulations. We know some State officials are disappointed at the lack of action by their legislatures. For them it means making an appraisal to see what action they can take that is likely to obtain passage of the legislation next time the legislature meets. In some States their hard work paid off in the passage of new legislation.

Even though your State does not have fully adequate laws and regulations for manufacturing milk and farm requirements, much can be done to improve milk quality with laws and regulations already available to you. C&MS' Dairy Division is working closely with the State regulatory agencies, but we believe

much more can and must be done concerning milk quality improvement than is being done today.

A NEW APPROACH?

Perhaps a new approach would help. For example, State regulatory officials could make good use of milk quality information provided under the USDA plant survey program mentioned above. One of the things we are doing on these inspections is making direct microscopic counts on samples taken from commingled milk in plant storage tanks. These counts are included in the USDA plant survey reports, copies of which are furnished to the State regulatory agencies. These records of DMC values are a good index to the quality of milk processed in plants. They show at a glance which plants are having quality problems. This information should be very helpful to the States in their quality improvement efforts. Our Inspection and Grading Branch Area Supervisors are glad to discuss with regulatory officials and State sanitarians the test results for plants in their State.

We are asking the plants to provide field service to farmers who ship high count milk. However, supervision of field service and attention to farm requirements is a responsibility of the States—a responsibility that needs more attention in many instances. Referring to my statement a moment ago—even though your State regulations may not be as complete as you would like, there is a fine opportunity for us—States, industry, and USDA—to work together now using the tools at hand—the DMC and other quality tests—to assist where necessary in improving the quality of your manufacturing milk.

A STATISTICIAN LOOKS AT GRADING

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quality should be, and we establish a rapid means of determining quality level. We do away with the "scoring" system and substitute a system of looking for points in which a sample will depart from the optimum. We use a constant sample unit size regardless of size of container being packed—assuring a "look" rather than a "peek" at the production and eliminating the special rules and calculations for different sized containers. We call any factor that detracts from the value of a product, a "defect."

Then all the grader needs to do is count these defects and refer to a statistical table showing the numbers of defects allowed within each grade. The grade is automatically determined from the table.

For frozen asparagus we still use the same quality factors, of course. But instead of assigning a numerical score for color, for example, the grader counts the times that a sample departs from best color.

We go even further. Defects are rated by level of importance. A minor defect won't affect the usability of the product, but means the product is not of best quality. A major or severe defect will affect the usability. A critical defect will not only affect the usability but also might make the product unsafe or unusable.

The quality control chart identifies how many of each type of defect is allowed in each size sample for each grade.

The grading is speeded up because the grader merely counts defects. Subjectivity is minimized because the standards describe the defects and the level of defect completely. And the process is well-suited to on-line inspection in the packing plant because a running sample can be maintained by counting defects on the line itself.

The third article in this series will describe the sampling plans used in this process, what we mean by acceptable quality level (AQL), and how the statistician helps develop theses sampling plans and quality control charts.

THE FATE OF *SALMONELLA TYPHIMURIUM* IN THE MANUFACTURE AND RIPENING OF LOW-ACID CHEDDAR CHEESE[1]

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Abstract

Cheddar cheese was made by the stirred-curd procedure from pasteurized milk inoculated with *Salmonella typhimurium* and with a slow acid-producing strain of *Streptococcus lactis*. The Most Probable Number technique was used to enumerate salmonellae in milk and in cheese during its manufacture and ripening. Salmonellae grew rapidly during manufacture and limited additional growth occurred in cheese during the first week of ripening at 13 C after which there was a gradual decline in population. Salmonellae survived during ripening for up to approximately 7 months at 13 C and 10 months at 7 C. Cheese made in 2 of 5 trials exhibited a limited increase in number of salmonellae during the first 2 weeks at 7 C followed by a decline in population of these bacteria. Other cheeses held at 7 C exhibited a reduction in number of viable salmonellae without the initial increase. Growth of salmonellae during the early stages of ripening and subsequent extended survival of these organisms may, in part, be attributable to high moisture (average 43.2%) and high pH (5.75 after overnight pressing) of the cheese which resulted from use of a slow acid-producing starter culture.

The increase in food-borne disease outbreaks in the United States during the past 30 years has been attributed both to mass production and distribution of convenience foods and to an improved reporting system. Even though milk and milk products were among the first of the convenience foods to achieve mass distribution, disease outbreaks involving these foods declined sharply after widespread acceptance of pasteurization by the dairy industry and after adoption of the grade-A milk ordinance many years ago.

Salmonellosis is one of the major food-borne diseases and recently it has received a great deal of attention. Concern about this disease in the dairy industry was prompted by the recovery, in 1966, of *Salmonella newbrunswick* from nonfat dry milk *(6)*.

According to a recent review by Marth *(6)*, the incidence of salmonellosis caused by consumption of contaminated cheese is quite low. Nevertheless, some outbreaks, mainly of typhoid fever, have been reported. Gauthier and Foley *(3)* described an epidemic of typhoid fever which occurred in Canada in 1941 and resulted in 40 cases and six deaths. The source of infection was 10-day old Cheddar cheese made from raw milk which had been handled by a typhoid carrier. Another outbreak of typhoid fever involving Cheddar cheese was described by Foley and Poisson *(2)*. In this instance it was believed that the cheesemaker's wife, who had an active case of typhoid fever, was responsible for contaminating the cheese. Menzies *(7)* observed that 111 of 507 cases of typhoid fever in Alberta between 1936 and 1944 resulted from consumption of infected Cheddar cheese.

Survivial of *Salmonella typhi* in Cheddar cheese was studied by Ranta and Dolman *(9)*. They mixed the organism with the cheese and were able to recover viable salmonellae after storage for one month at 20 C. When the surface of cheese was inoculated and the product then held at room temperature, survival of S. *typhi* was similar to that observed with the cheese-organism mixture. It was further noted that storage at a refrigeration temperature was accompanied by extended survival of salmonellae and that the bacteria penetrated into the cheese to a depth of 4-5 cm in 17 days.

Campbell and Gibbard *(1)* inoculated milk with S. *typhi* and used it to make Cheddar cheese. All cheeses were ripened for two weeks at 14.4 to 15.6 C, after which one cheese from each duplicate set was transferred to storage at 4.4 to 5.6 C. At the lower temperature seven out of 10 cheeses contained viable S. *typhi* cells for more than 10 months, whereas at the higher temperature the organism generally disappeared after three months of ripening.

More recently Goepfert et al. *(4)* reported that *Salmonella typhimurium* grew rapidly during the manufacture of stirred-curd Cheddar cheese until salt was added to the curd. They observed that

[1]Published with the approval of the Director of the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin.

10 to 12 weeks of ripening at 13 C or 14 to 16 weeks at 7.5 C were required before viable salmonellae in cheese dropped to essentially undetectable levels. Hargrove et al. *(5)* inoculated cheese milk with several serotypes of salmonellae and were able to recover these organisms from the resulting Cheddar cheese for a period of 3 to 7 months. They concluded that pH was the principal factor which governed survival of salmonellae in cheese.

It is well recognized that insufficient production of acid during cheese manufacture can permit staphylococci, if present, to grow and produce enterotoxin thus rendering the product unsafe for consumption *(10)*. Common reasons for inadequate formation of acid include: presence of antibiotics in milk, a starter culture infected with bacteriophage, or a slow acid-producing strain of lactic streptococcus. Since no reports have appeared on the survival of salmonellae in Cheddar cheese made in a manner to preclude development of sufficient acid, this work was undertaken. A preliminary report on some of the results has been presented *(8)*.

MATERIALS AND METHODS

Bacterial cultures

A 24 hr old nutrient broth culture of *S. typhimurium* (Department of Bacteriology, University of Wisconsin) was added to pasteurized milk to result in an initial level of approximately 100 salmonellae per milliliter of milk. The culture of *S. typhimurium* was maintained by daily transfer in nutrient broth.

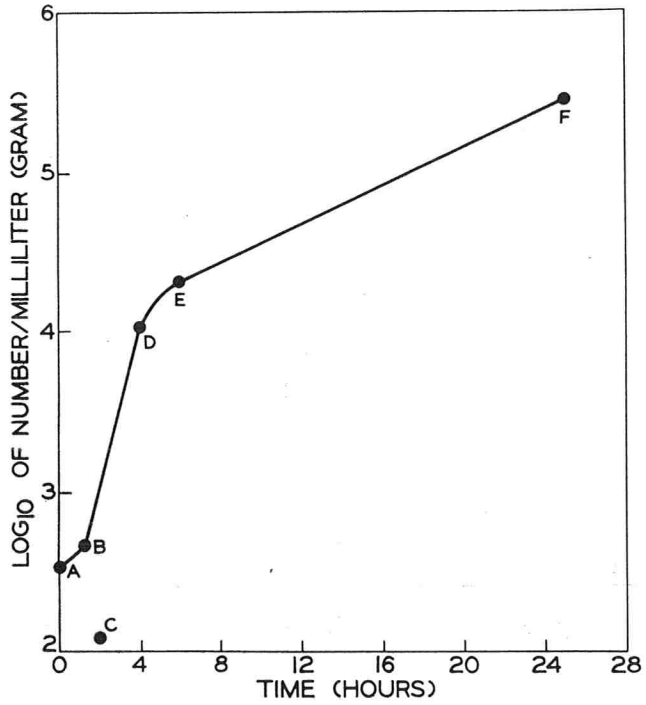

Figure 1. Growth curve of *Salmonella typhimurium* during the manufacture of low-acid stirred-curd Cheddar cheese. Each point represents the average value for five vats of cheese. (A) Milk after (5 min) addition of starter and *Salmonella*, (B) Curd prior to cutting, (C) Whey after cooking, (D) Curd after draining, (E) Curd prior to hooping, (F) Cheese after pressing overnight.

TABLE 1. TYPICAL MANUFACTURING SCHEDULE OF LOW-ACID STIRRED-CURD CHEDDAR CHEESE MADE FROM 440 LB LOTS OF PASTEURIZED MILK INOCULATED WITH *Salmonella typhimurium*.

Steps	Time	Temperature	Titratable acid (%)	pH
Add starter	8:30 a.m.	31.2 C (88 F)	0.155	
Add rennet (39.6 ml/440 lb milk)	9:15	31.2 C (88 F)	0.16	
Cutting curd	9:50	31.2 C (88 F)	0.09	
Steam on[a]	10:05	31.2 C (88 F)		
Steam off	10:35	40.6 C (105 F)		
Drain[b]	12:25 p.m.	40.6 C (105 F)	0.10	6.39
Stir and salt (5.87 oz)[c]	1:00			
Stir and salt (5.87 oz)	1:20			
Stir and salt (5.87 oz)	1:40.			
Hoop[d]	2:25		0.15	6.18
Press	2:40			
Vacuum on (25 in. vacuum)	9:30 a.m. (next morning)			
Vacuum off	10:20			

[a]To this point, 40 min additional time required over normal procedure.

[b]To this point, 55 min additional time required over normal procedure.

[c]To this point, 70 min additional time required over normal procedure.

[d]To this point, 90 min additional time required over normal procedure.

A slow acid-producing strain of *Streptococcus lactis* (Dr. G. W. Reinbold, Department of Food Technology, Iowa State University, Ames) was used as the starter culture and was added to cheese milk at a level of 1%. This culture was maintained by transfer in sterile 10% reconstituted nonfat dry milk at 48 hr intervals.

Enumeration of salmonellae

The methods described by Goepfert et al. *(4)* were employed to enumerate salmonellae in samples obtained during the manufacture and ripening of cheese.

Measurement of moisture and pH

The moisture content of cheese was determined by placing 3 g of cheese in a 50 ml beaker and then drying the cheese at 110 C for 16 hr in a forced draft oven. The pH of cheese was measured with a saturated calomel half-cell, gold electrode, and a Leeds and Northrup portable potentiometer.

Manufacture of cheese and sampling procedure

The procedure followed for manufacture of cheese and the sampling schedule are outlined in Table 1 and Fig. 1. Five vats of cheese were made, cheeses from each lot were ripened at 7 and 13 C, and they were tested for viable salmonellae weekly during the first month of ripening and monthly thereafter.

RESULTS AND DISCUSSION

Behavior of salmonellae during cheese manufacture

The behavior of S. *typhimurium* during the manufacture of low-acid stirred-curd Cheddar cheese is shown in Fig. 1. There was a slight increase in the number of salmonellae during the interval between inoculation of milk and cutting of the curd. As shown in Table 1, the elapsed time was about 80 min and the temperature was approximately 31 C, both conditions normal for the manufacture of Cheddar cheese. This initial period, or lag phase, during which a slight increase in numbers of viable salmonellae occurred, was probably a time of adjustment by the salmonellae to their new environment.

The lag phase was followed by a rapid increase in number of salmonellae during the interval between cutting the curd and draining the whey. From data in Table 1, it can be seen that approximately 55 min of additional holding time and a 1°C (2°F) elevation in cooking temperature beyond normal were required at this point for cheese manufacture. The increase in salmonellae during this period can be attributed to: *(a)* growth and *(b)* physical entrapment of bacteria by the curd particles. Such entrapment might account for a 10-fold increase in numbers.

After taking into account the entrapment factor, a generation time during the log phase of approximately 36 min was calculated using the formula $td = \log_{10} 2/\alpha$ (α = growth rate constant). The calculated generation time agrees well with the value of 35 min reported by Goepfert et al. *(4)*. Approximately 3.8 multiplications by salmonellae occurred during the 135 min from the beginning to the end of the log phase. This represents an added 0.3 division over that reported by Goepfert et al. *(4)* but this is easily attributable to the extra 25 min of incubation required because the starter culture was inactive.

At the time of cutting, draining, and hooping, subnormal production of acid was observed in all five trials, as determined by titratable acidity and pH measurements. The titratable acid and pH values at two of these stages for stirred-curd Cheddar cheese with more normal acid development are 0.17% and 5.9 at draining, and 0.30% and 5.5 at hooping.

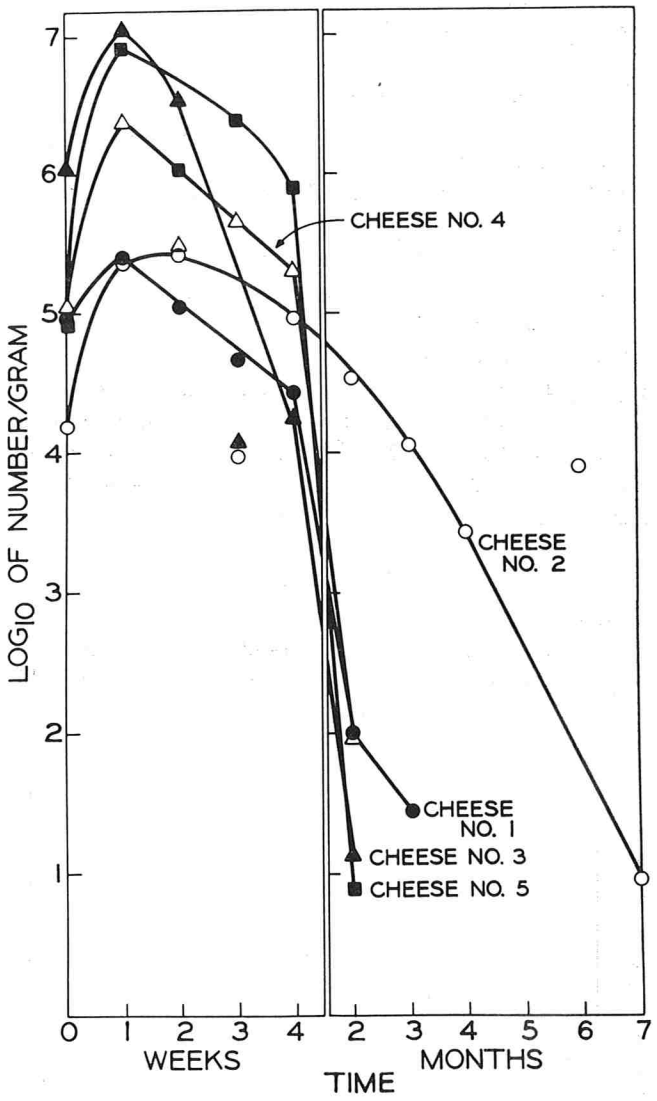

Figure 2. Survival of *Salmonella typhimurium* in low-acid stirred-curd Cheddar cheese ripened at 13 C.

TABLE 2. NUMBERS OF SALMONALLAE IN MILK, CURD, AND CHEESE DURING MANUFACTURE AND MOISTURE CONTENT AND PH OF CHEESE AFTER OVERNIGHT PRESSING

Trial	No. of salmonellae per ml or g						Cheese after pressing	
	Milk	Coagulated milk prior to cutting	Whey after cooking	Curd at draining	Curd prior to hooping	Cheese after pressing	pH	Moisture Content (%)
1	140	550	140	5,600	12,000	91,000	5.82	42.5
2	150	380	60	8,100	3,000	110,000	5.71	43.0
3	600	810	39	5,300	4,900	15,000	5.80	43.9
4	600	270	270	6,600	3,900	82,000	5.78	43.2
5	200	280	89	29,000	81,000	1,100,000	5.65	44.8
Average	340	460	120	11,000	21,000	280,000	5.75	43.2

Salting of the curd reduced the growth rate but it was not accompanied by a decline in numbers of salmonellae as was noted by Goepfert et al. *(4)* when they studied cheese made with a normal starter culture. Instead, an increase in numbers occurred during overnight pressing (Table 2). The failure of salting the curd to bring about a reduction in salmonellae, as observed in these trials, agrees with the data reported by Hargrove et al. *(5)*, although these investigators were studying cheese made by normal procedures.

Factors such as the high pH (average 5.75; Table 2) after pressing, high moisture content (average 43.2%; Table 2), and room temperature (approximately 21 C) storage during pressing were not detrimental to salmonellae and hence the increase in numbers of these bacteria during pressing became possible.

Behavior of salmonellae during ripening of cheese

The behavior of S. *typhimurium* in low-acid Cheddar cheese during ripening at 13 and 7 C is shown in Fig. 2 and 3, respectively. Data in Fig. 2 show that there was an increase in number of salmonellae during the first week of ripening at 13 C followed by a marked decline as ripening proceeded. Neither Goepfert et al. *(4)* nor Hargrove et al. *(5)* observed an increase in salmonellae in normal Cheddar cheese during ripening. The average pH value

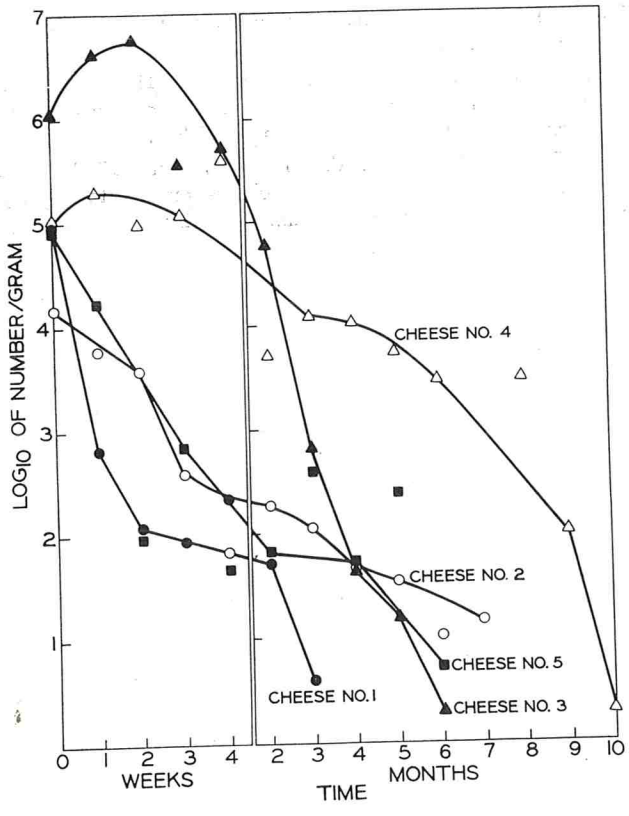

Figure 3. Survival of *Salmonella typhimurium* in low-acid stirred-curd Cheddar cheese ripened at 7 C.

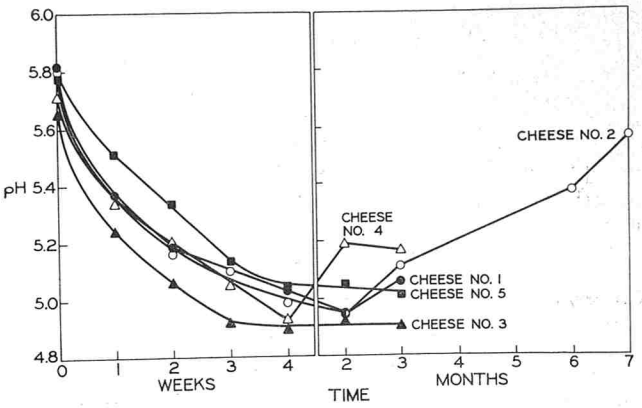

Figure 4. The pH of low-acid stirred-curd Cheddar cheese during ripening at 13 C.

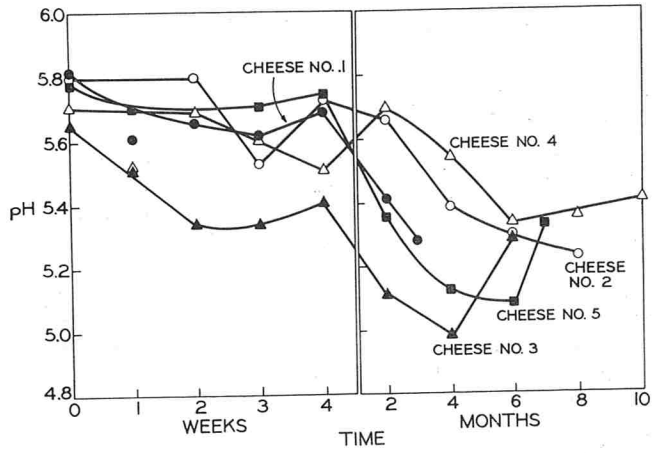

Figure 5. The pH of low-acid stirred-curd Cheddar cheese during ripening at 7 C.

of cheese in the five trials at the end of the first week at 13 C was approximately 5.4 but in one cheese the pH exceeded 5.5 (Fig. 4). This drop in pH from 6.18 at the time of hooping and from 5.75 after pressing may have contributed to the decline in numbers of salmonellae at 13 C even though the cheese contained an average of >43% moisture. Survival of salmonellae in cheese ripened at 13 C ranged from approximately 3 to 7 months, apparently depending on the rate at which the pH of the cheese dropped. A comparison of data in Fig. 2 and 4 reveal that the pH of one cheese (No. 2) began to increase when it was two months old and continued to do so until it approached 5.6 at the end of 7 months. The same cheese, according to data in Fig. 2, also exhibited extended survival of the salmonellae.

Figure 3 records the behavior of S. *typhimurium* in the five cheeses ripened at 7 C. Results of these trials were not as consistent as those observed when cheeses were ripened at 13 C. In cheese No. 1, there was a rapid decline in numbers and apparent loss of viability by salmonellae after approximately three months of ripening. The pH of this cheese

remained fairly constant during the first month of ripening and then dropped to approximately 5.3 after three months of storage (Fig. 5).

Salmonellae in cheese No. 2 (Fig. 3) behaved in a fashion somewhat similar to that of cheese No. 1, except that viable cells remained for at least seven months. The pH of this cheese remained elevated for a longer time than that of cheese No. 1. This may serve to explain the extended survival of salmonellae observed in cheese No. 2.

Two of the cheeses, No. 3 and 4 (Fig. 3), exhibited a limited increase in number of salmonellae during the first two weeks of ripening, followed by a sharp decline in viable salmonellae in cheese No. 3 and a slow decline in cheese No. 4. The pH of cheese No. 3 dropped more rapidly than that of cheese No. 4 (Fig. 5), which may account for the six months of survival by salmonellae in the former and 10 months in the latter cheese.

Results obtained with a fifth cheese (No. 5) were irregular but tended to approximate those observed with cheese No. 2. The drop in pH of cheese No. 5 also was similar to that noted with cheese No. 2 except that it occurred earlier in the ripening period.

Manufacture of Cheddar cheese with an inactive starter culture results in a product which may undergo any of a series of abnormal fermentations during ripening. Variation during ripening of cheeses made in this study is easily seen by examining data on pH changes presented in Fig. 4 and 5. These differences in fermentations may bring about variations in survival of salmonellae in such cheeses. Consequently, it is difficult to predict how much ripening time is needed before one can be sure that abnormal cheese is free of salmonellae. The extended survival of salmonellae in some of the abnormal cheeses (up to 10 months in these studies) is another reason why the cheesemaker must employ an active starter culture which will continue to produce acid during the entire cheese manufacturing process.

ACKNOWLEDGMENT

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CURRENT STATUS OF FOOD HANDLER EXAMINATIONS IN STATE AND LOCAL HEALTH DEPARTMENTS[1]

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ABSTRACT

A national questionnaire survey concerning the rationale and efficiency of food handlers examinations was completed by the public health personnel in charge of communicable disease control or food protection programs from each of the 50 states, and from 180 local health units in metropolitan areas which serve a population of over 100,000. The majority of states do not have a food handler examination law or regulation requiring medical surveillance. The responsibility is left to the county or city health departments. The respondents agreed with the position taken by the U. S. Public Health Service that such tests are very costly, give limited information, and cannot substitute for inspection and surveillance of sanitation and food handling practices. The detection rate of actual disease conditions through medical surveillance is small. There is, however, an appreciable reluctance to give up the requirement. Many respondents felt that the education and training of food service personnel would have more benefit and impact on the health of the public than the annual repetition of medical and laboratory tests. The requirement for food handler examinations is still at the state of the late 1930's and early 1940's. The epidemiologists and food protection authorities are aware of the inconsistencies in requiring food handler examinations, but there is little impetus to change.

The routine medical and laboratory surveillance of food handlers is not the source of lively discussions at present. In fact, a review of the literature on such food handler examinations for the last 20 years would give the impression that this was not a topic for investigation and perhaps not even a procedure which was current. There are still reports on food handler examinations and medical surveillance of food handlers in the foreign literature and in accounts of the overseas operations of the U.S. Army. But these same topics are almost non-existent in the American journals. In contrast, a perusal of the literature prior to World War II indicates some controversy on the merits and defects of these food handler examinations. For instance, Best *(1)* analyzed the experience of 11 years of medical examinations of food handlers (1923-1934) in New York City. At the end of this period the New York Board of Health discontinued the examinations for the following reasons: *(a)* examinations by private physicians were not reliable in excluding food handlers for communicable disease; *(b)* even if such examinations were reliable, the physical examination did not reveal the communicable disease conditions that may be transmitted by food handlers; *(c)* the cost of the proper examination including laboratory examination for typhoid, para-typhoid, and amebic and bacillary dysentery carriers is prohibitive; *(d)* even if the examination were complete and adequate, there would be no assurance that the carrier would remain free of communicable disease; *(e)* other examinations (as carried out at that time) were not relevant to the prevention of disease from food handling since they related to communicable conditions such as veneral diseases, tuberculosis, and skin conditions. Best showed that the cost of detection per typhoid carrier at that time would be $50,000. The evidence for New York City was so compelling that the routine examination and certification of food handlers was abandoned.

Geiger *(2)* reviewed the results of food handler examinations of 4,386 persons in San Francisco during the years 1931 to 1936. Here again the conclusion was that, even with a complete medical and laboratory examination, the cost of the procedure is not justified by the results obtained. The author argued that the same money spent in rational education activities would probably produce more tangible results. A study of 3 years of experience in Los Angeles County *(3)* led to the same conclusions.

There were, of course, dissenters from this point of view. Scott *(4)* and Terrell *(5)*, in the late 30's, were able to show significant detection rates for typhoid carriers in the Southwest in their series of food handler examinations. However, even in these discussions there were serious doubts about the relative costs and benefits of food handler examinations. Foodborne outbreaks of typhoid fever are relative rarities at present.

In the early 1940's the Public Health Service took

[1]Presented at the 97th Annual Meeting of the American Public Health Association, Philadelphia, Pennsylvania, November 12, 1969.

the position "that routine health examinations for persons who handle and process food are not of sufficient value in the prevention of foodborne illnesses to warrant the expense incurred. The medical examination of a food handler, at best, can only give information as to his status on the day of the examination. It is well known that a person may be entirely well one day, yet capable of transmitting the disease the next day. Therefore, routine medical examinations give a false sense of security as they cannot be relied upon to prevent the transmission of foodborne disease.

This position on periodic health examinations for food handlers is in no way intended to discount the desirability of having regular medical examinations as a personal health measure, a procedure which the U. S. Public Health Service recommends."

In the light of this history of food handler examinations it seemed worthwhile to explore the current status of such examinations in state and local health departments. There is a current interest in the assessment and evaluation of health activities and their analysis in terms of cost and benefits. The national survey of standards and practices for food handler examinations is an attempt to supplement the limited published material available and to see what changes in both practices and opinions have occurred.

The national questionnaire survey includes information from 50 states and 85% of the local health units in urban areas serving a population of over 100,000. Data were obtained on the procedures for food handler examinations recommended or required by state and local laws and regulations; the specific medical and laboratory examinations that are performed; the number of persons tested; and the number denied employment on the basis of these tests. Comments by the appropriate authority on the usefulness of health examinations in the prevention of foodborne diseases were also obtained. These comments emphasized both the epidemiological rationale and the cost-benefit aspects of medical surveillance of food handlers.

MATERIALS AND METHODS

The questionnaire (see Fig. 1) was sent to the director of the communicable disease control unit of the State Departments of Health. The names and titles of these persons were obtained from the Directory of State and Territorial Health Authorities for 1967, published by the U. S. Department of Health, Education, and Welfare *(6)*. The mailing to local units was based on health agency listings and population data from the publication, Local Health Organization and Staffing Within Standard Metropolitan Areas, compiled in 1963 by the U. S. Department of Health, Education, and Welfare *(7)*. The questionnaire was sent to all local health units serving a population of 100,000 or more and the name of the health officer or administrative head of these units was taken from the Directory of Local Health Units, 1964, also compiled by the U. S. Department of Health, Education, and Welfare *(8)*. These individual names were checked against the 1967 Membership Directory of the American Public Health Association *(9)* for the latest available listing. Three mailings of the questionnaire spaced at appropriate intervals resulted in answers from all of the states and from 85% (180) of 212 local health units.

RESULTS AND DISCUSSION

State health departments

The representatives of the State Health Departments of each of the 50 states who answered the questionnaire included 26 physicians and 24 from other public health disciplines. Not every question was answered by each respondent; only 36 respondents answered the question on the number of eating places in the state. These 36 states accounted for 320,000 eating places (though definitions of an eating place may vary somewhat from state to state). State health departments are not the agencies who actually carry on medical surveillance of food handlers. Only five states provided data on the number of food handlers examined in 1966, and only twelve states reported that they had regulations requiring the examination of food handlers. Therefore, information relating to the type of examination required was not available at the state level.

Local health departments

A total of 212 local health units were included in the survey, and answers were received from 180 units (85%). Respondents included 105 physicians and 75 of other disciplines. These are the units which actually carry out the medical surveillance activities. The distribution of units according to the size of the population served is shown in Table 1; the per cent return of the questionnaire was 75 in local health units serving 600,000-699,000 people, 80 in those units serving 100,000-199,000 and 200,000-299,000 people, and 90 or above in the remaining units.

TABLE 1. PERCENT RETURN OF QUESTIONNAIRE FROM LOCAL HEALTH UNITS BY SIZE OF POPULATION SERVED

Population served	Number of local health units contacted	Number of units replying	Per cent return
100,000-199,000	97	77	80
200,000-299,000	37	29	80
300,000-399,000	23	22	95
400,000-499,000	16	16	100
500,000-599,000	4	4	100
600,000-699,000	8	6	75
700,000-799,000	11	11	100
800,000-899,000	2	2	100
900,000-999,000	4	4	100
over 1,000,000	10	9	90
TOTAL	212	180	85

Of the 180 local health units who answered, half require one or more types of food handler examinations. Of these latter, the most common examination required is the chest x-ray. Almost one-third of those units requiring examinations specify a serological test for syphilis. The types of examinations that are required by these local health units is summarized in Table 2. It is interesting to note that most of the required examinations have little direct pertinence to foodborne disease.

TABLE 2. TYPE OF EXAMINATIONS REQUIRED BY 180 LOCAL HEALTH UNITS

Required examinations		Number of local health units
None		82 (45.6%)
One or more of the following		90 (50.0%)
Physical examination	12	
Chest x-ray	92[1]	
Initial skin test for tuberculosis	14	
Serological test for syphilis	26	
Other: Stool culture	3	
Nose and throat inspection	1	
Inspection of skin	1	
No answer		8 (4.4%)
TOTAL		180

[1]Although not a regulation, chest x-ray is required for administrative reasons by several local health units.

Table 3 gives the results of food handler examinations reported by the local health units for the year 1966. For those units reporting complete data on the results of examinations, the rate of positive findings ranged from 0.15 per 1000 physical examinations to 265.0 per 1000 skin tests for tuberculosis.

TABLE 3. RESULTS OF FOOD HANDLER EXAMINATIONS REPORTED BY LOCAL HEALTH UNITS, 1966

Examination	Number of units reporting	Number of examinations performed	Number positive	Positive per 1000 examinations
Physical examination	14	55,097	8	0.15
Tuberculosis screening				
Chest x-ray	90	948,947	1403	1.48
Skin test	11	33,336	8820	265.00
Laboratory examinations				
Syphilis serology	31	434,841	1859	4.28
Stool culture	8	20,157	53	2.63

Table 4 gives the number of persons actually denied employment reported by local health units in 1966, representing data from 61 units which include 572,000 food handlers. Twenty of these units (75,818 food handlers) reported no one was denied employment.

For the 61 units that provided complete information, 100 employees and 118 applicants were permanently denied employment in the food service industry, representing a rate of 0.39/1000 examined. For those employees and applicants temporarily denied employment on the basis of food handler examinations, the rate was 4.2 per 1000 examined. Both these rates would be even lower if 25 units who reported "no persons denied employment" had given the number of food handlers examined.

TABLE 4. NUMBER OF PERSONS DENIED EMPLOYMENT REPORTED BY LOCAL HEALTH UNITS, 1966[1]

Denied Employment	Temporarily	Permanently
Employees	1154	100
Applicants	1239	118
TOTAL	2393	218
Rate per 1000	4.2	0.39

[1]Population represented: 572,601 food handlers in 61 local health units

Opinions and comments on food handler examinations

Though food handler examinations are not carried on extensively by state health departments, the opinions of epidemiologists and food hygiene authorities in these agencies are important as sources of expertise and advice for local health departments. All but seven of the respondents from the state health departments agreed with the position that the U. S. Public Health Service has taken for many years regarding routine health examinations for persons who handle and process food. There were 147 respondents of the 180 local health units who agreed with the position taken by the U. S. Public Health Service; 8 disagreed, 10 were ambivalent, and 15 gave no answer. Their reasons for agreement with this position emphasize the large costs and insufficient benefits, the false sense of security, the possibility that examination may substitute for adequate sanitation requirements, and that testing at one point in time is misleading because of the intermittent carrier or disease state. Further, some of the laboratory physical or x-ray tests that are required may be inappropriate to the objective of preventing foodborne disease. Only one respondent from the local health units felt that examinations justified the expense.

Opinions given by state and local health authorities in response to a question asking which test would be best for the detection of communicable diseases in food handlers are shown in Table 5. Approximately one-fifth of the respondents, both from the state and local survey, considered that no tests are appropriate. Few of the authorities at the local

QUESTIONNAIRE

Definition: In this survey we shall consider Food Handlers to be employees of restaurants; luncheonettes; snack bars; taverns; caterers and similar public eating places, whose work involves the serving and preparation of food.

1. How many eating places are located in the state (city)?

   ---

2. Is there a state (city) law, regulation or requirement for a periodic physical or laboratory examination on food handlers as a condition of employment?

   Yes ------ No ------

3. How many food handlers were examined for the calendar year 1966 (January 1—December 31)?

4. Could you please supply the following information for the calendar year 1966 (January 1—December 31):

Examination and/or Tests	Number of Examinations	Frequency Required	Number of Disease or Carrier States Detected
1. Physical Examinations	---	---	---
2. Chest X-Ray	---	---	---
3. Laboratory Examinations:	---	---	---
A. Blood Tests:			
1. STS	---	---	---
2. Other - ------	---	---	---
B. Cultures:			
1. Nose & Throat	---	---	---
2. Stool	---	---	---
3. Sputum	---	---	---
4. Urine	---	---	---
5. Other - ------	---	---	---

5. How many people during 1966 were denied employment on the basis of these tests?

	Denied Employment Temporarily	Permanently
No. of employees	---	---
No. of applicants	---	---

"The U. S. Public Health Service has for many years taken the position that routine health examinations for persons who handle and process food are not of sufficient value in the prevention of foodborne illness to warrant the expense incurred. The medical examination of a food handler, at best, can only give information as to his status on the day of the examination. It is well known that a person may be entirely well one day, yet capable of transmitting the disease the next day. Therefore, routine medical examinations give a false sense of security as they cannot be relied upon to prevent the transmission of foodborne disease."

"This position on periodic health examinations for food handlers is in no way intended to discount the desirability of having regular medical examinations as a personal health measure, a procedure which the U.S. Public Health Service recommends."

1. Do you agree or disagree with this statement? Why?

2. Do you feel that the information relevant to prevention of of foodborne disease yielded by current examinations justifies their expense?

3. What would be the best test or tests for the detection of communicable diseases or carrier states in food handlers? At what frequency should these tests be performed?

Name ---

Department ---

Figure 1. Questionnaire used to obtain data on examination of food handlers.

TABLE 5. RESPONSE TO QUESTION ON BEST TEST(S) FOR DETECTION OF COMMUNICABLE DISEASES IN FOOD HANDLERS

Response	50 State health departments	180 Local health units
No Tests are Appropriate	9 (18%)	37 (20.6%)
Physical Examination	0 (0%)	3 (1.7%)
Test for Tuberculosis (chest x-ray or skin test)	4 (8%)	36 (20.0%)
Cultures (stool, nose and throat)	4 (8%)	10 (5.6%)
Combination[1]	4 (8%)	19 (10.6%)
Education, Training, Surveillance	11 (22%)	39 (21.7%)
No Answer	18 (36%)	36 (20.0%)
TOTAL	50 (100%)	180 (100.0%)

[1]Any combination of Physical Examination, Test for Tuberculosis, or Cultures.

level and no one at the state level considered physical examinations an appropriate test. The two groups differ essentially in that the local health authorities consider tuberculosis screening of positive value, and 20% listed such testing as the most appropriate for food handlers. At the state level, only 8% considered tuberculosis screening as one of the best tests for the detection of communicable diseases in food handlers. Local health departments are sometimes under pressure of public opinion to do "something" about food handler examinations. The chest x-ray is the most convenient of the screening tests and does contribute to the tuberculosis control program. One-fifth of each group considered education, training, and surveillance on the part of the employee, the employer, or the health department to be of more value than any test available. Eighteen per cent of the returns from local health units contained no answer to this question, whereas 36% contained no answer from the state authorities.

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OBSERVATIONS ON STERILITY AND HERMETIC PACKAGING IN FLEXIBLE CONTAINERS[1]

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Within the last year considerable market activity has taken place with sterilized dairy products packed in flexible containers. Regulatory officials at all levels are pondering how to apply the existing regulations to these packaging innovations. Two concepts appear to present most of the controversy: *(a)* Are the terms "sterile" and "sterilized" synonymous? *(b)* What is meant by "hermetic seals"? These are exceedingly important questions, because on their interpretation hinges the classification of products, or which regulatory agency supervises its distribution.

THE CONCEPT OF STERILITY

Let's first consider the concept of sterility. Webster defines sterile as: "free from living organisms and especially microorganisms". It is not necessary to get into a philosophical discussion of what is meant by "living organisms" and whether or not viruses and spores are included in this group. But it can be argued that this term refers only to the vegetative state of all living matter.

More important than these fine points of difference is the context in which these terms are used. For the Food Sanitarian, it is his concern with the protection of the public's health.

The presence of organisms in a food can be viewed by the Sanitarian as either an adulterant, or a contaminant, or both. We do not tolerate adulterants in foods, but we concede that some foreign matter is often unavoidable. For instance, canned tomato products contain high levels of dissolved tin. But this is not considered adulteration because it is a routine consequence of canning tomato products. Furthermore, it has been shown to be harmless. For other substances which unavoidably are a part of commercial food production but which are, or may be toxic, the Food and Drug Administration establishes tolerance levels. Pesticides are an example. Spores are often present in canned foods, but unless they are toxin producing strains or spoilage producing under commercial conditions, they are not considered contaminants.

STERILE VERSUS STERILIZED

Now let's get back to the question of sterile versus sterilized. In a recent policy statement the Food and Drug Administration requires that sterilized whipping cream be "hermetically sealed and so processed by heat as to prevent spoilage and remain sterile until it reaches the consumer."

We fully agree with this statement because it contains all the necessary elements which set any sterilized or processed food apart from perishable foods. *(a)* It provides for hermetic sealing which we will discuss later. *(b)* It identifies the product and the process. (Heat in this instance.) *(c)* It states why the product was processed (i.e. "to prevent spoilage"). *(d)* It identifies the conditions under which the product is expected to remain sterile. (Until it reaches the consumer.)

This statement is universally applicable in the food industry because *all* sterilized foods are processed so as to prevent spoilage before they reach the consumer. This process rarely achieves "absolute sterility" as the term is used in the medical field; rather it results in what is commonly referred to as "commercial sterility". And "commercial sterility" takes into consideration: *(a)* the growth inhibiting factors present in the food such as sugars, acids, salts, etc; and *(b)* the temperatures to which the product is exposed in the channels of distribution.

The reason why foods are not processed to absolute sterility is obvious; such processing would result in unpalatable foods. Nor will processing beyond the point of "commercial sterility" improve the shelf-life of the product. Think of sweetened condensed milk which is recognized as being self-stable by virtue of its high sugar content and hot fill. Further processing would ruin the product, making it unsalable, without prolonging its shelf life. Think of meat products such as canned corned beef hash which is terminally sterilized to "commercial sterility" and which suffers when processed beyond this point.

The other factor mentioned was the temperature to which the product is exposed in commercial channels. The canned hash is a good case in point. This product is a popular item in hot vending machines where it may be kept at 130 F for days prior to being consumed. Obviously this is an ideal environment

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[1]Presented at the Fifty-first annual meeting of the California Association of Dairy and Milk Sanitarians, Pomona, California, October 15, 1969.

for the growth of thermophilic organisms. Therefore these cans are processed to a higher sterilizing value than those sold off the grocery shelf. "Commercial sterility" reflects the commercial conditions encountered by the individual products.

Let's go back to the sterilized whipping cream we discussed earlier. Its commercial environment is the refrigerated channel of distribution. This is natural because whipping cream is subject to substantial flavor changes when kept above refrigeration temperature. "Commercial sterility" of sterilized whipping cream therefore refers to the absence of spoilage causing organisms under refrigerated conditions.

HERMETIC SEALS

Now to the question of hermetic seals. Let's get out the dictionary again, and we find the following definition: "Made perfectly close or airtight by, or as by, fusion, so that no gas or spirit can enter or escape; as, a hermetic seal." There are some interesting terms used in this definition. Webster speaks of "close or airtight" and of "gas or spirit".

As with the earlier definition on sterility, the context is the important factor because in the abstract these terms are meaningless. In the food industry hermetic seals are related to spoilage and more specifically to recontamination after processing. Actually Webster also refers to this by the term "spirit" which is "life". Although metal can seals are not fused they are "perfectly close" provided they do not encounter an environment of high external vacuum. Under high vacuum the can ends, which are normally concave, become convex and the containers cannot be considered hermetically sealed anymore. But, of course, such high environmental vacuum is not normally encountered by the product, and the "commercial sterility" of the canned food is maintained. In other words, the passage of gas into, or out of, a container is only incidental; what matters is whether or not the product is so protected that it reaches the consumer in "sterile" or perhaps more accurately, "commercially sterile" condition.

Why all this fuss about gas passage? Because in defining products, terms, etc. we always go from the known to the unknown. In the modern packaging industry we tend to interpret our new experiences with flexible packages in the light of what we are most familiar with—which is the metal can. Unfortunately we often fail to recognize the basic differences between the two containers. In canned foods the absence of air is necessary to prevent internal rusting. In flexible plastic containers no such defect will occur and if the product tolerates the presence of air there is no need to remove it. Therefore, in defining hermetic seals as they apply to flexible packaging we should confine ourselves to whether such seals protect the product from contamination adequately.

SUMMARY

In summary then we can make the following statements: *(a)* The terms "sterile" and "sterilized" are synonymous but have to be modified by the normal environment to which the product is exposed. *(b)* Hermetic seals, as used in the food industry, refer to the maintenance of a "sterile" state.

I believe that these definitions protect the public's health, are good commercial practice, and stand up under close scrutiny. Furthermore these definitions parallel the wording used by the U. S. Public Health Service in its definition of "Sterilized dairy product" which is: " . . . products hermetically sealed in a container and so processed, either before or after sealing, as to prevent microbial spoilage . . . "

AMENDMENT TO 3-A SANITARY STANDARDS FOR INTERNAL RETURN TUBULAR HEAT EXCHANGERS FOR USE WITH MILK AND MILK PRODUCTS

Serial #1203

Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

The amended "3-A Sanitary Standards for Internal Return Tubular Heat Exchangers for use with Milk and Milk Products", approved April 29, 1952, Serial #1200, are further amended by the following:

The title of this standard is hereby changed to "3-A Sanitary Standards for Tubular Heat Exchangers for Use with Milk and Milk Products, Serial #1200" and the words "internal return" are hereby deleted where they appear in the standard and the amendments thereto.

Delete the following that appears in the heading before the Material section, "Internal Tubular" and "Having 0.902 inch I. D. or Larger Tubes."

In subsection 1. of A. MATERIAL make the following change and addition:

In the second sentence replace the words "nickel alloy" with "optional metal alloy (see Appendix, Section A, for the composition of an acceptable optional metal alloy)".

Add the following to the second sentence:

except that none of the product contact surfaces of a heat exchanger designed to be mechanically cleaned shall be of optional metal alloy.

Add the following at the end of paragraph A.1:

Note: The term "designed to be mechanically cleaned" means that the equipment is designed to be cleaned solely by circulating and/or flowing chemical detergent solutions and water rinses over and onto the surfaces to be cleaned by mechanical means.

Add the following to the first sentence of paragraph B.1:

except that the milk contact surfaces of tubular heat exchangers designed to be mechanically cleaned do not have to be accessible for inspection if the heat exchange surface is one continuous tube. Milk contact surfaces of tubular heat exchangers shall be accessible for manual cleaning and inspection when necessary if the heat exchange surface is two or more tubes in parallel.

Add the following to paragraph B.2:

In a heat exchanger designed to be mechanically cleaned of the type that incorporates two or more concentric tubes, means shall be provided to keep the tubes equally spaced. The means provided to keep tubes equally spaced shall not interfere with mechanical cleaning.

The construction of a heat exchanger of the concentric multi-tube type designed to be mechanically cleaned shall be such that product and/or cleaning and/or sanitizing solutions will not enter areas that are not readily cleaned and/or rinsed.

Add the following to B.5:

Heat exchange tubing that is not circular in cross section shall have minimum radii of 1/8 inch on all internal angles of 135° or less on product contact surfaces.

Add the following to B.6:

except that circular cross section heat exchange tubing used in a heat exchanger may be of smaller diameter if the heat exchanger is designed to be cleaned solely by mechanical means.

Appendix

A. OPTIONAL METAL ALLOY

An optional metal alloy having the following minimum and maximum composition is deemed to be in compliance with A.1:

Zinc—8% maximum
Nickel—19 1/2% minimum
Tin—3 1/2% minimum
Lead—5% maximum
Iron—1 1/2% maximum
Copper—the balance

An alloy of the composition given above is properly designated "nickel silver", or, according to ASTM #B 149-52, may be entitled, "leaded nickel bronze".

C. This amendment shall become effective Aug. 23, 1970.

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Paul W. Scherschel, Dir. of Field Services, Pure Milk Association, 343 S. Dearborn Street, Chicago, Illinois 60604.

Robert Simon, Head Fieldman, Borden Milk Company, Baton Rouge, Louisiana.

Stephen B. Spencer, Dairy Specialist, 213 Borland Laboratory, Pennsylvania State University, University Park, Pennsylvania 16802.

Donald K. Summers, Food & Drug Administrator, Region VIII, 9017 Federal Building, Denver, Colorado 80202.

Leon Townsend, Milk Survey Officer, Kentucky State Dept. of Health, 275 East Main St., Frankfort, Kentucky 40601.

Mrs. Helene Ullmann, R.P.S., Milk Co-ordinator, Calumet Region Milk Sanitation Dept., 1429 Virginia Street, Gary, Indiana 46407.

R. J. Weaver, Director of Field Operation, Milk Control

District No. 1, Associated Suburban Boards of Health, 75 East Lancaster Ave., Ardmore, Pennsylvania 19003.

James Welch, Asst. Mgr. Farm Sales, Klenzade Products, Division of conomics Laboratory, Inc., Osborne Building, St. Paul, Minnesota.

Robert L. West, Dairy Foods Inspector, Bureau of Dairy Service, Dept. of Agriculture, 2550 Mariposa Street, Room 3051, Fresno, California 93721.

Harvey J. Wilhelm, Field & Laboratory Supv., Mountain Empire Dairyman's Assn., Inc., 945 - 11th Street, Denver, Colorado 80204.

STATE AFFILIATES WITH PARTICIPATING FARM PRACTICE COMMITTEES

State of Connecticut, Contact: Albert R. Pernice, Connecticut Assn. of Sanitarians, 355 Benton St., Stratford, Connecticut 06497.

State of Florida, Contact: Melvin Ness, Northeast Florida Milk Prod. Assn. 5634 Dunn Avenue, Jacksonville, Florida 32218.

State of Idaho, Contact: Jess Sproul, City-County Health Dept., 1455 N. Orchard, Boise, Idaho 83704.

State of Indiana, Contact: Verne Cavanaugh, Public Health Sanitarian, Indiana State Board of Health, 205 Harrison St. LaPorte, Indiana 46350.

State of Iowa, Contact: H. E. Hansen, Milk Sanitation Section, State Health Department, Stae Office Building, Des Moines, Iowa 50319.

State of Kansas, Contact: David Monk, Wichita Sedgwick County Public Health Dept., 1900 East Ninth Street, Wichita, Kansas 67214.

State of Missouri, Contact: James F. Kennedy, Missouri Div. of Health, State Office Building, Jefferson City, Missouri 65101.

State of New York, Contact: Don Race, Dairyman's League, 402 Park Street, Syracuse, New York 13208.

Province of Ontario, Contact: Wm. D. McCorquodale, 409 Huron St., Toronto, Ontario, Canada.

State of Oregon, Contact: James Wm. Green, Carnation Company, 3342 S. E. Morrison St., Portland, Oregon 97214, or Paul Boeckli, Mayflower Farms, 2720 S. E. 6th Ave., Portland, Oregon 97202.

State of Pennsylvania, Contact: Dr. Charles W. Livak, Penn Dairies, Inc., 1801 Hempstead Rd., Lancaster, Penna. 17601.

State of Virginia, Contact: M. K. Cook, Virginia Assoc. of Fieldmen & Sanitarians, R. R. No. 1, Box 437, Roanoke, Virginia.

State of Washington, Contact: Ray Carson, State Dept. of Agriculture, 2505 S. McClellan St., Seattle, Washington 98144.

State of Wisconsin, Contact: Emmett Fincher, 2614 Waunona Way, Madison, Wisconsin 53713.

Following is the breakdown of the nine task committees of the International Association Milk, Food & Environmental Sanitarians Farm Methods Committee, including the State Affiliates.

I

Antibiotics, Pesticides and Other Adulterants

M. W. Jefferson—*Chairman*
D. K. Summers
Ben Luce
W. J. Harper
Leon Townsend
Robert L. West
State of Pennsylvania—Dr. Chas. Livak

II

Cleaning and Sanitizing of Farm Milk Equipment

James Welch—*Chairman*
D. G. Raffel
Glenn Cavin
C. C. Gehrman
Keith A. Harvey
John W. Ring
D. F. Goyer
Roy R. Perkins
Floyd M. Copenhauer
State of Connecticut—Albert R. Pernice

III

Education

Vernon Nickel—*Chairman*
A. N. Myhr
Clifford J. Cosgrove
C. Bronson Lane
Ben Luce
Sydney Barnard
Leon Townsend

IV

Bernard M. Saffian—*Chairman*
W. T. Pickavance
R. G. Raup
Robert Dawson
Richard Rintelmann
State of Kansas—David Monk

V

Sediment

M. H. Roman—*Chairman*
Paul W. Scherschel
Frank Blumenschein
Richard Weaver
Phillip Bergner
State of Iowa—H. E. Hanson
State of New York—Don Race

VI

Proper Milking Practices

Kenneth Harrington—*Chairman*
Glenn Cavin
James McDowell
Boyd M. Cook
Harvey Wilhelm
Richard Weaver
Robert Simon
R. G. Raup
W. T. Pickavance
State of Indiana—Verne Cavanaugh
State of Washington—Ray Carson

VII

Cleaning and Sanitizing of Farm Milk Pickup Tankers

Stephen Spencer—*Chairman*
R. E. Lock
Frank Blumenschein
Loren Pine
Roy R. Perkins
State of Virginia—M. K. Cook
State of Florida—Melvin Ness
State of Oregon—Jim Green

VIII

Sampling of Bulk Milk

Wm. L. Arledge—*Chairman*
Ben Luce

Harvey J. Wilhelm
Helene Uhlman
Leon Townsend
Clinton Mechan
C. W. Dromgold
State of Oregon—Paul Boeckli

IX

Water Protection
Henry Atherton—*Chairman*
C. W. Dromgold
Phillip Bergner
Loren Pine
State of Idaho—Jess Sproul
State of Missouri—James F.Kennedy

Committee Supervisor

J. B. SMATHERS	A. E. PARKER
Committee No. I	Committee No. II
IV	III
VII	V
VIII	VI
IX	

COMMITTEE ON COMMUNICABLE DISEASES AFFECTING MAN
(Appointments expire 1971)

Frank L. Bryan, Ph.D., *Chairman*, Chief, Foodborne Disease Activity, Training Program, National Communicable Disease Center, Atlanta, Georgia 30333.

Robert K. Anderson, D.V.M., School of Veterinary Medicine, University of Minnesota, St. Paul, Minnesota 55101.

John Andrews, Chief, Sanitation Section, North Carolina State Board of Health, 255 North McDowell Street, Raleigh, North Carolina 27602.

Thomas E. Collins, M.D., Chief Resident, Medicine Service, V.A. Hospital, Case Western Reserve University, 10701 East Blvd., Cleveland, Ohio 44106.

John H. Fritz, 1612 Rockhurst Lane, Cincinnati, Ohio 45230.

Stanley L. Hendricks, D.V.M., Iowa State Department of Health, Des Moines, Iowa 50319.

Dr. Charles A. Hunter, 4224 Emland Drive, Fountaine Bleau Apartments, No. 1, Topeka, Kansas 66606.

E. R. Price, D. V. M., Director, Bureau of Zoonoses, The Division of Health of Missouri, Jefferson City, Missouri 65101.

P. N. Travis, Jefferson County Health Department, Birmingham, Alabama 35302.

LETTERS TO THE EDITOR

Bacterial mastitis and public health

DEAR SIR:

In his paper "Updating Abnormal Milk Tests" in the April issue of the Journal, Maurice Weber suggests "that regulatory enforcement agencies should be concerned, from a public health hazard standpoint, *only with bacterial mastitis*. Certainly, the ingestion of somatic cells has not and will not make anyone ill."

First, evidence of bacterial mastis is rarely found when examining fresh quarter samples. With herd samples representing two to four milkings, the odds against finding such evidence under the microscope must be very high. In this connection it was reported (*JMFT* 32:224, 1969) that of 100 quarter samples with CMT scores of 2 or 3, only 29% yielded mastitis pathogens when cultured. So if attention is confined to samples with clustered leucocytes with enmeshed bacteria, a great deal of milk of a distinctly unwholesome nature would be considered acceptable.

Second, the only known "public health hazard" from mastitis pathogens in milk is from toxigenic strains of *Staphylococcls aureus*. When allowed to grow in low-count milk, there is danger of food poisoning. While this hazard is small, every step taken to reduce mastitis also reduces this hazard. As indicated above, to restrict attention to milk containing clusters of leucocytes with enmeshed bacteria, as Weber suggests, would increase the hazard.

Finally, the producer is the chief beneficiary of the Abnormal Milk Program. Since his family generally consumes raw milk, it reduces the potential hazard of food poisoning by S. *aureus*. And by improving his milking procedures and following a proven program of milking hygiene he can sharply reduce new infections, greatly improve udder health, and increase production while saving on drugs and veterinary bills and cutting losses from milk discarded because of antibiotic residues.

C. K. JOHNS
Ottawa, Ontario
Canada

A response from the author

DEAR SIR:

C. K. Johns' Letter to the Editor refers to an article in *JMFT* 32:224, 1969. Were the milks giving the CMT 2 and 3 reactions ever checked microscopically to establish that high leucocyte levels were actually present? Perhaps the CMT is not a good test to establish bacterial infections. In his address at the 1969 National Mastitis Council Annual Meeting, President Haller stated: " . . . the best 'cow side' test for abnormal milk is the CMT. However, we find many of the CMT-positive quarters are free of any bacterial infection. Antibiotic treatment of these quarters only further irritates the tissue . . . "

I am not setting the standards; the National Mastitis Council has legislated the limits of leucocytes in milk as reflecting mastitis. The intent of my article is just the reverse of Dr. John's contention that " . . . a great deal of milk of a distinctly unwholesome nature would be considered acceptable . . . " If more than 1.5 million leucocytes per milliliter of milk are found or if bacterial mastitis can be established, corrective measures must be taken. I am merely promoting the use of an accurate tool for the detection of "abnormal" milk.

A word of caution is in order on implementing the present abnormal milk regulations. Quoting from *JMFT* 32:138,

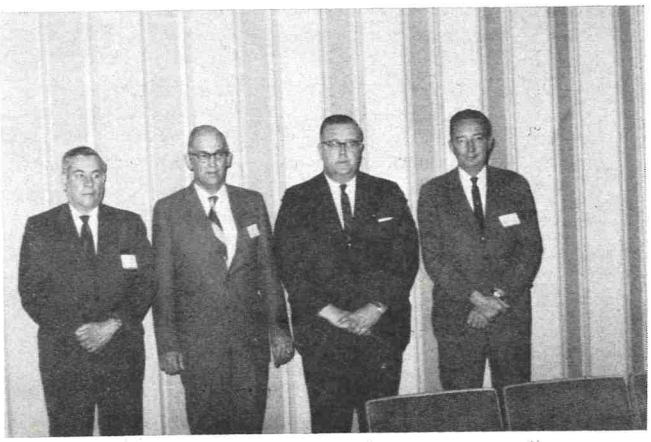
1969, "It is also recognized that more information is needed on factors affecting the cell count in milk from healthy cows. The control limits should be designed to prevent the sale of milk from cows with mastitis, without penalizing the dairymen for cell count changes resulting from normal sources of variation in healthy, well managed cows."

I did not intend to infer that finding clusters of leucocytes with enmeshed bacteria was the only criterion for putting a milk supply into the category of "abnormal." A high leucocyte count, if not caused by bacterial infection would indicate poor milking procedures and it would be to the advantage of the farmer to correct this condition for his own economic benefit. If bacterial mastitis can be established microscopically even though the leucocyte count is low, action should be taken.

Actually, Dr. Johns and I are striving for the same thing: the eradication of mastitis and the reduction of high leucocyte counts from poor milking practices with the attendant benefits for both the producer and the consumer.

MAURICE WEBER
New Jersey Dairy Laboratories
222-
226 Easton Ave.
New Brunswick, New Jersey
08903

ANNUAL MEETING OF THE VIRGINIA ASSOCIATION OF SANITARIANS AND DAIRY FIELDMEN



Left to right: R., J. Schutrumpf 1st Vice President, J. H. McGavock President, W. H. Gill Secretary-Treasurer, and V. M. Yeary 2nd Vice President.

The Virginia Association of Sanitarians and Dairy Fieldmen held their Annual Conference at the Donaldson Brown Center for Continuing Education, Blacksburg, Va. on March 5, 6, 1970.

One of the two keynote speakers, Mr. Leonard Ault, Chief Identification and Publications Branch, Technology Utilization Division, National Aeronautics and Space Administration, Washington, D. C. told of how much of the research that went into the moon landings also resulted in devices to help people on earth.

Mr. Ault described how special glasses worn by the astronauts enable them to push buttons by moving their eyes. These same glasses can be worn by bedridden persons to operate light switches and turn television sets on and off. A six-legged chair, patterned after the moon walker, can climb stairs, walk on sand, and negotiate curbs—things that wheelchairs cannot do. Other space equipment such as fittings, gaskets and tubing were adapted for use in refrigeration and other related industries.

The other keynote speaker was Dr. A. C. Dale, Department of Agricultural Engineering, Purdue University who talked about farm and industrial waste disposal. Dr. Dale said, "we have the technology to solve our pollution problems now if we could afford the high cost. People produce about 183 million tons of waste each year with factories and other sources contributing about the same amount. Biodegradation of waste to activated sludge will change almost anything, including human and animal waste to a useable form. Biodegradation will not solve all of the pollution problems, but it will cure about 98% of them." Dr. Dale attacked the waste disposal problem from both the industrial, as well as, the farm aspect and provided the group with several pertinent facts as to the seriousness of our waste disposal system.

One entire afternoon was spent on a panel discussion dealing with food handling, meat and poultry, seafoods, fruits and vegetable, and milk products. Five specialists in their field from VPI gave brief talks, then entertained questions from the participants.

Thursday evening's informal discussions were held on the activities of sanitarians, dairy fieldmen and laboratory technicians. Each group freely talked about items of general interest and each section reported lively conversation from many of the members.

The session closed on Friday with a provoctive talk on understanding people. The lecture given by Dr. J. D. Richardson, a project leader at VPI, was most fascinating, particularly when he placed pictures on display for the membership to relate what each individual saw, or thought he saw in the pictures. After listening to Dr. Richardson we could well understand the difficulties encountered in communicating and the interchange of thoughts between individuals.

The program this year was by far the most stimulating and exciting of any held for many years. The membership expressed their appreciation for an all-inclusive program which covered many facets of the sanitation field.

3-A COMMITTEES SIGN NEW STANDARD AND AMENDMENT

Milk meters are the subject of the latest 3-A Sanitary Standard, designated Serial #2800, and entitled "3-A Sanitary Standards for Flow Meters for Milk

and Liquid Milk Products". Signed with the final validating signature on April 23, 1970, the new standard becomes effective one year hence.

On and after April 23, 1971 the 3-A Symbol Council may issue authorization for use of the 3-A Symbol on equipment which complies with the new meter standard.

Publication of the new 3-A Standard will take place in the Journal of Milk and Food Technology 90 days prior to the effective date. Reprints from the Journal will be made available for distribution. Copies may be requested from the Journal, Box 437, Shelbyville, Ind. 46176.

An amendment to the "3-A Sanitary Standards for Internal Return Tubular Heat Exchangers for Use with Milk and Milk Products, Serial #1203" was also signed on the same date. The amendment provides for certain optional construction features in tubular heat exchangers.

This new amendment carries an effective date of August 23, 1970. Publication will take place 3 months prior to the effective date, and copies as usual will be available from the Journal at that time.

C. BRONSON LANE ACCEPTS POSITION AT THE UNIVERSITY OF FLORIDA

C. Bronson Lane has joined the faculty at the University of Florida's department of dairy science as an Associate Professor and Associate Extension Dairy Technologist. He will be responsible for developing and implementing dairy technology extension programs at the farm and processing plant levels.

Dr. Lane received his B. S. degree in dairy manufacturing from Pennsylvania State University, and the M. S. and Ph. D. degrees in dairy science from the University of Maryland. He attended Dallas Theological Seminary from 1966 to 1967 for studies in Greek and Theology.

Prior to accepting the Florida position, Dr. Lane served for three years as an Assistant Extension Professor of Dairy Technology in the Department of Animal Sciences at the University of Kentucky.

He is the author of numerous publications relating to the dairy industry, is an active member in many professional associations, and functions on committees of the Interstate Milk Shipments Conference, the International Association of Milk, Food and Environmental Sanitarians, and the National Association of Dairy Fieldmen.

HAROLD E. THOMPSON, JR., HONORED BY PUBLIC HEALTH SERVICE

The "technical competence and leadership" of a man who has made major contributions to the purity and safety of the Nation's milk supply was cited at a special ceremony in Washington, D. C., Tuesday, June 2. Harold E. Thompson, Jr., Chief of the Food and Drug Administration's Milk Sanitation Branch was presented the Public Health Service Commendation Medal by FDA Commissioner Charles C. Edwards in the presence of colleagues and friends for his accomplishments in the field of milk sanitation spanning 24 years. He attained his position as top man in the FDA's milk program not only as a result of academic preparation and single minded dedication to his tasks, but because of the variety and value of his contributions.

Working in a number of locations, but always in the same field, he helped with the periodic revisions of Grade "A" milk ordinances and codes, helped develop industry guidelines, played a key role in the 1966 investigation of salmonellae in dry milk, and participated extensively in the sanitary design and construction of dairy equipment.

He is a recognized authority in the commercial processing of dairy products and an outstanding expert in milk sanitation procedures and investigations.

A native of Clinton, Massachusetts, Thompson earned a degree in dairy technology from the University of Maine in 1941 but was delayed in launching his professional career by military service. However, after three years service with the Virginia State Department of Health as an assistant milk sanitarian, he became in 1949 a commissioned officer of the U. S. Public Health Service. The Food and Drug Administration is a part of the U. S. Public Health Service. Subsequently he served as regional interstate milk shipper consultant in New York, as staff officer at PHS headquarters in Washington, and as regional milk and food consultant in Kansas City.

As Chief of FDA's Milk Sanitation Branch, he is now headquartered in Cincinnati.

While pursuing his career, Thompson earned a masters degree in public health from the University of Minnesota (1959) and became professionally affiliated with the International Association of Milk, Food and Environmental Sanitarians and the American Intersociety Academy for Certification of Sanitarians. He is married and the father of three children.

IOWA ASSOCIATION NAMES OUTSTANDING SANITARIAN OF THIS YEAR

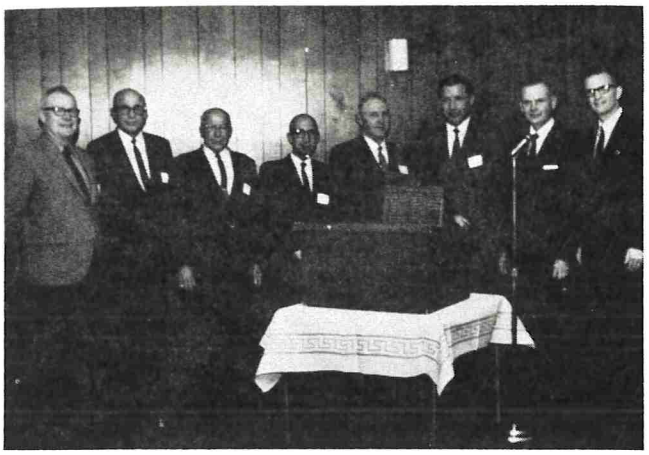
Don Jaeger (L) presenting to Ed Wegermann $50.00 Savings Bond, which is given with the award.

Award—Candidate shall have made a meritorious contribution in the field of milk, food or environmental sanitation to the Public Health & Welfare of a municipality or county within the state of Iowa, or to the State of Iowa.

Edgar Wagerman, Cedar Rapids, was named the outstanding Iowa Sanitarian of the year

This award was given Mr. Wagerman at the Annual Conference of Sanitarians and Fieldmen held at Ames, Iowa on March 23, by President Don Jaeger, This outstanding award is known as the Dr. M. P. Baker Award given each year at the annual meeting and conference, a $50.00 savings bond accompanies the award.

Mr. Wagerman owns and operates a Milk and Food Laboratory in Cedar Rapids known as the Sanitation Laboratories Inc. He was cited for his leadership in the field of sanitation. He is a past president of the Sanitarians' Association and has contributed a lot of time and effort in making this organization a success.



Iowa Association of Milk, Food & Environmental Sanitarians, Inc. Executive Board 1970: L-R—Earl Wright Faculty Advisor, Hale Hensen Secretary-Treasurer, Glenn Cavin 2nd Vice President, Al Grey 1st Vice President, Farris Biggart President-elect, Don Jaeger President, Duane Hagedon Immediate Past President, and William S. LaGrange Faculty Advisor.

Before starting his own organization in the field of sanitation, he was employed by Sanitary Farms Dairy, Cedar Rapids, as a sanitarian. He received his education in Minnesota and his degree in Dairy Bacteriology from the University of Minnesota.

From the small laboratory located in the basement of a grocery store to his large laboratory in a separate building located between Cedar Rapids and Marion, Iowa, is quite an achievement.

NEWS AND EVENTS

FUTURE COURSES TO BE GIVEN AT FDA TRAINING INSTITUTE, CINCINNATI, OHIO

Current Concepts in Food Protection, August 24-28, 1970, Albany, N.Y.

Milk Pasteurization Controls and Tests, Sept. 14-17, 1970, Cincinnati.

Milk Pasteurization Controls and Tests (2), Sept. 28-Oct. 2, 1970, Rutgers University.

Laboratory Analysis of Milk and Milk Products II, Oct. 5-9, 1970, Cincinnati.

State Laboratory Survey Officers Workshop, Oct. 26-30, 1970, Cincinnati.

Milk Pasteurization Controls and Tests, Nov. 8-12, 1970, Albuquerque, N. M.

Laboratory Analysis of Milk and Milk Products I, Nov. 16-20, 1970, Cincinnati.

Pesticide Residue Analysis of Food, January 25-29, 1971, Cincinnati.

Laboratory Analysis of Milk and Milk Products I, Jan. 1971, Charleston, S.C.

Milk Pasteurization Controls and Tests, Feb. 8-12, 1971, Cincinnati.

Current Concepts in Food Protection, Feb. 22-26, 1971, Glen Ellyn, Illinois.

Food Microbiology, March 22-April 1, 1971, Cincinnati.

Milk Pasteurization Controls and Tests (2), April 12-16, 1971, Milwaukee, Wisconsin.

All correspondence should be addressed to Robert B. Carson, Chief, Cinn. Training Facility, FDA Training Institute, 1090 Tusculum Ave., Cinn., Ohio 45226.

BELSHAW ELECTED BEMA PRESIDENT

Thomas E. Belshaw, President, Belshaw Bros. Inc., Seattle, Washington, was unanimously elected president of the Bakery Equipment Manufacturers Association at the Annual Convention held at the Doral Country Club, Miami, Florida, June 23-29, 1970. He succeeds Maynard R. Euverard, Executive Assistant to the President, Bakery Machinery Division, AMF, Richmond, Virginia who completed two outstanding terms as the Association's chief executive.

Mr. Belshaw has long been active in the Association's affairs serving on many of its important committees. He has been a member of the Board of Directors since 1964 and as Vice President for the past two years ably assisted President Euverard in the conduct of the Association. He is also active in the American Society of Bakery Engineers, the American Retail Bakers Association, the National Association of Food Equipment Manufacturers, the Bakery Council of Canada, the Western International Trade Group, the Japan American Society and the Seattle Chamber of Commerce where he also serves as a member of the World Trade Division.

His extensive international market development work for the bakery equipment industry and particularly for the donut industry outside the United States earned Belshaws' firm a citation from the Secretary of Commerce in 1963 and the President of the United States "E" Award for excellence in Export in 1967.

BEMA's new President attended the University of Washington School for Engineering and also met the University's educational requirements for, and passed the Certified Public Accountants National Examination.

Due to the continued growth in size and scope of the Association, the Constitution and By-Laws were amended to provide for the first time for two Vice Vice Presidents. Unanimously elected to these positions were: *First Vice President*—Douglas M. Kerr, President, Stewart Engineering & Equipment Company, Richardson, Texas. *Second Vice President*—Frank M. Irving, Jr., Executive Vice President, Alto Corporation, York, Pennsylvania. Raymond J. Walters continues to serve as the Association's Secretary-Treasurer and Counsel with executive offices being maintained in New York City. Two new members of the Board of Directors were unanimously elected as follows: *Director*—Harry D. Gardner, Vice President Union Steel Products Company, Albion, Michigan. *Director*—Edwin H. Leedy, Vice President Ekco Products, Inc., Chicago, Illinois.

HELDMAN TO CHAIR ASAE FOOD ENGINEERING DIVISION

The American Society of Agricultural Engineers, at their annual meeting banquet Friday evening, July 10, in the Leamington Hotel, Minneapolis, Minn., named the following five leaders in agricultural engineering as chairmen of the five ASAE Divisions. Included was Dennis R. Heldman as chairman of the Food Engineering Division.

Heldman is associate professor of agricultural engineering and food science at Michigan State University, Lansing, where he received his Ph.D. in agricultural engineering in 1965, after taking his bachelor's and master's degrees in the same subject from Ohio State University. His current position involves both research and teaching in food engineering. His research interests include investigations dealing with the thermal and rheological properties of processed foods, heat and mass transfer during food processing operations, and the improvement of environmental quality in processing plants, and he is the author or co-author of approximately 50 technical articles in his field. He is a member of the American Dairy Science Association, the International Association of Milk, Food, and Environmental Sanitarians, and the Institute of Food Technologists, in addition to the American Society of Agricultural Engineers, which he has served as a member of numerous committees. Heldman lives with his wife, Joyce, two daughters, and one son in East Lansing. He is the son of Mr. and Mrs. Merritt L. Heldman of Arlington, Ohio.

KNOX RECEIVES ADSA DISTINGUISHED SERVICE AWARD

William D. Knox, Editor of *Hoard's Dairyman*, received the Distinguished Service Award of the American Dairy Science Association at the opening session of the association's annual meeting here Sunday evening, June 28.

Knox became youth editor of the national maga-

zine in 1941. After serving in the Navy for four years, he became Associate Editor and then Editor of this publication in 1949. As the third editor in the 82 year history of this periodical, his editorials have been an inspiration in the fields of livestock conservation and dairy products marketing. He was the founding chairman, secretary, and president of the National Brucellosis Committee. He keynoted the formation meeting of the National Mastitis Council and has served effectively as a board member and on key committees.

In 1961 he was appointed by the President of the U. S. to the bipartisan National Agricultural Advisory Commission. As a part of his duties, he served with the National Stabilization Committee on Dairy Products, the Strategic Food Reserve Committee, and the USDA Departmental Administration Committee. Other accomplishments are too numerous to mention.

Some of the honors which have been bestowed upon Knox are: Honorary member of the American Veterinary Medical Association, Distinguished Service Award of National Brucellosis Committee, Rotary International Service Citation, Michigan State University Distinguished Agricultural Alumnus Award, Honorary Future Farmer, National 4-H Alumni Award, Tri-State Man of the Year, and numerous citations.

REINBOLD RECEIVES PFIZER-PAUL LEWIS AWARD

George W. Reinbold, Department of Food Technology, Iowa State University, received the Pfizer - Paul Lewis Award at the annual meeting of the American Dairy Association.

Reinbold has made many contributions to the understanding of the intricate relationships of the various steps in manufacturing procedures which were instrumental in the standardization of the technology of both domestic and foreign varieties of cheese. The merit of his work in the industry was evidenced by the award of the coveted Jade Ring of the Kraft Company for his outstanding services.

He and his coworkers have made a number of significant research contributions concerning the technology and microbiology of Swiss and Cheddar cheese, technology and market evaluation of low fat cheese varieties, ultra-low temperature preservation of starter cultures, bacteriological evaluation of raw milk quality, enumeration of special groups of microorganisms in raw and pasteurized dairy products, and in-depth studies of the enterococci and propionibacteria.

He is the author of vol. 1 of the Pfizer Cheese monographs, *Italian Cheese Varieties*, co-author with W. L. Wilson of vol. 2, *American Cheese Varieties*. He also has contributed to chapters in several other books including the most recent edition of *Standard Methods for the Examination of Dairy Products*.

THOMPSON RECEIVES BORDEN AWARD

Marvin P. Thompson, Biochemist in USDA's Eastern Regional Laboratory in Philadelphia, and Adjunct Associate Professor, Dairy Science, at Penn State, received the Bordon Award at the annual meeting of the American Dairy Science Association (ADSA).

Thompson is recognized worldwide for his research on the proteins of milk and a foremost authority on milk protein polymorphism. His work has opened up areas of research that have brought a new measure of understanding of factors that affect the physical stability of milks, the mode of inheritance or protein polymorphs, gene linkage, and the origin of Western breeds of dairy cattle. His work has provided the impetus for many researchers, worldwide, to engage in such studies, and he has enthusiastically encouraged this independent and collaborative research.

As a member of the ADSA Committee on Protein Nomenclature and Methodology, he worked persistently and effectively in developing a rational scheme for naming these new molecular species of milk proteins and others whose existence is surmised but not yet proved.

Thompson is the author of 50 technical publications. He has been invited to give seminars to dairy and food science groups throughout the United States. He has presented his research at 11 annual meetings of the ADSA and has been an invited participant in protein symposia sponsored by the American Chemical Society.

A NATIONAL EDUCATIONAL CONFERENCE ON GOOD MANUFACTURING PRACTICES ANNOUNCED

The Institute of Sanitation Management in cooperation with the U. S. Food and Drug Administration, the Association of Food and Drug Officials of the United States and the University of Florida will sponsor and conduct a National Educational Conference on GOOD MANUFACTURING PRACTICES and How to Achieve Them, from September 13-18, 1970 at the Ft. Harrison Hotel in Clearwater, Florida.

The purpose of the conference is to discuss, in length, the Good Manufacturing Practices regulations (GMP's) of the Food and Drug Administration and how to achieve them. An outstanding list of speakers from government and private industry has been

assembled to assure that the subject matter will be handled in a practical manner by attendants from all types of food industries. Personnel from the Food and Drug Administration and the Association of Food and Drug Officials of the U. S. will discuss GMP's from an authentic base, while outstanding authorities on espects of food control have been recruited from private industry.

T. G. LEE RECEIVES AWARD AT ADSA MEETING

T. G. Lee, dairy producer and distributor in central Florida, Orlando, was named Dean of the Florida Dairy Industry by the Florida Department of Dairy Science at the annual meeting of the American Dairy Science Association. The certificate of appreciation presented to Lee is in recognition of the years of leadership and dedicated service to the Florida Dairy Industry.

Lee has long been in the forefront of dairying in Florida. He grew up in Central Florida, attended the University of Florida, and served in the U. S. Air Corps in World War I. Mr. and Mrs. Lee launched their career as dairy people in 1925 with one family cow. Today, Mr. Lee owns Central Florida's most modern dairy plant in addition to the two dairies where 1500 lactating cows are housed. The Lee operations now employ more than 400 people.

Lee served on the Florida State Dairymen's Association committee on University facilities in 1948, fostering the present University of Florida Dairy Research Unit. He was a charter member of the Orange County Dairy Herd Improvement Association (DHIA), and helped to incorporate the Orange County Artificial Breeding Association—the first in Florida. Lee has long been an active advocate of the Cooperative Extension Service and a strong supporter of the youth programs.

MICHIGAN STATE SCIENTIST RECEIVES TEACHING AWARD

W. W. Snyder, a recent professor at Michigan State, received the ADSA Teaching Award posthumously at the annual meeting of the American Dairy Science Association. Snyder passed away on January 20, 1970.

Professor Snyder's responsibility has been largely in the teaching area, mainly in dairy cattle management. However, he did conduct research in milking management and dairy cattle housing. He was co-author of some 25 publications reporting results of the research. He did Extension work and was involved in the initial operation of the Michigan Animal Breeders Cooperative.

As a teacher and counselor he has been described by former students as totally committed to students — in the class room, as an academic advisor and friend, and in important committee assignments which are a part of the total teaching program.

He was advisor for the M.S.U. Dairy Club, an Agricultural Council Advisor, member of M.S.U. Faculty Committee on Student Affairs, and Chairman of a committee on special teaching innovations and improvement of instruction.

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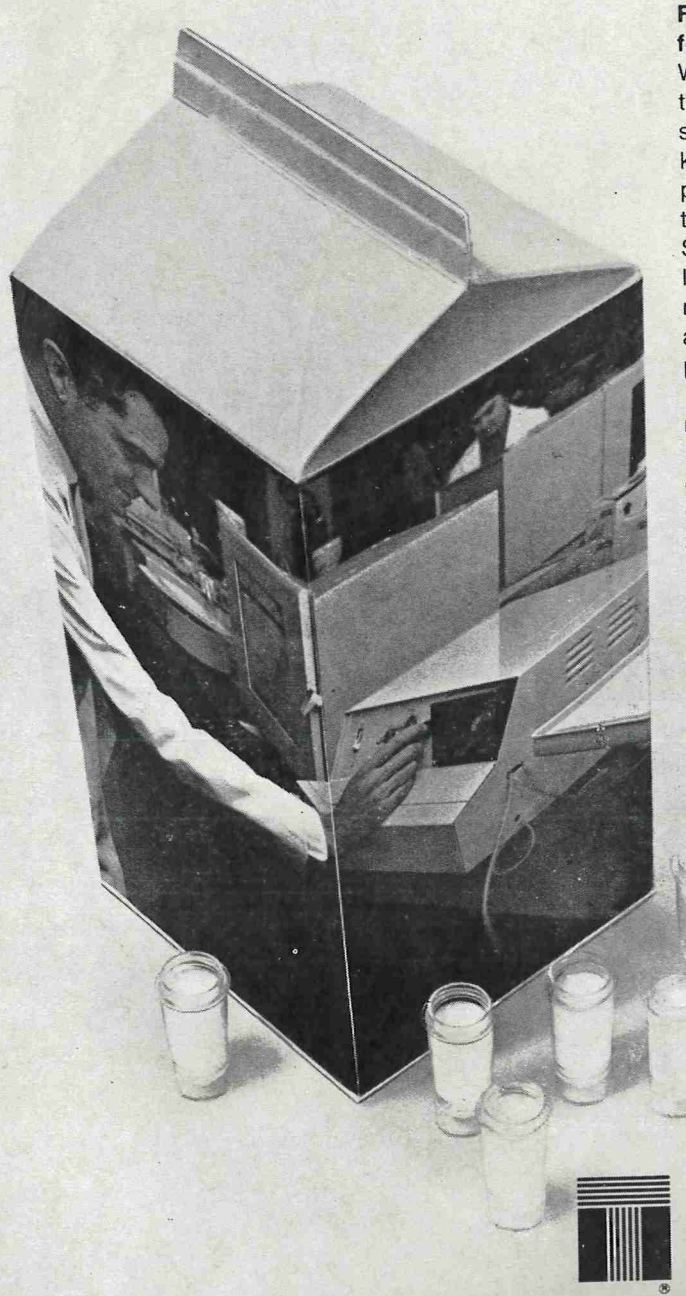

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