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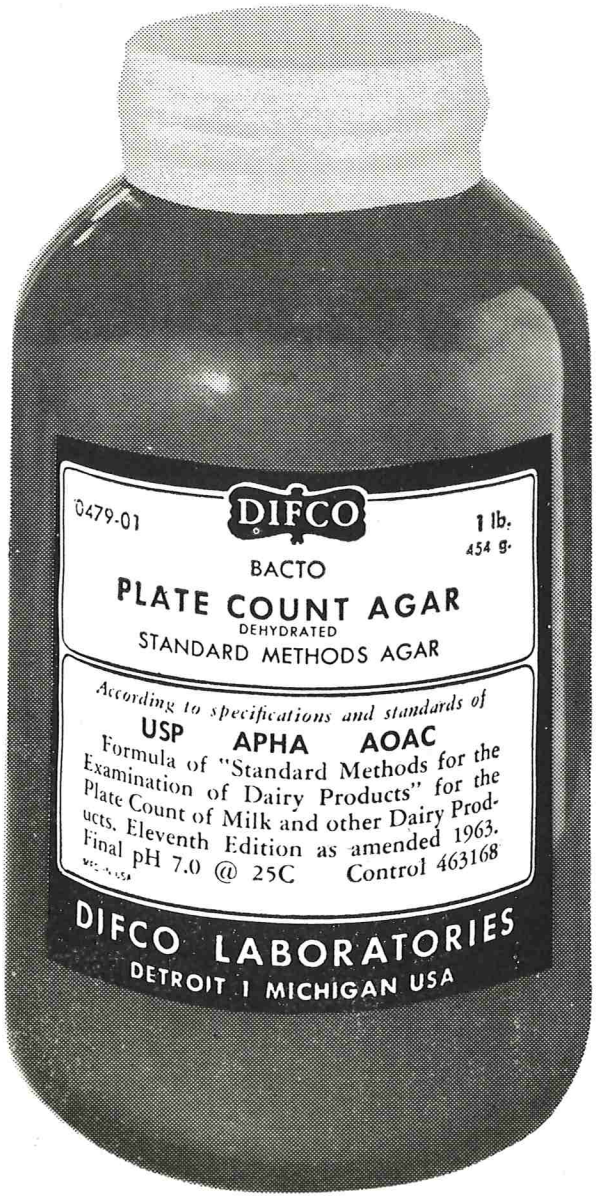
STANDARDIZATION OF MILK PLATING MEDIA

Report of the Coordinating Committee on Laboratory Methods

VOL. 53, NO. 8, A.J.P.H. 1305-1310, AUGUST, 1963

"It is recommended that media be used which has been tested by the APHA methods and bearing a label indicating that it has met the prescribed standards of the APHA."

This report of the Coordinating Committee on Laboratory Methods of the Committee on Evaluation and Standards (APHA) was approved by the Executive Board of the American Public Health Association on June 27, 1963.



TENTH EDITION 1953
ELEVENTH EDITION 1960
AMENDED 1963

QUALITY COMPARISONS OF HIGH-TEMPERATURE, SHORT-TIME AND ULTRA-HIGH-TEMPERATURE PASTEURIZED MILK[1]

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(Received for publication February 20, 1963)

Temperatures in excess of the usual high-temperature, short-time (HTST) temperatures for the pasteurization of milk and ice cream mix are being used by a number of commercial dairies, but reports of controlled experimental work with commercial equipment are still limited. Some speak of the lower ranges of ultra-high-temperature (UHT) pasteurization, i.e., 190-200 F, as "VHT" (very-high-temperature) pasteurization, reserving the term "UHT" for temperatures on up to the 300 F area. However, in this paper UHT means any of the temperatures between 192-300 F, and VHT will not be used.

PREVIOUS WORK

Although some of the earlier UHT milk had an objectionable cooked or scorched flavor, it is quite reasonable to expect no more cooked flavor from UHT temperatures of 193 F and higher with no essential holding period than from lower temperatures and correspondingly longer holding times. Quinn and Burgwald *(6)* and Dahlberg *(1)* determined that less cooked flavor will develop in milk pasteurized at 160 F for 15 seconds than at 145 F for 30 minutes. Studies reported in 1951 *(9)* indicated that ice cream mix may be pasteurized at temperatures above the boiling point with no deleterious effect on flavor. This indicates that cooked flavor is more a function of the time above a certain temperature than of the maximum temperature used or that heat-induced changes result from a cummulative effect that includes heat-up time, temperature reached, holding time at the peak temperature and cooling time.

Marquardt and Dahlberg *(5)*, in studying the influence of the temperature of the heating medium, reported that there was no correlation between the fat content of the milk and a cooked flavor development in milk pasteurized at 62 C (143.6 F). They did find an increase in cooked flavor in cream as compared to milk and also an increase as the fat content of the cream was raised.

Keeping quality is of major concern to processors. With a definite trend toward consolidation, and consequent longer hauls of raw and pasteurized milk, plus the elimination of dating, shelf life becomes a vital point of comparison. Considerable work has been done at the University of Illinois and at North Carolina State College on the survival of bacteria in milk exposed to UHT *(4, 7)*. In comparing steam injection UHT pasteurization at 194 F and approximately three-quarters of a second hold with 143 F for 30 minutes and with 161 F for 15 seconds, Speck *(8)* reported that bacterial counts were markedly lower at 194 F and only the most heat-resistant types of bacteria would survive.

Pasteurization at 206 F for 3 seconds was reported by Franklin *et al (3)* to be much superior bacteriologically to pasteurization at 176 F for 16 seconds and to increase shelf life to 30 days when the milk was stored at 45 F. Claims of keeping ability in excess of 3 weeks have been made for milk pasteurized at 220 F for 2 seconds and at other higher temperatures, but the present writer has not found actual substantiating data.

MATERIALS AND METHODS

The primary purposes of this investigation when it was started in July 1960 were to see if milk of good flavor and better keeping quality could be processed in our commercial HTST plate type equipment at temperatures in excess of 193 F as compared with 172 F for 16 seconds. Previous trial runs had resulted in some consumer complaints of too much cooked flavor when temperatures of 195-196 F and 3 seconds holding time were used. However, in those runs it was found that at the low press capacity, with 4½ feet of 1½-inch sanitary tubing between the flow diversion valve discharge and the pasteurized regenerator section inlet, the velocity was so low that it added greatly to the actual holding time. Consequently, a rather strong sulphide cooked taste resulted. Reduction of this tubing to a 1-inch size greatly reduced the flavor problem. This reduced the calculated flow time from the flow diversion valve into the regenerator from 3 seconds to 1.3 seconds.

More plates were added to the P-5[2], 3600-lb/hr HTST press to take care of the regeneration and cooling when heating to 193 F or higher. An 18-inch holding tube 1½ inches in diameter with a 1-second holding time replaced the 16-second holding

[1]Scientific Contribution No. 22, Agricultural Experiment Station, University of Connecticut, Storrs.

tube[3]. A single chamber Vacu-Therm[2] located between the regenerator and timing pump was run at a vacuum to provide a flash cooling of 5 F on all UHT and HTST comparison runs. All milk was homogenized.

The raw milk was stored in a 1000-gallon storage tank and was properly agitated. Five runs were made using raw milks of 3.6 - 3.9% fat, part of each run being processed under HTST conditions at 172 F for 16 seconds and part under UHT at 193 F. Thus, there was always a common raw milk of identical score on a given day for the UHT and HTST trials. Samples were taken in sterile sample bottles as the milk left the final cooler section, and quart-bottle samples were saved from the commercial glass bottle filler to observe any differences in the method of sampling and to obtain samples processed and filled completely under commercial conditions. The pasteurized milk lines and filler were completely drained of UHT or HTST milk in switching from one to another. Fifteen minutes then elapsed before saving any samples.

Flavor scores of the raw milk were determined by two trained judges immediately prior to pasteurizing and of all pasteurized samples at the end of 1, 7, 14, 21, and 28 days unless previously spoiled. The scoring was done on a rigid basis, a score of 40 being reserved for a perfect milk. A very light cooked flavor was scored as 39.5.

Coliform counts, standard plate counts (SPC) and psychrophilic counts were made at 0, 7, 14, 21, and 28 days. The psychrophilic plates were incubated at 5 C for 7 days, SPC plates at 35 C for 48 hours, and coliform plates (violet red bile agar) at 35 C for 24 hours.

In the early stages of this project a user of UHT plate equipment had experienced some consumer complaints of cooked flavor in high fat milk. Therefore, some separate trials were included to determine if differences occurred between high and low fat milks. Such might be anticipated, as more sulfhydril compounds might logically be produced from high serum-solids milk than from low. Conversely, one might presume that the addition of 1% of fat might tend to mask the possible increased cooked flavor.

Raw milks of approximately 3.6% and 4.6% fat were pasteurized at 193.5 F and compared with the same milks pasteurized at 172 F for 16 seconds. The raw milks used had scores as close as possible on any given day, always within 0.5 point of each other, generally 39 each, so that there would not be a feed flavor in the pasteurized samples. All milks received a vacuum treatment (5 F) between the regenerator and the heater and were homogenized.

[2]Manufactured by The DeLaval Separator Company, Poughkeepsie, New York.

[3]The calculated Reynold's No. for this tube is approximately 39,000.

RESULTS AND DISCUSSION

The data on flavor scores in Table 1 not only show no appreciable cooked flavor in the UHT milk the first day after processing, but also show no difference in scores between the UHT and HTST pasteurized milks. Although differences in flavor scores in favor of the UHT milk might be expected after 1-3 weeks in storage because of flavor deterioration in the HTST samples, at the end of 7 days both milks had essentially the same scores as at the end of 1 day. At the end of 14 days there was a drop of but 0.20 - 0.25 points in the average scores, there being little difference between the UHT and HTST samples. No sample scored below 38.5. It should be kept in mind that the HTST milk was pasteurized at 172 F rather than at 161 F; this might be expected to improve keeping quality considerably.

No spoiled sample was given a score below 32, this score being set as the arbitrary minimum to provide a value to use in computing the average scores at 21 and 28 days in case one or more samples had deteriorated to this extent. After 21 days some samples were cut as "lacking freshness" or slightly stale. Samples which scored 35-37 were bitter or slightly fruity, and samples that scored 32 were bitter and high acid.

TABLE 1. COMPARISON OF FLAVOR SCORES AFTER UHT AND HTST PASTEURIZATION (SUMMARY OF FIVE TRIALS)

Storage period at 36 F	Flavor scores after treatment indicated			
	UHT[a] - S.B.[b]	UHT - C.B.[c]	HTST[d] - S.B.	HTST - C.B.
1 day	39.50	39.50	39.55	39.55
7 days	39.45	39.50	39.50	39.50
14 days	39.40	39.25	39.30	39.30
21 days	37.10	37.15	36.85	38.40
28 days	37.00	35.65	35.65	35.50

[a]UHT = 193.5 F for 1 sec; [b]S.B. = Sterile Bottle; [c]C.B. = Commercial glass milk bottle; [d]HTST = 172 F for 16 sec.

Both the SPC's (Table 2) and psychrophile counts (Table 3) favored the UHT milk. All five samples of the UHT milks taken in sterile bottles had SPC counts of <300/ml at 0 and 7 days while 3 of the HTST samples had counts below 300/ml. After 21 and 28 days storage more high counts were found in the HTST milk samples, although this was not true for the commercially bottled milk. Psychrophile counts increased to a greater extent in the case of the HTST milks than for the UHT milks after 14 days, but it was found generally that they had to exceed 10 million per ml before they reflected a lower flavor score.

TABLE 2. COMPARISON OF STANDARD PLATE COUNTS OF MILK AFTER UHT AND HTST PASTEURIZATION (SUMMARY OF FIVE TRIALS)

Storage period at 36 F	Count range[a]	Number and type of samples in count range indicated			
		UHT[b] - S.B.[c]	UHT - C.B.[d]	HTST[e] - S.B.	HTST - C.B.
0 days	<300	5	3	3	2
	300 - 3,000	0	1	2	3
	3,000 - 30,000	0	1	0	0
7 days	<300	5	3	3	0
	300 - 3,000	0	2	2	5
14 days	<300	2	0	2	1
	300 - 3,000	1	1	1	3
	3,000 - 30,000	0	2	0	1
	30,000 - 300,000	2	2	2	0
21 days	<3,000	2	1	2	2
	3,000 - 30,000	1	1	1	2
	30,000 - 300,000	2	3	1	1
	>300,000	0	0	1	0
28 days	<3,000	2	0	2	0
	3,000 - 30,000	0	1	1	2
	30,000 - 300,000	2	2	0	2
	300,000 - 3,000,000	1	1	0	0
	>3,000,000 or discarded because spoiled	0	1	2	1

[a]Raw milk counts on the 5 trial milks were 79,000; 150,000; 160,000; 280,000 and 550,000.
[b]UHT = 193.5 F for 1 sec; [c]S.B. = Sterile bottle; [d]C.B. = Commercial glass milk bottle; [e]HTST = 172 F for 16 sec.

TABLE 3. COMPARISON OF PSYCHROPHILE COUNTS IN MILK AFTER UHT AND HTST PASTEURIZATION (SUMMARY OF FIVE TRIALS)

Storage period at 36 F	Count range	Number and type of samples in count range indicated			
		UHT[a] - S.B.[b]	UHT - C.B.[c]	HTST[d] - S.B.	HTST - C.B.
0 days	<300	5	4	5	5
	300 - 3,000	0	1	0	0
7 days	<300	1	3	0	4
	300 - 3,000	1	1	3	1
	3,000 - 30,000	3	1	2	0
14 days	<3,000	3	1	3	2
	3,000 - 30,000	0	1	0	0
	30,000 - 300,000	0	0	0	1
	300,000 - 3,000,000	1	3	1	2
	>3,000,000	1	0	1	0
21 days	<3,000	2	0	1	0
	3,000 - 30,000	0	1	0	0
	30,000 - 300,000	1	1	2	0
	300,000 - 3,000,000	2	1	0	2
	3,000,000 -30,000,000	0	1	2	3
	>30,000,000 or discarded because spoiled	0	1	0	0
28 days	<3,000	2	0	1	0
	3,000 - 30,000	1	0	0	0
	30,000 - 300,000	1	0	1	0
	300,000 - 3,000,000	0	1	0	0
	3,000,000 -30,000,000	1	1	2	3
	>30,000,000 or discarded because spoiled	0	3	1	2

[a]UHT = 193.5 F for 1 sec; [b]S.B. = Sterile Bottle; [c]C.B. = Commercial glass milk bottle; [d]HTST = 172 F for 16 sec.

TABLE 4. COMPARISON OF COLIFORM COUNTS OF MILK AFTER UHT AND HTST PASTEURIZATION (SUMMARY OF FIVE TRIALS)

Storage period at 36 F	Count range	Number and type of samples in count range indicated			
		UHT[a] - S.B.[b]	UHT - C.B.[c]	HTST[d] - S.B.	HTST - C.B.
0 days	<1	5	4	5	4
	1 - 10	0	1	0	1
7 days	<1	5	4	5	4
	1 - 10	0	1	0	1
14 days	<1	5	3	4	4
	1 - 10	0	1	0	1
	10 - 100	0	0	1	0
	>100 or discarded because spoiled	0	1	0	0
21 days	<1	5	3	3	5
	1 - 10	0	1	0	0
	10 - 100	0	0	0	0
	>100	0	1	2	0
28 days	<1	5	1	3	3
	1 - 10	0	1	0	0
	10 - 100	0	0	0	0
	>100 or discarded because spoiled	0	3	2	2

[a]UHT = 193.5 F for 1 sec; [b]S.B. = Sterile Bottle; [c]C.B. = Commercial glass milk bottle; [d]HTST = 172 F for 16 sec.

Although the counts on violet red bile agar (Table 4) were uniformly negative in UHT and HTST samples collected in sterile bottles at 0 and 7 days, some HTST samples showed high counts upon further storage. The colonies on the violet red bile agar were not confirmed as coliforms; consequently, there is some doubt as to their identity.

The flavor score data from the high-fat, low-fat milk comparisons are contained in Table 5. The values represent the differences in score between the UHT high-fat milk and HTST high-fat milk and the differences between the low-fat milks processed by each system. The flavor scores of the day-old high-fat milks averaged very slightly higher than those of the low-fat, while the reverse was true at the end of 7 and 14 days. Consumer complaints were not received from either milks that were included randomly in home deliveries or in the University Creamery salesroom 24 - 48 hours after pasteurization.

CONCLUSIONS

Milk can be pasteurized in plate-type equipment at temperatures approximating 193-194 F for 1 second without imparting objectionable cooked flavors. Keeping quality may be about the same as that of milk pasteurized at 172 F for 16 seconds. The keeping quality of either of these milks should be very good when stored at 36 F. High-fat milk pasteurized at UHT did not present more flavor problem than low-fat milk similarly processed.

ACKNOWLEDGMENTS

The writer appreciates the help of Dr. A. C. Smith in the flavor scoring of all the samples and of George Norman for his assistance in the plant.

TABLE 5. DEVIATION OF FLAVOR SCORES OF HIGH FAT AND LOW FAT UHT MILKS FROM SCORES OF DUPLICATE HTST MILKS

Trial	Storage period at 35 F					
	1 day		7 days		14 days	
	High fat	Low fat	High fat	Low fat	High fat	Low fat
I	0.0	0.0	-0.25	0.0	+0.25	+0.50
II	-0.25	0.0	-1.00	-0.50	-0.50	+0.25
III	-1.00	-1.50	-0.50	-0.50	-0.25	-0.50
Avg diff.	-0.42	-0.50	-0.58	-0.33	-0.17	+0.08

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THE ENUMERATION OF PSYCHROPHILIC MICROORGANISMS IN DAIRY PRODUCTS[1]

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ABSTRACT

The eleventh edition of *Standard Methods for the Examination of Dairy Products* sanctions optional use of incubation temperatures and times (5-7 C for 7-10 days) for determination of the psychrophilic bacterial count of dairy products. This study shows that this 2 degree difference in incubation temperature, the 3 day difference in incubation time and a combination of these factors could be responsible for a significant variation in psychrophilic bacterial counts. A total of 67 raw milk, 58 pasteurized milk, 19 ice cream and eight cottage cheese samples were plated at 5 and 7 C for 7 and 10 days. Significantly higher counts were obtained after 10 days than after 7 days incubation at both temperatures; however, greater increases in counts resulted from raising the temperature from 5 to 7 C. Highest counts were obtained at 7 C for 10 days. A total of 559 isolates were picked from plates of 12 milk samples that had been incubated at 5 and 7 C for 7 days and 7 C for 10 days. Classification of the isolates indicated that variations in counts were due to differing abilities of organisms within genera to grow at low temperatures and not to preferential growth of different genera. Adoption of one incubation temperature and time for the determination of psychrophilic bacterial counts is recommended.

Organisms capable of growing at refrigeration temperatures long have been recognized as a primary cause of dairy product spoilage. The problem of enumeration of these organisms has been considered by many workers. Numerous incubation temperature and time combinations for psychrophilic bacterial counts can be found in the literature. Thomas *(9)* listed 28 such combinations used by various workers, with temperatures ranging from 0 to 25 C and times ranging from 3 to 28 days. Problems arising in the enumeration of psychrophilic bacteria have been reviewed by Davis *(5)*, Ingraham and Stokes *(6)*, Witter *(12)* and Baumann and Reinbold *(2)*.

Holding plates at 5-7 C for 7-10 days is suggested by the eleventh edition of *Standard Methods for the Examination of Dairy Products (1)*. This work was undertaken to determine if the difference in incubation temperature from 5 to 7 C, the difference in incubation time from 7 to 10 days or a combination of both factors would be sufficient to cause a significant variation in the psychrophilic bacterial count of dairy products.

EXPERIMENTAL PROCEDURE

A total of 67 raw milk samples, representing both can and bulk tank manufacturing grade and grade A milk, were obtained from six different Iowa dairy plants. Nineteen samples of ice cream, eight samples of cottage cheese and 58 samples of commercially pasteurized milk were obtained from quality control samples received by the Food Products Analysis Laboratory.

Procedures for preparing dilutions and plating were those outlined in "Standard Methods" *(1)*. Sextuplet platings of each dilution were poured with Standard Methods agar *(1)*; three plates of each dilution were placed at 5 and 7 C. Indicating thermometers, previously calibrated against a standard thermometer, were placed in each incubator. Temperatures were checked by a recording thermometer and were found to vary less than $\pm$ 0.5 C.

Colonies were counted with the aid of a Quebec colony counter after 7 and 10 days incubation. Plates were protected from airborne contamination by being counted, unopened, in an inverted position. The location of each colony was marked with ink on the bottom of each plate. Different colored inks were used for each incubation time to designate those colonies that were countable at 7 days and those that

[1]Journal Paper No. J-4299 of the Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa. Project No. 1050.

TABLE 1. LOGARITHMIC MEANS OF COUNTS OF COTTAGE CHEESE, ICE CREAM, RAW AND PASTEURIZED MILK SAMPLES

Product	No. samples	Incubation temperature				Ratio
		5 C		7 C		
		7 days	10 days	7 days	10 days	7 C, 10 d/ 5 C, 7 d
		(Count/ml)				
Cottage cheese	8	2.5	21	44	62	24.8
Ice cream	19	37	170	360	610	16.5
Raw milk	67	8,500	16,000	28,000	50,000	5.9
Pasteurized milk	58	21,000	32,000	43,000	55,000	2.6

TABLE 2. ANALYSIS OF VARIANCE OF COUNTS OF RAW AND PASTEURIZED MILK SAMPLES OBTAINED BY INCUBATION OF PLATES AT 5 AND 7 C FOR 7 AND 10 DAYS

Source of variation	Degrees of freedom	Sum of squares	Mean square	F
Type of product	1	6.254	6.254	
Samples within type of product	123	1092.904	8.88	
Temperature	1	19.729	19.729	70.46[a]
Temperature x type of product	1	1.581	1.581	5.64
Error (a)	124	34.599	0.28	
Days	1	5.445	5.445	53.38[b]
Days x temperature	1	0.081	0.081	0.79
Days x type of product	1	0.485	0.485	4.75
Error (b)	247	25.300	0.102	

[a]F = mean square ÷ error (a) mean square
[b]F = mean square ÷ error (b) mean square

became countable by 10 days. Plates were counted at the end of 7 days incubation, marked with ink and retained in the incubator to be recounted at the end of 10 days. Counting was done in the incubator to prevent moisture condensation from obscuring colonies and to avoid warming of the plates which could have influenced the appearance of colonies between 7 and 10 days. Psychrophilic bacterial counts were computed by arithmetically averaging colony counts from triplicate plates and multiplying by the reciprocal of the dilution used. Usually, only plates with between 30 and 300 colonies were selected for counting. Plates with fewer than 30 colonies at 5 C were selected for counting if the corresponding plates at 7 C had more than 30 colonies. Plates with fewer than 30 colonies after 7 days incubation were counted if it was felt that the counts after 10 days incubation would surpass 30. Except where differences in counts were more than tenfold, plates of the same dilution at 5 and 7 C were selected for counting and picking to reduce errors resulting from plating procedure.

Six samples of raw milk and six samples of pasteurized milk were selected at random from among those used for psychrophilic bacterial counts. Colonies which had appeared at 5 and 7 C in 7 days and at 7 C between 7 and 10 days were picked into tubes of sterile litmus milk. Single plates representing each temperature treatment were selected. Where possible, plates with 15-30 colonies were used to reduce error resulting from unequal distribution of colonies of different genera within plates. Otherwise, approximately 20 colonies from each plate were selected by picking all colonies within a predesignated zone. After purity had been determined, inoculations were made into media suggested primarily by the *Manual of Microbiological Methods (8)* for classification of the isolates. *Bergey's Manual of Determinative Bacteriology (4)* was consulted for identification of the organisms.

RESULTS

Effect of time and temperature of incubation upon the psychrophilic bacterial count.

Logarithmic means of psychrophilic bacterial counts of various dairy products obtained at 5 C and 7 C for 7 and 10 days are shown in Table 1. This table also presents the logarithmic mean ratios between counts at 7 C for 10 days compared with counts at 5 C for 7 days. The great disparities that exist between counts on the same sample when obtained by incubation at these temperatures and times were further reflected by the range in ratios for individual samples: cottage cheese, 4.5 to 600; ice cream, 1.5 to 720; pasteurized milk, 0.9 to 156; raw milk, 1.02 to 1,370.

The analysis of variance of the counts of raw and pasteurized milk samples is shown in Table 2. Values of F for variations in counts resulting from temperature of incubation and days of incubation were significant at the 1% level. Increasing the temperature from 5 to 7 C was found to increase counts more than increasing the incubation time from 7 to 10 days. In addition, results of "t" tests showed greater differences in counts obtained at 5 C at 7 and 10 days

than in counts obtained at 7 C at 7 and 10 days. Interaction between temperature and type of product and between days and type of product was significant at the 5% level of F.

Types of microorganisms contributing to counts.

In an attempt to determine whether differences in counts obtained from plates incubated at 5 or 7 C for 7 or 10 days were due to the types of microorganisms present, 559 isolates representing six samples of raw milk and six samples of pasteurized milk were identified as to genus. The number of organisms representing each genus was considered in relation to the total psychrophilic bacterial counts of the samples. These results are shown in Tables 3 and 4.

Members of ten different genera were picked from the plates. *Pseudomonas* appeared in nine samples, *Micrococcus* in seven and *Achromobacter* were found in five different samples.

Tables 3 and 4 reveal a general tendency for members of the various genera to increase in number as the plate incubation temperature and time are increased. Considering the calculated numerical response by individual genera per sample, 26 increases in count occurred as the plate incubation temperature and time were changed from 5 C for 7 days to 7 C for 7 days. In eight instances, the count per genus decreased; in one instance, there was no change in count. As plate incubation conditions were changed from 5 C for 7 days to 7 C for 10 days, 28 increases and seven decreases in count of an individual genus per sample occurred. Using a 7 C incubation temperature, an increase of plate incubation time from 7 to 10 days produced 17 increases, 12 decreases and six instances of no change in count of individual genera per sample.

DISCUSSION

Effect of time and temperature of incubation upon the psychrophilic bacterial count.

As the temperature of incubation approaches the optimum temperature for a group of microorganisms, plate counts of a culture of these organisms are expected to increase to a maximum. Similarly, as the time of incubation of a culture increases, counts are expected to eventually reach a maximum. The temperature yielding highest counts of most psychrophilic microorganisms has been established in the vicinity of 20 C *(5, 7)*. Therefore, counts obtained at 5 C

TABLE 3. THEORETICAL DISTRIBUTION OF GENERA WITHIN THE PSYCHROPHILIC BACTERIAL FLORA OF RAW MILK SAMPLES

Sample No.	Genus	Incubation temperature and time: 5 C - 7 days	7 C - 7 days	7 C - 10 days
		(Organisms/ml)		
R 1	*Pseudomonas*	3,140[a] (26)	2,600 (8)	2,820 (3)
	Micrococcus	240[b] (2)	2,280 (7)	2,820 (4)
	Streptococcus	120[c] (1)	320 (1)	260 (-)
	Total	3,500[d] (29)[e]	5,200 (16)[f]	5,900 (7)[g]
R 2	*Pseudomonas*	320 (10)	360 (1)	350 (-)
	Micrococcus	220 (7)	3,220 (9)	7,740 (13)
	Flavobacterium	---- (-)	720 (2)	1,060 (1)
	Streptococcus	60 (2)	---- (-)	350 (1)
	Total	600 (19)	4,300 (12)	9,500 (15)
R 3	*Pseudomonas*	353,000 (21)	471,000 (19)	493,000 (3)
	Micrococcus	17,000 (1)	49,000 (2)	67,000 (1)
	Total	370,000 (22)	520,000 (21)	560,000 (4)
R 4	*Pseudomonas*	420,000 (7)	---- (-)	---- (-)
	Micrococcus	60,000 (1)	700,000 (1)	500,000 (-)
	Aerobacter	600,000 (10)	2,800,000 (4)	5,500,000 (7)
	Escherichia	120,000 (2)	10,500,000 (15)	12,000,000 (9)
	Total	1,200,000 (20)	14,000,000 (20)	18,000,000 (16)
R 5	*Pseudomonas*	77,000 (3)	528,000 (3)	440,000 (-)
	Achromobacter	104,000 (4)	880,000 (5)	734,000 (-)
	Aerobacter	207,000 (8)	1,060,000 (6)	1,330,000 (3)
	Escherichia	52,000 (2)	355,000 (2)	2,350,000 (14)
	Flavobacterium	---- (-)	177,000 (1)	146,000 (-)
	Total	440,000 (17)	3,000,000 (17)	5,000,000 (17)
R 6	*Micrococcus*	1,800,000 (16)	3,700,000 (17)	35,000,000 (13)
	Total	1,800,000 (16)	3,700,000 (17)	35,000,000 (13)

[a] [b] [c] Theoretical no. of organisms in each genus calculated from actual psychrophilic bacterial count/ml

[d] actual psychrophilic bacterial count/ml

[e] actual no. of isolates picked from plate incubated at 5 C-7 days

[f] actual no. of isolates picked from comparable plate incubated at 7 C-7 days

[g] actual no. of isolates picked that had developed on same plate in 3 days *after* the 7 C-7 day count (f + g = representative portion of the total flora on a 7 C-10 day plate).

TABLE 4. THEORETICAL DISTRIBUTION OF GENERA WITHIN THE PSYCHROPHILIC BACTERIAL FLORA OF PASTEURIZED MILK SAMPLES

Sample No.	Genus	Incubation temperature and time: 5 C - 7 days	7 C - 7 days	7 C - 10 days
		(Organisms/ml)		
P 1	*Pseudomonas*	800[a] (3)	2,130 (6)	3,470 (7)
	Achromobacter	260[b] (1)	---- (-)	---- (-)
	Micrococcus	---- (-)	710 (2)	534 (-)
	Flavobacterium	260[c] (1)	360 (1)	266 (-)
	Alcaligenes	3,980[d] (15)	3,900 (11)	3,730 (3)
	Total	5,300[e] (20)[f]	7,100 (20)[g]	8,000 (10)[h]
P 2	*Pseudomonas*	1,050 (11)	22,800 (19)	27,800 (5)
	Achromobacter	570 (6)	---- (-)	---- (-)
	Micrococcus	280 (3)	1,200 (1)	1,200 (-)
	Total	1,900 (20)	24,000 (20)	29,000 (5)
P 3	*Pseudomonas*	---- (-)	---- (-)	1,500 (3)
	Achromobacter	4,500 (9)	2,900 (4)	2,000 (-)
	Streptococcus	3,000 (6)	11,100 (15)	10,500 (6)
	Leuconostoc	1,000 (2)	---- (-)	---- (-)
	Total	8,500 (17)	14,000 (19)	14,000 (9)
P 4	*Proteus*	16,000,000 (20)	22,000,000 (21)	22,000,000 (-)
	Total	16,000,000 (20)	22,000,000 (21)	22,000,000 (-)
P 5	*Pseudomonas*	5,400,000 (18)	6,300,000 (20)	6,300,000 (-)
	Total	5,400,000 (18)	6,300,000 (20)	6,300,000 (-)
P 6	*Achromobacter*	50 (15)	73 (10)	107 (2)
	Alcaligenes	---- (-)	37 (5)	133 (10)
	Total	50 (15)	110 (15)	240 (12)

[a, b, c, d]Theoretical no. of organisms in each genus calculated from actual psychrophilic bacterial count/ml
[e]actual psychrophilic bacteria count/ml
[f]actual no. of isolates picked from plate incubated at 5 C-7 days
[g]actual no. of isolates picked from comparable plate incubated at 7 C-7 days
[h]actual no. of isolates picked that had developed on same plate in 3 days *after* the 7 C-7 day count (g + h = representative portion of the total flora on a 7 C-10 day plate).

naturally would be expected to be lower than those obtained at 7 C, since the lower temperature is further from that generally considered optimum for most psychrophilic organisms. It also would seem reasonable that, at either of these temperatures, higher counts will be obtained after 10 days than after 7 days incubation. Even greater differences would be expected between counts obtained at the lower temperature and shorter time than those obtained at the higher temperature and longer time.

The results presented show statistically significant differences among counts obtained within the range of temperature and time of incubation specified in "Standard Methods" *(1)*. In many instances, colony size was responsible for these count differences, particularly between 5 and 7 C. Frequently, colonies were too small to be counted accurately at the lower temperature or shorter incubation time. Although it was possible to detect the presence of colonies, accurate counting was impossible at the magnification provided by a Quebec colony counter. Incubation at 7 C for 7 days, or at either 5 or 7 C for 10 days, usually resulted in colonies large enough to be counted. Van der Zant and Moore *(11)* found colonies on plates incubated at 5 C for 7 days difficult to count because of the small size. Boyd *et al. (3)* discontinued using incubation at 5 C for 7 days because the resulting colonies were small and difficult to count.

Table 1 shows that differences in counts were greater in some types of products than in others. Cottage cheese samples showed the greatest differences in counts, followed by ice cream and raw milk. The smallest differences among counts were observed in pasteurized milk samples. This suggests that different types of organisms may contribute to the psychrophilic count. The data, however, indicate that the types of organisms usually are alike. The high counts on the pasteurized milk were due to their age, since they were commercial samples obtained through the Food Products Analysis Laboratory from local grocery stores after considerable storage. Because of the small numbers of samples, comparisons of counts of ice cream and cottage cheese should be made with caution.

The products which showed the greatest increases in count with increasing temperature and time of incubation were found to have the lowest count at any given temperature and time. Disregarding types of products, samples with lower psychrophilic populations demonstrated greater increases in counts as temperature or time were increased. This agrees with the findings of Thomas *et al. (10)* who compared counts obtained at 3-5 C for 10 days with counts obtained at 7 C for 10 days. Higher ratios (7 C, 10 days/3-5 C, 10 days) were obtained with samples giving low counts at 3-5 C. Although there usually

are wide variations between counts, samples with higher counts at 5 C for 7 days show smaller increases. This may account for the differences among products in Table 1.

Of the 58 pasteurized milk samples, 21 had the same count at 7 C for both 7 and 10 days. The results, which show a significant difference in counts obtained at 7 and 10 days, must be interpreted carefully. The average difference in count was found to be statistically significant. Therefore, one would expect differences in counts among a large number of samples. For any one sample, however, it cannot be said that incubation at 7 C for 10 days will result in a higher count than incubation at 7 C for only 7 days. Thirty-seven of the 58 samples did show increases large enough to significantly affect the average increase. This indicates that, for any one sample, one may obtain a higher count at 10 days than at 7 days. In some instances, the count at 10 days may be considerably higher than at 7 days. To obtain the highest counts, 7 C for 10 days should be used in the method suggested by "Standard Methods" *(1)*.

The range of logarithmic mean ratios for individual products has been given to emphasize the extreme variability that could exist between counts on the same sample obtained by different laboratories, both operating within recommendations made by "Standard Methods" *(1)*.

Types of microorganisms contributing to the psychrophilic bacterial count.

As mentioned previously, differences in counts obtained at different incubation temperatures may result from preferential growth of different types of organisms. Some organisms may grow better at lower temperatures than others. Thermoduric organisms have been known to appear on psychrophilic plates incubated at 10 C. Thomas *et al. (10)*, however, found no thermoduric bacteria contributing to counts obtained at 7 C for 10 days. If this is true, thermoduric microorganisms should not influence the count when plates are incubated at 7 C for 10 days to obtain maximum counts.

The results in Tables 3 and 4 indicate no tendency for one type of organism to occur more frequently at the lower temperature or the shorter incubation time than at the higher temperature or longer time. Where decreases in the count of an individual genus occurred with an increase in plate incubation temperature or time, the decreases were usually insignificant, resulting only from mathematical calculations based on relatively few colonies.

Tables 3 and 4 show that no single genus caused most of the differences between counts. Each of the ten different genera, in one sample or another, increased progressively in number as the incubation temperature and time were increased. In some samples, the increase in numbers of a particular genus was striking, in others, negligible. Variations in counts, therefore, appeared to be due to differing abilities of organisms within each genus to grow at low temperatures.

SUMMARY

Psychrophilic bacterial counts were determined for samples of cottage cheese, ice cream and raw and pasteurized milk. Plates were incubated at 5 and 7 C for 7 and 10 days.

Results obtained showed significantly higher counts after 10 days than after 7 days incubation at both temperatures. Counts obtained at 7 C for 7 days were higher than counts obtained at 5 C for 10 days. Highest counts were obtained at 7 C for 10 days. Greater increases in counts resulted from raising the temperature from 5 to 7 C rather than from lengthening the time from 7 to 10 days.

Identification of organisms isolated from plates of raw and pasteurized milk samples indicated that the significant differences in counts had not resulted from preferential growth of different genera of organisms because of different temperature and time treatments. Instead, variations in counts were due to differing abilities of organisms within each genus to grow at low temperatures.

In the interest of obtaining greater reproducibility among testing laboratories, it is recommended that one time and temperature combination for plate incubation be adopted for determination of the "Psychrophilic Bacterial Count."

CONCLUSIONS

The conditions of incubation selected for psychrophilic bacterial counts depend largely upon the worker's definition of psychrophilic microorganisms. Predilection for some definitions would require incubation below 5 C; other definitions allow incubations above 7 C. In any case, maximum counts of microorganisms included in the definition usually are desired. If the plating procedure in "Standard Methods" *(1)* is followed, organisms producing colonies on plates within 7-10 days at 5-7 C would be considered as psychrophilic. Among these temperatures and times, 7 C for 10 days yielded highest counts. Whether this is the "best" temperature and time for enumeration of psychrophilic organisms may be debatable. Within the suggested range of incubation conditions, however, significant variation in counts occurs. If one particular temperature and time combination were adopted, reproducibility of counts among laboratories would be more likely than at present.

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EFFECT OF TEMPERATURE AND TIME OF PLATE INCUBATION ON THE ENUMERATION OF PASTEURIZATION-RESISTANT BACTERIA IN MILK[1]

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Abstract

This study was undertaken to determine the effect of temperature and time of plate incubation upon the count of thermoduric bacteria in milk. Specific types of thermoduric bacteria in pure culture, as well as those present in the mixed flora of commercial milk samples, were enumerated. Plate incubation at 28 C for 4 days was the temperature-time combination that produced the highest thermoduric bacterial count with laboratory-pasteurized milk. Incubation at 21, 32 or 35 C gave lower counts. Thermoduric bacteria subjected to pasteurization were more exacting in their growth temperature requirements than were unheated bacteria. Cultures of *Arthrobacter* sp., *Micrococcus varians* and *Streptococcus* sp. grew over a much wider temperature range before laboratory pasteurization than after the heat treatment. The incubation temperature and time currently recommended for the standard plate count, while presumably adequate for the enumeration of bacteria in raw milk, may not be equally satisfactory for the determination of the maximum viable bacterial population of pasteurized milk.

Recent changes in milk production and handling practices have necessitated reappraisal of certain bacteriological tests. Tests applied directly to raw milk are not always effective in detecting faulty production practices because the growth of bacteria in raw milk is greatly retarded by efficient cooling. Therefore, tests for specific groups of organisms that might serve as indices of contamination are now receiving considerable attention.

The count of laboratory-pasteurized samples has been suggested as an index of unsanitary milk handling. The most common procedure for determining the viable bacterial population of milk is the agar plate method as outlined in *Standard Methods for the Examination of Dairy Products (6).* In this procedure, plates are incubated at 35 or 32 C for 48 ± 3 hr for both the standard plate count of raw or commercially-pasteurized milk and the thermoduric bacterial count of laboratory-pasteurized milk.

Incubation at 37 C for 2 days was originally employed to give pathogens that might be present in milk an opportunity to develop at their optimum growth temperature. This procedure had been followed for over 20 years before studies *(2, 13, 16, 19)* revealed that 32 C was nearer the optimum for many bacteria found in milk. The eighth edition of *Standard Methods for the Examination of Dairy Products (3)* recognized incubation at either 37 or 32 C for 48 hr for the agar plate method. Later reports *(8, 24)* concerning plate counts on raw and commercially pasteurized milk showed that counts after 48 hr of incubation of plates were somewhat higher at 35 than at 37 C and still slightly higher at 32 C than at 35 C. Plate incubation at 32 or 35 C for 48 hr was recognized in 1948 as standard procedure in this country *(4).*

Although "Standard Methods" *(6)* continues to stipulate that plates be incubated at 35 or 32 C for 48 hr, some investigations *(7, 18, 21)* have suggested that longer incubation at these and other temperatures might be advantageous for the enumeration of bacteria in pasteurized milk. These investigations point out that the development of colonies on plates inoculated with pasteurized milk tended to be slower than on plates prepared from raw milk. Incubation for 3 days is required for plate counts on dried milk *(6).*

The present study was undertaken to determine the effect of temperature of plate incubation and length of the incubation period upon the enumeration of pasteurization-resistant (thermoduric) bacteria in milk. The identification of specific types of thermoduric bacteria was carried out, as well as their enumeration both in pure cultures and as the mixed flora of commercial milk samples.

Experimental Methods

Except for certain indicated modifications, the methods employed were those outlined in "Standard Methods" *(6).* To reduce the time required for preparing replicate plates, 1.0 ml and 10.0 ml pipettes graduated in tenths of a milliliter were used for delivery of 0.1 ml and 1.0 ml quantities.

Twelve samples of manufacturing grade milk, cooled in bulk tanks, and 20 can-cooled samples were examined. A standard plate count at 32 C was determined for each sample prior to laboratory pasteurization. A "complete immersion" laboratory pasteurization technique was employed. Ten ml of raw

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milk were pipetted aseptically into a sterile 125 x 15 mm test tube, using care to avoid contamination of the upper portion of the tube. The tube was closed with a sterile rubber stopper and was completely immersed in an electrically heated water bath. The pasteurization temperature was 62.5 ± 0.1 C, and the pasteurization time was 30 min. Less than 5 min were required for the sample to reach pasteurization temperature. Immediately following pasteurization, the tube of milk was cooled in ice water. The tube was completely inverted 12 times; the upper part was thoroughly flamed before aliquots were removed for plating.

Duplicate plates for each dilution were incubated at the following temperatures and times:

Incubation temperature	Incubation time			
(C)	(days)			
35	2	3	4	
32	2	3	4	
28	3	4	5	
21	4	5	7	
10	7	14	21	28

At the end of each incubation period, colonies were counted with the aid of a Quebec colony counter, and the location of each colony was marked with ink on the bottom of the plate. Plates were protected from air-borne contamination by counting, unopened, in an inverted position. Various colored inks were used to designate colonies appearing after each respective incubation period. This system of color-coding facilitated subsequent isolation and identification of bacteria according to their ability to form colonies during incubation at the various temperatures.

Milk samples showing either a wide variation or no variation in thermoduric count, among the various incubation temperatures and times, were selected for study of the bacterial types encountered. Immediately after the colonies were counted, representative colonies from suitable plates were picked by a random method *(15)* and inoculated into tubes of sterile litmus milk. Following incubation at 32 C for 3 to 5 days, a loopful of milk from each tube was streaked onto a plate containing Plate Count Agar plus 0.25% non-fat milk solids. Surface colony characteristics were noted on the streaked plates after 72 hr at 32 C.

To assure the isolation of pure cultures, a single colony picked from each streak plate was inoculated into a tube containing 5 ml of sterile litmus milk. The reaction was noted at intervals during a 14-day period at 32 C. Slants inoculated from the litmus milk tubes were incubated at 32 C for 24 hr; smears were prepared from the slants, Gram stained and examined microscopically.

A preliminary classification of the isolates into genera was based upon cell morphology, Gram staining characteristics, reaction in litmus milk and colony characteristics. Additional cultural and biochemical testing of representative isolates verified classification into genera and, in some cases, into species.

Four isolates, representative of the predominant genera of thermoduric bacteria found, were selected for study of the effect of temperature and time of plate incubation upon the growth of pure cultures before and after laboratory pasteurization. The selected isolates were classified as *Microbacterium lacticum*, *Micrococcus varians*, *Streptococcus* sp. and *Arthrobacter* sp. Stock cultures were prepared by inoculating sterile litmus milk with representative colonies from agar slants and then incubating the milk for 24 hr at 32 C. One ml of each culture was added to 100 ml of sterile reconstituted skim milk containing 10% non-fat milk solids. After thorough mixing, 10 ml of the inoculated skim milk were transferred to a sterile test tube for laboratory pasteurization. A second portion of the nonpasteurized, inoculated skim milk was refrigerated at 3.3 to 4.4 C for 24 hr before laboratory pasteurization. The pasteurized and nonpasteurized cultures were plated and incubated in the manner previously outlined for pasteurized samples of raw milk.

RESULTS

The effect of various incubation temperatures and times upon the average arithmetic mean thermoduric plate count of 25 manufacturing grade milk samples is shown in Figure 1. The greatest mean count was obtained at incubation temperatures of 28 C for 4 days and 21 C for 7 days. The mean thermoduric colony counts obtained after 2 days at 35 and at 32 C were 31.0 and 73.7%, respectively, of the mean count obtained at 28 C for 4 days. Although the count increased upon prolonged incubation at 35 and 32 C, the maximum count obtained at each of these temperatures was appreciably lower than that obtained at 28 C for 4 days.

The mean thermoduric count obtained at 10 C for 28 days exceeded the mean count at 35 C for 2 days and was almost half of the highest mean count obtained at 28 C for 4 days. However, as indicated in Figure 1, these bacteria, as a rule, were slow in forming colonies at 10 C.

Analysis of variance showed that counts obtained after 3 days of incubation at 35, 32 and 28 C were significantly different ($P < 0.01$). Differences of the same significance were obtained when counts after 4 days at 35, 32 and 28 C were compared. The counts at 32 C for 2 days were significantly lower ($P < 0.01$) than counts at 32 C for 3 days.

The distribution of bacteria that survived pasteurization of milk, as influenced by the temperature and time of plate incubation, is presented in Table 1. As the incubation temperature was decreased from 35 to 28 C, microbacteria accounted for a greater share and micrococci for a lesser share of the thermoduric count. Microbacteria also accounted for a greater share than did micrococci of the colonies developing on plates after extended incubation at 35, 32, 28 and 21 C. Incubation temperature and time did not appreciably affect the proportion of thermoduric bacteria of types other than microbacteria and micrococci.

Thermoduric lactobacilli were slow in forming colonies at both 35 and 32 C. None of the colonies counted after 2 days at 35 and 32 C were composed of lactobacilli. An appreciable number of the colonies developing upon extended plate incubation at 35 and 32 C were, however, the result of growth of lactobacilli. There was some indication that these bacteria are capable of producing colonies after 3 days of incubation at 28 C, but colony development was favored by longer incubation even at this temperature.

Figure 2 shows the effect of temperature of plate incubation upon the colony counts of a pure culture of *Arthrobacter* sp. before and after laboratory pasteurization. Approximately equal counts were obtained for the unheated culture when plates were incubated at 35, 32, 28 and 21 C for 2 days. The counts on the pasteurized culture were definitely higher at 32 and 28 C than at 35 C. Although the colony count at 21 C for 2 days was appreciably less than that obtained at 32 and 28 C for 2 days, the count at 21 C increased substantially upon extended incubation. After 3 days, the count at 21 C approximated the count obtained at 32 and 28 C after 2 days.

Both unheated and pasteurized cultures of *Microbacterium lacticum* failed to produce countable colonies at an incubation temperature of 35 C. If non-

TABLE 1. AVERAGE DISTRIBUTION OF THERMODURIC BACTERIA IN MILK[a] AS DETERMINED BY INCUBATION OF PLATES AT VARIOUS TEMPERATURES AND TIMES

Incubation temp, C	Incubation time, days	Distribution of bacteria (% of total)		
		Microbacteria	Micrococci	Others[b]
35	2	13.1	68.4	18.5
	4	30.4	47.3	22.3
32	2	20.8	57.7	21.5
	4	31.9	45.8	22.3
28	3	37.9	45.7	16.4
	4	54.6	31.8	13.6
21	4	24.2	75.8	—
	7	44.5	37.0	18.5
10	28	59.5	26.1	14.4

[a]Pasteurized at 62.5 ± 0.1 C for 30 min.
[b]Arthrobacters, lactobacilli, streptococci and unidentified bacteria.

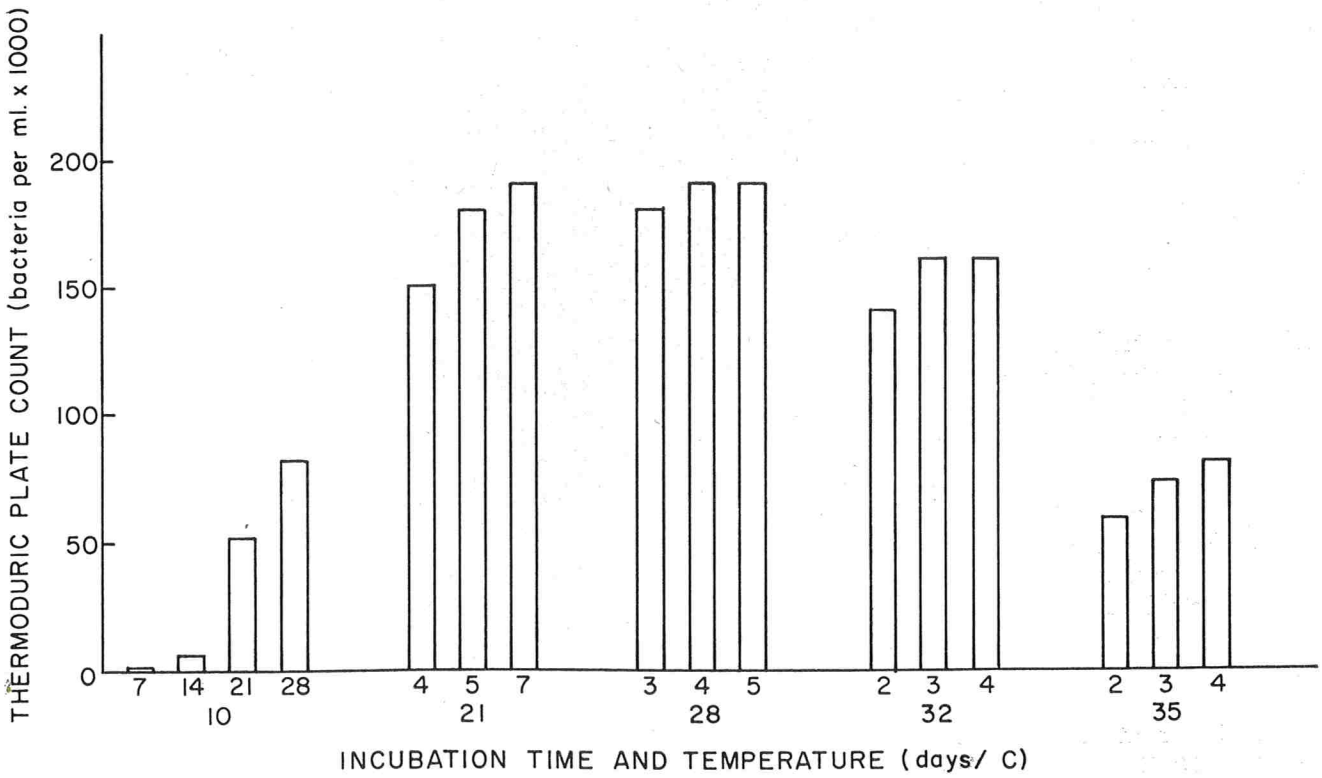

Figure 1. Mean thermoduric plate counts of 25 milk samples obtained by incubation of plates at various times and temperatures. (Pasteurization was at 62.5 ± 0.1 C for 30 min).

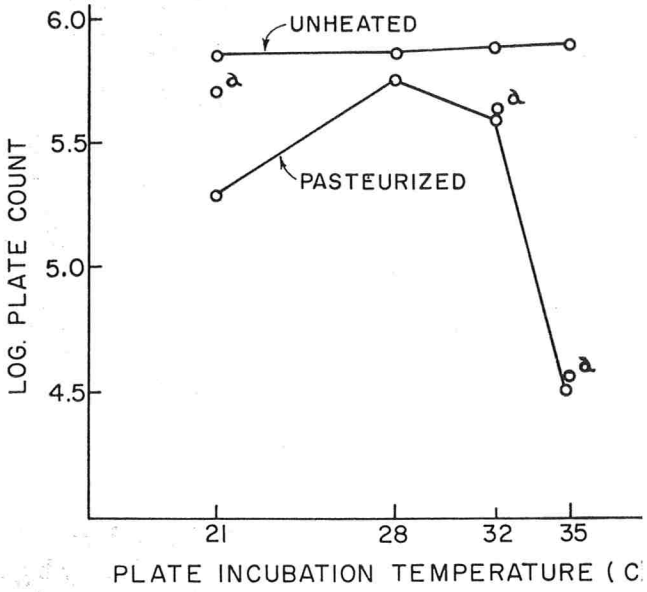

Figure 2. Effect of plate incubation temperature upon the 48-hr plate count of a culture of *Arthrobacter* sp. before and after laboratory pasteurization. [a]3 day count of pasteurized sample at indicated plate incubation temperature.

pasteurized cultures of *M. lacticum* were refrigerated prior to pasteurization, the count after pasteurization was substantially larger than before pasteurization. This phenomenon did not occur with cultures that were not refrigerated before pasteurization. Repeated trials showed similar increases in colony count after pasteurization for cultures of this organism that had been refrigerated before pasteurization. Microscopic examination of stained smears of the refrigerated *M. lacticum* culture before and after pasteurization revealed that pairs and small clumps of cells were common in the unheated culture, but single cells were prominent in the pasteurized culture.

Both unheated and pasteurized cultures of *Micrococcus varians* failed to produce countable colonies at 35 C. Differences in colony counts were not obtained at 32, 28 and 21 C for the unheated cultures. Although no increase in colony count was obtained for the unheated culture beyond 2 days of incubation at 32 and 28 C, plates prepared with the pasteurized culture required extended incubation at 32 C for colony development (Figure 3). A 28 C prolonged incubation increased the count somewhat; at 21 C, the effect was slight.

An unheated culture of *Streptococcus* sp. showed no appreciable difference in colony counts at plate incubation temperatures of 35, 32, 28 and 21 C. However, colony count for the pasteurized culture was definitely lower at an incubation temperature of 21 C than at 35, 32 and 28 C. Colony development at 28 C appeared slower for the culture refrigerated before pasteurization than for the non-refrigerated culture.

DISCUSSION

No single medium incubated at a given temperature for a given period of time can be expected to initiate and sustain growth of all types and physiological states of bacteria present in milk. A plating method for the enumeration of organisms in milk should nevertheless have the objective of determining the greatest possible proportion of the bacteria present. Relative to the question of time versus maximum recovery, a balance should be achieved commensurate with the objectives of the test.

A second objective of a plating procedure should be the production of easily discernible and countable colonies. Minute or "pinpoint" colonies overlooked in counting afford a source of error. This is especially true of the thermoduric colony count. Many thermoduric bacteria are known to produce colonies of minute size.

For the agar plate method of enumerating bacteria in milk, "Standard Methods" *(6)* recommends incubating plates for 2 days at 35 or 32 C. This standard applies for raw, commercially-pasteurized and laboratory-pasteurized milk. However, results of the present study have indicated that incubation temperatures lower than 35 C and even lower than 32 C for incubation periods longer than 2 days may have some distinct advantages for the enumeration of pasteurization-resistant bacteria in milk.

A comparison of various incubation temperatures and times showed that the average thermoduric colony count obtained at 35 C for 2 days was only 31% of the average count obtained at 28 C for 4 days. With incubation at 32 C for 2 days, the average arithmetic count was more than double that

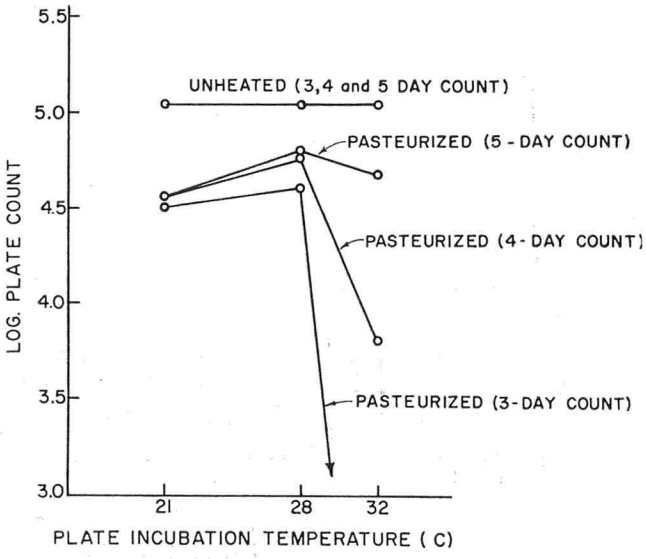

Figure 3. Effect of plate incubation time and temperature upon the plate count of a culture of *Micrococcus varians* before and after laboratory pasteurization.

obtained at 35 C for 2 days. Significantly, of 32 samples examined, 31 had a higher count at 28 C for 4 days than at 35 C for 2 days. Twenty-seven of the 32 samples gave a higher count at 32 C for 2 days than at 35 C for 2 days.

Highly heat-resistant microbacteria commonly accounted for an appreciably larger share of the colony count at 32 and 28 C than at 35 C. These findings are in accord with those of other workers (11, 14, 23) who suggested that large numbers of microbacteria in pasteurized milk probably had been overlooked as a result of incubating plates at 37 C. The results of this study indicate that 35 C also is too high an incubation temperature for accurate enumeration of microbacteria in pasteurized milk.

Buchanan *(9)* suggested that, when large numbers of microbacteria are present in milk, plate incubation temperatures lower than 35 C, and possibly even lower than 32 C, may be necessary for estimation of the total thermoduric population. Results of the present study confirm that incubation at 28 C frequently results in larger numbers of colonies of microbacteria than does 32 C. These organisms accounted for a substantially greater portion of the colonies obtained at 28 C than at 32 C.

Micrococci and arthrobacters also frequently contributed to the higher counts obtained with incubation below 35 C. Although these organisms usually accounted for a major portion of the count obtained at 35 C for 2 days, they contributed even more substantially to the higher counts obtained at 32 C for 2 days.

Extending the plate incubation period to 3 or 4 days at 35 and 32 C resulted in an increased thermoduric count in a majority of cases. This was especially true for milk samples containing lactobacilli or microbacteria. Seemingly, microbacteria not only prefer incubation temperatures lower than 35 C, but also are slow in developing colonies even at the lower temperatures. An incubation temperature of 30 C for 3 to 6 days has been advocated by European workers *(10, 12, 14)* for thermoduric counts. In most cases, microbacteria have been found to constitute 60 to 80% of the thermoduric flora that grow on plates incubated under these conditions.

Lactobacilli have not been reported to contribute significantly to the thermoduric count of milk. As shown in this study, this could be a result of failure to incubate plates long enough to permit lactobacilli to grow on solid media. Many lactobacilli grow poorly under aerobic conditions and require a rather complex medium for growth. In this study, lactobacilli were detected on plates incubated for 3 to 4 days at 35 and 32 C but not on plates incubated at these temperatures for only 2 days. This indicates that the types of thermoduric bacteria found in milk depend upon the plate incubation procedure used in their recovery from the pasteurized product. Unidentified bacteria, showing characteristics dissimilar to those of the more common thermoduric bacteria, also contributed substantially to increased counts for some samples upon extended plate incubation at 35 and 32 C. These organisms also may have been overlooked by other workers who did not incubate the plates long enough.

A thermoduric count in excess of 10,000 per ml has been suggested *(12, 20)* as providing evidence of unsatisfactory milk handling. In this study, 45% of the samples which met this standard when plates were incubated at 35 C for 2 days failed to meet the standard when plates were incubated at 28 C for 3 days. Of the samples showing a thermoduric count of 10,000 per ml or less at 32 C for 2 days, 40% gave counts in excess of 10,000 per ml at 28 C for 3 days. All samples with counts above this standard when plates were incubated at 35 or 32 C for 2 days also exceeded this standard when plates were incubated at 28 C for 3 days. Assuming that the standard of 10,000 per ml is valid, these results indicate that the lower incubation temperature would do a better job of detecting milk of poor quality.

The average thermoduric count obtained using incubation at 21 C for 5 days exceeded the average counts obtained at 35 and 32 C for 4 days. However, 7 days incubation at 21 C was necessary for the average count to equal the maximum average count obtained after 28 C for 4 days. Of 32 samples examined, 21 gave counts at 28 C for 4 days equal to or higher than those obtained at 21 C for 7 days. However, in no case was the difference between the counts obtained at 28 C for 4 days and 21 C for 7 days of great magnitude. Although incubation at 21 C might have some advantage over incubation at 35 or 32 C, the results of this study indicate that 21 C incubation would offer no real advantage over 28 C incubation.

Many of the thermoduric bacteria observed in this study were capable of forming colonies on Plate Count Agar during incubation at 10 C if the incubation period was long enough. Notable among these were *Arthrobacter, Microbacterium* and *Micrococcus.* However, at 10 C, an incubation period of 21 to 28 days was necessary for any appreciable colony development. Even after 28 days at 10 C, the average arithmetic colony count of 25 samples was only 42.6% of the maximum average count obtained at 28 C for 4 days.

Of the thermoduric bacteria examined in this study, spore-bearing rods were the only ones that grew better at 35 C than at lower temperatures. However, they did not appear in large numbers in any of the samples tested. Spore-bearing rods sometimes

accounted for a major portion of the thermoduric flora of samples with a thermoduric count of less than 3,000 per ml but did not contribute appreciably to the thermoduric flora of milk with a thermoduric count of more than 3,000 per ml. These results support reports by other workers *(1, 14)* that few spore-bearing rods are found in milk having a high thermoduric count.

Studies with pure cultures indicated that thermoduric bacteria generally are more exacting in their growth temperature requirements after they have been subjected to laboratory pasteurization than before. This was found to be true for cultures of *Arthrobacter* sp., *Micrococcus varians* and *Streptococcus* sp. These bacteria grew well over a rather wide temperature range before pasteurization. After laboratory pasteurization, they exhibited a definite preference for a much narrower growth temperature range.

These results help to explain why earlier investigations *(16, 19, 25)* showed that lowering the temperature of plate incubation from 37 to 32 or 30 C resulted in a greater percentage increase in count with pasteurized milk than with raw milk. An explanation is that certain of the thermoduric bacteria in the raw milk grew equally well at all temperatures. However, after pasteurization, colonies developed more readily at the lower incubation temperatures.

Comparative studies *(8, 24)* of plate counts of raw milk and pasteurized milk, following plate incubation at 37, 35 and 32 C for 48 hr, have shown that counts were somewhat higher at 35 C and were higher yet at 32 C. As revealed by this study, the increase in colony count at the lower temperatures results from failure of certain bacteria to produce colonies at the higher temperatures. Notable among these is *Microbacterium lacticum*. A culture of this organism failed to grow at 35 C before, as well as after, laboratory pasteurization. However, excellent colony development was exhibited by both unheated and pasteurized cultures of this organism at a plate incubation temperature of 32 C.

Although micrococci generally were found to grow fairly well at 35 C throughout this study, there were some exceptions to this general rule. Colony formation by unheated and pasteurized cultures of *Micrococcus varians* was favored by an incubation temperature of 32 C, in contrast to 35 C. These results are in agreement with observations made by Buchanan *(9)*, who found some micrococci, particularly *M. varians*, grew better at 32 C than at 35 C after laboratory pasteurization.

A plate incubation period of 48 hr is specified in "Standard Methods" *(6)* for both raw and pasteurized milk. Results of this study indicate that incubation in excess of 2 days is necessary for colony formation by certain of the pasteurization-resistant bacteria. The maximum colony count for an unheated culture of *M. varians* was obtained at 2 days of incubation at 32 and 28 C. However, appreciable colony formation by a pasteurized culture was evident only after 3 days of incubation.

Hussong and Hammer *(17)* observed that the count obtained for some milk samples after laboratory pasteurization was higher than that obtained initially. They did not attempt to identify the bacterial flora of these samples but indicated that the increases in count could not be due to growth during pasteurization. As shown in the present study, the highly heat-resistant flora encountered by these workers could have been composed largely of *M. lacticum*. Not only were cultures of this organism highly heat resistant, but occasionally they produced higher colony counts after laboratory pasteurization than before. Growth of *M. lacticum* cultures during pasteurization was ruled out by their failure to produce colonies on Plate Count Agar at an incubation temperature of 35 C.

All nine cultures of *M. lacticum* which Robertson *(22)* isolated from milk, survived pasteurization at 145 F for 30 min; determinations of percentage survival showed increases of 10 to 120%. Growth was not observed when laboratory strains of these organisms were inoculated into sterile skim milk and held at pasteurizing temperatures. An attempt to explain the results by assuming that clumps of cells were broken up sufficiently to cause the entire percentage increase following pasteurization was unsatisfactory. The present study showed that if laboratory cultures had been refrigerated prior to pasteurization, disintegration of clumps during pasteurization might have occurred to a greater degree.

SUMMARY

Incubation at 28 C for 4 days was the temperature-time combination that most frequently produced the highest colony counts with laboratory pasteurized milk. The mean arithmetic thermoduric colony counts obtained after 2 days of incubation at 35 and 32 C were 31.0 and 73.7%, respectively, of the mean count obtained after 4 days of incubation at 28 C. Colony counts tended to increase upon extended plate incubation at 35 and 32 C, but, even after 4 days of incubation, they were significantly lower ($P < 0.01$) than counts obtained at 28 C for 4 days. The mean thermoduric colony count obtained at 21 C for 7 days equalled that obtained at 28 C for 4 days. Pasteurization-resistant bacteria formed colonies slowly on plates incubated at 10 C, and the mean count after 28 days of incubation was only 42.6% of the mean count after 4 days at 28 C.

Colony production on Plate Count Agar by those microbacteria surviving pasteurization was notably

inhibited at an incubation temperature of 35 C. Colonies produced by these bacteria were increased at 32 C and were further increased at an incubation temperature of 28 C. Colony production by *Arthrobacter* and *Micrococcus* was favored more at 32 and 28 C than at 35 C. Pasteurization-resistant lactobacilli produced colonies on Plate Count Agar only after 3 to 4 days of incubation at 35 and 32 C. Microbacteria and micrococci also contributed appreciably to increases in thermoduric colony counts upon extended plate incubation at 35 and 32 C.

Thermoduric bacteria that have been subjected to pasteurization are more exacting in their growth temperature requirements than are unheated bacteria. Thermoduric cultures of *Arthrobacter* sp., *Micrococcus varians* and *Streptococcus* sp. grew over a much wider temperature range prior to than after laboratory pasteurization.

Results of this study have indicated that the temperature and time currently recommended for the standard plate count, while adequate for the enumeration of bacteria in raw milk, may not be satisfactory for the determination of the maximum viable population of pasteurized milk.

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PRESIDENTAL ADDRESS

R. A. BELKNAP, *President*

International Association of Milk, Food, and Environmental Sanitarians

On behalf of the Officers and the Executive Board, I bid each of you "Welcome" to the 50th Annual Meeting of the International Association of Milk, Food, and Environmental Sanitarians. However, this is not our golden anniversary, but our 52nd year of existence and service.

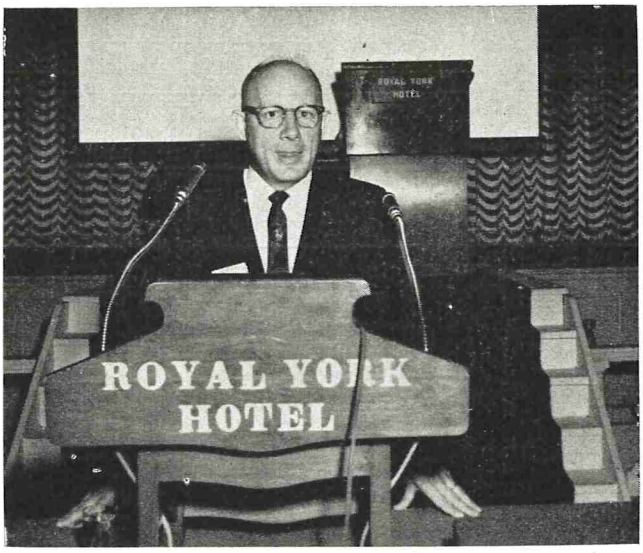
We are happy to be here with our Canadian members and friends, who through the sponsorship of the Ontario Milk Sanitarians Association, have so graciously opened the doors of the City of Toronto to our Association. Toronto is an Indian word meaning "place of meeting", and was given as a name to the City because in early days two main Indian trails crossed at this point. Toronto, likewise, is the International's "place of meeting" this year.

We are all here with a common interest — that of securing greater knowledge in our particular fields of milk, food, and environmental sanitation. We hope also that each person here will utilize fully this opportunity for the interchange of ideas and information for the purpose of self-improvement and furthering the objectives of the profession of the Sanitarian, thus serving mankind to a greater extent.

For over fifty years the International, in following the objectives contained in our constitution, has steadfastly endeavored to improve the professional status of the sanitarian through the dissemination of information concerning milk, food, and environmental technology and administration.

The Association has also encouraged and helped develop uniform and proper methods for the examination of milk, milk products, and other foods. It has developed and promoted methods of supervision and inspection of dairy farms, milk and milk products plants, food establishments, including restaurants, warehouses and transportation equipment; as well as the general environment. Improvements in sanitary methods of production of milk and related food products, and the development of equipment and supplies to improve the sanitary handling of dairy and food products are constantly being encouraged by the Association. Assistance has been continually rendered to the membership in their technical work and development. Through co-operation with other professional groups, the International aids in advancing the public health through improved milk and food technology and the promotion of general and environmental sanitation programs.

Our accomplishments over the years have been outstanding, and each project or objective has been developed or completed with the ultimate thought of service to the Sanitarian, industry, and the public.



Ray Belknap, President IAMFES delivers Presidential address.

In 1944 the International joined in participation with the Dairy Industry Committee and the U. S. Public Health Service in the formulation of 3-A Sanitary Standards, covering the design and construction of various items of milk equipment. Since that time twenty-four such Sanitary Standards have been developed, and more are in the process of being drafted. Equipment manufacturers have long followed these Standards in the fabrication of their equipment, and, as an aid to the Sanitarian and the buyer of such equipment, the manufacturer is authorized by the 3-A Symbol Council to use the 3-A Symbol on all items of equipment complying with the appropriate Sanitary Standards. To date, 135 authorizations have been granted to manufacturers to use the 3-A Symbol.

It is of interest to know that as a result of the success of the 3-A Sanitary Standards other groups of manufacturers are now giving consideration to the development of some symbol similar to the 3-A Symbol for application to their items of equipment, manufactured for other segments of the food industry.

The manual, "Procedure for Investigation of Foodborne Disease Outbreaks" has received wide acceptance since its publication, even having been translated into Spanish. For the past year, the Committee on Communicable Diseases Affecting Man has been engaged in revising and up-dating this Manual. This

excellent work, first published in 1955, describes the proper techniques and epidemiological procedures for investigating milk and food-borne disease outbreaks. The manual has stimulated and improved epidemiological investigations of such outbreaks at the local level, thus indirectly leading to the correction of many conditions which might otherwise have been responsible for the transmission of disease. Over 17,000 copies of the manual sold to date have proven to be a valuable guide for state and local health departments, as well as the individual health worker. The new revision of the "Procedures" will be published soon and is expected to contribute further to the improvement of epidemiological techniques.

More recently the International has sponsored and contributed leadership in the formation and development of two national organizations—the National Mastitis Council and the National Labeling Committee, both of which have submitted reports this year indicating progress. The National Mastitis Council has developed and published a manual entitled "Current Concepts of Bovine Mastitis" which discusses the major factors involved in mastitis. The manual also recommends certain procedures and practices for the control of mastitis.

The National Labeling Committee submitted their Recommendation No. 1, in which a uniform coding system for the identification of plants processing fluid milk, fresh milk products, and frozen desserts is proposed. A survey of all states indicated widespread acceptance of this recommended coding system. The 9th National Conference on Interstate Milk Shipments has recommended its utilization by resolution and has requested the Public Health Service to incorporate this coding system in future publications of the Interstate Milk Shippers List.

These are but a few of the activities in which the International participates to help the Sanitarian and industry to better serve the public in a constantly changing environment.

Each year a certain amount of effort and progress, as well as lack of effort is recorded in the Association records. This past year is no exception. You are, of course, aware of the change in the Constitution, brought about by a vote of our membership in favor of a change in the name of our Association. This significant step in the Association's development and growth is certainly indicative of our interest in including the Environmental Sanitarians as partners in this organization. A similar action was taken in 1947 to include Food Sanitarians in the Association.

As in all expansion or growth of organizations certain problems evolve, but with understanding and work this new change should help us develop a larger, stronger organization, better able to serve all our members. This year we have welcomed another new affiliate into our Association — the Massachusetts Association of Milk Inspectors. We are pleased with their decision to affiliate with the International.

While committee activities are important in any organization, our continuing committees are the very backbone of the International. Too few of us realize the influence and contributions on milk and food sanitation policies and developments that have been made by such committees as Sanitary Procedures, Communicable Diseases Affecting Man, the Committee on Dairy Farm Methods, the Committee on Laboratory Procedures, the Committee on Baking Equipment Sanitation, the Committee on Food Equipment, the Committee on Frozen Food Sanitation, the Committee on Ordinances and Regulations Pertaining to Milk, the Committee on Education and Professional Development and the Committee on Environmental Health Programs. The members of these committees are the unsung heroes of our Association.

From time to time other committees such as the Advisory Committee on Association Activities, Programs, and Administrative Practices and the Journal Management Committee, are appointed by the President or Executive Board to study some particular problem. Both of these committees have done outstanding work in their respective assignments, with each committee making substantial contributions by providing sound guidance to the Executive Board in the management of the Association and the Journal.

Due to the press of activities and duties of the individual members of the Association in maintaining their routine jobs and the extra time and work it takes to make the committees function to the fullest extent, the Executive Board, this year, at the recommendation of the Advisory Committee, began the rescheduling of appointments to the various continuing committees. The ultimate objective is to appoint chairmen and committee members for two year terms, with half of the committees being appointed each year. This procedure will allow committees more time in which to make studies and complete reports.

However, on the other side of the ledger, it's a disheartening experience for the Executive Board and the Committee Chairmen when some of the membership exhibits a lack of effort, a rather tardy approach, or displays little interest in Association affairs. To be explicit: there was a distinct lack of interest in the proposed insurance plan; the vote regarding the constitutional amendment to change the Association's name was relatively poor for a matter of such importance; the attendance at our Annual Meetings could improve immeasurably; and the lack of interest on the part of some affiliates is noticeable. Another good example of indifference was displayed by the response received by Dr. Israel Light in his man

power study, when only about 50 percent of our membership even bothered to complete the questionnaire relative to their professional status. This endeavor, on the part of the individual Sanitarian, would have required only a few minutes time and a five cent postage stamp. Such a lack of interest on the part of those not replying would indicate they have reservations about their own activities or are merely disinterested in their own future as well as that of their associates.

The advancement of the professional status of the Sanitarian, is, and has been, and will continue to be, one of the objectives of the International. While your past and present Executive Boards have followed a policy that Sanitarians cannot legislate themselves into professionalism, they have supported registration as one means of achieving professional recognition, believing that registration should be used to denote professional attainment and proficiency, based upon high-level qualifications and ability, and that registration is not a device to insure job security and to perpetuate mediocrity. Past Executive Boards appreciated the fact that explicit criteria could be written into registration laws, and when the time came, did support the devolpment and acceptance of a Model Registration Act for Sanitarians as recommended by our representatives on the Sanitarians Joint Council. At present, 22 States have Laws for the registration of Sanitarians, some of which were sponsored by affiliates of this Association.

Currently, in co-operation with other professional organizations, our representatives to the Sanitarians Joint Council have submitted to your Executive Board, a proposal for the establishment of the American Intersociety Board for the Certification of Sanitarians. This proposal is not without precedent, other professional groups have long had certification boards. In contrast to registration, certification is the process undertaken and executed by the profession itself through its constituent societies and affiliates. Certification is the recognition of professional achievement resulting from educational preparation and competent practice of the profession with marked distinction.

Registration is a legel process by a governmental licensing body created by State legislative action. There is no conflict between registration and certification.

Your Executive Board has studied this proposed Board of Certification and accepts the principal as set forth therein. We have notified our representatives to the Sanitarians Joint Council of our approval and willingness to join with the National Association of Sanitarians and the American Public Health Association supporting the proposed board.

As I have briefly indicated, the International's past has been a busy productive past, and as we enter our second half century, we can justifiably ask, "Where is the International going?" and "What must our Association accomplish to provide continuing professional leadership for our members?" These questions are ones that past and present Executive Boards, as well as many members, have pondered. No organization stands still, it either progresses or slips backwards. A lack of proper self-evaluation or willingness to make appropriate changes has caused many organizations to wither and die on the vine.

We have now reached a point where some soul searching evaluation and future planning is urgently needed if our Association is to continue and to prosper. One important step in this direction was taken this year when we changed the name of our organization. Although we have for many years had "Environmental Sanitarians" in our organization, this name change is a distinct move toward recognizing such individuals and encouraging their active participation in Association efforts.

It appears that our membership level has reached a plateau — neither gaining nor losing for the present. This is a situation that cannot be endured long due to increasing costs of administering the business of the Association and the publishing of the Journal. We are at a point where managing the Association is more than a one-man job. An attempt was made last year to cope with this problem by employing an assistant to the Executive-Secretary. While this produced some tangible improvements, the problems of administration and the cost of operation have increased steadily due to the assignment of additional duties to the Association's home office and the pressure for added services to Association affiliates. These problems are in no way singular to the International. These and similar problems plague other Sanitarian organizations — all organizations for that matter.

During the past two years I have had occasion to meet Sanitarians in several States and have had the opportunity to attend some of the State affiliate meetings. It has been an interesting and illuminating experience. Of all questions asked me, the two most frequently voiced are concerned with the need for two national Sanitarian organizations and the professionalism of the Sanitarian.

Today we have three State affiliates that are dual affiliates in that a number of their members belong to the International, while others are members of the National Association of Sanitarians. Two other State affiliates are also giving consideration to dual affiliations. Perhaps in response to the question of "Why two National Sanitarian Organizations?", our first step should be to evaluate these State affiliates to gain an insight to the advantages and/or disadvantages of such a system.

The information gleaned from such a study, to-

gether with our experiences in the operation of the Sanitarian's Joint Council, should prove extremely valuable to us in any study which might be undertaken with regard to this question.

In this connection, you are aware, I am sure, there are some members of our Association who feel we have reached the time when the advantage, and/or disadvantages of either consolidation or the development of some over-all organization to encompass the various National Sanitarian Associations and Societies, must be studied. In fact there have been discussions relative to this in the past. In any event the Executive Board is continually exploring ways and means by which the members of the International may be better served. Whether or not a consolidation of the efforts of the two National Associations would better serve the Sanitarian of this country, has yet to be determined. Whatever the proposals, thought should be given toward maintaining the individuality of the present Associations and Journals, but the ultimate objectives will be to give the Sanitarian the best possible service in terms of economy in operation and administration of the Associations and publication of the Journals, and the continued development of professionalism and representation of the Sanitarian, upholding the ideals we have thus far achieved.

It is important that we stress the obligation of each and every Sanitarian to be open minded, to be active, to support his organization, and to do what he as an individual can do through his own "personal image" and professionalism to elevate the status of the Sanitarian in general.

Re-evaluation of our Association's future is imperative and the question, "Where is the International going?" as well as other questions, will have to be taken under serious consideration and advisement. What are our prospects for the future? Will an increase in Association dues and Journal subscriptions offset the temporary economic problems, or is consolidation of all Sanitarians the answer?

The future for all Sanitarians, regardless of affiliation, is full of expectancy. The proposed establishment of the Intersociety Board of Certification and the recent appointment of one of our members as liaison officer to represent all Sanitarians on the staff of the Surgeon General of the Public Health Service, points to an extremely hopeful future. Professionally speaking, the Sanitarian's star is an ascending star.

FIFTIETH ANNUAL MEETING OF IAMFES
in cooperation with
The Central Ontario Milk Sanitarians' Association
October 22-25, 1963, Toronto, Canada

ONTARIO SPONSORS OUTSTANDING MEETING

Stateside participants at the Annual Meeting last month in Toronto were treated to a most excellently organized five days of activities centered in the spacious Royal York Hotel. Over 350 were registered plus about 54 wives. In fact, the ladies registration this year reached an all time high. Elsewhere in this issue is a special report of the ladies program.

In organizing the program this year the Committee provided excellent balance between topics in the areas of milk and food sanitation and the broader aspects of environmental sanitation. As usual, the milk sanitation section meetings were the most heavily attended. Attendance at the other sectional meetings was especially encouraging in view of the Association's decision this year to include in its name the word "Environmental" thus broadening the scope of activities to which the Association is now committed. These new responsibilities were emphasized by President Belknap in his address at the opening session. The complete text of his address appears elsewhere in this issue.

The Board of Directors whose executive sessions began Sunday afternoon and continued through Tuesday morning tackled numerous Association problems. Significant was their decision to support, in principle, the proposal of the Joint Sanitarians Council for implementation of a plan for certification of sanitarians. This action is discussed elsewhere in this issue of the Journal.

After years of growing dissatisfaction with the mechanism for the election of the Association officers, the membership in the business meeting voted to amend the Constitution and By-Laws in such manner as to provide for election of officers by mail ballot rather than at the annual meeting. It was emphatically emphasized by several individuals during the business meeting that under present procedure only a fraction of the membership has an opportunity to vote for officers of the Association. The new voting procedure must yet be ratified by mail vote and if approved, names of nominees for office will be published in the Journal with a biographical sketch of

Dr. Carl Byers, General Motors Corporation, Banquet Speaker.

each to acquaint the membership with their background. Further details will be forthcoming.

Two developments initiated by the International, the National Labeling Committee and the National Mastitis Council have now reached the point where continuity of effort must be exercised in order to implement the respective programs. The Executive Board gave much time to ways and means of assisting with these programs. Quite likely the National Labeling Committee's headquarters will be centered at the Association's executive office in Shelbyville.

All was not serious business at the annual meeting, for the local committee headed by Fred Hamilton of Guelph arranged for a get together session for early arrivals Tuesday evening at which time a buffet lunch featuring some of "Canada's Best" (cheese) was available for the enjoyment of all. Thursday evening all in attendance were guests of the Ontario Association at a cocktail party preceding the annual banquet.

Highlighting the annual banquet Thursday evening was the presentation of the various Association awards. The Sanitarians Award and accompanying check for one-thousand dollars went to R. L. Cooper, Murray, Kentucky.

In recognition of outstanding service to the International, the Citation award was presented to Dr. Merle Baker, Professor of Dairy Bacteriology, Iowa State University, Ames. The Association also honored two well known and long time members, Dr. C. K. Johns, Head of the Dairy Section of the Food Research Institute, Canada Department of Agriculture, and Dr. Harold Macy, Professor emeritus and recently retired Dean of the Institute of Agriculture, University of Minnesota, by presenting them with honorary life memberships.

At the Affiliate Council meetings on Tuesday, Mr. Richard March, Professor of Dairy Industry, Cornell University was reelected President and Mr. Sam Noles, Jacksonville, Florida was reelected Secretary. A complete report of the minutes of the Affiliate Council will be carried in the next issue of the Journal.

At the business meeting Thursday afternoon Dr. Paul R. Elliker, Professor of Microbiology and Chairman of the Department of Microbiology, Oregon State University was elected *Second Vice-President*, and Karl Jones, Director, Food and Restaurant Section, Indiana State Board of Health, Indianapolis, was re-elected *Secretary-Treasurer*. Since the *President-Elect*, *First* and *Second Vice-Presidents* advance automatically to the offices of *President*, *President-Elect* and *First Vice-President*, respectively, the Executive Officers of the Association now are as follows:

Canada Dairy Princess.

President, Mr. John H. Fritz, Milk and Food Branch, Division of Environmental Engineering and Food Protection, U. S. Public Health Service, Washington, D. C.; *President-Elect*, Dr. W. C. Lawton, Director of Laboratories and Quality Control, Twin City Milk Producers Association, St. Paul, Minnesota; *First Vice-President*, Mr. Fred E. Uetz, The Borden Co., New York; Dr. Paul R. Elliker, newly elected *Second Vice-President;* and Karl Jones, *Secretary-Treasurer*.

August 18-20, 1964 are the dates of the 1964 Annual Meeting in Portland, Oregon. The Oregon Association is well along with plans for the meeting. The meeting next year is earlier than usual and affords an excellent opportunity to combine an enjoyable vacation in the West with attendance at the meeting. Plan now to attend.

SANITARIAN'S AWARD AND $1,000 GRANTED TO MR. R. L. COOPER, MURRAY, KENTUCKY OFFICIAL

The 1963 Sanitarian's Award of International Association of Milk, Food and Environmental Sanitarians has been awarded to Mr. R. L. Cooper, Administrative Assistant, Calloway County Health Department, Murray, Kentucky, in ceremonies at the Fiftieth Annual Meeting of IAMFES, October 24, Royal York Hotel, Toronto, Canada.

The award, carrying with it a $1000 check, is the highest professional honor in the field of sanitation. It is annually presented to the municipal or local sanitarian who has contributed most to the welfare and health of his community for the five year period just past.

Mr. Cooper has been active in the field of sanitation and public health since 1940 when he joined the Calloway County Health Department as a sanitarian. After spending three years in military service, he rejoined the same health department in 1946. He was assigned to a U.S.P.H.S. cooperative project of insect and rodent control in 1948.

Mr. Cooper accepted a job as sanitarian of the Paducah-McCracken County Health Department, Paducah, Kentucky, in 1953. He returned to the Calloway County Health Department in 1954 as sanitarian and Administrative Assistant.

Mr. Cooper has promoted milk sanitation in Calloway County by securing an ordinance requiring pasteurization of milk in Murray, promoting better construction of dairy farm buildings, getting local dairymen to comply with standards of the National Coneference of Interestate Milk Shipments, and helping eradicate brucellosis in the county.

Mr. Cooper has actively supported food sanitation by organizing training classes for restaurant and school cafeteria workers. His efforts with the plumbers has helped improve construction of housing and industrial facilities in Calloway County.

One of the major supporters of community projects, Mr. Cooper has actively worked in securing flouridation of water for Murray, supported the work of the Heart Association, Salk Polio Campaign and Tuberculosis Society.

It was through the strenuous efforts of Mr. Cooper that Calloway County approved a special public health tax to finance additional programs in a growing community.

It is a distinct privilege to present the Sanitarian's Award to Mr. R. L. Cooper.

R. L. Cooper receives the coveted Sanitarians Award from John Sheuring, Chairman, Awards Committee.

The Sanitarian's Award is made possible by five companies: Diversey Corporation, Klenzade Products, Inc., Olin Mathieson Chemical Corporation, Pennsalt Chemicals, Inc., and Oakite Products, Inc. Selections of the recipient is an exclusive function of IAMFES however.

Earlier recipients, and their positions at the time are:

Paul Corash, Chief of the Milk Division, New York City Health Department (1952)

Dr. E. F. Meyers, Chief of the Milk, Meat and Food Division of Grand Rapids, Michigan, Health Department (1953)

Kelly G. Vester, Senior Sanitarian of the Rocky Mount, North Carolina, City Health Department (1954)

B. G. Tennant, Chief Sanitarian of the Escambia County Health Department, Pensacola, Florida (1955)

John H. Fritz, Chief of the Milk and Food Section of the Kansas City, Missouri, Health Department (1956)

Harold J. Barnum, Chief of the Milk Sanitation Services of the Department of Health and Hospitals, Denver, Colorado (1957)

Carl A. Mohr, Sanitarian and Deputy Health Officer, Health Department, Green Bay, Wisconsin (1958)

William Kempa, Dairy and Milk Inspector for the City of Regina, Saskatchewan, Canada (1959)

James C. Barringer, Director of Sanitation of the City of Evansville, Indiana (1960)

Martin C. Donovan, Airport Sanitarian of the Dade County Department of Public Health, Miami, Florida (1961)

Larry Gordon, Director, City-County Health Department, Albuquerque, New Mexico (1962)

IAMFES CITATION AWARD FOR OUTSTANDING SERVICE GIVEN TO DR. MERLE P. BAKER

Dr. Merle P. Baker, Professor of Dairy and Food Industry, Iowa State University, Ames, Iowa, was presented the Citation Award of the International Association of Milk, Food and Environmental Sanitarians at the Fiftieth Annual Meeting on October 24th, in Toronto, Canada.

A framed certificate is bestowed annually by the Association to salute outstanding service to it and to the advancement of the professional status of all sanitarians. The award this year honored a distinguished educator, counselor, and author in the public health field.

Dr. Baker received all of his college education at Iowa State College being awarded the Ph.D. degree in 1931. His teaching experience began in 1923 when he joined the faculty of Iowa State University as an Instructor in the Dairy Industry Department. Except for two interruptions, he has continued as a staff member of the Dairy Industry Department. In 1933, he was a member of the staff of the Wisconsin Alumni Research Foundation, Madison, Wisconsin, and in 1944-45, he was a field representative for Sealtest Corporation, New York City.

Dr. Baker is held in high esteem by his colleagues, students, and alumni of Iowa State University. His excellent teaching methods, inspirational lectures, thoroughness of subject matter, and keen interest in the individual student has endeared him to the hearts of all who have had the privilege of being associated with him.

Citation Award received on behalf of Dr. Merle Baker by Harold Bayes.

For many years, he has been a leader in the field of milk sanitation. He has taken an active leadership in the Iowa Association of Milk Sanitarians and guided the organization through many of its activities.

Dr. Baker is a loyal member of IAMFES, served on many of its committees, and as an Associate Editor of the Journal of Milk and Food Technology.

JOHNS ELECTED TO HONORARY LIFE MEMBERSHIP

Dr. C. K. Johns, Head of the Dairy Section, of the Food Research Institute, Research Branch was elected to Honorary Life Membership at the 50th Annual Meeting of IAMFES. Dr. Johns retires on October 31 after 36 years of service in the Department. Best known for his work in sanitation and quality control of milk and egg products, he earned an international reputation in this field.

Cyril Kay Johns was born in 1899 in London, England, and came to Alberta with his parents in 1910. At the age of 17, he enlisted in the army and served overseas with the Canadian Expeditionary Force, returning to civilian life in 1919. He entered the University of Alberta and graduated with a B.Sc. degree in animal husbandry and dairying in 1925. He went on to McGill University where he obtained his M.Sc. degree in bacteriology in 1926. In 1927 after a brief stay with the Alberta Dairy Branch, he joined the staff of the Bacteriology Division of the Experimental Farms Service, and commenced his lifetime work in dairy bacteriology. On leave of absence, he continued graduate study at the University of Wisconsin and was granted a Ph.D. degree in bacteriology and biochemistry in 1937. He became Head of the Food Microbiology Section of the Division of Bacteriology and Dairy Research in 1939, and was ap-

John Sheuring presents Dr. C. K. Johns with certificate of Honorary Life Membership.

pointed Officer in charge of the Dairy Technology Unit in 1953. Dr. Johns held the position of Director of the Dairy Technology Research Institute from the time of its formation in 1959 until its incorporation into the Food Research Institute in 1962.

A hard worker and prolific writer, Dr. Johns has had an outstanding career in dairy bacteriology and he is recognized as an international authority in this field. He is probably best known for the development of the triple-reading resazurin test, and of the preliminary incubation tests for assessing the sanitary quality of milk. During World War II, he undertook studies of the sanitation of the egg-drying industry and was directly responsible for the excellent reputation gained by the Canadian product on the British market. He has published over 90 scientific papers and research bulletins, and dozens of extension and popular articles.

Dr. Johns has served on many committees, and was called upon twice to serve as Secretary and Chairman on FAO-WHO committees on milk hygiene in Geneva. He was elected President of the International Association of Milk and Food Sanitarians in 1934-35.

He has served as Associate Editor of the Journal of Milk and Food Technology, Contributing Editor and Research Consultant for the Canadian Dairy and Ice Cream Journal, a member of the editorial board of the Journal of Dairy Science, and as a member of the Canadian Government Specifications Board and Sub Committees of Disinfectants and Dairy Products.

In recognition of his outstanding contributions, he was elected a Fellow by the American Public Health Association, and by the Agricultural Institute of Canada. In 1954, he received the Citation Award for "Meritorious Service to the Association" from the International Association of Milk and Food Sanitarians.

He is also a member of the American Dairy Science Association, Canadian Society of Microbiology, New York State Association of Milk Sanitarians, Ontario Institute of Professional Agrologists, and the Professional Institute of the Public Service of Canada. He is a member of the honorific Society Sigma Xi.

In 1925, Dr. Johns married Dorothy Farnalls of Jackson Valley, Pennsylvania. The Johns have one daughter, Mary Cicely (Mrs. John Simpson) and two grandchildren. Dr. and Mrs. Johns reside at 58 Fulton Avenue in Ottawa.

HONORARY LIFE MEMBERSHIP AWARDED TO HAROLD MACY

Dr. Harold Macy, Professor Emeritus and recently retired as Dean, Institute of Agriculture, University of Minnesota, was honored by election to Honorary Life Membership in the International Association of Milk, Food and Environmental Sanitarians. The award was presented at the annual meeting of the Association in Toronto last month.

Dean Macy has long been associated with the International Association and during his 44 years at the University has made many contributions in the field of dairy bacteriology and milk sanitation. He was primarily responsible for the organization of the Quality Control Committee of Minneapolis and St. Paul. This organization is unique in its operation in that efforts directed toward the sanitary production, processing and distribution of milk produced in this area are integrated through this Committee on which regulatory and industry organizations in the area are represented.

During the war years Dean Macy, then Colonel Macy, served as a member of the SHAEF (Supreme Headquarters American Expeditionary Forces) and USFET (U. S. Forces European Theater) missions to France. His work largely in the public health field contributed significantly to the bringing of order out of the chaos that existed in France after her liberation. In recognition of his work, the Government of France awarded him the rank of Chevalier in the National Order of the Legion of Honor of France. He was also awarded the same rank in the National Order of Public Health of France.

In the absence of Dr. Harold Macy, J. C. Olson accepted the Honorary Life Membership in his behalf.

Since his retirement Dean Macy has rejoined informally his old associates in the Department of Dairy Industries at the University of Minnesota. It is hoped that he may remain active for many years to come.

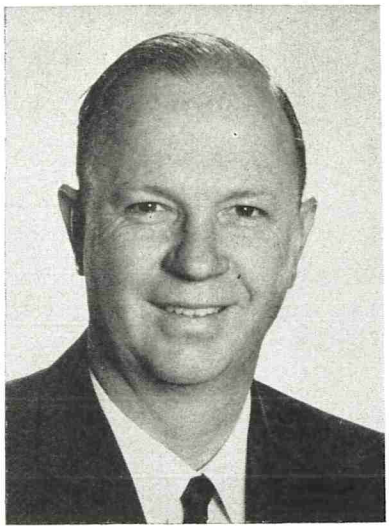
PAUL R. ELLIKER ELECTED SECOND VICE-PRESIDENT OF IAMFES

Dr. Paul R. Elliker, a member of the Oregon Association of Milk Sanitarians was elected Second Vice-President of IAMFES at the International Association's annual meeting in Toronto, Ontario, Canada last month. Dr. Elliker is Professor of Dairy Microbiology and Chairman of the Department of Microbiology at Oregon State University, Corvallis. He has long been active in the Association and is a frequent contributor of research papers to the Journal of Milk and Food Technology. His chief interests, professionally, have been dairy and food sanitation and the microbiology of cultured milk products.

Dr. Elliker received his doctorate from the University of Wisconsin. Prior to joining the microbiology staff at Oregon, he was Professor of Dairy Bacteriology at Purdue University. During World War II military service, he was in a research assignment at the biological warfare laboratories at Camp Detrick, Maryland.

In 1952 Dr. Elliker was the recipient of the coveted Borden Award for his research in microbiology as related to the dairy industry. He is also the author of the book *Practical Dairy Bacteriology.*

Dr. Elliker has traveled extensively in this country as well as abroad. In 1959 he served as dairy ambassador with the U. S. exhibit at the International Trade Fair in Madrid. Later that year he attended the International Dairy Congress in London, England and subsequently, visited numerous research institutes throughout Europe. In 1962 he again attended the International Dairy Congress, this time, however, as an official U. S. delegate.



Paul R. Elliker

LADIES PROGRAM IMPRESSIVE AT ANNUAL MEETING

Beginning Wednesday morning with a get-acquainted coffee party with Mrs. Belknap, wife of the Association's President, as hostess more than forty ladies had an unusual opportunity to become acquainted with Toronto. After the coffee party the ladies walked to the O'Keefe Centre for the performing arts, a short two blocks from the hotel, where for about an hour they toured this outstanding 12 million dollar cultural center which was given to the city by the O'Keefe Brewery. One of the outstanding features of this beautiful theatre building is its special audio antenna system which makes it possible for any hard-of-hearing person to sit in any location and pick up the theatre's audio system in near high fidelity sound. This feature is a "first" in the world. A bus tour of the city followed, including a visit to historic Fort York (York was at one time the name of the city which is now Toronto). The battle of Fort York was re-fought for the ladies by a narrated description through use of a panoramic display set in a topographical model of the battle area. A tour of expansive High Park followed and the morning ended with lunch in the Park at Ship Inn. After lunch the tour continued to Casa Loma. This interesting structure is patterned after an European medieval castle and was built by a Toronto business man some years ago. It is now owned by the Toronto Kiwanis Club.

Ladies luncheon.

Thursday's program began with a lovely luncheon at the Royal York and was followed by a fashion show of "Wigs and Hats" presented by Cathy of Toronto's Cathy's Boutegue. The day ended with the Annual Banquet which was preceded by cocktails at the Ontario Association's pre-banquet party for all present.

Certainly the ladies program at our annual meeting is becoming a special event and is attracting an increasing number of the wives of Association members.

ABSTRACTS OF PAPERS GIVEN AT THE 50TH ANNUAL MEETING, INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS

The complete text of most papers which were presented at the Annual Meeting will be published in subsequent issues of the Journal.

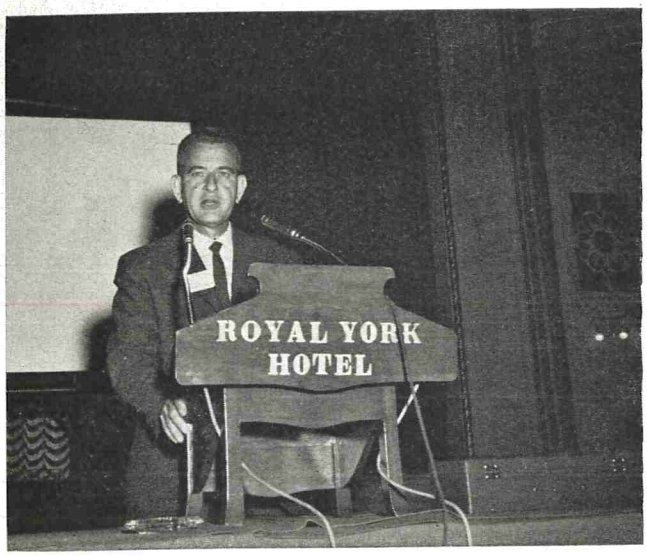
Psychrophilic Bacteria and Keeping Quality of Pasteurized Dairy Products, P. R. Elliker, B. L. Sing, L. J. Christensen and W. E. Sandine, Dept. of Microbiology, Oregon State University, Corvallis, and Mayflower Farms, Portland — One of the most important sanitation problems facing the dairy industry today is post-pasteurization contamination with subsequent growth of bacteria during marketing and use of the products. The most effective approach to this problem has been application of the Moseley keeping quality test which involves storage of the pasteurized sample of milk, cream, ice cream mix or cottage cheese at 45 F for 5 days and then running a standard plate count on it with incubation of plates at either 77 or 89.6 F. An appreciable increase above the average fresh product counts indicates bacterial growth at 45 F and therefore post-pasteurization contamination. The keeping quality test combined with a bacterial count after 5 days at 45 F is much more sensitive and useful than the coliform test in detecting post-pasteurization contamination in dairy products. Most plants using this method also find it more informative than bacterial counts on fresh products and have tended to discontinue fresh product counts except where legally required. Special in-line sampling techniques that are helpful in pin pointing sources of equipment contamination also are described. In-line sampling results indicate that filling equipment usually offers the most difficult problem in coping with post-pasteurization contamination. Recommendations for cleaning and sanitization of such equipment are suggested. Application of the keeping quality test with follow-up in improved plant sanitation procedures has greatly extended shelf-life of pasteurized dairy products, extended the marketing period, and provided financial return far greater than the time and expense involved in executing the program.

Environmental Health Factors of Nursing Homes, Franklin H. Fiske, Allegheny County Health Department, Pittsburgh, Pennsylvania — Nursing homes fill an important need in the care of the elderly in our communities. The public health factors related to nursing homes have been presented and discussed. The extent of those factors involving the environment have been shown in order to establish the scope of the field. The relationship between the types of problems and the normal activities of a trained and experienced sanitarian have been mentioned. In order to qualify for such an assignment it is proposed that the sanitarian have a background of basic sanitation knowledge in water supply, waste disposal, food sanitation and housing hygiene. In order to deal effectively with the problems of nursing homes by evaluation and consultation, extensive training of staff is indicated. Because of the scope of a control program it is recommended that the sanitarian can fill an important position on the team, along with nursing, medical and engineering personnel. The sanitarian should be able to deal effectively with the environmental health factors of nursing homes.

Co-operative Studies on Milk Quality Tests, C. K. Johns, Canada Dept. of Agric.; Pamela M. Morse, Canada Dept. of Agric.; L. F. L. Clegg, University of Alberta; A. G. Leggatt, Ontario Agric. College; and J. M. Nesbitt, University of Manitoba — This paper reports the results of a two-year study at Edmonton, Winnipeg and Guelph of the effectiveness of various bacteriological methods in detecting insanitary conditions of milk production. In contrast to previous studies, Preliminary Incubation (P.I.) at 55 F for 18 hours showed no significant advantage with either the SPC or the Resazurin Reduction Test. Resazurin reduction times equivalent to various SPCs varied strikingly between the various centers; all were appreciably greater than those currently in vogue. Bacteriological standards as stiff as 10,000/ml SPC failed to detect appreciable percentages of farms with insanitary production conditions, emphasizing anew the importance of regular, frequent, careful farm inspections. Furthermore, there were significant differences between centers in the percentages of unsatisfactory farms detected at a given count or reduction time level.

Sanitation in Plants Fabricating Plastic, Paper, Paperboard, or Molded Pulp for Single Service Milk and Milk Product Containers, Harold Wainess, 510 N. Dearborn St., Chicago — Although single-service containers have been used in the dairy industry for many years, these containers have always been given some type of bactericidal treatment after the container was formed. The development of plastic-coated board, vacuum formed and blow molded plastic containers, plastic bags and extruded and fabricated sheets for these uses has created certain environmental sanitation problems. The formed container no longer receives bactericidal treatment either at the dairy plant or the plant where the container is preformed. Bactericidal treatment is accomplished at the point where the board is laminated, the blank formed, or, in the case of all plastic containers, where the carton is preformed in part or in its entirety. This creates the necessity of applying public health safeguards at the point of production and distribution. Standards or codes for this purpose do not exist and the present wording of the Milk Ordinance and Code, 1953 Recommendations of the Public Health Service is vague in this respect. A specific manual has been developed, due to the many problems of environmental sanitation that are present in these plants. However, only a few Federal, State and Local milk enforcement agencies have included inspection of facilities for manufacturing these containers as a part of their normal routine.

Infant Formula Plant Sanitation, Harold Wainess, 510 N. Dearborn St., Chicago — It is estimated that during 1963, over 500,000 infants will be fed formulas prepared by commercial formula services. Although this service was originally established in San Francisco 16 years ago, it is only within the past few years that it has become an important factor in the feeding of infants. Their growth has been spurred by many factors. The ever-present danger of outbreaks due to contamination by pathogenic organisms or by careless use of toxic chemicals can be completely eliminated. To public health administrators, this can mean the assurance of safe formulas every day of the year. In some cases, it reduces the necessity of policing 100 hospitals to one establishment under complete control of the public health authority. Very few public health authorities have anticipated the establishment of commerical formula services and, as a result, only a handful of regulations have been promulgated to insure the safety of the product. In order to expedite the enactment of a uniform code, such a code is submitted. In a few cities, home deliveries have been inaugurated, and this aspect of formula preparation and delivery is expected to have its greatest growth in the next few years. In 1960, there were over 4,000,000 births in hospitals in the United States, and the greatest percentage of these infants will be fed by a commercial formula service in the very near future. Those companies preparing such a formula today realize that only



Malcom C. Hope presenting Keynote Address

John J. Sheuring left, presents Past President Certificate to Charles E. Walton.

by adherence to an exacting set of standards can they maintain their important place in the feeding of infants. Health authorities on a national, state, and local level, must recognize that the establishment and enforcement of a uniform, rigid and practical code is the answer.

Problems Associated with the Evaluation of the Effectiveness of New Thermal Processes for Milk and Milk Products, R. B. Read, Jr., Milk and Food Research, Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio — Several developments in the dairy industry have increased interest in thermal processes that permit greater lethality to bacteria than conventional pasteurization but minimize deleterious chemical changes in the milk. Because bacteria are generally more sensitive to high temperatures for short holding times than are many chemical constituents of milk, emphasis has been placed on ultra-high-temperature (UHT) processes with holding times of a few seconds to less than 1 second and final heating temperatures of 190 F and higher. Basically, UHT pasteurization processes can be effective from a public health standpoint, providing practical solutions can be found for several operational problems. In plate-type pasteurizers operating in the UHT range of times and temperatures, these problems include (*a*) redesign of the control system so that the lag time of the flow-diversion valve and controller combined is not greater than the holding time of the process, (*b*) selection of a time-temperature combination or combinations of UHT pasteurization, (*c*) determination of the effect that entrance-flow conditions into the holding tube have on holding time, and (*d*) development of suitable procedures for determining flow-diversion valve and controller speed of response in the field. Available data indicate that pasteurization by steam injection is also feasible for the UHT range of times and temperatures. Problems associated with the evaluation of this process include (*a*) determination of times and tube lengths required to mix the injected steam with the product, (*b*) determination of holding times, (*c*) control difficulties similar to those associated with the holding tube and flow-diversion valve in UHT plate-type pasteurizers, (*d*) flow-rate change with change in product temperature, (*e*) prevention of vapor formation in the holding tube, and (*f*) selection of proper controllers and location

Evening Milk Sanitation discussion group.

Evening food and environmental sanitation discussion group.

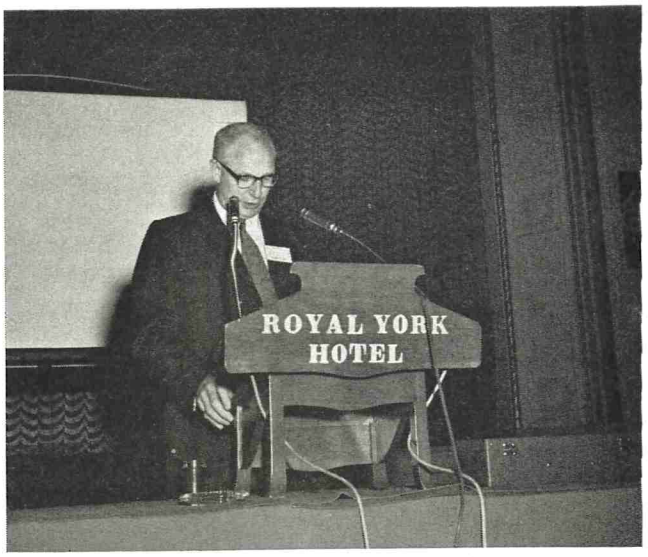
of sensing elements. In addition to process and equipment problems involved in UHT pasteurization of milk and milk products, there is a need for more data on the thermal inactivation of pathogenic microorganisms in the UHT range.

The Challenge of People, Herbert M. Ewell, Pennsalt Chemicals Corporation, Philadelphia, Pa. — Since the beginning of time when a rightful order was introduced, establishing proper balance in all things, we find we must still maintain such balance to sell sanitation, or anything else. Selling is based on four basic fundamental principles, namely quality, service, satisfaction and profit. If we humans hope to do a good job to help keep our industry great, we must develop our personalities to a proper balance also. Most men are capable of much more than their regular effort and action indicate. The only thing they lack is a plan. Assuming our knowledge and work effort is acceptable, there remains only our personalities, therein lies the key to selling.

The Next 50 Years with IAMFES, K. G. Weckel, Dept. of Dairy and Food Industries, University of Wisconsin, Madison — It seems that the future of the IAMFES will involve activities of the following order: (*a*) evaluation of the necessity, effectiveness and cost of the the work done in its professional service; (*b*) a modernization of the procedures by which to attain food sanitation from specific to general programs, with greater utilization of more rapid monitoring techniques and statistical procedures; (*c*) greater participation in research and surveillance services at a national, rather than a local level; (*d*) professional participation in improved surveillance procedures for food-related illness and in acceptability of consumer food supplies; (*e*) professional participation in the development of international standards for import and export food materials and in the development of improved food process and product standards geared to large-scale operations; (*f*) professional participation in greater educational activities designed to meet the modernized scope and level of foods processing and of its management personnel.

Prerequisites to Professionalism, S. H. Hopper, Dept. of Public Health, Indiana University Medical Center, Indianapolis — In 1950 a meeting was held in Battle Creek, Michigan to discuss undergraduate training for sanitarians. A group of public health workers realized that the first step towards professionalism was the need for education at the college level. Professional services are different from those of a skilled tradesman. Included also is a list of twelve attributes of a profession as seen by a physician who is a professional public health worker. The author discusses somewhat briefly the relative value of Registration Laws and takes a dim view of them. He is of the opinion that they are nothing more than a political expedient, and that they cannot confer professional status. They may have other values, he concedes, but are not part of professional status since this must be earned by training and experience. He concludes with a plea for continued leadership, initiative and technical competence in order to lengthen the shadow cast by W. T. Sedgwick.

Dr. D. L. Gibson, University of Saskatchewan, presenting paper at general session.



Dr. K. G. Weskel, University of Wisconsin, looks into the future with his paper. The next Fifty years with IAMFES.

What Do I Expect from a Dairy Fieldman, John Dean, Dean Milk Co., Rockford, Illinois — Many duties are expected of the sixteen fieldmen of the Dean Milk Company. These men work out of ten different receiving stations in seven states. Fieldmen must make all quality calls on milk producers. Some of the quality tests which are run on producers' milk are the raw milk bacterial count, catalase test, disc assay for antibiotics and the methylene blue test. When a producer is above tolerances in any of these tests, the fieldman must make a farm call and do what he can to help the producer improve the quality of his milk. All results of tests and field calls are reported regularly. Operating under the USPH Code of 1953, surveys and inspections are made regularly. Fieldmen usually ride with local health inspectors in order to know exactly what violations are made by the producers. Water supplies and wells are a big item the fieldman must watch. They make sure the wells on each farm have good covers and are properly constructed. Our laboratory is state approved to analyze water samples and we have a water sample analysis from the well of each producer on our market. If at any time, there is a change in well structure, a new water sample is taken. Fieldmen are also responsible for the personal appearance and work habits of the bulk milk pickup haulers. Bulk load bacterial counts are run each day on milk from each bulk tank truck. Also, weight gains and losses are watched as well as butterfat gains and losses. If there are any irregularities in weights and butterfat tests, the fieldman must check them out.

Evaluation of Environmental Health Programs, Morton S. Hilbert, Associate Professor of Environmental Health, University of Michigan School of Public Health, Ann Arbor — The true measure of statesmanship and administrative ability comes with the ability of the health agency to re-direct its

efforts away from traditional programs to less spectacular activities when it can be shown that the effort expended on the more traditional pays less public health dividends than is expected on the newer and more pressing problems that then confront the communities of our rapidly growing areas. We must ask ourselves penetrating and searching questions in reference to each of the environmental health programs in which we are involved. What are the objectives of the program? Is the program worth the effort being expended? Can we expect to accomplish our objectives with our present methods of approach to the problem? Are there other areas of environmental health in which we might more profitably be spending our time and effort? When these questions are answered, we are in a position to plan and administer the environmental health program in a more rational method. Far too many of the present-day environmental health programs are based upon tradition and what has been expected of the health agency over a period of many years. Some program emphasis can be traced to the early days of prevention of epidemics and the control of widespread pestilence. Technological and scientific advancement in the field of environmental health, the increasing demands for service and the limited availability of trained personnel demand that we approach administrative program planning, evaluation, and administration with a critical inquisitive, scientific and coldly analytical attitude. Such a fearless approach is long overdue in environmental health and demands the efforts of all practicing sanitarians. Research is needed to develop the tools for adequate evaluation and for methods of application of these tools to existing programs. The results of such action should assure the more rapid expansion of environmental health programs into the new and developing areas of health protection and should provide an increased justification for the support of environmental sanitation activities.

Environmental Health — Today and Tomorrow, A. G. Baker, Lake County Health Dept., Waukegan, Illinois — The remarkable achievements in public health in the past half century have been due primarily to the application of principles gained through the study of bacteriology. In the post war period population growth and urbanization, modern technology, increased social consciousness, growing concern with water and air conservation, and interest in the public health aspects of community planning have introduced health needs that often are either unrecognized or ignored by local health departments. In order to meet this situation, it is recommended that public health personnel intensify both internal and external communication. Public health workers are called upon to define their goals and examine their traditional organizational patterns in order to determine if they are effective in meeting modern public health problems. Particular attention should be directed to the strengthening of local health department organization, upgrading of personnel, clarification of responsibility for public health programs, and promotion of training and research opportunities in local health departments. Recognition must also be given to community relationships in order to share with the community the objectives of the professional worker and, thus, serves the cooperation of business, industry, and citzens in the attainment of optimum environmental health.

Disinfection in the Preservation of Udder Infections, F. H. S. Newbould, Ontario Veterinary College, Guelph — It appears that it is not impossible under experimental conditions by means of disinfection to reduce significantly the number of new intramammary infections caused by *Streptococcus agalactiae* and *Staphylococcus aureus.* There is need to stimulate interest in producing equipment for the practical application of these proved experimental methods. Finally it is doubtful if any other line of research has demonstrated the potential in reducing the spread of udder infections and the economic losses incurred, as has that involving the application of disinfection by heat and chemicals in the milking routine.

Communications in the Food and Dairy Field, D. L. Gibson, Dept. of Dairy Science, University of Saskatchewan, Saskatoon — Communications media are a phenomena of the twentieth century, however, their origin predates civilization. Communications really mean public relations and it is necessary to know the thoughts of others as well as make our thoughts clearly known if we wish to persuade people to see events from our point of view. In presenting a program it is essential to have it clear, interesting, convincing, and the material memorable. A study of semantics helps to add clarity to ideas, and a practical background in the field is a necessity. Jargon is well on the way to destroying communications today, thus it is necessary to simplify our languages.

Hospital Sanitation, R. E. Bond, School of Public Health, University of Minnesota, Minneapolis — An attempt has been made to describe the magnitude and complexity of hospital services as they exist today in the United States. Attention has been directed to the characteristics of the hospital community in terms of problems of communicable disease control and particularly as they may be influenced by environmental sanitation practices. Attention has also been directed to the broad spectrum of environmental health problems that exist in hospitals. Finally, it has been recommended that the sanitation programs of hospitals not be isolated from community services. The public health department of the community should, however, recognize the hospitals as an area requiring special attention in the overall environmental health needs of the community. Training of hospital personnel in public health, and the educational requirements for public health personnel to know more about hospitals have been described briefly.

EXECUTIVE BOARD APPROVES CERTIFICATION PROPOSAL

A step toward enhancing the professional level of the sanitarian was taken at the IAMFES Executive Board Meeting during the Annual Meeting when the Board approved, in principle, the plan for certification of sanitarians.

For the past two years the Sanitarians Joint Council has had under consideration a plan to establish an American Intersociety Board for the Certification of Sanitarians. The Council, composed of delegated representatives from the International Association of Milk, Food and Environmental Sanitarians, the National Association of Sanitarians, and the American Public Health Association, has submitted the certification plan to each of the above Associations for comment.

The plan for certification of sanitarians calls for the establishment of a mechanism for issuing a certificate to qualified sanitarians indicating special knowledge and competence in various fields of environmental health. In submission of this plan to the organizations represented on the Sanitarian's Joint Council, the Council makes a clear distinction

between certification and registration. It recognizes registration as a process undertaken and executed by the profession itself through its constituent societies and affiliations. Certification is the recognition of professional achievement resulting from educational preparation and competent practice of the profession with marked distinction. Certification is not available to a candidate at the start of his professional career and it is in no sense an authority to practice the profession.

Financing of the certification plan has not been worked out as yet. Further consideration of the plan will occur at the meeting of the Sanitarian's Joint Council which will be held during the Annual Meetings of the American Public Health Association in Kansas City the week of November 11, 1963.

NEWS AND EVENTS

SECOND ANNUAL MEETING, MISSISSIPPI ASSOCIATION OF SANITARIANS, JACKSON, MISSISSIPPI, OCTOBER 14-15, 1963

The Association had a very excellent meeting this year. Registration began at 10 a.m. on October 14 and at 11 o'clock the Association was called to order by President A. K. Monroe for the dispatch of the following business and/or program:

Invocation — Dr. Herman A. Milner, Baptist Minister, Jackson, Mississippi; an outstanding welcome address by the Honorable Allen C. Thompson, Mayor of Jackson, Mississippi, followed by a report by President Monroe. After lunch the Association was privleged to hear Dr. Robert Roark, Director, Division of Public Relations, Mississippi Chemical Corporation; Mr. H. L. Bradfield, Assistant Chief Food Sanitarian, Memphis-Shelby County Health Department, Memphis, Tennessee; Dr. R. L. Wyatt, Director of the Marshall County Health Department, Holly Springs, Mississippi.

It is my observation that these three were among the most outstanding papers to be presented to an association of this kind in my experience. Dr. Roark, Mr. Bradfield, and Dr. Wyatt, all are highly successful in their respective fields of endeavor and all gifted with the ability to present their ideas most entertainingly.

At 7:30 on the night of October 14, the Association assembled in the Coronet Room of the King Edward Hotel for a delightful banquet. The speaker was the Honorable E. A. Khayat, South Mississippi banker; Supervisor and Executive Secretary of the Mississippi Supervisors' Association. I wish every member of our International Association might have heard Mr. Khayat's address.

On Tuesday, October 15, the meeting was called to order at 9 a.m. and on this date we heard papers by Mr. Blanton C. Wiggin dealing with "Added Water in Milk"; Mr. John P. Lamb, Jr. on "Some Qualifications of Tomorrow's Sanitarians"; Dr. Robert Tischer on "Sewage Treatment", plus an address by the Honorable Carroll Gartin, Lieutenant Governor Elect of Mississippi.

Mr. Wiggin, a representative of Advanced Instruments, Inc., Newton Highlands, Massachusetts; Mr. Lamb, Dean of the College of Health, East Tennessee State University, Johnson City, Tennessee; Dr. Tischer, Head of the Department of Microbiology, Mississippi State University, all delivered timely and scholarly approaches to the above mentioned subjects.

On Tuesday afternoon, October 15, the Association in a business session elected Mr. J. L. Lary, President; Mr. J. L. Knight, President Elect; Mr. P. L. Bradshaw, First Vice President; Mr. Laverne Butler, Second Vice President; Mr. James Mason, Secretary-Treasurer for the ensuing year.

Between 70 and 75 members attended this year's meeting which was enthusiastic to the point of encouraging us all to believe that the Association will continue to grow and assume a very responsible position in Mississippi public health.

A. R. Russell, Secretary-Treasurer
Mississippi Association of Sanitarians

PUBLIC HEALTH SERVICE AWARDS RESEARCH GRANTS

The Public Health Service today announced the award of 36 research grants in environmental engineering and food protection totaling $608,051 in the three months ending September 30, 1963, bringing the number of grants supported in the Division of Environmental Engineering and Food Protection to 243 totaling $4,554,398.

Wesley E. Gilbertson, Chief of the Division of Environmental Engineering and Food Protection, said that the research grants program is designed to enlist the competencies at universities, state and local health departments, and other non-profit institutions, in the study of problems resulting from the increased urbanization of populations and from technological changes in the food industries. He cited as an ex-

ample the present trend toward widespread distribution of perishable foods which have been prepared at some central point. Two of the new grants are for studies of microbiologic changes in such foods.

Eight of the new grants, amounting to $134,584, were for studies of environmental engineering problems; 7 amounting to $141,266 were in milk and food microbiology; 10 amounting to $190,479 were in support of studies in basic food biochemistry and food technology. The remaining 11, amounting to $141,721, support projects studying chemical contaminants in food.

Prior to award by the Public Health Service, grant applications are reviewed by advisory groups of consultants composed primarily of non-government experts in the particular field of research and by a National Advisory Council. All awards are made on a competitive basis.

STERILIZED MILK UNDER EUROPEAN CONSUMER TESTING

Over 900 cases of a new sterilized milk concentrate — processed from milk produced on Wisconsin farms — are now rocking gently in the holds of ocean steamers en route to 12 African countries for market testing.

These shipments of sterilized milk concentrate are part of a continuing research program underway at the University of Wisconsin to determine the reaction of consumers and marketing firms in foreign countries to the new product. The project was financed by the American Dairy Association of Wisconsin and is under the direction of Truman Graf and Harlow Halvorson, agricultural economists at the University of Wisconsin.

The African shipments left Wisconsin in mid-October. They will arrive in the countries of Algeria, Nigeria, Ghana, Tanganyika, Egypt, Morocco, Belgian Congo, Upper Volta, Senegel, Ethiopia, Liberia, and Kenya about the middle of November.

The sterilized milk concentrate is being distributed free of charge in each of these countries. Questionnaires have also been sent along to determine the reactions of those who use it. They will be asked to give their reactions to the taste of the milk product, how it was used, if it is competitive price-wise, and if it was better or worse than processed milk products now on the market. Distribution of the milk in the African countries is being handled by agricultural attaches, Church World Service, and Catholic Relief Services.

The University department of dairy and food industries has been working on the development of the sterilized milk concentrate for several years. The product is a canned, sterilized, homogenized milk which has been reduced from its original volume.

Refrigerated storage helps protect the milk's quality, but the product can be carried at normal room temperatures for considerable periods. The product's ability to withstand long periods of storage without refrigeration will receive a rigid test in the Africa marketing program.

The milk will be shipped in unrefrigerated holds, will have to withstand high temperatures as it waits on docks for further shipment, and will generally receive no refrigeration when it finally arrives in the home of the African housewife.

Sterilized milk concentrate can be reconstituted and used as fluid milk, or it can be used in concentrated form. Limited consumer tests in this country have indicated that people like the product reconstituted for beverage use or in more concentrated form for use with cereals and coffee.

If the reactions from these 12 countries toward the product are favorable, there's a good chance that Wisconsin, and other states with surplus milk production, will have a new market.

Wisconsin annually produces over 17 billion pounds of milk. But only about 20 per cent of this total production is sold as fluid milk. The other 80 per cent goes into manufactured dairy products which sell at considerably lower prices.

Development of overseas markets for sterilized milk concentrate would help reduce surpluses. It would also permit the sale, at higher prices, of some of the milk now going into manufactured products. Today, about 85 per cent of Wisconsin's total milk production is used outside of the state's borders.

MINNESOTA AND ILLINOIS TOP WINNERS IN COLLEGE DAIRY JUDGING CONTEST

The three-man dairy products judging team from the University of Minnesota, coached by Professor Elmer Thomas, emerged victorious in a taste-testing duel with teams from 23 other universities from across the nation gathered in Dallas, Texas, November 4-5, for the 29th Collegiate Students' International Contest in Judging Dairy Products.

The Minnesota team not only took the All Products Bowl for excellence in judging all five dairy products — milk, butter, ice cream, cheddar cheese and cottage cheese — and the $2300 cash fellowship which will be awarded to one of the team members, but it also took top honors in cheddar cheese judging as well.

Second-ranking team in judging All Products was the one from the University of Illinois, coached by

Prof. Joe Tobias. The Illini received a $2150 cash fellowship and also swept the field in milk and butter judging.

Awards were presented to the winners at a banquet November 5 at the Statler Hilton Hotel in Dallas. Teams received cups and fellowships for their judging performances, while outstanding individuals in each division were awarded gold watches and silver and bronze desk sets for first, second and third placings, respectively, in each division.

Thus, in the All Products Division, a gold watch was awarded Michael F. Campbell of the University of Illinois, a silver desk set to Dale A. Kennen of University of Minnesota and a bronze desk set to Harvey Krohn of Michigan State University.

All Products awards and fellowships were presented by Dairy Industries Supply Association, which, with American Dairy Science Association, has cosponsored the contest since 1930.

Milk Awards

The Milk Cup for outstanding team performance in milk judging was awarded to the University of Illinois.

Individual awards in the milk division went to Robert J. Kosman of Ohio State University, first, Warren W. Weber, Jr., of Pennsylvania State University, second, and Ramon Hayes of Oklahoma State University, third.

The Milk Cup and individual awards in this division were presented by the Milk Industry Foundation.

Butter Awards

The Butter Cup for outstanding team performance in butter judging was awarded to the University of Illinois.

Individual awards in the butter division went to Marvin L. Alwes of the University of Illinois, first, Michael F. Campbell of University of Illinois, second, and Lyle Bartholeme of University of Minnesota, third.

Individual awards in this division were presented by the American Butter Institute.

Cheddar Cheese Awards

The Cheddar Cheese Cup for outstanding team performance in cheddar cheese judging was awarded to the University of Minnesota.

Individual awards in the cheddar cheese division went to Clinton L. Carroll of Mississippi State University, first, Michael F. Campbell of the University of Illinois, second, and Harrison Tim Roth of University of Missouri, third.

Individual awards in this division were presented by the National Cheese Institute.

Ice Cream Awards

The Ice Cream Cup for outstanding team performance in ice cream judging was awarded to Michigan State University.

Individual awards in the ice cream division went to Patrick Heslip of Michigan State University, first, Harvey Krohn of Michigan State, second, and Paul P. Koeppel of the University of Wisconsin, third.

The Ice Cream Cup and individual awards in this division were presented by the International Association of Ice Cream Manufacturers.

Cottage Cheese Awards

The Cottage Cheese Cup for outstanding team performance in cottage cheese judging was awarded to the University of Connecticut.

Individual awards in the cottage cheese division went to Marvin Wulf of Iowa State University, first, Richard L. Smith of University of Wisconsin, second, and Robert J. Kosman of Ohio State University, third.

The Cottage Cheese Cup and individual awards in this division were presented by the American Cottage Cheese Institute.

FDA REAFFIRMS RECOMMENDATION ON SMOKED FISH

At the request of the nation's fishing and fish products industry the Food and Drug Administration today reaffirmed that its recommendations of Friday, October 25, regarding smoked fish apply only to fish caught in the Great Lakes area or smoked in plants in the Great Lakes area.

FDA re-emphasized that its advice to housewives to destroy such products DOES NOT apply to smoked fish from other areas or to fresh, frozen, pickled or canned fish.

FDA said the smoked varieties which have been associated with recent occurrences of botulinus poisoning in Kalamazoo, Michigan and in the Knoxville-Nashville, Tenn. area are whitefish and chubs. An earlier botulinus case involved smoked ciscoes. The FDA warning also applied to other varieties of smoked fish processed in Great Lakes area plants because the type E botulinus organism has been found in the products from three of these plants.

Five of the seven recent deaths from botulism from smoked fish involved vacuum-packed products in plastic but two other deaths involved smoked whitefish which apparently had never been packaged. For this reason the FDA warning covered both packaged and unpackaged products. It does NOT, however, involve canned fish of any kind.

FDA said it was glad to repeat the information previously given because of reported misunderstanding by consumers which has adversely affected the market for fish products generally.

NEW TEST FOR DETECTING STAPHLOCOCCAL POISONING IN FOOD

The Food and Drug Administration today announced a new means of detecting stayhylococcal poisoning in food. The agency said it is a major step forward and will for the first time permit the identification in food of the specific staphylococcal toxin which is responsible for most of the food poisoning

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outbreaks in the United States.

The method, developed over the past 15 years, will save health officials from dependence upon often vague epidemiological evidence during food poisoning outbreaks and the use of expensive animals in tests which are often unreliable. FDA said the method is scientifically accurate and will ease the job of tracking down the sources of food poisoning.

It was reported by Ezra P. Casman, Ph.D., and Reginald W. Bennett, M.S., of FDA's Division of Microbiology, to the 91st annual meeting of the American Public Health Association at Kansas City, Mo., Wednesday, November 13, 1963.

The new test employs a serological method. Minute quantities of staphylococcal poison in food are detected through use of its antibody, a neutralizing agent developed in the blood of an infected animal.

Food poisoning caused by the staphylococci toxin is generally not fatal to the normal, healthy individual. It may last for only several hours, but is extremely uncomfortable and incapacitating. It is different from the seldom found but often fatal type of food poisoning caused by various botulinus organisms which produce toxins when oxygen is lacking.

For years, methods of tracing the causes of food poisoning have called for isolating the bacteria from the suspected food and demonstrating their toxicity by feeding monkeys or injection into cats. These tests, however, are not always reliable because the animals vary in susceptibility to the toxins. And, the tests are time consuming.

FDA's research for a reliable method of detecting the causes of food poisoning began in 1947 with a long range program which only recently has been completed.

The agency's scientists first demonstrated that nearly all food poisoning cases result from type A toxin produced by staphylococci bacteria. Once this was done, FDA scientists applied a method known as the "gel double diffusion test" to detect and identify the poison. Minute quantities can be detected. The food sample being examined is placed in an electric blender and turned into a uniform mash. A special column — a glass tube containing certain chemicals — is used to separate the toxin from the food parts. The toxin is then removed from the chemical and concentrated.

Samples of the toxin and of an antitoxin are applied to a gel medium into which they are diffused. When they meet a line is formed. The characteristics of this line matched against a known reference line enable the bacteriologist to make a positive identification.

Journal of Milk and Food Technology

INSTRUCTIONS TO CONTRIBUTORS

The Journal of Milk and Food Technology is designed primarily for the publication of scientific and technical papers concerned with milk and food sanitation and technology, and other subjects in the area of environmental sanitation.

Manuscripts are accepted, subject to editorial review. Membership in the Association is *not* a prerequisite for acceptance of a manuscript for publication.

Papers, when accepted, become the copyright of the Journal and can be reprinted only through arrangement with the Association Office.

All manuscripts should be submitted *in duplicate* by first class mail in flat form to the Managing Editor, H. L. Thomasson, P. O. Box 437, Shelbyville, Indiana.

Preparation of Manuscripts

1. The Style Manual for Biological Journals (published by The American Institute for Biological Sciences, 2000 P Street N.W., Washington, D. C. Price $3.00) has been adopted as a guide for authors in the preparation of manuscripts submitted for publication.

2. All manuscripts should be typed double-spaced on 8½ by 11-inch bond paper. Preferably use paper with pre-numbered lines. The side margins should be one inch wide.

3. The title should appear at the top of the first page followed by the author(s) name and affiliation(s).

4. Manuscripts reporting the results of experimental work generally should be organized as follows in the order indicated: summary; an introductory statement of the problem and objective(s) of the work; procedures or methods; results and discussion (separate or combined); conclusions; acknowledgements, if any; and references.

5. General discussion type manuscripts should be divided into sections with appropriate subtitles descriptive of the subject of the pertinent section.

6. Figures consisting of drawings, diagrams, charts and similar material should be done in India ink on tracing paper, white drawing paper or blue linen. Sheets should not exceed 8½ x 11 inches. Do not use paper with green, red or yellow lines. Titles for all figures must be on separate sheets. A letter guide should be used for all lettering on figures. Submit original figures rather than photographs of them.

7. Tables should be typed on a separate sheet of 8½ x 11-inch bond paper; place only one Table on a sheet. Use Arabic numbers for numbering Tables. Titles should be as brief as possible but fully descriptive. Heading and subheadings should be concise with columns or rows of data carefully centered below them. Use *only* horizontal lines to separate sections of Tables. Data in Tables should not be repeated in Figures.

8. Refer to the Style Manual for Biological Journals for correct abbreviations and punctuation for titles of periodicals and for biological, chemical, physical, mathematical and statistical terms.

9. References should be arranged alphabetically by author(s). Use initials rather than full first and middle names. Reference citations in the text should be given by the number in parentheses corresponding to that number in the list of references. For guidance in the form of listing references, see a recent issue of the Journal.

10. News items and announcements should be typed double spaced with an appropriate title given at the top of the item. News of the activities of affiliate associations, members and events is particularly desirable. Letters to the Editor are encouraged. Such letters must be signed by the writer.

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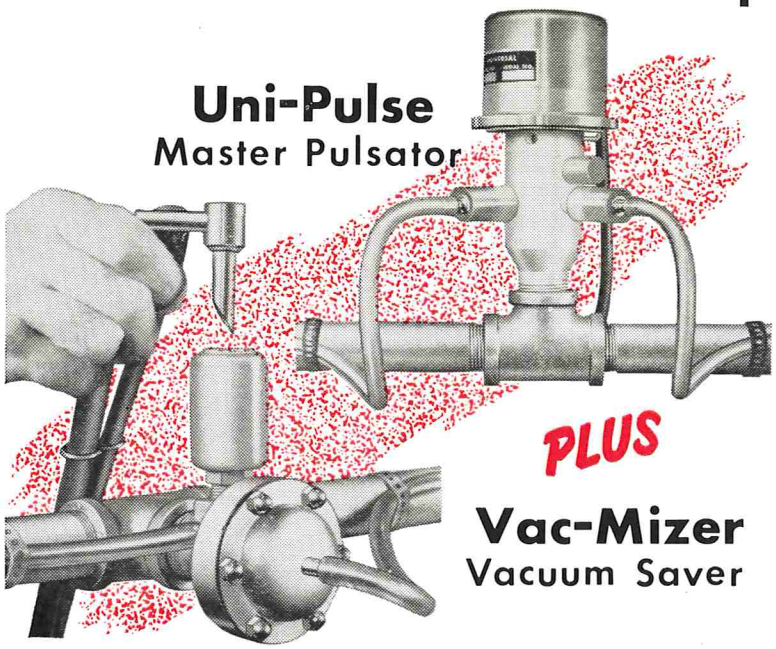

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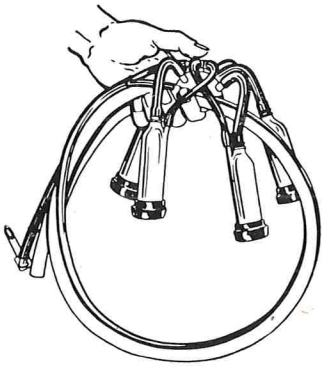

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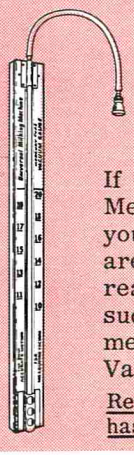

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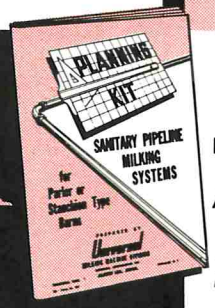

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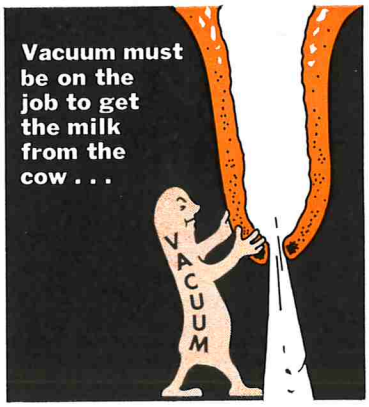

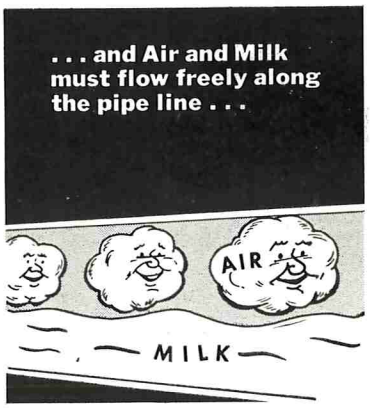

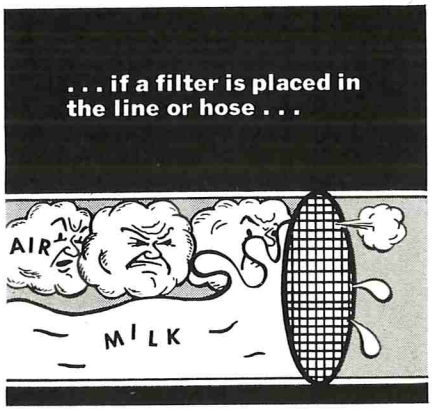

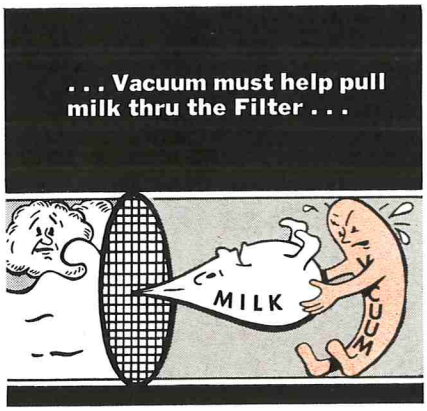

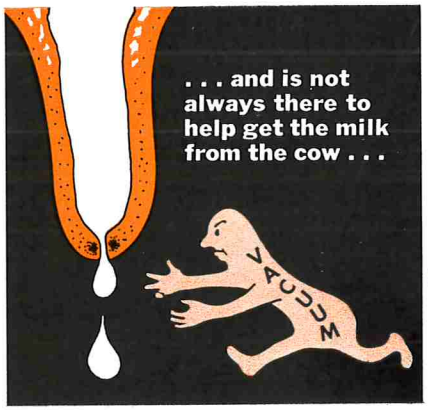

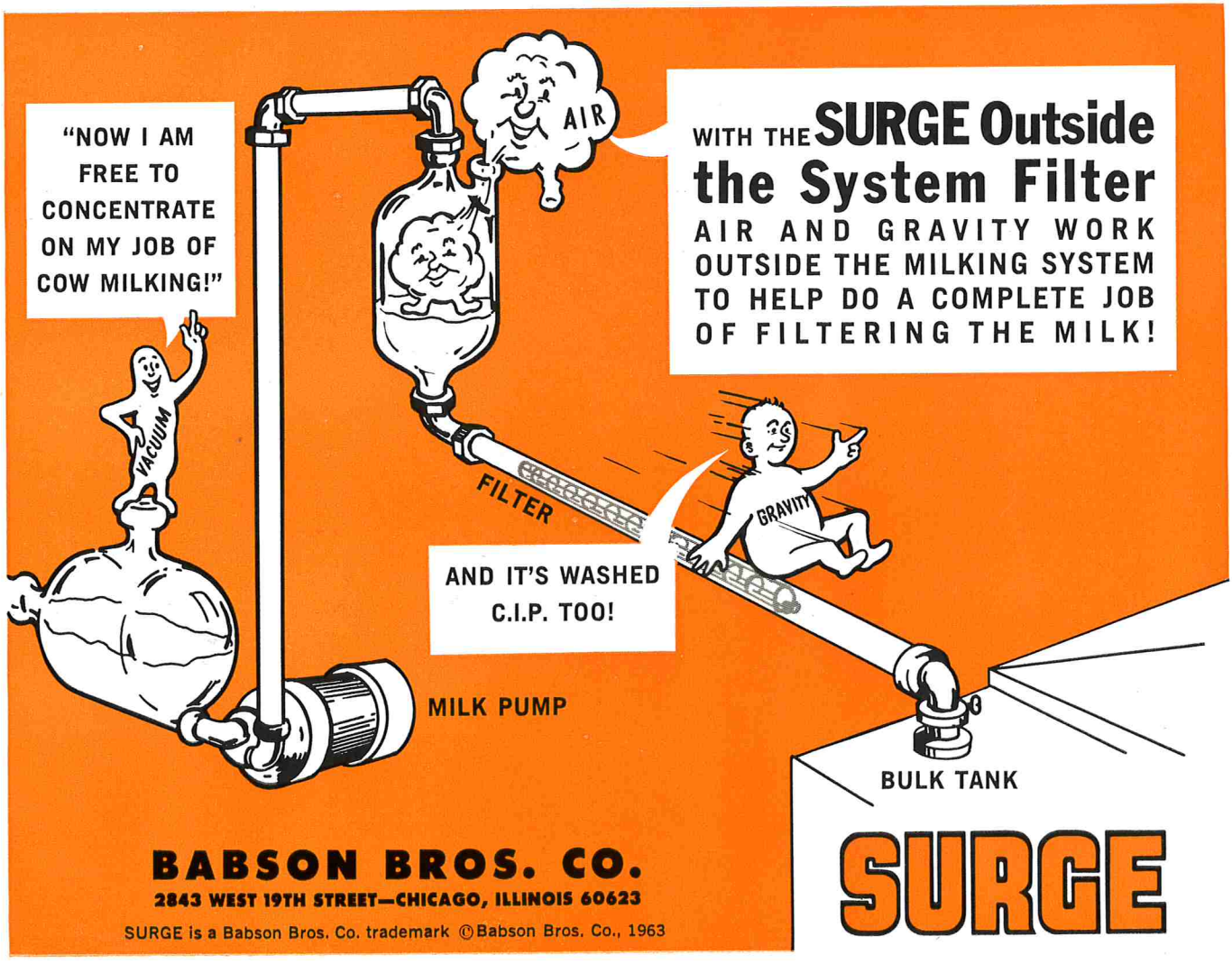

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