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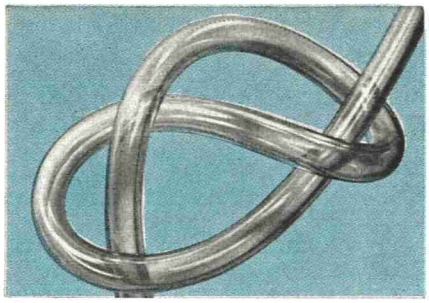
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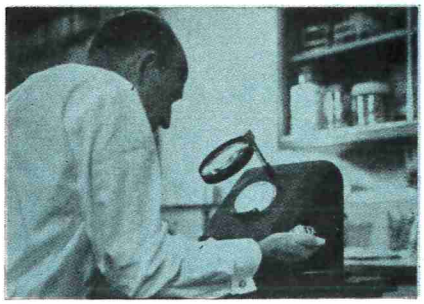
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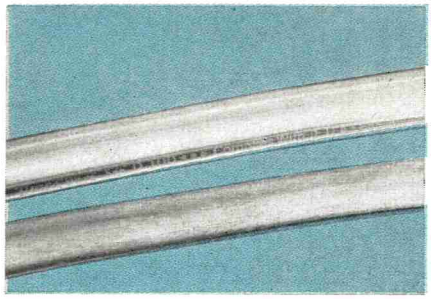
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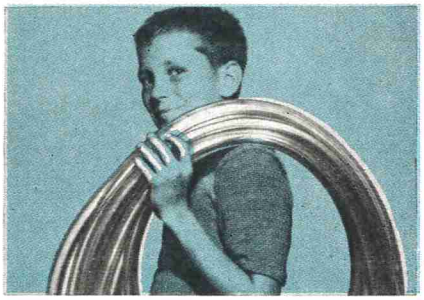
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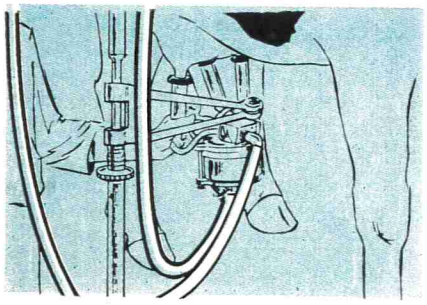
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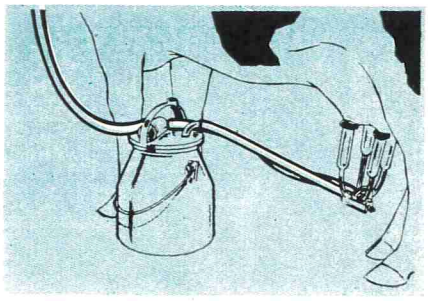
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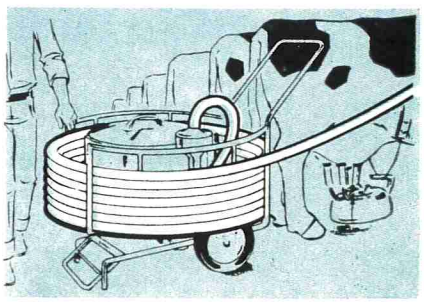
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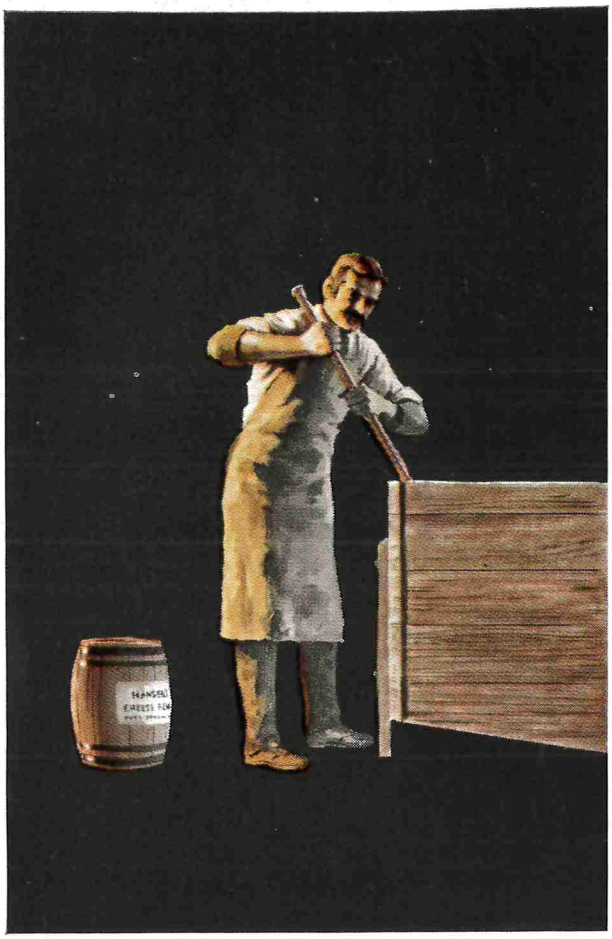

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ISOLATION OF STAPHYLOCOCCI FROM DRIED MILK[1]

R. T. Marshall, C. D. Neighbors, and J. E. Edmondson

Dairy Department, University of Missouri, Columbia

(Received for publication November 22, 1964)

Summary

This study was made to evaluate, for use with dry milk, several media used in selective quantitative analyses for staphylococci in food products. The principal problems involved in culturing staphylococci from dry milk are *(a)* growth of *Bacillus* organisms and *(b)* obtaining good recovery of coagulase-positive staphylococci while eliminating growth of micrococci and coagulase-negative staphylococci, or at least providing a means of differentiating colonies of these organisms on the plates. Tellurite-polymyxin-egg yolk (TPEY) agar produced highest counts of coagulase-positive staphylococci for two-thirds of 40 strains tested in comparisons with Staphylococcus 110 (S110) and tellurite-glycine (TG) media. Highest counts of coagulase-negative staphylococci and of micrococci were found on S110 medium for 9 to 12 cultures. TG agar gave the poorest recovery in both experiments. TG and Vogel-Johnson (VJ) media were found too inhibitory to be used for staphylococcus counts on dry milk. Mannitol salt (MS) agar reacted very similarly to S110 agar. Colonies of *Bacillus* were easily discernible on TPEY medium but often were mistaken for staphylococci on the media which depend upon salt concentration for selectivity.

Recent outbreaks of staphylococcal food poisoning associated with dried milk *(2)* emphasize the need for a sensitive quantitative test for viable staphylococci in such products.

The media recommended in the 11th edition of Standard Methods for the Examination of Dairy Products *(1)*, mannitol salt agar, has, in the experience of the authors, been found unsuitable due to the growth of members of the genus *Bacillus* which are common in dried milk. These organisms are often salt-tolerant and ferment mannitol. Furthermore, they often form spreading colonies which add to the difficulties of counting.

Experiments were therefore initiated to determine whether other available media are more useful for this application.

Crisley *(5)* has recently and thoroughly reviewed the literature on selective culturing of staphylococci. He classified the various selective media into the following groups: *(a)* the "classic" media, containing 7.5 percent sodium chloride, *(b)* the tellurite media, *(c)* media containing polymyxin as a selective agent, *(d)* egg yolk and tween-80 media, and *(e)* the tellurite-egg yolk media. In Part II of the same publication a formula is presented for tellurite-polymyxin-egg yolk agar. This is a comparatively new medium which must be put together in the laboratory. It is "recommended . . . for the bacteriological examination of foods by laboratories having public health responsibilities" *(7)*.

Materials and Methods

Experiments with retail dry milk samples

Dilutions of 11 samples of non-fat dry milk (NFDM) were prepared according to Standard Methods *(1)*. Plates, each containing 10 to 12 ml of medium, were inoculated with 0.1 ml of appropriate dilutions. Inocula were spread with sterile bent glass rods. Plates were incubated at 37 C for 24 hr and 48 hr. Tellurite-glycine (TG) *(10)*, Vogel-Johnson VJ *(9)*, staphylococcus 110 (S110) *(4)* and mannitol salt (MS) *(3)* media were used in the comparisons.

Comparisons of selected media using pure cultures

Forty cultures of coagulase-positive phage-typed staphylococci and twelve cultures of coagulase-negative micrococci and staphylococci were tested for ability to grow on various media. In addition, pure cultures of isolates from NFDM were tested in the same manner. Media for these comparisons were (TG), S110 TPEY and Plate Count agar (PCA). Test organisms were propogated in sterile skimmilk. The final dilution before plating was made in sterile skimmilk. Dilutions were made so as to produce from 30 to 300 colonies per plate. Incubation was at 37 C for 24 hr.

Results and Discussion

Experiments with retail dry milk samples

Duplicate platings were made of eleven samples of commercial NFDM on S110, MS, VJ and TG media. Dilutions were made at 1×10^{-3} in order to minimize the number of colonies produced. Counts obtained are shown in Table 1.

Colonies which resembled staphylococci in morphological appearance were picked and Gram-stained. All were Gram-positive bacilli. Two colonies each were transferred to sterile skimmilk from the MS agar and the S110 plates.

These were incubated for 24 hr at 37 C, then replated on the experimental media and in PCA. Two cultures each of coagulase-positive and coagulase-negative staphylococci were plated in the same manner (Table 2).

This preliminary experiment showed that a small percentage of the aerobic spore-forming bacilli would be expected to grow on media containing 7.5 percent salt as the primary inhibitor but not on media containing tellurite. In fact, in another similar experi-

[1]Contribution from the Department of Dairy Husbandry, the Missouri Agricultural Experiment Station. Journal Series Number 2843.

TABLE 1. TOTAL COLONY COUNTS OF PLATINGS OF 1 x 10^{-3} DILUTIONS OF NFDM ON VARIOUS SELECTIVE MEDIA

Media	Sample number										
	1	2	3	4	5	6	7	8	9	10	11
	colonies/plate (duplicate plates)										
MS	12	5	8	7	4	6	5	19	8	30	7
S110	21	5	15	11	3	9	2	18	14	36	7
TG	0	0	0	0	0	0	0	0	0	0	0
VJ	0	0	0	0	0	0	0	0	0	0	0

TABLE 2. PLATE COUNTS OF 24-HR SKIMMILK CULTURES OF *Bacillus sp.* AND STAPHYLOCOCCI PLATED AT 1 x 10^{-7} DILUTION

Culture	Colonies/plate from medium indicated				
	S110	MS	VJ	TG	PCA
Bacillus sp.					
4 S110[a]	2	4	0	0	95
7 MS	2	2	0	0	23
7 S110	15	54	0	0	120
8 MS	6	5	0	0	85
Mean count	5	16	0	0	81
Staphylococci					
Coag.-pos. 1[a]	1400	1194	975	1235	1404
Coag.-pos. 2	90	30	0	0	110
Coag.-neg. 1	200	190	6	4	208
Coag.-neg. 2	1950	1690	0	0	2145
Mean count	910	776	[b]	[b]	947

[a]4 S110 = culture No. 4 picked from S110 medium.
[b]Averages not used due to high variability.
[c]Coag-pos. 1 = coagulase positive culture No. 1.

ment, no colonies grew on VJ and TG plates seeded with from 30- to 50-thousand viable sporeformers. It indicated also that recovery of staphylococci was highly variable for the media containing tellurite as the primary inhibitor. There was little apparent discrimination for the staphylococci regardless of coagulase reaction on the part of the two high-salt media. All counts were only slightly lower than the standard plate count. The tellurite-containing media proved highly inhibitory to three of the four staphylococcus cultures. This agrees with the findings of Moore and Nelson *(8)* in recovery studies of staphylococci using various tellurite-glycine media.

Comparisons of selected media using pure cultures

It was decided at this point that the specificity and sensitivity of S110 and MS media were essentially equal, and that the same was true for VJ and TG media. For this reason the S110 and TG media were chosen for experiments with pure cultures. At about the same time TPEY medium was introduced and was highly recommended *(5, 6)*. Therefore, it was included in these experiments.

Forty cultures of coagulase-positive staphylococci previously isolated from inflamed udders of 20 different dairy herds were used for the comparisons. Table 3 shows counts for each strain on each medium.

TPEY medium produced the highest average count per plate (15 percent more than S110). In addition, two-thirds of the TPEY plates possessed the higher number of colonies per strain. Counts on TG plates averaged only slightly more than 50 percent of TPEY counts. Only two of the 40 strains grew more colonies on TG media, and in each case the difference was very small.

Twelve strains of coagulase-negative staphylococci which had been isolated from milk from inflamed quarters were tested as were the coagulase-positive strains. There was little difference in average count per plate on S110 and TPEY media (Table 4). However, 9 of 12 strains produced more colonies on S110 plates.

These data indicate that TPEY medium is slightly more selective toward coagulase-positive staphylococci isolated from raw milk. In addition, most coagulase-positive organisms cause the formation of a halo or precipitate around the colonies; whereas, coagulase-negative organisms do not.

The eleven samples of NFDM were surface-plated

TABLE 3. PLATE COUNTS OF COAGULASE-POSITIVE STAPHYLOCOCCI TESTED FOR GROWTH ON THREE SELECTIVE MEDIA

Culture	Counts from medium indicated			Culture	Counts from medium indicated		
	S110	TG	TPEY		S110	TG	TPEY
K11	0	0	1	G26B	32	34	55
K18	0	0	1	MO 839A	77	8	57
K31	0	0	2	B5B1	48	0	62
K67	8	0	2	Br4D	70	46	67
F11C	0	0	4	B1B	101	80	78
H185D	0	0	8	HA1	70	27	82
L12A	11	17	10	Br1B	98	57	82
Hall 21	14	15	12	K19	64	47	87
CC10	0	0	19	Br7C	77	48	88
B4A	28	19	19	CC9	132	78	88
Hall 17	15	6	20	B2A	88	46	90
E11A	24	19	26	C24	116	74	90
D1A	32	11	28	MO444D	80	0	126
Harvey	26	24	32	C20	60	108	138
MO 821B	40	21	32	M1	156	79	157
K6	51	2	33	C3B	24	154	161
C1A	28	23	37	C7C	148	76	172
H37B	32	0	38	C4C	119	120	180
B5B2	37	0	39				
He4B	31	0	42				
G2D	29	24	42				
KM2	35	27	54				
Mean count/medium					50	32	59

TABLE 4. PLATE COUNTS OF COAGULASE-NEGATIVE STAPHYLOCOCCI TESTED FOR GROWTH ON THREE SELECTIVE MEDIA

Cutlure	Colonies from medium indicated		
	S110	TG	TPEY
E1C	1	0	0
D41B	3	0	0
MO861A	10	0	0
D40B	2	0	2
K24	8	0	2
B3C	9	7	6
B5C	33	0	7
K32	7	0	10
Ha5	28	0	20
Br8B	9	0	21
K45	0	26	29
B6C	62	0	44
Mean count/medium	14	3	12

TABLE 5. PLATE COUNTS OF SAMPLES OF NFDM (1 x 10^{-3} DILUTION)

Sample	Colonies from medium indicated			
	S110	TG	TPEY	PCA
1	13	0	8	133
2	2	0	0	408
3	2	0	4	111
4	0	0	1	144
5	1	0	0	122
6	0	0	3	400
7	2	0	1	740
8	0	0	10	300
9	1	4	32	350
10	1	0	0	222
11	6	0	13	177

TABLE 6. PLATE COUNTS OF ORGANISMS ISOLATED FROM NFDM, GROWN IN STERILE MILK, THEN REPLATED ON SELECTIVE MEDIA AT 1 x 10^{-7} DILUTION

Culture[a]	Colonies/Culture/Medium			
	S110	TG	TPEY	PCA
TPEY-1	0	0	2	1,500
S110-2	0	0	0	840
S110-3	0	0	0	1,200
S110-5	0	0	1	1,300
TPEY-6	0	0	10	1,380
S110-7	0	0	1	1,600
TPEY-8	8	0	6	1,890
TG-9	0	0	2	1,420
S110-11	0	0	0	350

[a]Culture identity composed of symbol for medium from which picked plus number of NFDM sample yielding the colony.

on the three selective media, and standard plate counts were made. Results are shown in Table 5.

Representative colonies were picked from the above-mentioned plates, transferred to sterile milk, incubated 24 hr, then replated on the same mediums. All colonies picked were spore-forming bacilli. Results shown in Table 6 reflect a tendency for the organisms to be more easily inhibited after culturing than when plated directly from dry milk. When these organisms were replated, only TPEY medium would support their growth. However, they appeared as dark brown mucoid colonies which were easily distinguished from the staphylococcus types.

CONCLUSIONS

Colonies of aerobic spore-forming bacilli often appear on plates resulting from plating NFDM when the selectivity of the plating medium is dependent upon its high salt content.

TG and VJ media are too inhibitory for use in enumerating the small numbers of viable staphylococci which might be expected to be found in dried milks.

MS and S110 media are about equal in ability to select and promote growth of staphylococci.

TPEY agar gives slightly better selectivity for coagulase-positive over coagulase-negative staphylococci than does S110 medium. In addition, a distinctive halo or precipitate normally forms around coagulase-positive colonies. Aerobic spore-formers were easily differentiated from staphylococci on TPEY plates.

Because TPEY media must be compounded in the laboratory and surface plating must ordinarily be used, it is somewhat more difficult to use than some other selective media.

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CHLORINE RESISTANCE OF ENTEROCOCCI[1, 2]

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Department of Dairy and Food Industry,
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(Received for publication November 22, 1964)

SUMMARY

Data indicate that chlorine can be used effectively as a sanitizing agent against enterococci. Exposure, in phosphate-buffered water suspensions, to 100 ppm available chlorine resulted in complete destruction in 0.25 min. An initial concentration of 10 ppm chlorine resulted in variable destruction of enterococci after 2 min; 5 ppm for 30 min never completely destroyed any of 50 enterococcus strains studied. Acidification of the chlorine solution is important for effective germicidal action. With a concentration of 10 ppm available chlorine at pH 5.8, no survival was noted after 2 min. With this concentration at pH 8.4, there was appreciable survival after 2 min.

Coliform organisms have been used for years as indices of unsanitary or improper production, processing and handling of dairy and other food products. Recently, attention has been focused on the use of enterococci for this purpose. Before a group of microorganisms can be used as an index of contamination or unsanitary procedures, detailed knowledge of its characteristics is essential.

Chlorine is effective in destroying many microorganisms. The germicidal effect of chlorine on enterococci is not well known, however, Tonney, Greer and Danforth *(9)* reported that 11 strains of *Streptococcus faecalis* were destroyed by 0.10 ppm free chlorine in 15 to 30 sec. Two other strains were killed by 0.15 ppm free chlorine in the same time. These workers concluded that destruction of *Bacterium coli (Escherichia coli)* in water was a criterion of effective chlorination because, of the microorganisms studied, *E. coli* was the most chlorine resistant. However, *Standard Methods for the Examination of Water and Wastewater (2)* states that "enterococci may be more resistant than coliform bacteria to chlorine used for disinfection." Larkin, Litsky and Fuller *(7)* obtained 99.999% destruction of a single pure culture of *S. faecalis* when exposed to 50 ppm chlorine for 15 sec in phosphate-buffered water.

This investigation was undertaken to determine the efficiency of chlorine, under given conditions, in destroying different species and strains of enterococci that had been freshly isolated from dairy products.

Modified Chambers Procedure

An adaptation of the Chambers procedure *(4)* for evaluating the efficiency of bactericidal agents was used. Only procedures differing from those recommended by Chambers will be described.

Glassware. Six-oz prescription bottles were used in place of 250-ml wide-mouth Erlenmeyer flasks.

Preparation of culture suspension. Test organisms recently isolated from dairy products were transferred 3 consecutive days on Standard Methods agar slants *(1)* and incubated at 37 C for 18 hr. The third transfer was used immediately as the source of inoculum for germicide test cultures. Fifty strains were used in three replications: 12 strains each of *Streptococcus faecalis, S. faecalis* var. *zymogenes* and *S. faecalis* var. *liquefaciens,* and 14 strains of *S. durans.*

Each test culture was inoculated into 6-oz. prescription bottles containing 30 ml of Standard Methods agar *(1),* fortified by the addition of 1.5% extra agar and allowed to solidify with the bottle resting in a horizontal position, flat-side down. Incubation was at 37 C for 18 hr.

Neutralizer. Sodium thiosulfate was an effective chlorine neutralizer, non-toxic to enterococci. Neutralizer blanks were prepared by using a ten-fold increase in the amount of neutralizer compared with that calculated as sufficient for neutralization. The blanks were sterilized at 121 C for 15 min.

Plating Conditions. Standard methods agar *(1)* was used as the plating medium. Incubation was at

[1]Journal Paper No. J-4999 of the Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa. Project No. 1050.

[2]Data taken from a thesis submitted by the senior author to the Graduate College of the Iowa State University in partial fulfillment of the requirements of the degree Master of Science.

[3]Present address: Department of Dairy and Food Industries, University of Wisconsin, Madison, Wisc.

32 C for 48 hr ± 3 hr.

Test Water. The test water was prepared by boiling tap water for 30 min, cooling, adding buffer, adjusting pH to the desired level and dispensing into dilution bottles. Test water blanks were sterilized at 121 C for 20 min.

The phosphate buffer described in *Standard Methods (1)* was used. The pH was adjusted before sterilization (approximately 1.5 pH units below the desired pH) by using 1 N HCl or 1 N NaOH. This correction was necessary to obtain the desired final pH. A Beckman Zeromatic pH Meter[4] was used to determine pH.

The tap water used had a hardness of approximately 420 ppm. This water was dispensed in 103-ml quantities to give 99 ml after sterilization. Non-toxic rubber liners, as described in *Standard Methods (1)*, were used in the bottle caps. Caps were boiled for 30 min prior to use. Absence of active chlorine in the tap water after sterilization was verified by titration with sodium thiosulfate *(3)*. Lack of chlorine demand by the water was determined through addition of predetermined amounts of chlorine, permitting reaction to occur and retitrating by the same method. A significant reduction in the amount of chlorine remaining indicated an existing chlorine demand.

Performance of Test. One-ml portions of test water, containing chlorine and the culture suspension, were transferred to neutralizer blanks at desired time intervals. Thorough mixing was accomplished after each addition. Because of the short contact times used in some cases, milk pipettes, allowing rapidity of delivery, were used for all work.

Agar plates were prepared from the contents of the neutralizer tubes. The entire amount (10 ml) of a tube was divided evenly between two petri dishes. Following incubation, the number of colonies in each of the plates was counted. Results were reported as number of survivors per milliliter removed from the solution.

Preparation of Chlorine Solutions

Each day, 2 g of B-K Powder[5] were weighed and placed into a 100-ml volumetric flask. The contents of the flask were brought to volume by using boiled, cooled, distilled water. Any pH adjustments were made by using 1 N HCl or 1 N NaOH. This stock solution was diluted to give a solution which, when placed into the test menstruum, would give the desired concentration of active chlorine. Volumetric pipettes were used for preparing dilutions.

Chlorine Concentrations and Exposure Times

The relationship between chlorine concentrations and exposure times was determined by using the following treatments: 5 ppm available chlorine for 30 min; 10 ppm available chlorine for 0.25 min, 0.5 min and 2 min; and 100 ppm available chlorine for 0.25 min. Solutions were adjusted to pH 8.4.

Effect of pH

Chlorine solutions at pH 5.8, 6.4 and 8.4 were studied. A concentration of 10 ppm available chlorine was used; the exposure time was 2 min.

Sterility Controls

Sterility tests were made by removing 1-ml aliquots from each solution tested. Standard methods agar *(1)*, incubated at 32 C for 48 hr ± 3 hr, was used as the plating medium. Tests were completed on the following: neutralizer, each type of test water, chlorine solutions and media.

RESULTS AND DISCUSSION

Preliminary studies indicated that low chlorine concentrations (1 to 5 ppm) with a contact time of 30 min were insufficient for complete destruction of enterococci. Investigations were continued with higher concentrations of chlorine and correspondingly shorter exposure times. The use of 10 ppm available chlorine gave a significant reduction in the numbers of enterococci surviving (Table 1). However, survival within and between species was variable. Using 100 ppm available chlorine for 0.25 min completely destroyed the enterococci in all trials.

The inability of 5 ppm available chlorine, in an exposure time of 30 min, to reduce the enterococcus population to countable levels without dilution is evident. The inefficiency of this low chlorine concentration probably may be attributed, in part, to the initial cell population. If lower enterococcus populations had been used at first, this concentration-time exposure might have been more effective. Since milk usually is not treated directly with chlorine, the enterococcus count of milk is not of concern. The important factor is the number of enterococci that may be present on dairy equipment, utensils and in wash water. It seems likely that large numbers may be present on improperly cleaned surfaces or in contaminated water; therefore, larger numbers of enterococci were used.

The use of 10 ppm available chlorine as a germicidal agent against enterococci resulted in considerable variation in destruction, depending upon the time of exposure. Some inconsistency was noted within strains since, in some of the replicate platings, estimates of the enterococcus population ranged from less than 1/ml to 200/ml. Averages were obtained by using all three of the replicate platings in all cases. It is desirable, however, to indicate the number of trials resulting in a count of less than 1/ml (averaged as zero) which were used in calculation

[4]Beckman Instruments, Inc., Fullerton, Calif.
[5]Pennsalt Chemicals Corp., Philadelphia, Pa.

TABLE 1. EFFECT OF CHLORINE CONCENTRATION AND CONTACT TIME ON ENTEROCOCCI[a, b]

Culture	Control	Concentration of chlorine (ppm) 5	10			100
		Time of exposure (min) 30	0.25	0.5	2.0	0.25
		(Count/ml[c, d])				
S. faecalis	48 x 10^5	>300	140 (5/36)[e]	50 (5/36)	6 (7/36)	<1 (36/36)
S. faecalis var. *zymogenes*	64 x 10^5	>300	160 (3/36)	54 (14/36)	18 (10/36)	<1 (36/36)
S. faecalis var. *liquefaciens*	140 x 10^5	>300	110 (2/36)	59 (6/36)	19 (9/36)	<1 (36/36)
S. durans	84 x 10^5	>300	75 (4/42)	32 (13/42)	10 (17/42)	<1 (42/42)

[a]Average of 12 strains of each species except for 14 strains of *S. durans*.

[b]Determined at pH 8.4.

[c]Average of three replicate platings of each strain reported as no./ml.

[d]Standard Methods agar, incubated at 32 C for 48 hr ± 3 hr.

[e]Indicates number of samples containing <1/ml; (5/36) = 5 of 36 trials contained <1/ml.

TABLE 2. EFFECT OF pH ON THE BACTERICIDAL ACTIVITY OF CHLORINE[a]

Culture	Control	pH 5.8	6.4	8.4
	(Count/ml[b, c])			
S. faecalis (avg of two strains)	38 x 10^5	<1 (6/ 6)[d]	60	170
S. faecalis var. *zymogenes* (avg of three strains)	59 x 10^5	<1 (9/ 9)	70 (1/ 9)	270
S. faecalis var. *liquefaciens* (avg of seven strains)	100 x 10^5	<1 (21/21)	130	310
S. durans (avg of four strains)	99 x 10^5	<1 (12/12)	22 (2/12)	190

[a]Chlorine concentration 10 ppm; time of exposure 2 min.

[b]Average of three replicate platings.

[c]Standard Methods agar, incubated at 32 C for 48 hr ± 3 hr.

[d]Indicates number of samples containing <1/ml; (6/6) = 6 of 6 trials contained <1/ml.

of the average (Table 1).

The combination of 100 ppm available chlorine and an exposure time of 0.25 min effectively destroyed enterococci indicating that chlorine would control the enterococcus population in most instances. Numerous factors, such as presence of organic matter, type of surface and improperly cleaned equipment, affect the action of chlorine and should be considered in each situation.

Test temperatures are critical in chlorine germicide studies. Results reported by Rudolph and Levine *(8)* showed that every 10 C increase in temperature in the range of 20 to 50 C reduced the killing time for *Bacillus metiens* spores up to 65%. Charlton and Levine *(5)* observed that a similar increase in temperature from 25 to 55 C reduced killing time about 70%. A temperature of 25 C was used in this investigation, following the procedure of Chambers *(4)*.

One of the most important factors governing the germicidal activity of chlorine is hydrogen-ion concentration. Rudolph and Levine *(8)* reported that, if the alkalinity were above pH 8.0, a distinctly longer time would be required for germicidal activity. To examine the effect of pH, 16 enterococcus cultures were selected which survived 10 ppm available chlorine for 2 min at pH 8.4. These cultures were exposed to a chlorine concentration of 10 ppm at three pH levels (Table 2). The results of these tests show a significant reduction in viability as the

pH is lowered. This reduced viability was such that, at pH 5.8, there was no survival; at pH 8.4, the enterococcus count was 240/ml. Hays, Elliker and Sandine *(6)* recently demonstrated the increased bactericidal efficiency of hypochlorite solutions, with lowered pH, against *Pseudomonas fluorescens*, *Ps. fragi* and *Alcaligenes metalcaligenes*. The present study shows that acidification of water would decrease the ability of enterococci to survive if chlorine were used as the germicidal agent. Lowering the pH would allow a corresponding decrease in the chlorine concentration necessary. This would be especially important when necessary to use a limited concentration of available chlorine.

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A COMPARATIVE STUDY OF THE VOLUMETRIC DELIVERIES FROM GLASS AND PLASTIC PIPETTES

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SUMMARY

This study was undertaken to determine the accuracy of 0.1- and 1.0-ml deliveries from disposable plastic pipettes. Actual volumes delivered by plastic, and glass pipettes purportedly manufactured according to American Public Health Association specifications were determined. Results indicated that calibrations of the plastic pipettes were more consistent and accurate than those of glass pipettes.

This study was undertaken to determine the feasibility of using disposable plastic pipettes in the routine bacteriological examination of milk and milk products. No information was found in the literature on the accuracy of plastic pipettes for use in bacteriological procedures for the examination of milk and milk products.

Standard Methods *(1)* states that the tolerance for a 1.0- and 1.1-ml pipette is ± 0.025 ml from the tip to any graduation and between successive graduations. Glass pipettes have been the standard transfer instrument used in all milk laboratories. Although Standard Methods *(1)* states that "recalibration is desirable" this has not been a common practice.

Scientific catalogues list 1.1 ml glass milk dilution pipettes as manufactured in accordance with specifications of the American Public Health Association. Therefore, this study was designed not only as a check for accuracy but also as a comparison between plastic disposable pipettes and the commonly used glass pipettes.[1]

METHODS

Glass pipettes were those used in the routine work of the laboratory. Pipettes with chipped or broken ends were not used. To insure the complete cleanliness of glass pipettes washing procedures recommended in Standard Methods *(1)* were applied as follows:

Immediately after use milk was rinsed out from pipettes with clear, flowing water. Pipettes were soaked overnight in a cleaning solution. They were next washed in a fresh cleaning solution. Pipettes were then rinsed in an automatic pipette washer. Cold tap water was used for four rinses and hot tap water for another four rinses. Pipettes were then boiled in fresh distilled water and sterilized in a hot air oven at 180°C for two hours. Routinely, several pipettes in each batch were checked with brom thymol blue and found to be free of residual acid or alkali.

The 0.1-and 1.0-ml deliveries were weighed on a Mettler gram-atic balance. This was done under simulated daily working conditions in a milk laboratory. Pre-weighed plastic disposable petri plates[2] were used. The net weight of the sample delivered was obtained by deducting the weight of the empty petri plate from the total weight of the plate plus sample. The sample was converted to volume by dividing by the density of the product.

The range of density of mixed milk supplies is narrow. Density values given by Jacobs *(2)* were confirmed by using a 50-ml volumetric flask and a pycnometer. The volume of the flask was checked with water at 20°C. This method of determining density was considered adequate for the purpose of this study. The same method of determining density was applied to all undiluted dairy products used in this experiment. When diluted, the actual weight was interpreted as actual volume delivered; the density of diluted milk was found to be 0.9992 or, for all practical purposes, unity.

One hundred plastic and one hundred glass pipettes were checked with each type of dairy product. Each pipette was checked at the 1.0-and 0.1-ml graduations. A total of 700 plastic and 700 glass pipettes were used. In all instances the same sample was used for plastic and glass pipettes.

The following dairy products were used: Homogenized milk, chocolate milk, skim milk, chocolate drink, heavy cream and, a 1:100 dilution of homogenized milk in buffered distilled water.

Samples of cream normally are weighed in this laboratory. However, the evaluation on cream was deemed desirable because many municipal milk laboratories use a pipette to measure cream samples. The undiluted products were used at 36°F to 41°F; diluted milk was at room temperature. Standard Methods *(1)* recommends use of dilution waters at 15-25°C. Undiluted samples were returned to cool in the refrigerator every 20 min. This time interval is specified in Standard Methods *(1)* as the maximum allotted time for testing any series of samples.

All samples were properly mixed before each use. Pipetting techniques were as recommended in Standard Methods *(1)*. The pipette was inserted no more than 1 in. into the sample. The tip of the pipette was drained against the inside neck of the bottle while adjusting the volume. For 1-ml transfers, after reaching an apparent rest point the last drop of undiluted milk was blown out once into both dilution bottles and petri plates; the last drop of diluted milk was touched off once against a dry spot on the petri plate. Each transfer was completed in 2-3 sec.

For 0.1-ml deliveries, the pipette was held at an angle of about 45° with tip touching inside bottom of petri dish. The pipette was not touched off on a dry spot of the plate after completion of 0.1 ml deliveries.

The same technique as described above was applied to all

[1]All mention of plastic pipettes refer to Falcon brand No. 7514; all mention of glass pipettes refer to either the Kimax or Exax brands.

[2]Falcon brand.

Table 1 Comparison of 1.0-ml Volumetric Deliveries from Plastic and Glass Pipettes

Product	Average volume delivered by 1.0-ml pipettes		± Values from ideal 1.0-ml volume		% Higher or lower than specified A.P.H.A. range	
	Glass	Plastic	Glass	Plastic	Glass	Plastic
Homo. Milk	0.9850	1.0120	−0.0150	+0.0120	1% High 17% Low	11% High
Dil. Homo Milk	0.9718	1.0079	−0.0282	+0.0079	62% Low	6% High
Choc. Milk	0.9440	0.9842	−0.0560	−0.0158	100% Low	13% Low
Skim Milk	1.0009	1.0070	+0.0009	+0.0070	None	7% High
Half & Half	0.9750	0.9920	−0.0250	−0.0080	54% Low	6% Low
Choc. Drink	0.9602	0.9873	−0.0398	−0.0127	92% Low	9% Low
Heavy Cream	0.9440	0.9685	−0.0560	−0.0315	88% Low	49% Low

Table 2. Comparison of 0.1-ml Volumetric Deliveries from Plastic and Glass Pipettes

Product	Average volume delivered by 0.1-ml pipettes		± Values from ideal 0.1-ml volume		% Higher or lower than specified A.P.H.A. range	
	Glass	Plastic	Glass	Plastic	Glass	Plastic
Homo. Milk	0.1128	0.1020	+0.0128	+0.0020	11% High	1% High
Dil. Homo Milk	0.1043	0.0964	+0.0043	−0.0036	None	None
Choc. Milk	0.1158	0.1040	+0.0158	+0.0040	19% High	1% High
Skim Milk	0.1091	0.0987	+0.0091	−0.0013	None	None
Half & Half	0.1092	0.0982	+0.0092	−0.0018	None	None
Choc. Drink	0.1089	0.0972	+0.0089	−0.0028	1% High	2% High
Heavy Cream	0.1140	0.0991	+0.0140	−0.0009	8% High	2% High

products. In order to avoid differences that could arise from individual variations between analysts, all pipetting and weighing operations were performed by the same person.

Results and Discussion

According to Standard Methods *(1)* the acceptable range of delivery for a 1.0-ml pipette is 0.975 to 1.025 ml; for 0.1-ml amounts the range is 0.075 to 0.125 ml. Each of the values reported in the Tables under "Average volume delivered" represents the average value in ml of one hundred pipettes.

On the basis of average values, Table 2 indicates that both the plastic and the glass pipettes fall within the acceptable range for 0.1-ml graduations with all products tested. Examination of the ± values from the ideal 0.1-ml delivery shows that average values for the plastic pipettes tended to fall on the low side of the range whereas average values for the glass pipettes tended to fall on the high side of the acceptable range. However, the plastic pipettes fell closer to the true value of 0.1 ml than the glass.

Further scrutiny of Table 2 indicates that there is slightly more variation in individual glass pipettes than in the plastic. A greater number of glass pipettes fell outside the acceptable range. They delivered volumes higher than the specified 0.125 ml. This was particularly true when glass pipettes were used with homogenized milk, chocolate milk and heavy cream.

The number of plastic pipettes deviating from the 0.075 to 0.125 ml range did not seem to be significant. One pipette out of 100 delivered more than 0.125 ml homogenized milk, one out of 100 exceeded the limit for chocolate milk, 2 for chocolate drink and 2 for heavy cream. Whereas, 11 glass pipettes exceeded the 0.125-ml limit for homogenized milk, 19 for chocolate milk, 8 for heavy cream and one for chocolate drink. None of the 0.1-ml deliveries fell below 0.075 ml for either the glass or the plastic pipettes.

Average values shown in Table 1 indicated that the 1.0-ml graduation for plastic pipettes was more consistently within the 0.975 to 1.025 range than the same graduation on glass pipettes. All average

values obtained for plastic pipettes with the exception of heavy cream, fell within that range. Whereas average values for glass pipettes were low when delivering diluted homogenized milk, chocolate milk, chocolate drink, heavy cream and were just within the tolerance with half and half. Consequently, the ± values of variation from the ideal 1.0-ml delivery indicated that plastic pipettes varied to a lesser degree from an exact 1.0 ml.

Table 1 also shows that there was far less variation in individual calibrations of plastic pipettes than in calibrations of glass pipettes. Of the 100 glass pipettes checked with homogenized mlik, one delivered a greater volume than 1.025 ml and 17 a lower amount than 0.975 ml. Of the 100 pipettes checked with diluted homogenized milk, 62 were lower than 0.975 ml.; for chocolate milk all 100 pipettes were low; 54 of the 100 were low with half and half, 92 were low with chocolate drink and 88 were low with cream. The difference is striking when one compares these results with those obtained with plastic pipettes. Of the 100 plastic pipettes checked with homogenized milk 11 delivered a greater volume than 1.025 ml. With diluted homogenized milk 6 of the 100 were higher; for chocolate milk 13 out of 100 were lower than 0.975 ml; with skim milk, 7 were high compared to none for the glass product. Six were low with half and half, 9 low with chocolate drink and 49 were low out of 100 with cream.

The values obtained for cream were not surprising; it has always been recommended that cream be weighed. However, the comparison is interesting; as already stated, 49 plastic pipettes delivered less than 0.975 ml whereas 88 glass pipettes delivered less than that amount.

CONCLUSIONS

In the case of 1.0-ml measurements fewer plastic pipettes fell outside the 0.975 to 1.025 ml range specified in Standard Methods *(1)* than was the case from glass pipettes. The variation in volumes delivered by the glass pipettes was surprisingly high.

With the possible exception of homogenized milk, chocolate milk and cream, the 0.1-ml deliveries of both glass and plastic pipettes compared favorably. There seemed to be far less variation in the 0.1-ml volume delivered. However, here again, there was less variation in the calibration of plastic pipettes as compared to the glass pipettes especially when used with homogenized milk, chocolate milk and cream.

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AIR POLLUTION CONTROL[1]

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Intense fog settled on the British Isles, the air was still, and large numbers of people complained of respiratory difficulties. Before increased atmospheric ventilation removed the stagnant air, hundreds of fatalities had occurred. The cause of death may have been listed as bronchitis, asthma, or emphysema, but a significant factor that could not escape blame was the aggravation of existing respiratory ailments by severe air contamination. Similar occurrences in other areas of the world have established air pollution as a public health problem.

The history of air pollution reveals eras of misunderstanding and neglect of the problem preceding the present concern for atmospheric cleanliness. Malaria, for example, is a contraction of the Italian words mala aria, meaning bad air. The name was derived from the mistaken notion that malaria was caused by the bad air of swamps. Other diseases were similarly blamed on atmospheric contamination until the actual causes were isolated. The attitude toward the air changed rapidly from one of undue concern to complete neglect. Man's talents were devoted to developing water, milk and food sanitation procedures that are familiar in modern public health circles. Even with isolated cases of acute air pollution effects occurring periodically, an apathetic attitude prevailed on the assumption that the air supply was unlimited, self-cleansing, and capable of absorbing any amount of pollution that should be released. Increased urbanization has exposed the fallacy of the unlimited air concept, however, and man is once again seriously concerned about the preservation of his air supply.

The reasons for concern are basic. The average person's consumption of air far exceeds his intake of food and water combined, on a weight basis. Survival time without air is a small fraction of the time people can go without food or water. In addition, contamination in the atmosphere is not in the confined state that occurs with pollution of water or contamination of food. An air purification plant that could pipe the treated substance through a tap to each individual on a continuous basis is impractical. It is therefore essential that air pollution control be related to the sources of contamination rather than to a purification of the contaminated atmosphere.

In addition to the health aspects, air pollution has created a serious economic impact on this country. Recent estimates cite the national costs of air pollution effects at 4 to 12 billion dollars annually.

There should be no doubt that air pollution is a firmly established environmental problem worthy of the consideration of government, business, and the public. There is a great deal left to be determined on actual cause and effect relationships that are attributed to air contaminants, but action should not be delayed until all the research is done. Sufficient evidence has been compiled to establish air pollution as an existing or potential problem in many communities. To delay action until disaster strikes could only be classified as short-sighted negligence.

THE PROBLEM

Air pollution is complex, involving innumerable sources, economic and health effects that are difficult to document, and meteorological variables that complicate the establishment of specific source and effect relationships.

Sources

Contamination is released to the atmosphere during most of man's activities. All sources, large and small, are important as each contributes to the total pollution burden.

Industry is often cited as the major or sole source of air pollutants. It is true that in most urbanized areas, industry makes a significant contribution to air pollution. They should be urged, and when necessary required, to control their effluent to minimum practical concentrations. It is equally important to realize, however, that many other sources of air pollution exist, and industry alone cannot assume responsibility for deterioration of the atmosphere.

Combustion is a major source of emissions that brings governmental agencies and the public into intimate contact with air pollution, both as contributors and recipients. Heating of homes, offices, and other buildings consumes millions of tons of fuel annually. Combustion products from an individual household seem infinitesimal when compared to the smoking stack of a large industry. However, when this small amount of pollution is multiplied by the number of homes and buildings in a community, it reaches astounding proportions. Figure 1 shows the relationship between the smoke-

[1]Presented at the 51st Annual Meeting of the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC., at Portland, Oregon, August 18-21, 1964.

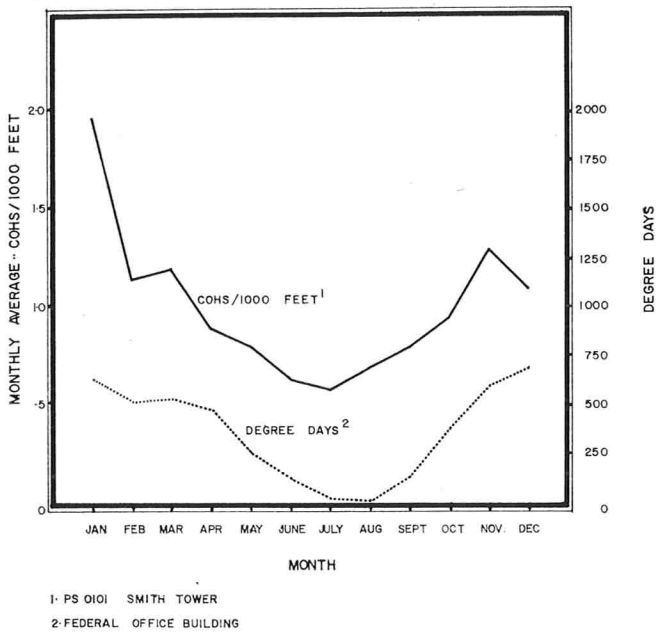

Figure 1. Smoke-haze index and degree days.

haze index and degree days. The smoke-haze index is a measurement of fine particle concentration in the atmosphere. Degree days are temperature measurements recorded daily by the weather bureau. This unit indicates the number of degrees necessary to raise the daily average temperature to 65 F and can be used to calculate fuel consumption for heating purposes. A remarkable correlation exists between the smoke-haze pollution index and the degree day measurement in the winter months. This correlation serves to indicate the relationship between fine particulate pollution and combustion products from space heating.

Burning of refuse is another air pollution source that cannot be overlooked. Backyard burning barrels, open burning dumps, municipal incinerators and use of fire for land clearing purposes release significant amounts of contamination to the air. Single contributions may again be small, but the total volume of pollution created on a community-wide basis by waste disposal is significant.

Transportation media are another example of a multitude of minor individual sources creating a major problem. The amount of pollution placed into the atmosphere by the various modes of transportation is difficult to conceive. The automobile has been cited as the major source of pollution in some areas, and will be fitted with exhaust control devices in California by 1967.

The relative impact of various sources is different for each community. Studies must be conducted to place all sources in proper perspective before an effective control program can be initiated.

The Effects.

Problems created by air pollution are diversified. The insidious nature of many effects complicate the establishment of specific causal relationships. The economic impact of air pollution has been estimated to be as high as 65 dollars per capita per year in this country. This compares with a few cents per capita per year being spent on control. Establishment of precise cost is impractical, due to the varied manifestations of the problem.

Vegetation damage by air pollutants is an established fact in many areas. The effect varies from obvious damage to unapparent changes in the plants resulting in reduced yield or mediocre crops.

Soiling of fabrics and surfaces and deterioration of materials exposed to the atmosphere are two other common air pollution effects.

Reduction in visibility is a difficult effect to evaluate monetarily, but it is known that people place value on scenic views that are too often obstructed by excessive air pollution. Figures 2 and 3, courtesy of the Seattle Post Intelligencer, show the visibility reducing effects of air pollution in Seattle.

Air purification systems for sensitive processes, and reduction in property values are other costs that can be attributed to air pollution. An economic balance must be attained between effect and control,

Figure 2. Seattle, Washington on a clear day.

Figure 3. Seattle, Washington — visibility reduced by air pollution.

and at the present time, the cost of neglect far exceeds control expenditures.

Economics is an important facet in overcoming any environmental problem. However, cost should not be allowed to dominate decisions affecting public health. It is a well-documented fact that severe air pollution episodes aggravate existing respiratory conditions. Chronic effects from long-term exposure to low concentrations of air pollutants are not as well substantiated. Research is establishing a circumstantial and statistical link between air contamination and disease, however, and a positive relationship is becoming apparent. To wait until indisputable evidence is compiled may unnecessarily cause widespread sickness. Environmental hazards are more effectively controlled by preventative than corrective measures. It is still not too late in some areas to apply this premise to air pollution.

Complicating Variables.

Pollutants that have left their source through release to the atmosphere are out of the control of man. The specific relationship between the sources and the receptors of the pollutants is complicated by meteorological factors. Wind determines the direction of pollution and the ventilation rate. Vertical stability, often referréd to as an inversion, is another significant variable in establishing the total volume of air available for dilution purposes. Low-level inversions in conjunction with light winds seriously restrict atmospheric mixing and cause high pollutant concentrations to occur. Solar radiation, rainfall, and temperature also influence the type and extent of air pollution. An evaluation of potential atmospheric problems in a community must include a comprehensive study of meteorological conditions.

The Solution

A community air pollution problem, existing or potential, cannot be solved hurriedly. It is necessary to gain an understanding of the cause of the pollution, its movement throughout the area and synergistic effects resulting from atmospheric reactions.

Technical Control.

Pollution from most sources can be substantially reduced by the installation of available control equipment, and the establishment of proper operating and maintenance procedures. Control equipment for industry is expensive. In some cases, a valuable by-product can be obtained from the material recovered. Unfortunately many control installations must be installed for the sole purpose of abating air pollution. Sizeable amounts of money are often needed for pollution abatement, but the capital and operating costs of equipment should be considered an integral part of business expenses.

More research is needed to improve existing techniques of control and to develop highly efficient collection systems for pollutants that are undesirable in minute concentrations.

The Legislative Approach

Many air pollution ordinances have been written and rewritten. Their effectiveness is generally directly proportional to the knowledge of the local situation obtained prior to the adoption of the regulations. Air pollution control laws can be written at city, county, or state levels, and under the recently adopted Clean Air Act can, under certain conditions, be adopted and enforced by the federal government. Although it appears at times to be infeasible, the most efficient enforcement is obtained at a local level. Air pollution has no regard for political boundaries, so cooperation or formal agreement is required between cities and counties to attack the problem on a practical basis. Primarily a local problem exhibiting large variations between areas, air pollution is deserving of control by local government.

Private Contributions to Control.

The Air Pollution Foundation of Los Angeles was brought into being by industry for the purpose of investigating the causes of air pollution in the Los Angeles Basin. The Foundation made a significant contribution to the knowledge of atmospheric contamination, but this action was taken only after extensive regulations had been adopted.

Very recently, a non-profit corporation was formed in Seattle, Washington for the purpose of evaluating air pollution in the Puget Sound Basin. Known as the Puget Sound Air Resources Council, this privately financed corporation will work toward a better

understanding of existing and potential atmospheric conditions in the region, and establish factual information on which to base an effective area-wide control program. Air pollution has been aptly described as a problem of the people, and it seems proper that the public and the business community share in the responsibility for air pollution control.

One of the greatest needs at the present time is to educate the public to the fact that the atmosphere is not unlimited and that air quality is rapidly deteriorating. Leadership is necessary to bring the problem into the open where it can be effectively handled. The sanitarians may view air pollution as an additional duty that can only interfere with their existing programs. Realistically, however, air pollution is an environmental problem — the type sanitarians can effectively handle, and one that is within their jurisdiction as a potential menace to public health. The air surveillance program of the Washington State Department of Health has been made possible by the interest and cooperation of sanitarians in local health departments throughout the state. Air pollution can be handled on a local basis, and it is a challenge to sanitarians to accept their part in coping with this problem before an outraged public demands cleanliness in the air they breathe.

ENVIRONMENTAL SANITATION IN NATIONAL PARK SERVICE AREAS[1]

GEORGE F. WHITWORTH

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Your National Park Service of the United States Department of the Interior brings you greetings, and hopes that while in this area you will have an opportunity to visit some of your National Parks and Monuments including Coulee Dam National Recreation Area, Mount Rainer and Olympic National Parks, Whitman Mission and Fort Vancouver National Historic Sites in Washington, and Fort Clatsop National Memorial, Crater Lake National Park, and Oregon Caves National Monument in Oregon.

Before proceeding with the discussion of environmental sanitation, it would appear advisable to present some basic information regarding the Park Service. The Federal Government has two major conservation organizations that some people confuse, the U. S. Forest Service and the National Park Service. Each has an important part to play in the conservation program for these United States. However, the Forest Service's function is to provide for utilization of resources without abuse, including grazing, lumbering, and mining as well as recreation, whereas the basic law for the Park Service provides that the natural areas under its jurisdiction are to be kept as closely as possible in the condition God made them. The Park Service is also responsible for keeping other areas in such a manner as to provide full appreciation for the historic and prehistoric events the area commemorates, and for administering recreation areas of national significance.

A word too, is in order about the place of the concessioner in park operation. Aside from camping and picnicking facilities, provisions for lodging and feeding the visitors are provided by private enterprise. Many of the people who visit the Parks make their primary contacts with the concessioner at his hotel, lodge, or in the dining room, and believe he represents the Service. Actually, after careful study by Service representatives of a proposed concessioner's background, ability to perform, finances, and the like, he is granted a contract to provide necessary services. All factors are subject to careful examination and review by Park Service officials at all times to insure that they are adequate, responsible, and conform to comparable services and prices for areas in the vicinity of the Park. If the visitor does not think the service is adequate or if the prices seem to be out of line, the Superintendent should be informed so that he can take steps to rectify any irregularities that may exist.

ORIGINS OF THE NATIONAL PARK SERVICE

Historically, the beginning of the first National Park was at a campsite in the present Yellowstone National Park, September 19, 1870 where a party had explored the area and was overwhelmed with the wonders they had seen. They agreed that these wonders were too great for any person or group of persons to control, but that they should belong to the people of these United States. A year later, in December 1871, a bill was introduced in Congress to establish Yellowstone National Park as a "public

[1]Presented at the 51st Annual Meeting of the INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS, INC., at Portland, Oregon, August 17-21, 1964.

park or pleasuring-ground for the benefit and enjoyment of the people." The bill was passed and signed by President Grant, March 1, 1872. The creation of Yellowstone National Park was a culmination of some earlier conservation efforts by broadminded citizens throughout all the United States. The birth of the national park concept and the first national recreational withdrawal of land for public use was accomplished by a bill introduced in March 1864 and signed by President Lincoln in June of the same year which granted the Yosemite Valley and the Mariposa Grove of Big Trees to the state of California upon the "express condition that the premises shall be held for the public use, resort, and recreation, inalienable for all times." In 1890 the lands around the original valley and grove were established as a National Park, and in 1906 California ceded the valley and the grove back to the United States as part of Yosemite National Park.

THE NATIONAL PARK SERVICE TODAY

The National Park Service at the present time consists of some 201 areas with a total area of 26,465,000 acres varying in size from the smallest, Lincoln Museum National Memorial, Washington, D. C. with 0.18 acres to Katmai National Monument in Alaska with 2,698,000 acres. The total number of visitors during 1963 for the Park Service was 102,710,600.

At the present time the Park Service organization consists of the Washington Office with the Director and his staff establishing the general policies and six regions which in turn are responsible for the overall administration of the various field areas. The design and construction of all facilities, including roads, trails, buildings, various utilities, and the like are under the supervision of the Division of Design and Construction with offices in Philadelphia, San Francisco, and the National Capital Parks in Washington, D. C. The San Francisco office is responsible for all such activities west of the Mississippi.

Each area is administered by a superintendent. Under him are personnel responsible for the several divisions of protection, interpretation, and maintenance.

There are several agencies that cooperate with the Park Service in the design, construction, and operation of the areas and of their facilities. The two principal cooperating agencies in the field in which we are interested are the Bureau of Public Roads of the Department of Commerce which assists in the design and construction of the main roads in the Parks, and the Public Health Service of the Department of Health, Education, and Welfare, which cooperates in all sanitation activities.

Environmental sanitation requirements exist, of course, in all areas throughout the Park Service. However, this paper will concentrate on the activities in the Western Region with which the writer is more familiar. The Western Region includes the seven western states and consists of 31 areas with a total area of 12,936,000 acres, varying in size from Sitka National Monument in Alaska with an area of 54 acres to Katmai National Monument with the acreage mentioned before. During 1963 there were over 11 million visitors to these 31 areas. The 1964 fiscal year operating budget for the Western Region totaled $9,198,000, of which $4,338,000 was for the maintenance and rehabilitation program, including $2,000,000 for buildings, grounds, utilities, and sanitary facilities, and a little over $2,250,000 for roads and trails. The maintenance-rehabilitation program varied from a minimum of $5,000 for a single area to a maximum of $820,000 at Yosemite. Thus, it will be seen that the operation of the Park Service in the Western Region is no small business.

There are three types of jurisdictions exercised by the United States over areas administered by the Park Service: exclusive, concurrent, and proprietary.

Exclusive jurisdiction is the broadest type wherein the state has ceded exclusive jurisdiction over the entire area to the United States regardless of the ownership of the land. In such instances, state laws as such have no application or effect within the area.

Concurrent jurisdiction is that of two powers over one and the same place. It is secured by a cession from the state or by reservation in a cession of what would otherwise be exclusive jurisdiction. The effect is to enlarge the proprietary jurisdiction of the United States by granting it authority to control activities which otherwise would be outside its field of authority. Concurrent jurisdiction, however, involves substantially less authority than does exclusive jurisdiction.

Proprietary jurisdiction exists by virtue of ownership alone. Regardless of whether the state cedes or grants to the United States jurisdiction of any type or form it cannot affect the Federal title or interfere with the protection, use, and control of the area by the United States. Federal laws and regulations for the reasonable protection, control, and regulation of the property of the United States in such areas are paramount to those of the states.

COOPERATION WITH THE PUBLIC HEALTH SERVICE

In view of the different types of jurisdiction it would appear advisable for the Park Service to deal with one agency regarding public health problems that are encountered in National Park areas. The Public Health Service is the agency of choice for this purpose. It has issued an *Administrative Guide* covering its role in the Park Service activities. This paper includes much of the material published

in this guide. The guide lists the following among the services provided by the Public Health Service to the Park Service: protective sanitation surveys including water supplies, milk supplies, food service establishments, facilities for sewage and refuse disposal, and insect and vector control; review of plans of important sanitary facilities; and field studies and surveys when requested. The Park Service reimburses the Public Health Service for these environmental health services including personal services and travel expenses.

In areas covered by exclusive jurisdiction the normal operating procedure is to conduct Park Service activities independently of the state and local health authorities. An exception to this procedure is commonly made when the effluent from a sewage disposal plant discharges to a water course that flows beyond the Park boundary or when the effluent will be conveyed to a watershed outside the Park boundary. Under these conditions the state pollution control agencies involved are normally contacted regarding the degree and type of treatment to be provided and the point of final disposal when the disposal plant outlet discharge is beyond the Park boundary.

Where concurrent or proprietary jurisdiction exists, the Public Health Service may provide liaison between the Park Service and state health authorities covering environmental sanitation problems.

OPERATION AND MAINTENANCE OF SANITARY FACILITIES

The Recreation Advisory Council, consisting of Secretary of the Interior Udall; Secretary of Commerce Hodges; Secretary of Agriculture Freeman; Assistant Secretary of Defense Paul; Secretary of Health, Education, and Welfare Celebrezze; and Administrator, Housing and Home Finance Agency, Weaver, has issued a series of Recreation Advisory Council Circulars. Circular No. 3, dated April 24, 1964, outlines areas of consolidation and cooperation between agencies having administrative responsibility for an area and the qualified health personnel or health agency having jurisdiction. These areas of joint cooperation include steps to:

1. Insure that the operation and maintenance of sanitary facilities are in accordance with applicable requirements or regulations of Federal, state, and local health departments.
2. Certify the quality of all food and drink products served to the visiting public.
3. Control animals and insects harboring disease vectors or capable of transmitting diseases to humans.
4. Control environmental factors relating to communicable diseases.
5. Provide accident prevention services.
6. Prevent air and water pollution arising from recreation facilities.
7. Detect and control all other environmental hazards.
8. Train and periodically inspect personnel responsible for the operation and maintenance of concessioner and sanitary facilities in order to insure compliance with applicable health regulations.
9. Assure implementation of adequate water safety measures.

Environmental sanitation in National Park areas cover many specific areas of interest to sanitarians. One might state that on a greater or lesser scale nearly every problem met in environmental sanitation occurs in one or more of our National Park areas. Some of the aspects of environmental sanitation are discussed in the balance of this paper.

WATER SUPPLY

Water supply requirements vary from small individual ranger outposts and small high mountain camp areas through a wide range of size and location to areas like Yosemite Valley where there are facilities similar to those found in a medium-sized city or in Death Valley where water availability is limited as to location, but in some cases, surprisingly enough, is large in capacity. The water supply systems include the works and auxiliaries for collections, treatment, and distribution of the water from the source of supply to the free-flowing outlet of the ultimate consumer, be it campground hydrant, employee's residence, or concessioner facility. Sanitary protection is concerned with all parts of a water system which comes within the above definition. However, for practical purposes attention may be concentrated mostly on those portions which have to do with sources, treatment, and distribution of the water.

Surface water supplies are frequently used as sources of water for Park Service developments, and in some rather rare cases such supplies are used without treatment. The untreated surface water supplies generally originate in heavily forested areas uninhabited by man, and they are therefore subject to a low degree of contamination by trespassers or animals. Other areas have springs as a source of supply and in many areas the source of water may be either surface or deep wells.

Where possible the use of untreated water supplies is limited to underground waters not subject to any possibility of contamination and meeting in all respects the requirements of the *Public Health Service Drinking Water Standards* as determined by frequent sanitary inspections and laboratory tests. The elim-

ination of the use of all untreated waters is a goal toward which the Park Service is striving and as rapidly as possible adequate treatment for all Park Service water supplies will be provided within the limitations imposed by available funds. In the majority of cases, contaminated water supplies can be made safe for drinking purposes by means of simple chlorination or its equivalent. Where chlorination is considered impractical for small, relatively pure surface water supplies, consideration is given to the use of wells, springs, or infiltration galleries.

Sampling schedules have been established for the various Park Service areas. In general, during periods of heavy use samples are taken from each system at a minimum of twice a month with an immediate and thorough checking of unusual or bad results. Arrangements are made with laboratories operated by the state or local health authorities for the bacteriological examination of water samples. Copies of these tests are forwarded to both the Public Health Service Regional Office and the Western Regional Office of the National Park Service with the results being summarized annually to determine whether or not the supply continually meets the requirements of *Public Health Service Drinking Water Standards.* When a supply fails to meet the standards, the Public Health Service recommends appropriate action. The Western Regional Office cooperates with both the Public Health Service and the superintendent to insure the proposed improvements are installed as rapidly as funds can be made available.

Chlorination equipment for the disinfection of water supplies where the flow is variable at the proposed points of application of chlorination is designed to proportion the flow of disinfectant to the flow of the water. When simple chlorination is used the Park Service tries to maintain 0.05 to 0.2 parts per million of free residual chlorine in the treated water after a contact period of at least 20 minutes in the distribution system beyond the point of chlorine application. This does not mean that it is mandatory that a chlorine residual exists in all parts of the distribution system.

SEWER SYSTEMS

Sewage disposal facilities in the Parks offer a wide divergence of methods. Obviously the most elemental and the one in use in much of the backcountry is the ordinary pit toilet. With the larger areas, and particularly those with greater visitor use, the sewage disposal facilities grow in complexity from simple pit toilets to septic tanks with subsurface absorption systems, to major systems, such as the activated sludge plant serving the Yosemite Valley area, the high rate trickling filter plant serving the Yosemite El Portal area, and the extended aeration plant serving the Sequoia Ash Mountain residential area. The Park Service is beginning to make more effective use of sewage lagoons which in many cases can give the most economical and the most satisfactory disposition of sewage.

In the design of sewage disposal systems the Park Service is programing for the preservation of surface and ground waters and where necessary the restoration of such waters to the best possible condition consistent with the public health and welfare, the propagation and protection of fish and wildlife, and the recreational developments of these areas. Since many of the streams and lakes in Park Service areas have not been adversely affected by developments, its objective is to preserve these waters to the highest standards consistent with reasonable and beneficial future developments.

In designing new sewage disposal plants consideration is given to the method of treatment to provide the degree of purification desired and to the best location for disposal plant sites. In the northern states operations are frequently on a seasonal basis with the utilities taken out of service during the winter months. Under such circumstances it is generally considered infeasible to design a sewage disposal plant that will provide for bacteriological treatment, including sludge digestion units, due to the conditions under which they will operate and the time required to reseed these facilities.

The Park Service is reluctant to design sewage treatment plants requiring a great deal of mechanical equipment when other methods will serve the same purpose, inasmuch as available funds for maintenance, repair, and operation are limited.

The general policy regarding the installation of ordinary pit privies, masonry vault privies, and chemical treatment for developed areas such as campgrounds, picnic areas, etc., requires these facilities to be installed only for temporary use or until funds become available for the construction and/or maintenance of modern sanitary facilities. The principal use of privies is in isolated areas such as trail shelters and the like when the installation of modern sanitary facilities is considered infeasible or impractical, or in developed desert areas where water is scarce. A good example of the use of lined pit privies is at Jumbo Rocks Campground in Joshua Tree National Monument. The soil is rocky making excavation difficult and expensive. By using a steel tank with a small amount of liquid and chemicals the unit is kept in a relatively sanitary condition and may be pumped out periodically as required. Thus far the Park Service has found it impractical to use burnout treatments due primarily to the very expensive initial costs of such units.

Septic tanks with subsurface tile systems are the most common type of sewage disposal in the Park Service areas as this type of construction has normally proved most economical and practical. The Park Service experience has demonstrated that septic tanks and subsurface tile systems give satisfactory service for many years when properly designed, constructed, maintained, and operated. The principal reason for unsatisfactory operation or for the failure of septic tank systems is inadequate inspection and cleaning. Each area is required to check each septic tank at least once every six months to insure that neither the bottom of the scum nor the top of the sludge gets too close to the bottom of the outlet baffle. If these accumulations become too great solids will flow from the tank and clog the disposal area. When the sludge and scum are removed from septic tanks or masonry vault privies the material is drained to an adjoining sludge bed, buried in uninhabited places selected for this purpose, or emptied into a sanitary sewer system. Such wastes are never emptied into storm drains or distributed into any stream or water course. In those isolated areas where septic tanks are operated on a seasonal basis the tanks may be drained to an adjoining sludge bed at the end of the visitor season. Although the undigested sludge and scum can be offensive when withdrawn the dried material can easily be disposed of prior to the start of the next visitor season. This method of operation is primarily satisfactory where the areas are not accessible to the public during winter months.

The use of sewage lagoons or stabilization ponds is a comparatively recent development and in many circumstances is the most practical and economical way of disposing of sewage wastes. As you probably are aware, this type of disposal consists of a relatively water-tight basin into which the raw sewage is deposited. Normally there is a depth of three to five feet of water in such a lagoon. During the summer months there is a rapid growth of algae resulting in aerobic action disposing of the sewage wastes without odor. Even during the winter months there is some aerobic action so that a properly designed unit can work the year around. Thus far the design of oxidation ponds is based largely on empirical formulae and data. Both the Public Health Service and the Park Service are continually investigating the operation of these units so that eventually more precise design data will be available.

REFUSE DISPOSAL

Wherever a group of humans collect there is always the problem of refuse collection and disposal. In the smaller areas the disposition is relatively simple but with the larger areas the quantity becomes excessive and disposition becomes difficult.

Refuse includes all garbage, rubbish, ashes, and other putrescibles and non-putrescible solid wastes except sewage. Proper sanitation consists of adequate storage, collection, and disposal of refuse essentially for the control of rats and insects and for the prevention of nuisances. Another factor that complicates the storage of large quantities of refuse, particularly garbage, is the bear problem. At one time in most of the larger parks the garbage was deposited at a central dump and each evening the bears from near and far gathered for their evening meal. Good wildlife management frowns on this procedure and there are comparatively few if any areas at the present time in the Park Service that have the so-called nightly or public feedings for the bears at the garbage pit.

The Park Service has the major responsibility of providing for the collection and storage of refuse, although in some areas the concessioners have some of this responsibility. The disposal facilities are generally provided and operated by the Park Service.

An attempt is made to keep all garbage in durable, water-tight, non-absorbent, and easily washable receptacles with close fitting lids and adequate handles. These containers are kept covered pending removal and are of adequate capacity and provided in sufficient numbers to hold all garbage that accumulates between collections. In areas with a bear population adequate provisions must be made to keep the bears out of the garbage cans. Many different devices have been used and the Park Service has just designed a durable, effectively anchored collecting can that it believes will foil the efforts of the bears. The Park Service has used garbage can liners in some places with mixed results. Probably some of the difficulty with these liners is that too light weight material has been used. In other places the Park Service has experienced difficulties resulting from theft of these liners.

The final disposition of the garbage varies in the several areas. Except in the major parks the disposal is usually by sanitary landfill methods, occasionally after burning the combustibles. The three types of landfill include the trench, the ramp or progressive slope, and the so-called area method. Regardless of the type of sanitary fill it is essential that the material be compacted into the smallest practical volume by a crawler type tractor followed by a prompt covering with a layer of earth to prevent the escape of odors and the outbreak of fire, and to exclude rodents and discourage bear incursions.

Incineration is an effective means of refuse disposal in many of the areas. Its adoption is particularly desirable where suitable land is not available for landfill purposes and where bears are a

problem. Care must be taken in the location to result in the minimum of intrusion on the natural scene. When used provision must be made for adequate disposal of ashes and non-combustible materials and the design should be such as to provide for the washing and storage of garbage cans.

Some of the areas have installed garbage grinders. This applies particularly to some of the concessioner developments. This is a practice that the Park Service does not particularly encourage because the grinding of the garbage and the disposing of it in the sewer system increased the load to an extent where expansion of the existing sewage systems might be required. The use of garbage grinders will not eliminate the need for either a sanitary landfill or an incinerator as normally garbage is only a relatively small percentage of all refuse.

In some areas the separation of garbage and combustible material has been tried. The garbage is disposed of by either burial in a previously prepared trench or by disposal to farmers or others for hog feeding, the combustible materials being burned in suitable enclosures. The use of garbage for hog feeding has not been universally satisfactory. In general, it should be used only in areas located in states requiring minimum heat treatment prior to use for hog feeding.

INSECT AND RODENT CONTROL

The Public Health Service assists in insect and rodent control, particularly to assure adequate vector control. A primary feature in the problem of rodent control is the importance of sanitation including proper garbage disposal, food storage, harborage elimination, and rat-proofing. Sanitation is essential to the permanent control of flies, rats, and mice. The use of insecticides and rodenticides is considered supplementary to sanitation. The Park Service is reluctant to use insecticides, rodenticides, or any control chemicals, and before any may be used the field area involved prepares a survey and study followed by recommendations to a committee in the Regional Office. After a careful analysis of these data by this committee all of the information is forwarded to Washington with the Regional Director's recommendation. Based on these facts and recommendations the Director refers the question to the Federal Pesticide Advisory and Review Board before he determines whether insecticides may be used in the particular case in question. Each proposed usage of insecticide follows the same procedure.

SWIMMING POOLS

The concessioners have provided swimming pools in a few areas in the Western Region. The pamphlet, *Recommended Procedure for Design, Equipment, and Operation of Swimming Pools and other Public Bathing Places*, as published by the American Public Health Association, is the basic guide for design and operation of swimming pools. Appropriate tests are made to insure that the water meets satisfactory bacteriological standards and that it is sufficiently clear to permit a black disc 6 inches in diameter in a white field to be clearly visible from the sidewalks of the pool at all distances up to 10 yards when the disc is placed at the bottom of the pool at the deepest point.

HOUSE TRAILERS AND CAMPERS

The use of trailers is becoming more and more important at all Park Service areas. Trailer courts per se are not provided, but trailers are permitted in campgrounds where adequate space is available. In general no special facilities are provided for trailers except that in a few of the parks provision has been made for service areas for dumping sewage from the trailer installation. In one or two of the parks concessioner facilities have been installed to take care of trailers, including sewer, water, and power connections. The operations of such facilities are similar to and under the same supervision as other public facilities furnished by private concessioners.

PRIVATE INHOLDINGS

Private inholdings are located in some of the parks with exclusive jurisdiction. In such areas sanitary facilities are subject to such regulations as the Park Service believes necessary. Normally such regulations are similar to those of the state and/or county in the immediate vicinity of the park. Frequently the assistance of the county health officer is obtained to see that the installations conform to those in the surrounding country.

MILK AND FOOD SANITATION

Milk and food sanitation, particularly such features as pertain to the concessioners, are under the general supervision of the Park Service. The *Milk Ordinance and Code*, the *Frozen Desserts Ordinance and Code*, and the *Food Service Sanitation Manual*, all developed by the Public Health Service, are used as the basic regulations.

In effect the Park Service has delegated to the Public Health Service the inspection and certification as to purity of milk, fluid milk products, and frozen desserts. This will be discussed in more detail by the representative of the Public Health Service at this conference.

Periodical inspections, normally once a year at the beginning of the visitor season, are made of all the

concessioner's food service establishments. Special circumstances may dictate more than one inspection per season. The inspection, usually made by a Public Health Service consultant, representatives of the protection and maintenance divisions of the Park Service, and a representative of the concessioner, includes wholesomeness and protection of all foods, the health and cleanliness of food service personnel, the sanitary design and cleanliness of food equipment and utensils, and the provision of satisfactory maintenance of all sanitary and other facilities pertaining to the storage, preparation, and serving of food. Before leaving the area, the Public Health Service consultants discuss their findings with the park superintendent and his staff and emphasize the importance of having defects corrected as soon as possible.

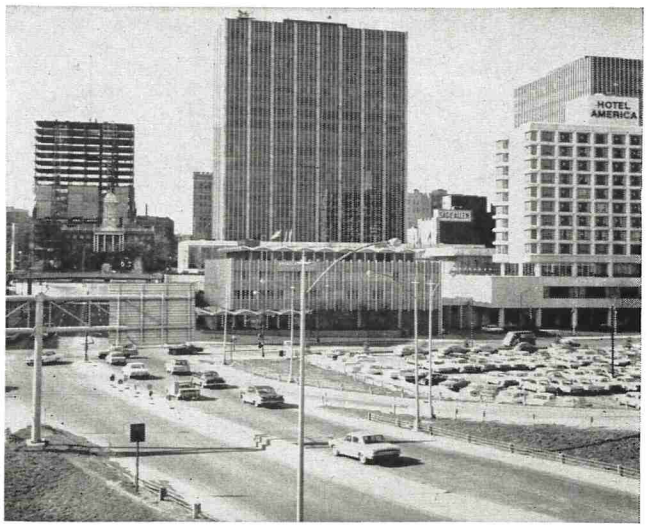
CONCLUSION

From this discussion it is quite evident that virtually all phases of environmental sanitations are inherent to a greater or lesser extent in areas administered by your National Park Service. The engineers of the Park Service, together with engineers, sanitarians, and other consultants of the Public Health Service are exercising eternal vigilance to insure that health standards are maintained at the highest level at all times. In addition, constant research is being undertaken so that constant improvements may be made in environmental sanitation to the end that the health of the visitor to your parks and monuments will be protected at all times.

ASSOCIATION AFFAIRS

COME TO HARTFORD, CONN.!!!
HOST TO I. A. M. F. E. S. 52nd ANNUAL MEETING

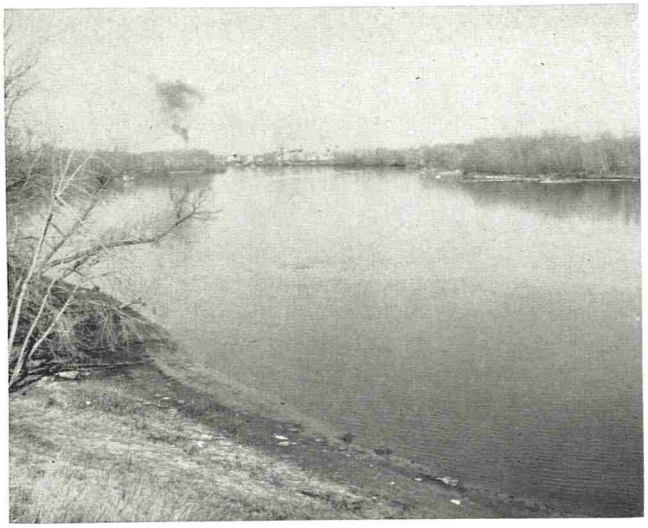
LOOKING WEST—A view of Hotel America in the Heart of Constitution Plaza. This is site of 1965 convention.



A SOUTHWESTERN VIEW—of some of the new construction in downtown Hartford.

One of the nation's most attractive shorelines is the New England Coast—and it's always at its best in autumn. Everywhere, there will be displayed nature's own show of brilliant colors, as seen only with the changing of the fall foliage. Once a guest of Hartford, a visitor will find it difficult to move on, for this historic old city has many famous shrines of the Revolutionary War days to keep one busy for weeks.

There, too, is the dramatic new skyline that boasts, quite proudly, to be one of the nation's most inspiring and successful urban renewal projects. Constitution Plaza! new, clean, modern; is the showcase of Hartford and its more than 175,000 people. Located on the banks of the Connecticut River, which virtually runs through the middle of the state, proudly and



LOOKING NORTH—A view up the Connecticut River from "The Plaza."

rightfully called the "Constitution State." The very days of our nation's birth come alive in historic Connecticut as it is truly the embarkation site for the famous Heritage Trail of New England. Connecticut is small in area (100 miles long and 50 miles wide) and is the third smallest of the states; but you will find warmth and welcome when you reach its Heart: Hartford. Hartford is quite easy to reach as it is linked with U. S. Interstate Routes 84, 91 and 95 which cross the state. Bradley Field in Windsor Locks is only 14 miles from Hartford and is serviced by most major airlines and handles more than one hundred flights daily.

Manufacturing is the largest source of income, with over 800 firms employing some 93,000 people with an annual payroll of about $600 million. Some of the products Hartford is noted for are: aircraft engines, helicopters, propellers, fuel control systems, firearms, typewriters, brushes, atomic reactors, electrical supplies, precision machine tools, turbines, vacuum cleaners, plastics, pipe organs to mention a few.

In agriculture, more than $65 million annually of dairy products, tobacco, fruit and farm produce are distributed through Hartford outlets.

However, insurance is the second largest source of income. More than forty companies whose home or executive offices are in Greater Hartford underwrite most every known form of insurance coverage, and employ nearly 30,000 people with an annual payroll close to $113 million. All over the nation, Hartford is known as the "Insurance City". You will be insured of a good time when you visit here for the convention on September 13, 14, 15 and 16.

Plan now to make the trip to Hartford in September. We will show all why and what our city's motto "Post Nubila Phoebus" means: "after the clouds, the sun."

WISCONSIN ASSOCIATION PLANS AN INTERNAL EVALUATION STUDY

Stating that in every organization there comes a time when an internal appraisal and a review of activities and purposes is necessary, President D. G. Raffel, Wisconsin Association of Milk and Food Sanitarians, has appointed a committee to make such a study. The committee is charged with the responsibility of evaluating the following:

1. The purpose of the organization.
2. The recommended general direction for the years following.
3. A study of the present organizational setup.
4. The subject of dues.
5. Evaluation of the varied interests of the present membership.
6. Giving direction as to how membership can be expanded.
7. Review of the Wisconsin Association magazine and newsletter and its impact on membership.
8. Possibility of becoming more closely associated with the International organization.
9. Consideration of "local" memberships.

Dr. K. G. Weckel, first president of the Wisconsin Association and past president of IAMFES, has been appointed chairman of the committee. His report will receive wide interest.

NEWS AND EVENTS

DR. LEE PRAISES ROLES OF SANITARIANS OVERSEAS

Dr. Phillip Lee, medical director of the Agency for International Development, has just returned from a trip to the Far East with high praise for environmental health and the role of the sanitarians in making health programs effective and thereby making many friends for the United States.

In many areas of the world, environmental health is the major point of contact between the United States and the residents of other nations, and the sanitarian is in the forefront of that contact, Dr. Lee said in an interview.

He had particular praise for the program in Thailand, where programs in basic sanitation and water supply have elevated the health level of the people. The highly successful waterseal privy program in Thailand was cited by Dr. Lee as an excellent example of a cooperative effort in environmental health.

"The sanitarian abroad is doing a tremendous job for the American taxpayer, one that is not fully appreciated here or abroad," Dr. Lee said, "We wish we had more of them."

In addition to Thailand, Dr. Lee visited Laos, the Philippines, Taiwan, Vietnam, and Pakistan. In all of the countries he visited, he came away with a new appreciation of the importance of both environmental health and the sanitarian in AID programs, he said.

NEW NRA POLICY MANUAL

The National Restaurant Association has recently released a document entitled "Association Relationships between the National Restaurant Association and other Associations". This is represented as a statement of policy, approved by the NRA Board of Directors, which will govern relationships between NRA and other organizations with which it deals. In offering the Policy Manual it is stated that:

"A primary objective of the NRA is to aid in the growth and development of the total food service industry. The NRA recognizes the total food service industry as including not only businesses which have face to face contact with food service customers but also businesses which provide the food equipment and supplies needed by the field. In carrying out this primary objective, the NRA collaborates with, supports and receives aid from many societies, organizations, associations and business groups. The Association also collaborates with many governmental and private agencies which directly or indirectly further the growth of the entire industry.

"The NRA recognized that leadership is exercised through many associations and groups directly concerned with the field and through many other associations, societies and organizations whose interests are secondarily related to the field.

"It is the broad purpose of the NRA to seek to maintain and to strengthen relationships with many trade, professional and business groups. In carrying forward this objective, the NRA shall at all times maintain its relationships within the guiding principles which are set forth in the By-Laws of the Association and the Standards of Business Practice adopted by the NRA".

The Policy Manual than covers in some detail NRA's activities, memberships, collaboration, support and liaison with other industry and governmental organizations and its services to its own members and to other industry related groups in the broad interest of better food service operations.

AIB BULLETIN ON SALMONELLA

The American Institute of Baking has recently issued a bulletin on Salmonella food poisoning with particular emphasis on prevention of contamination of bakery products.

This new Bulletin No. 109 describes briefly the organism and symptoms of Salmonellosis, sources of contamination, raw ingredient quality, heat treatment required, preventive measures, avoidance of recontamination and other factors applicable of bakery operations. Of particular interest is a list of precautions including:

1. Purchase only top quality Salmonella-free ingredients.
2. Minimize contamination from airborne sources through the use of covered containers and control of air currents.
3. Thaw frozen egg products rapidly and maintain below 45°F.
4. Never re-use single service egg cans.
5. Minimize human contact with the bakery product.
6. Use particular care, proper equipment and proper heat treatment in production of cream fillings and other perishable products.
7. Properly refrigerate and maintain cream-filled or custard-filled products. Destroy left over material.
8. Avoid spread of contamination from clothing, mops and other equipment.
9. Deliver products in sanitary containers and under sanitary conditions.

Further basic plant sanitation and equipment cleaning procedures are discussed with emphasis again on good quality raw materials, handled and processed under conditions designed to produce clean wholesome bakery products. Single copies of Bulletin No. 109 are available by writing the American Institute of Baking, 400 E. Ontario, Chicago, Ill. 60611.

MAKING SALT WATER DRINKABLE[1]

Because of population growth, the need for drinking water is becoming steadily more acute in various parts of the world, and methods of obtaining potable water from the sea or from brackish and waste water are being widely investigated. These methods were reviewed by Professor E. D. Howe, Director of the Sea Water Conservancy Laboratory of the University of California, at a WHO Expert Committee on Environmental Change and Resulting Impacts on Health, held in August 1964.

The chief difficulties in desalinization at the moment are the cost of processing, the disposal of chemicals removed during the operation, and the possibility that harmful substances may remain afterwards. From a chemical viewpoint, the quality of fresh water may be stated in terms of the total dissolved inorganic chemical content, measured in parts per million (p.p.m.) by weight, the desirable maximum being 500 p.p.m. and the absolute maximum 1000 p.p.m. for potable water. Sea water has a content of about 35,000 p.p.m., brackish well water of 2000 to 4000 p.p.m., and irrigation drainage water of 4000 p.p.m. upwards.

Quality standards for water must also take into consideration the suspended solids, stated in terms of turbidity, the biological oxygen demand (BOD), and the chemical oxygen demand (COD) required to oxidize organic materials, the undegraded detergent residues—generally expressed in terms of the content of alkyl benzene sulfonate (ABS)—, and the residual chlorine content. Standards for these materials are included in the specifications of the U. S. Public Health Service and other similar regulatory bodies.

Desalinizing processes at present available, or likely to become commercially practicable as a result of current research, may be grouped in three categories: (1) those involving a phase change, e.g., all methods of distillation, freeze-separation, and hydration; (2) those in which sheet plastic membranes are used, including electrodialysis and reverse osmosis; and (3) those in which chemical bonds are used, including ion exchange and solvent extraction.

Of all these, distillation is the only process at present in commercial operation that will produce water of potable quality from all types of raw water.

Common Problems

All the above processes have two problems in common—that of reducing the cost of the energy required to achieve the separation process, and that of waste disposal, since each system uses part of the water entering the plant to flush away the unwanted mineral salts.

Present-day plants use 15 to 100 times the amount of energy that would be required by an ideal system and the cost of energy thus accounts for a large part of the final cost of the water produced—it is estimated, for instance, at about 34% in the San Diego, Calif., plant of the U. S. Office of Saline Water. Ways are being sought to reduce the amount of energy required and also to reduce the cost of the energy itself (by using "waste" heat from nuclear reactors, for example). With sufficiently cheap energy, it is felt, plant design could be simplified and the cost of desalinated water brought down to about $0.25 per 1000 U. S. gallons (3785 l).

Waste brine from sea-water distillation plants can be turned back into the sea. The discharge of waste from inland plants on to the surface of the ground or into local streams would degrade the quality of local water supplies, and other means of disposal must be found. For instance, the distillation plant at Roswell, N. Mex., which can process a million U. S. gallons (3,785,000 l) of water per day, disposes of its waste brine by atmospheric evaporation in a 90-acre (36-ha) pond lined with polyethylene film.

The Phase-Change Processes

In the distillation, freeze-separation, and hydration processes, about the same amount of energy is needed to obtain pure water from slightly saline water as from sea-water. Since the final product is produced from pure vapour in the first process, and in the other two from crystals of pure ice, all three should, theoretically, produce pure water. In practice, however, only distillation does so, since both the ice and hydrate crystals have about the same density as water and must be separated mechanically from the brine. Freeze-separation plants in use today yield water with a salinity of about 250 p.p.m.

Distillation, the oldest of the three processes, is used in about 80% of the world's water desalinization plants. Distillers with capacities of a million U. S. gallons a day produce fresh water for about $1 per 1000 gallons.

The present distillers expose all the water being processed to temperatures of about 200°F (93°C), and so protect it from pathogenic organisms. Some

[1]WHO Chronicle, March, 1965.

proposed distillation systems (such as solar distillers) operated at lower temperatures, and others involve heat transfer liquids of the hydrocarbon type, which come into direct contact with the distillate. Their use might present hazards for public health.

The other two processes are much more recent. The first small production plant using freeze-separation was set up early in 1964, and the hydration process is still under laboratory development.

Compared with distillation, these processes are attractive because the latent heat of formation of ice is only about one-seventh of the latent heat of evaporation and they thus require less energy. The low temperatures used also eliminate the operational problem of scale formation.

Preliminary studies of the use of these systems for waste renovation indicate that more than 90% of the raw feed could be recovered as potable water as far as salinity is concerned. Some reduction in the COD and the BOD occurs, however, and the problem of the satisfactory control of these parameters awaits further research.

PROCESSES USING MEMBRANES

Electrodialysis plants were first set up in the middle nineteen-fifties, and in 1964 they represented at least 10% of the total capacity of the world's desalinization plants. Reverse osmosis is still in the pilot plant stage.

In both systems, the energy required varies with the salinity of the raw water and is much less than that required by the distillation process in cases where the salinity is low. The electrodialysis plant at Buckeye, Ariz., with a capacity of 650,000 U. S. gallons (2,457,000 l) per day, requires only 12 kWh per 1000 gallons as compared with more than 50kWh for a comparable distiller. These processes are thus particularly attractive for the treatment of raw water of low salinity by comparison with sea-water.

Electrodialysis plants use raw water supplies with a total dissolved inorganic chemical content of up to a little over 4000 p.p.m. and produce potable water with salinities of 300 to 400 p.p.m. Pre-treatment of the raw water is needed to eliminate particulate matter and to adjust pH for scale control. Although membranes last from 5 to 7 years, their replacement cost is a major item in the cost of water produced. The lowest cost so far achieved is (in the Buckeye plant) $0.51 per 1000 U. S. gallons at a load factor of 48%.

Reverse osmosis (in essence a sieving process) is the simplest method so far conceived. However, membranes have up to the present needed renewal after about six months and, although cheap, such replacements represent about 50% of the cost of the water obtained.

THE CHEMICAL PROCESSES

In the chemical processes (ion exchange and solvent extraction) the operating costs are at present so great that there are no desalinization plants in which they are used for the production of potable water. Ion exchange is, however, extensively used for water softening.

NEW FOOD SCIENCE BUILDING AT NORTH CAROLINA STATE UNIVERSITY

Site dedication ceremonies for North Carolina State's $2.3 million-dollar food science building to be erected soon on the campus were held December 11, 1964. Heading a gathering of government, business and university officials on hand for the event was Governor Terry Sanford, who has made the expansion of food processing industries in North Carolina a major concern of his administration.

According to Chancellor John T. Caldwell, who presided at the dedication, the building is one of the most complex ever designed for the campus. The building will house the Department of Food Science, created to center the university's research, teaching and extension work with dairy products, fruits and vegetables, seafoods, poultry and meats.

NEW BISSC OFFICE OF EQUIPMENT CERTIFICATION

Establishment of a new Office of Equipment Certification and provision for the issuance of a new "BISSC Symbol", applicable to equipment for the baking industry meeting its standards, has been announced by Philip E. Winters, Chairman of the Baking Industry Sanitation Standards Committee.

This Committee, established in 1949 and composed of representatives of six national trade organizations in the baking industry and from three national sanitarian organizations and the FDA and USPHS, has long been active in creating and establishing standards for design and construction of bakery equipment and machinery. To date twenty three separate standards have been developed, approved and published and a number of other standards are nearing completion.

With the establishment of the new Office of Equipment Certification, patterned after the 3-A organization, the new BISSC Symbol will be trade-marked and copyrighted and will be available to all manufacturers whose equipment and machinery is built in conformance with BISSC Sanitation Standards. Registration and application forms will be available by October 1, 1965 and a target date of January 1,

1966 is set for the issuance of the first certifications, according to Mr. Winters.

HIGHLIGHTS OF NSF ACTIVITIES

The January 1965 edition of FOUNDATION NEWS published by the National Sanitation Foundation gives the result of a survey on the use of NSF Standards and Seal of Approval and carries a number of items of general interest.

A comprehensive survey was made earlier this year to determine the degree of acceptance and the use of various NSF Standards and Seal of Approval Programs. A comprehensive survey was distributed to each of the State health agencies, as well as, the District of Columbia, requesting information as to the extent of the usage of the Standards and Seal of Approval Program. Inquiry was also made as to the manner in which they were utilized and adopted. Where states indicated they did not have jurisdiction in one field or another, the appropriate agency, or agencies, were contacted and the survey data obtained. Replies were received from all but 3 of the 51 agencies (50 states and the District of Columbia) contacted.

Based upon the survey data received, the following summary statements can be made:

1. 47 of the agencies adopted NSF Food Equipment Standards. These agencies serve 92% of the population of the United States.

2. 45 of the agencies have adopted the NSF Seal of Approval Program as regards thermoplastic pipe for potable water applications. These agencies serve 90% of the population of the United States.

3. 30 of the 41 agencies having programs relating to swimming pool equipment have adopted the NSF Standards covering such equipment. These agencies serve 45% of the population of the United States.

Further analysis of the data submitted indicates that there has been a marked increase in the number of agencies requiring that equipment or products bear the NSF Seal of Approval, and that an increasing number of agencies are adopting the NSF Standards and/or Seal of Approval Program by regulation and code. However, the predominant method of reference to the Standards and Seal of Approval Program is through administrative policy.

Thermoplastic Standard Adopted

The NSF Joint Committee on Plastics, and the NSF Council of Public Health Consultants, have taken action to recommend and adopt the NSF Standard relating to Thermoplastic Materials, Pipe, Fittings, Valves, Traps and Joining Materials. This action culminates two and one-half years of development, review and revisions. Like all other NSF Standards, it has been developed cooperatively by public health and industry. The Standard provides minimum requirements for materials as regards applicable toxicological properties, organoleptic properties, chemical resistance, and physical characteristics. Performance requisites for end use products are also established, as are requirements for joining materials.

Standards To Be Printed

The Foundation has announced plans to release printed editions of the following NSF Standards and Criteria during 1965:

NSF Standard No. 2—Food Service Equipment

NSF Standard No. 7—Food Service Refrigerators and Food Service Freezers

NSF Standard No. 14—Thermoplastic Materials, Pipe, Fittings, Valves, Traps and Joining Materials

NSF Basic Criteria C-2—Special Equipment and/or Devices

Printing of NSF Standard No. 2 will culminate the comprehensive revision carried out of this Standard during the past three years. It will replace the previous edition of this Standard originally issued in 1952. The printed publication of Standard No. 7 and Basic Criteria C-2 will mark the availability of the first printed editions of these publications. Photographs and descriptive detail will be contained in each of these publications in order to portray the category of equipment covered by each, as well as, to provide definitive description of various requirements. Availability of printed copies will be announced as soon as they are released.

Joint Committee On Food Equipment

The NSF Joint Committee on Food Equipment Standards met in Ann Arbor, Michigan, April 9 through 10, 1964. Some forty persons from industry, public health, and user groups participated in the sessions. Major highlights of the meeting included the following:

1. Final review and recommendation for adoption NSF Standard No. 12 relating to Automatic Ice-Making Equipment.

2. Review and discussion of the Summary Report on Dishwashing Machine Research.

3. Preliminary review of proposed revision to Standard No. 3—Commercial Spray-Type Dishwashing Machines based upon research conducted.

4. Recommendation of the Joint Committee that as an appendix to NSF Standard No. 3, the "Guide to Field Evaluation of the Operation, Maintenance and Installation of Commercial Spray-Type Dishwashing Machine Installations", be included.

5. Provision of more definitive requirements for

temperature controls as set forth in NSF Standard No. 4 relating to Commercial Gas, Electric Cooking and Warming Equipment.

6. Consideration of request from industry to provide definitive requirements for wood cutting surfaces.

7. Recommendation to the Foundation to explore the development of Standard covering Grease Filters and Ventilation Systems. Such exploration to be carried out in cooperation with professional groups concerned.

8. Comprehensive review of proposed revision to NSF Standard No. 1. General concurrence with the proposed Standard was given. Minor exceptions are to be resolved during the ensuing year by the Foundation.

9. Review and discussion of requirements for solders as used on food contact surfaces.

10. Final review and recommendation for adoption of proposed requirements for casters. These requirements to be found in NSF Basic Criteria C-2.

Comprehensive minutes of the NSF Joint Committee Meeting on Food Equipment Standards are available from the Foundation upon request.

ICE-MAKING STANDARD ADOPTED

NSF Standard No. 12 relating to Automatic Ice-Making Equipment was recommended for adoption by the NSF Joint Committee for Food Equipment Standards and subsequently adopted by the NSF Council of Public Health Consultants earlier in 1964. The adoption of the Standard culminates approximately eighteen months of diligent work on behalf of the NSF Joint Committee for Food Equipment Standards and the Industry Task Committee. Copies of the Standard are available from the Foundation at a nominal charge.

POOL CHEMICALS REPORT

The NSF Advisory Committee for Swimming Pool Water Treatment Chemicals and/or Processes rendered their final report to the NSF Committee for Swimming Pool Equipment Standards in September of 1964. The report covered recommended evaluation procedures for swimming pool water treatment chemicals and/or processes, together with technical references and a supplemental report making recommendations as to limits of acceptability and special other administrative considerations. The results of some two years of deliberations, it reflects the consensus of opinion of the top experts in swimming pool water treatment from industry, public health and educational institutions. The report is a milestone in a long awaited implementation of a certification program for swimming pool water treatment chemicals and/or processes.

HOSPITAL FLOOR CLEANING STUDY

The Foundation, in cooperation with the University of Michigan Hospital, and Economics Laboratory, is presently engaged in evaluating the efficacies of various floor cleaning methods and detergent and detergent-sanitizers on various types of hospital floors. This jointly sponsored cooperative program, clearly illustrates the concern and mutual interest of user groups, manufacturers and public health in problems of sanitation. The project scheduled to be completed early in 1965 will provide statistically sound comparative data as to the effectiveness of each of the following floor cleaning methods on three different flooring materials, (sheet rubber, nonconductive vinyl tile, and terrazzo).

a. wet mopping with wet vacuum pick up
b. wet mopping without wet vacuum pick-up
c. dry mopping with chemically treated dust cloth, reusable type
d. sprayer with wet vacuum pick-up
e. automatic scrub machine with wet vacuum pick-up

Also to be studied in this project are the effectiveness as a floor cleaner of a general purpose cleaner and a phenolic type detergent-sanitizer. The Rodac plate method, as described and whose reproducibility is confirmed in the report entitled "Development of a Method for Microbial Sampling of Surfaces, with Special Reference to Reliability"—University Health Service and School of Public Health, University of Minnesota, Minneapolis, July, 1963, will be used as the method of evaluation. Sampling is to be conducted on a random basis, with "before" and "after" determinations being made.

NEW MILKING MACHINE BOOKLET

The Milking Machine Manufacturers Council of the Farm and Industrial Institute has just published a new brochure "The Modern Way to Efficient Milking".

Much has been written about "the proper way" to operate a milking machine but recommendations have differed greatly. In the current publication, the Council, consisting of six leading manufacturers, has endeavored to bring some organization to the matter of proper operation and care of milk machines and associated equipment.

Chapters in the 34 page booklet cover such subjects as milking machine operation, the "musts" of good milking, the equipment user's responsibility, vacuum pumps and vacuum line recommendations

and other technical data and milking machine terminology. Copies of the publication can be secured at $1.00 each from the Milking Machine Manufacturers Council, 410 N. Michigan Ave., Chicago, Ill. 60611.

ENTERIC DISEASES—WHO REPORT[1]

In many developing countries infectious enteric diseases are highly endemic and represent the most important cause of sickness and death among children, particularly under five years of age, the mortality rates sometimes exceeding 100 per 1000 live births. Not only do they undermine health; they also impede economic progress. Meanwhile, as recent European medical history has forcefully demonstrated, these diseases can also occur epidemically in other types of environment if sanitation and standards of hygiene are allowed to lapse. A WHO Expert Committee on Enteric Infections,[2] which met in Geneva from 12 to 16 November 1963, recognized that many deaths and much sickness could be prevented by the application of knowledge already available, and that research is needed to establish priorities in areas at different stages of development.

Diarrhoea is a cardinal sign of most infectious enteric diseases, and acute diarrhoeal disease is recognized as a clinical syndrome and an epidemiological entity. Some infections, such as cholera and typhoid, are distinct entities characterized by particular epidemiological and clinical features. The Expert Committee suggested in its report that the non-specific categories of the International Classification of Diseases in which the undifferentiated enteric diseases are now included should be eliminated and a single category adopted for diarrhoeal diseases, divided into those with and those without mention of malnutrition. Provision should be made for specific coding of all recognized or suspected pathogens such as bacteria, viruses, protozoa, helminths, toxic substances, and other etiological agents for those cases in which an etiological agent is established.

USE OF AVAILABLE DATA

In the absence of more specific data, general infant mortality rates máy offer an adequate basis for planning and launching programmes for the control of acute diarrhoeal disease in areas of high endemicity. Where possible, local assessment of the situation should be made along the lines followed by the WHO Diarrhoeal Diseases Team established in 1959 to promote the control of enteric infections on an international basis. Laboratory examinations, though desirable, are not essential. It is generally more useful to obtain data on the relative frequency of pathogens in the groups afflicted with acute diarrhoeal diseases than in the population as a whole. Surveys provide an effective basis for training personnel as well as for control operations, and are useful in obtaining financial and administrative support, as has been shown by the impetus given to hookworm disease control in southern states of the USA by comprehensive studies of the sociological and economic implications of the disease. The Committee recommended studies to estimate the cost of enteric diseases at various levels of intensity.

PATHOLOGY AND PATHOPHYSIOLOGY

Shigella is accepted as the most common cause of acute diarrhoeal disease. Other causes may be *Salmonella*, enteropathogenic *Escherichia coli*, *Vibrio cholerae*, the enteroviruses and, occassionally, the protozoa *Ent amoeba*, *Giardia*, and *Balantidium*. However, a detailed autopsy study made in Guatemala showed that diarrhoea can occur in the malnourished infant and child in the absence of recognized enteropathogens but in the presence in the jejunum of abnormally large numbers of bacteria not classifiable as pathogens. As well as the better recognized methods of identification—rectal swabbing, direct plating on selective agar, sub-culture of suspected pathogens, biochemical characterization, and serological identification by employment of pooled, then type-specific, antisera—the recently developed fluorescent antibody technique is applicable in the identification of enteropathogenic *E. coli* and deserves wider use. In *Shigella*, enteropathogenic *E. coli*, and *Salmonella* infections the gross appearance of the mucosal surface of the intestine is distinctive primarily because extreme hyperaemia, ulceration, and necrosis are usually present, whereas they are absent in cholera. In cholera the vibrios may be cultivated from the intestinal contents but not from the intestine itself, which remains intact. In *Shigella* infections the bacteria may be cultivated from the intestinal contents and the intestinal wall. In *Salmonella* and enteropathogenic *E. coli* infections, there may be deeper penetration of the host, and organisms may be cultivated also from the mesenteric lymph nodes and, occasionally, the peripheral blood.

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[1]WHO Chronicle, January, 1965.

[2]Members: Dr. P. Arumanayagam, Ceylon; Professor G. J. Dammin, U.S.A. (Chairman); Dr. M. R. Faird, Sudan; Professor S. D. Nosov, USSR (Vice-Chairman); Dr. J. Olarte, Mexico (Rapporteur); Professor M. Sankale, Senegal; Mr. D. J. Schliessmann, USA. Secretariat: Dr. B. Cvjetanovic, WHO (Secretary); Dr. M. H. Goodwin, Jr., U.S.A. (Consultant); Professor K. W. Newell, U.S.A. (Consultant); Dr. W. J. van Zijl, WHO.

Animal experiments have recently shown that delay in the passage of intestinal contents can increase susceptibility to infection, and that protection against *Shigella* can be increased by the oral introduction of *E. coli* (inspite of their antigenic difference). They suggest that the presence of lactobacilli constitutes an expression of nutritional and physiological well-being and of the animal's resistance. These and other experiments indicate the need for further study of the basic physiology of the intestine, intestinal flora, and nutritional and other factors in the pathogenesis of diarrhoeal disease.

Recent publications have described the major pathophysiological changes in the patient afflicted with acute diarrhoeal disease. In cholera, the voluminous stools—of the same type as characterize the non-specific infection occurring in malnourished children—consist of fluid electrolytes without the protein or inflammatory cells abundant in the less voluminous stools of *Shigella, Salmonella,* and enteropathogenic *E. coli* infections. The massive loss of fluid and electrolytes leads promptly to renal insufficiency and acidosis, and ultimately to general potassium depletion in the host, dehydration, haemoconcentration, hypovolaemia, hypotension, and shock, with accompanying oliguria or anuria.

The clinical course of acute diarrhoeal disease may be divided into three principal stages. The first usually lasts no more than three days and is characterized by shock. The second is characterized primarily by a degree of renal insufficiency determined by the management during the first, and its clinical management differs because of the presence of aliguria or anuria and the loss of liquid in other ways—through sweating in hot climates, for example. It may last two or three weeks, and usually leads to recovery and entry into the third stage, which is a period of convalescence lasting perhaps several months, its length depending on the ability of the kidney to concentrate normally and on fluid and electrolyte replacement.

Factors Contributing To The Occurrence Of Enteric Infections

Enteric infections are a public health problem in all areas where knowledge of personal hygiene, sanitation facilities, nutrition, child care, and medical resources are inadequate. While the importance of microorganisms or enteroviruses associated with such disease cannot be minimized, it is apparent that synergistic or potentiating factors may profoundly affect the response to infection. Various studies have suggested that the response is determined by host resistance and immunity. The fact that acute infections are observed more frequently among young children, together with the characteristic age distribution of certain bacterial pathogens, supports this impression. Recent studies have shown that the majority of secondary cases following a case of diarrhoea in a family occur among the children of preschool age. This observation implies greater resistance among older persons and also suggests that communicable agents are responsible for the diarrhoea.

With regard to nutrition, the report of the WHO Expert Committee and the work of the WHO Diarrhoeal Diseases Team indicate that, while malnutrition and diarrhoea may not be directly related, overt malnutrition may be precipitated by diarrhoea when the nutritional state is precarious. Likewise, the malnourished child appears to be more susceptible to diarrhoeal diseases than the well-nourished child. It has also been pointed out that diarrhoea during the weaning period is due to a combination of malnutrition and infection, and that death during the second year of life should be considered an indication of poor nutritional status.

The main obstacles to the control of enteric infections remain, in developing countries, the lack of adequate environmental sanitation and, in areas that have the facilities, a casual attitude towards their use, often accompanied by the employment of euphemisms such as "gastric 'flu" to imply that nobody has been guilty of lack of hygiene.

Preventive Measures

Special studies made in the Americas emphasize the importance of water supply control, food control, fly control, and excreta and waste disposal in eradicating water-borne typhoid fever and cholera and reducing helminthic and protozoal infections. A 50% reduction in the diarrhoea and enteritis death rate in Costa Rica over an eight-year period has been attributed to the installation of more than 10,000 privies. In California, rates of *Shigella* infection in children of families having privies were still approximately twice as high as in families having an inside toilet. *Ascaris* infection rates in Kentucky were approximately four times higher among persons using privies than among those using inside toilets.

Other preventive measures must include health education (beginning in primary schools for the general public and being of special importance in training schools for professional health staff), better child care (breast feeding of infants should be encouraged and it should be borne in mind that lack of care often accounts for fatal dehydration in infants with acute diarrhoeal disease), hygienic food handling, improved housing, isolation of carriers, and immunization. The only enteric disease for which effective vaccines are available is typhoid fever, and there is evidence that

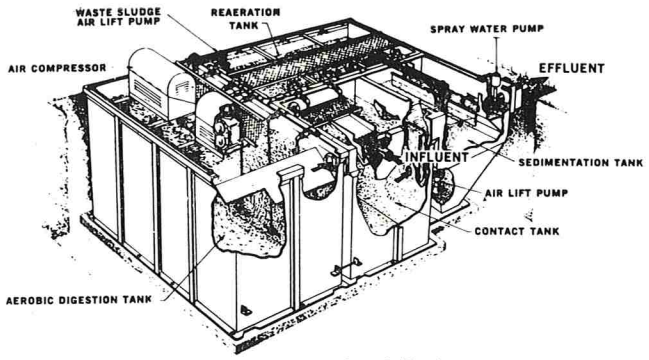
the use of drugs against enteric diseases is rather indiscriminate. The Committee therefore felt that, at least initially, sanitary measures and health education should be stressed.

In areas where the initial steps have been taken health centres should be equipped with facilities for parenteral rehydration and distribution of oral electrolyte solutions. Control programmes should be consolidated by the maintenance of appropriate records, the collection of specimens, provision for the transport of severely ill patients to a treatment centre, and the training of medical and paramedical personnel.

Research Needs

The Expert Committee recognized that a list of lacunae in the knowledge of infectious enteric diseases would indeed be a long one, and it concentrated on problems in the control of enteric infections in areas of moderate endemicity after sanitary improvements have been undertaken. Further studies should be made, for example, to determine precisely the etiological significance of *E. coli* in sporadic cases of diarrhoea as well as in outbreaks, the etiological significance of enteric viruses in diarrhoeal disease, and the relation of specific nutritional and dietary deficiencies to infectious agents and diarrhoea. Few efforts have been made to combine the measurement of diarrhoeal disease rates with attempts at control. Although the available evidence on the importance of environmental conditions is highly persuasive, definitive data should be gathered through special studies. Research should further include the development of new vaccines (with field trials of oral *Shigella* and possibly *E. coli* vaccine), new drugs and antibiotics, and artificial foods. More detailed studies of the intestinal flora are needed, and studies of the possibility of the biological control of enteric infections by means of non-pathological organisms that may be competitors of pathogens. In diagnosis, more rapid procedures such as fluorescent antibody techniques should be encouraged, and reliable serological and skin tests developed. Studies should be made at the national and international as well as local levels, to ensure that disease reporting is adequate; demonstration control projects should be set up; and Enterobacteriaceae reference centres should report regularly, not only on the types of strains isolated, but also on the occurrence of enteric infections. Laboratory methodology should be standardized, and attempts should be made to ensure that evaluations of diagnostic accuracy are internationally valid.

NEW PACKAGE SEWAGE TREATMENT PLANTS



BIO-CON Package Sewage Treatment Plant

American Radiator and Standard Sanitary Corp. has announced the introduction of a new line of package sewage treatment plants. The new line, marketed under the trade name, BIO-CON, includes seven standard plant sizes from 20,000 to 80,000 GPD plant flow.

The efficiency and simplicity of BIO-CON plants make them appropriate for a wide range of installations, including housing developments, apartments, industrial plants, hospitals, office buildings, schools, camps, country clubs, shopping centers, airports, trailer camps, small municipalities and other similar applications. BIO-CON treatment plants utilize a well-known, thoroughly tested modification of the conventional activated sludge process and provide efficient, dependable operation for modern package plant operation. BIO-CON plants can produce a sewage effluent with a 90% BOD reduction.

BIO-CON package waste treatment plants are complete factory-built units. Each plant consists of three sections designed for convenient shipping and easy, low-cost installation. Plants can be installed either above or below ground according to site conditions. General information, details and capacities are contained in a four-page brochure available from American Radiator and Standard Sanitary Corp., Water and Waste Treatment Dept., P. O. Box 2003, New Brunswick, New Jersey.

STEWART NAMED HEAD OF NEW TOXICOLOGY CENTER AT UNIV. OF CALIFORNIA, DAVIS

President Clark Kerr of the University of California and UC, Davis campus Chancellor Emil M. Mrak this week named George F. Stewart, formerly chairman of the department of Food science and technology on the campus, as director of the Toxicology Center, effective March 1.

The research and training Center was established recently at Davis through a grant from the U. S. Public Health Service and will be concerned with the chemical and microbial hazards associated with agricultural production, food processing, and food preservation.

The highly specialized Toxicology Center is a joint undertaking of the University and the U. S. Public Health Service. It will be headquartered in the newly completed Agricultural Toxicology Laboratory, where a number of research projects will be carried out under its sponsorship. Other research underwritten by the Center will be carried out in agricultural botany, anatomy, physiological sciences, poultry husbandry, and pathology. Other departments will be added later.

In making his announcement, Dr. Mrak observed that despite a rapidly mounting population figure, the abundant U. S. food supply is evidence that science and technology continue to meet unprecedented demands, and that this has been accomplished in large measure by the judicious and imperative use of chemicals in the various phases of food production. Furthermore, he stated, there is no evidence that the food supply is unsafe. However, he stressed the need for constant vigilance through appropriate research and education to assure that potential man-made and natural hazards do not accrue from meeting the demands of a burgeoning population.

Mrak emphasized also the training aspect of the new Center, which is basically concerned with environmental health. The Davis campus now has a wide offering of health-related graduate and postdoctoral training programs. Under Center sponsorship, new graduate and postgraduate programs will be organized to serve its specific interests, together with specialized training courses for practicing analysts and toxicologists.

The Center will also sponsor seminars and conferences that will present distinguished scientists discussing research findings related to chemical and microbiological hazards associated with food production, processing and preservation.

An information and documentation service will be an important asset of the new Center. It will provide a clearing house for queries concerning the environmental sciences, and will prepare bibliographies, abstracts and summaries of the technical literature in this field. This service will be made available not only to scientists working on Center-sponsored projects but also to anyone interested in technical developments in the field.

In outlining the research programs of the Center, Director Stewart indicated that initially they will be concerned with four general areas of investigation:

The Analytical Methods and Instrumentation program covers a wide spectrum of chemicals and deals with the development and application of advanced automated instrumental and colorimetric methods to the residue detection of pesticides and feed and food additives.

The Methods for Assessment of Chronic Toxicity program involved the development of rapid, sensitive and reliable tests for detecting and measuring very small amounts of toxicants in lower aquatic animals and their correlation with tests using mammals.

The Morphological, Physiological and Biochemical Aspects of Chronic Toxicity program will include research into the storage and elimination of toxic chemicals in mammals, their action on embryos as well as on young and adult birds, and the comparative effects of herbicides on proliferating plant and animal tissues.

The Environmental Fate Program will be designed to: survey the decomposition of pesticides by temperature, light and air; chemically identify the breakdown products and determine the toxicity of the decomposition products; and devise analytical methods for estimation of these compounds and apply the methods to treated crops.

Chancellor Mrak emphasized that the new Toxicology Center coordinates and expands the research effort that has been underway in this field in the University for several decades. Furthermore, the Center's documentation and information service provides for collection, storage, and retrieval of the enormous amount of published material concerning the use of chemicals in food production, and their environmental effects.

Organizationally, the Davis Toxicology Center is within the University's statewide Division of Agricultural Sciences. It will be governed by a policy-making Executive Board composed of members from within the Division, and administered by the Director who is appointed by the Davis Chancellor.

MICROBIOLOGICAL CONTAMINATION OF FOODS

A manual of definite interest to regulatory officials, industry sanitarians and others involved in the control and protection of quality of food products is the new publication "An Evaluation of Public Health Hazards from Microbiological Contamination of Foods", a report of the Food Protection Committee of the Food and Nutrition Board, National Research Council.

Innovations in food processing and distribution systems have created new potential microbiological hazards. This committee report reviews the incidence of food-borne illness and the adequacy of present

knowledge on the matter; it discusses microbial hazards associated with newer technologies of production, processing, distribution, handling and storage; and it suggests principles on which the development and use of microbiological criteria for foods might be founded.

As a result of this most comprehensive and expert study of the situation, the Committee concludes that current efforts are inadequate to cope with many of the problems associated with rapid changes and new developments in the food supply. More thorough investigation and more consistent reporting of food borne illnesses are needed for the guidance of industry and government in the protection of public health.

Technological changes present new challenges with respect to larger numbers and diversity of items, new uses for traditional foods, processing innovations, and revolutionary manufacturing techniques. Continuing evaluation of food protection programs and practices is required to keep abreast of technological changes.

This very informative and timely booklet of some 64 pages is available at a price of $2.00 from the Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Ave., N.W., Washington, D. C. 20418.

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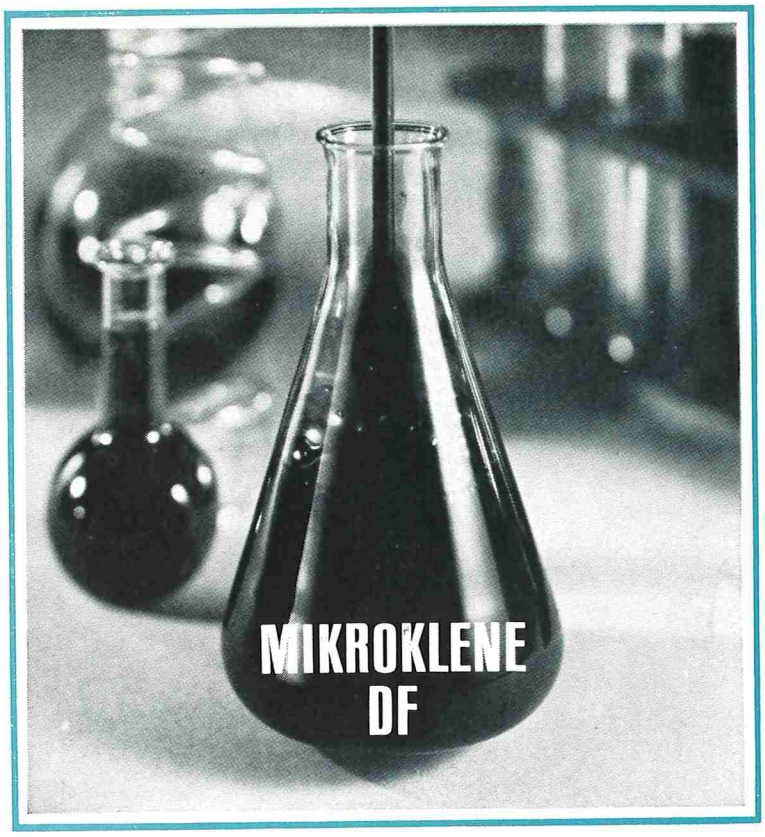

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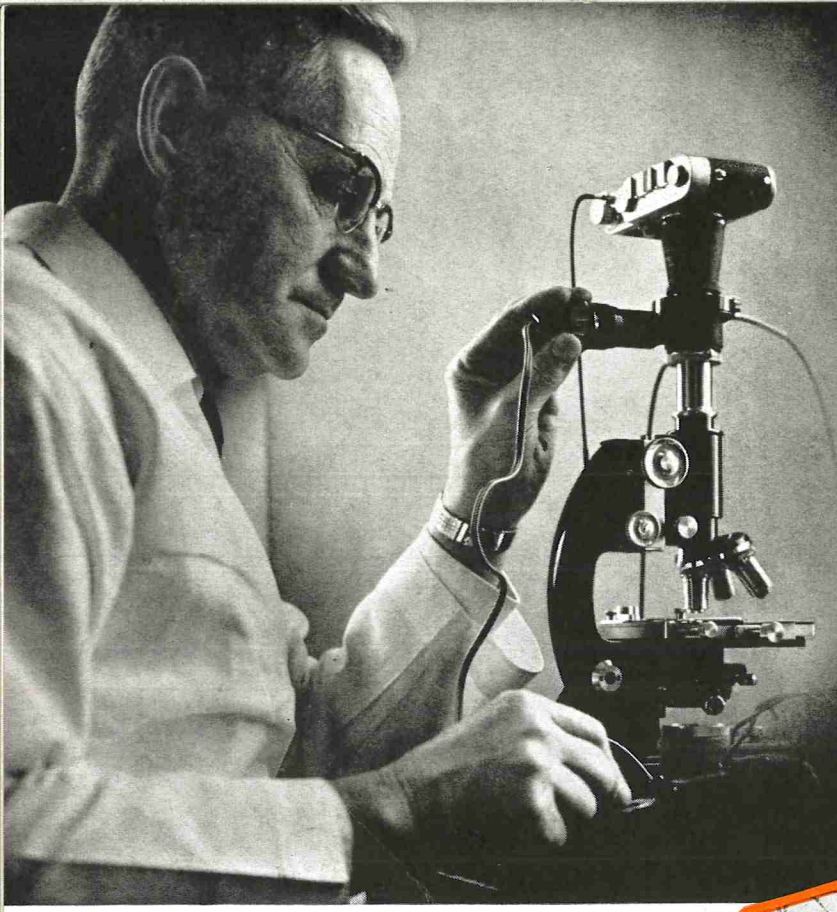

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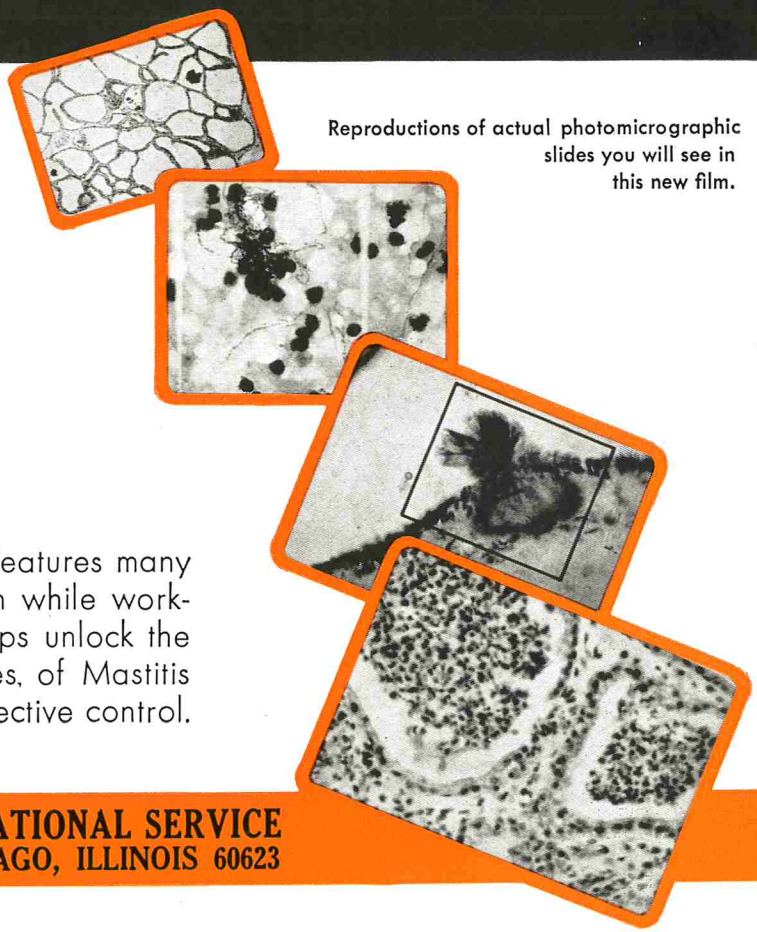

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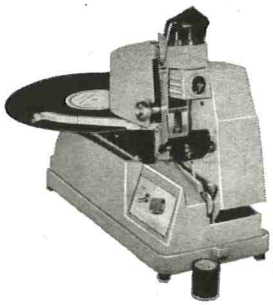

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