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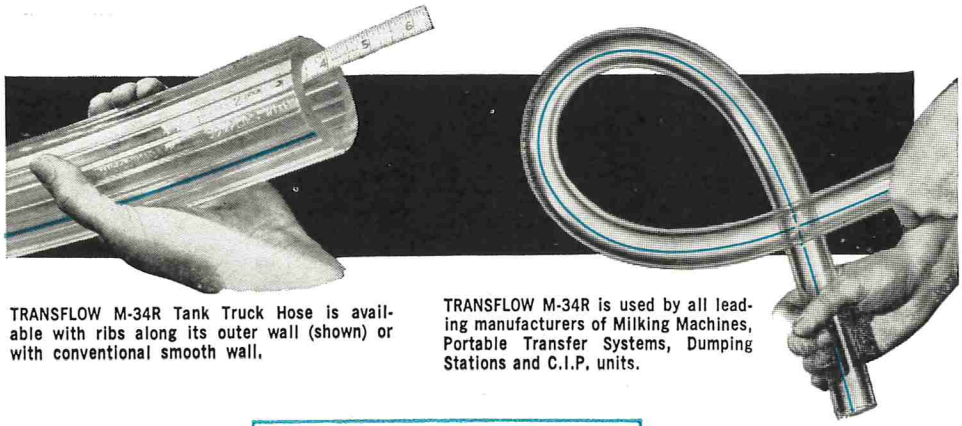

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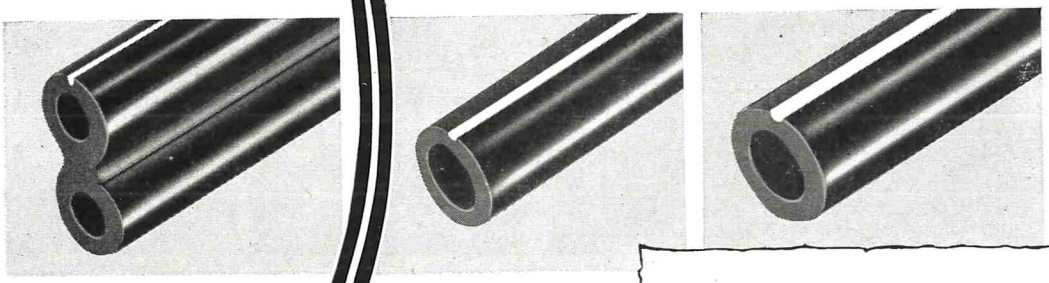

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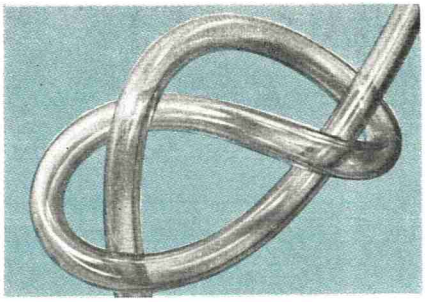

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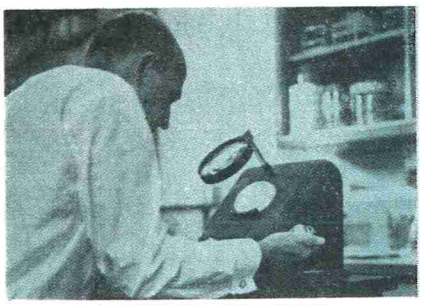

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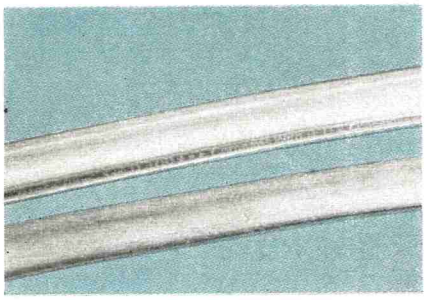

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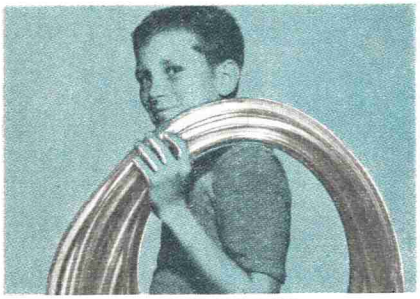

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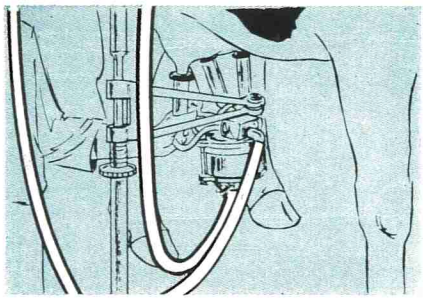

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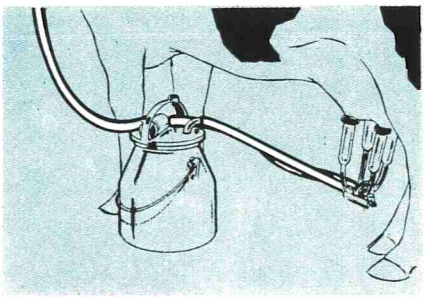

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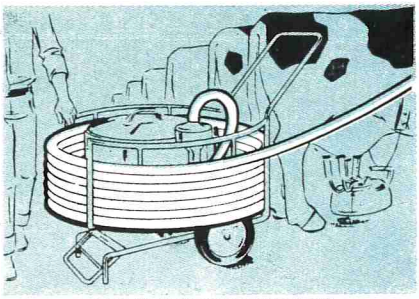

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PENICILLACTIA FOLLOWING INTRAMUSCULAR ADMINISTRATION OF PENICILLINS[1, 2]

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Department of Veterinary Science, North Dakota State University, Fargo, North Dakota

(Received for publication May 9, 1964)

Summary

Five penicillin preparations (G crystalline penicillin of potassium, sodium, benzathine, procaine and diethylaminoethylester hydriodide – DAEEH –) were administered to lactating cows at three, six and nine million unit dosages. The penicillins were in aqueous, peanut oil, sesame oil, and peanut oil with two percent aluminum monostearate (PAM) vehicles. DAEEH penicillin appeared in the milk at the highest concentration and benzathine penicillin was detectable in the milk for the longest period of all penicillins investigated. It would appear the DAEEH penicillin would be the penicillin of choice for mastitis medication in that high levels were obtained soon following administration and that this penicillin was adulterating milk for 48 hr only following administration. Aqueous and peanut oil vehicles provided the highest concentration of penicillin for the longest post-administration period. There was extensive variation in milk concentration of penicillin between cows and for the same cow upon repeat administrations. The concentration and duration of penicillactia following various dosage levels was comparable with the dosages given. Repeat administrations within 24 hr of the initial administration resulted in higher penicillin levels and extended the period of penicillactia. No definite relationship was demonstrated between milk production or stages of lactation and penicillin concentration in milk.

The availability of penicillin has strengthened the chemotherapeutic armamentarium for mastitis treatment. Though mastitis medication with penicillin has not always been successful, penicillin remains one of the most utilized chemotherapeutics.

Much emphasis has been placed on the milk levels that follow intramammary medication. Penicillin preparations are used extensively for parenteral medication of mastitis and other infectious bovine diseases. The parenteral medication will also cause a penicillactia.

Problems encountered in the fermentation processing of dairy products first created concern of penicillactia. The unsuitability of milk containing penicillin for the production of starter cultures, cheese manufacture, and dye reduction tests for milk quality evaluation has been enumerated *(5, 9)*. A national survey indicated extensive antibiotic contamination of market milk *(13)*. It is apparent that antibiotic contaminated milk was not only unsuitable for processing, but the possible problem of human sensitization and drug fast organisms existed *(6)*. These events stimulated sufficient interest and additional national surveys to warrant extensive investigations and interest in the adulteration of milk programs *(4, 7, 8, 14)*.

Some preliminary investigations with parenterally administered penicillin indicated the possibility that the lactating mammary gland was impermeable to penicillin *(2)*. Later investigators demonstrated that following intramuscular administrations, penicillin could be detected in the milk at least three days and up to five days *(11)*.

Recently, investigators demonstrated that following intramuscular administration of penicillin it could be detected in the milk in variable concentrations and for widely different post-administration periods. It was also suggested that penicillactia existed in low producing cows for longer periods than high producing cows. No breed differences were noted *(1, 3, 10, 15)*.

Materials and Methods

Five penicillin preparations were administered intramuscularly to Holstein cows in various stages of lactation. The cows were weighed at approximately monthly intervals. Milk production weight was recorded twice daily.

The penicillins utilized in this investigation were G crystalline penicillin of potassium, sodium, benzathine, procaine, and the diethylaminoethylester hydriodide (DAEEH). Each penicillin preparation was administered at least once to the same experimental animal after penicillin residues in the milk and blood had completly dissipated. The repeated use of the same animal was employed to eliminate some of the individual physiological variations encountered between individual animals.

Penicillin was administered in three, six and nine million units per animal in 20 milliliters of vehicle per administration. This schedule of dosage was utilized to approximate field conditions more closely where dosages frequently are determined by vial size and not by animal size.

Milk samples were collected immediately previous

---

[1]Penicillins for this investigation were provided by Norden Laboratories, Lincoln, Nebraska, Merck Sharp and Dohme Laboratories, Rahway, New Jersey, and Wyeth Laboratories, Philadelphia, Pennsylvania.

[2]Published with the approval of the Director of the North Dakota Agricultural Experiment Station as Scientific Journal Series Number 47. Funds for this investigation were, in part, provided by NIH Grant Number E-3703 (C-1) – Bovine Penicillactia after Intramuscular Injection.

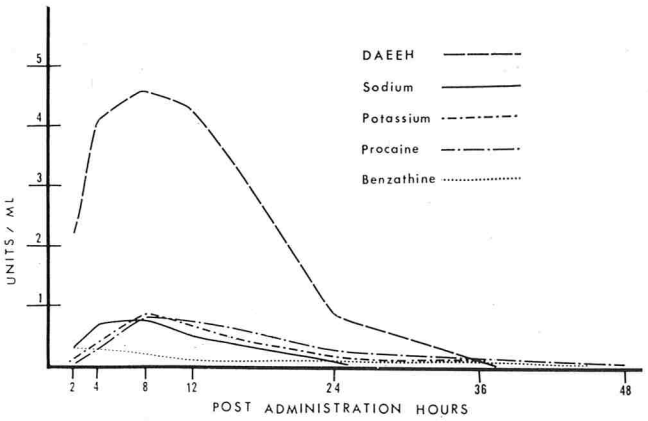


Figure 1. Milk levels of five penicillins following intramuscular administrations of six million units in an aqueous vehicle.

to administration for control samples and diluent for standard curve preparation. Milk samples collected at two, four and eight hr were composite samples of the fore milk removed from each teat. All milk samples collected after eight hr, and the control samples, were composite samplings of complete milkings of all quarters.

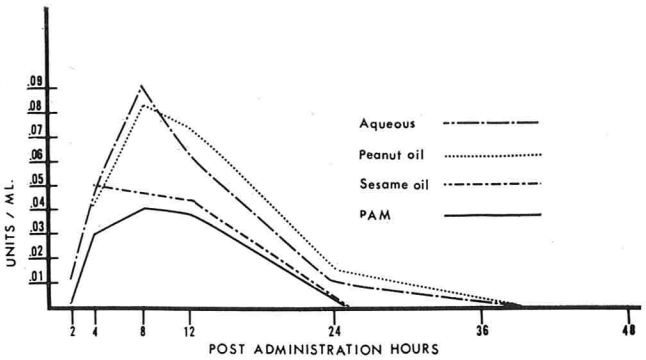
All milk was assayed within twelve hr of collection by the cylinder plate bio-assay method recommended by the Food and Drug Administration using Petri dishes and the test organism *Sarcina lutea* (ATCC 9341) *(12)*. The minimal detectable quantity of penicillin by this method was 0.006 unit per milliliter.

RESULTS

Milk concentrations and duration for the five penicillins following intramuscular administration of six million units per cow in an aqueous vehicle are presented in Figure 1. The more common penicillins appeared in the milk within two hr after administration, reached their highest concentrations within eight hr, began to decline thereafter and were undetectable after 48 hr. An exception was DAEEH penicillin which had the highest concentration of all penicillins investigated, particularly at two hr following administration and was not detectable after 36 hr.

Similar results were obtained when the same penicillins were administered in identical dosages utilizing sesame oil as a vehicle. The most obvious variation occurred with benzathine penicillin which was undetectable until 60 hr after administration and was detectable in the 72-hr sample. In that this was an unanticipated event, no other milk collections were made. Potassium and procaine penicillin were not detectable until four hr after administration, while procaine and DAEEH penicillins were detectable for 48 hr following administration.

One of the suggested factors contributing to the variations of penicillin content in milk is the vehicle utilized in administration. Comparisons of duration and concentration of potassium G crystalline penicillin, when administered intramuscularly at six million units per cow in four different vehicles, are presented in Figure 2. The vehicles evaluated were saline, peanut oil, sesame oil, and peanut oil with 2 % aluminum monosterate (PAM). The concentration of penicillin in milk for all vehicles investigated was quite variable for each vehicle with the highest concentration and longest post-administration

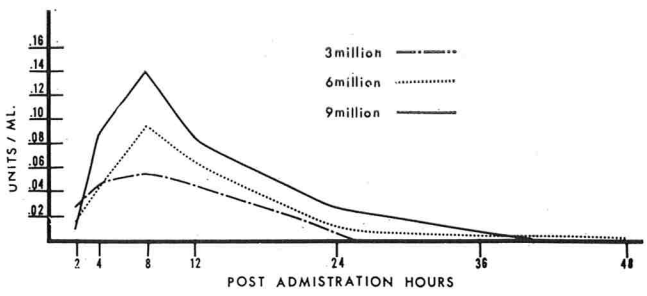


Figue 2. Comparison of milk levels following intramuscular administration of six million units of G penicillin potassium per animal in each of four vehicles.

detection recorded for peanut oil and saline vehicles.

As anticipated, the duration and concentration of potassium penicillin G crystalline in milk was increased with the dosage when comparisons were made of three, six and nine million units per animal (Figure 3). The concentration of penicillin in milk at eight hr was in general, comparable with the dosage, but this observation did not always hold true for other post-administration periods. However, generally, the longevity of elimination in milk was comparable with the dosage. A detailed presentation of milk levels of the various penicillins and dosages is presented in Table 1.

Potassium, procaine and benzathine crystalline penicillins were administered in an aqueous vehicle using six million units per administration for two



Figue 3. Milk levels of G penicillin potassium administered in three, six, and nine million units per animal employing an aqueous vehicle.

TABLE 1. PENICILLIN LEVELS IN MILK FOLLOWING INTRAMUSCULAR ADMINISTRATION OF VARIOUS DOSAGES IN AN AQUEOUS VEHICLE

Penicillin G	Dosage per cow (million units)	Post-administration time (hr) — units per ml								No. of exptl. animals / No. of expts.	Ave. dose units/pound / Standard deviation	Average daily milk prod. / Standard deviation
		2	4	8	12	24	36	48	60			
Potassium	3	.028	.048	.055	.045	.004	0	0	0	8 / 8	3030.0 / 178.8	32.9 / 8.0
	6	.01	.041	.086	.06	.01	.001	.001	0	21 / 32	5776.0 / 719.6	26.3 / 8.3
	9	.011	.09	.139	.081	.024	.008	0	0	6 / 6	8073.0 / 1123.0	25.3 / 31.5
Procaine	3	0	.01	.027	.034	.007	0	0	0	4 / 4	2998.0 / 397.1	31.5 / 3.4
	6	0	.037	.086	.075	.021	.007	.001	0	4 / 8	5892.0 / 380.1	35.8 / 5.8
	9	0	.013	.122	.069	.018	.004	.004	.004	4 / 8	8213.0 / 926.3	38.9 / 8.2
Sodium	6	.034	.068	.078	.058	.004	0	0	0	8 / 8	5735.0 / 575.7	30.1 / 9.1
	9	.137	.138	.111	.083	.043	.006	.002	0	4 / 4	9443.0 / 1099.0	29.5 / 4.4
Benzathine	6	.035	.044	0	.001	.001	.001	0	0	11 / 11	5664.0 / 562.5	32.0 / 6.7
	9	0	0	.002	.002	.002	.004	.004	.002	4 / 4	9048.0 / 1180.0	27.0 / 4.8
DAEEH	3	.143	.320	.333	.2	.064	.015	0	0	4 / 4	2982.0 / 216.4	29.0 / 2.9
	6	.219	.408	.464	.428	.074	.006	0	0	8 / 8	5316.0 / 445.3	26.4 / 8.4

dosages at 24-hr intervals (Figure 4). The average concentration for potassium and procaine penicillins for the first 12 hr was lower than the average of previous investigations as demonstrated in Table 1. Following the repeat administration at 24 hr, slightly higher levels were detected than in the first 12 hr period. Procaine penicillin was detectable in the milk for 72 hr following the first administration. Benzathine was not detectable in the milk until approximately 12 hr following the second administration and was detectable at 72 hr. No further attempts were made to determine milk levels after 72 hr.

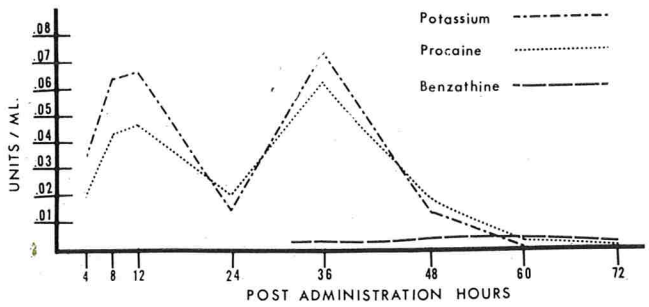


Figure 4. Milk levels of three penicillins following administration of six million units at 0 and 24 hours. An aqueous vehicle was used.

Comparisons of penicillin levels in milk in relationship with milk production, or stage of lactation, are presented in Table 2. The first experiment for each cow was completed within 30 days following calving. There is little evidence, on the basis of this phase of the investigation, that a relationship exists between production or stage of lactation and penicillin concentration in milk. Cows 207 and 208 had a greater tendency to maintain a uniform milk production over the investigation period than the other animals utilized. The penicillin concentration in milk for cow 207 remained very uniform for all post-administration periods for each experiment during the entire lactation period. Conversely, cow 208 exhibited greater concentrations of penicillin in the milk in the early lactation period than in the later lactation period.

ACKNOWLEDGMENT

The authors acknowledge the statistical assistance of Mr. Clayton N. Haugse, Department of Animal Husbandry, North Dakota State, University, Fargo, North Dakota.

TABLE 2. PENICILLIN LEVELS OF MILK AT VARIOUS STAGES OF LACTATION PERIOD[a]

Animal Number	Date	Units of penicillin per ml of milk at post-administration time indicated (hr)					Average milk production per day	Average dosage units/pound and std. deviation
		2	4	8	12	24		
205	1-30-1961	.034	.046	.126	.038	.011	48.0	
205	5- 9-1961	.013	.033	.050	.050	.008	32.0	4871 116
205	7-11-1961	.007	.050	.070	.050	.009	18.0	
206	1-30-1961	.024	.068	.121	.090	.015	32.0	
206	5- 9-1961	.001	.034	.125	.045	.010	20.0	5007 215
206	7-11-1961	.007	.060	.100	.060	.007	18.0	
207	1-30-1961	.050	.050	.127	.092	.007	32.0	
207	5- 9-1961	.013	.051	.114	.070	.010	24.0	6219 316
207	7-11-1961	.010	.058	.130	.090	.012	26.0	
208	1-30-1961	.040	.062	.150	.084	.007	32.0	
208	5- 9-1961	.012	.017	.130	.062	.007	22.0	6391 68
208	7-11-1961	.001	.080	.060	.060	.007	24.0	
214	1-30-1962	0	.050	.060	.043	.007	29.0	5100 163
214	8-14-1962	0	.016	.094	.048	0	19.6	
215	1-30-1962	0	.027	.050	.043	.007	28.0	6040 243
215	8-14-1962	0	.046	.092	.055	.009	19.0	
218	1-30-1962	0	.040	.070	.060	.008	30.6	6652 166
218	8-14-1962	0	.020	.110	.067	.015	16.0	

[a]G penicillin potassium administered intramuscularly in acqueous vehicle at 6 million units per animal.

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DETECTION EFFICIENCY OF MASTITIS SCREENING TESTS

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Biological Research Laboratories, Arvada, Colorado

and

E. V. Painter and G. H. Schnepper

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Summary

A comparison of the detection efficiency of five screening tests for mastitis was made by correlating test results with results of a specific laboratory standard based on a direct leukocyte count and/or the culturing of infectious organisms on the same samples of milk. Since the screening tests are "indirect" or non-specific in nature, the measure of effectiveness took into consideration not only the per cent detected as compared to that detected by the laboratory method, but also the per cent of readings which were false positives. Both per cent detection and per cent false positives increased with increasing test sensitivity. The level of detection at which the per cent of false positives began to increase rapidly was chosen as the optimum efficiency for each type of test. This optimum efficiency correlated with the presence of mastitis as follows: California Mastitis Test 69.5%; Whiteside Test 65.5%; Filter Disk Test 45.0%; Catalase Test 43.8%; Strip Plate Test 4.7%.

There are many reasons why mastitis has been a very difficult disease to eradicate, among which are the numerous causative agents as well as a variety of predisposing factors *(2)*. Very basic in the control of any disease is the availability of accurate, dependable, and economical methods of detection. There are a number of tests for abnormalities in milk which are often referred to as screening tests. However, none of these is a specific definitive test for mastitis, such as is available for many other more well-defined diseases. There has been considerable controversy regarding the use and accuracy of these screening tests, one of the reasons for this is that the various tests have seldom been used at the same time on the same sample of milk under controlled conditions. Also, the problem of the exact definition of mastitis has caused confusion in comparing results of different research studies of screening tests. The purpose of this study was to correlate the detection efficiencies of several commonly used screening tests, namely, the California Mastitis Test, Whiteside test, catalase test, filter disk method, and strip plate method in terms of per cent agreement with the more definitive laboratory tests, bacterial culture and leukocyte count.

Materials and Methods

The cows examined were from four separate herds and were between ½ month and 8½ months in their lactation periods. Three of the herds were Holstein and one was Ayrshire. All four were from Grade A dairy farms with bulk tank and pipeline milking systems. Three farms were parlor type and one was stanchion barn type, with the milking order random in all cases. Herd management was considered to be average or above in all instances.

Each cow's udder was washed with a sanitizing agent and then dried by the herdsman. Teats were cleaned with individual pieces of alcohol-soaked cotton. The sides of the teats were cleaned first, and then separate portions of cotton were used for cleaning the end of each teat. All excess moisture was removed with the cotton. An 8-to 10-ml sample of foremilk was collected in sterile vials from each quarter, and a bacterial culture and a direct microscopic leukocyte (Breed) count were made on each sample to establish a laboratory standard against which the results of screening tests could be compared. This standard was called "Laboratory Mastitis" (LM), and if a sample from any quarter met any one of the following three criteria, it was termed LM positive:

1. The presence of *Streptococcus agalactiae* in numbers greater than 200/ml of milk *(1, 4, 8, 11)* was considered evidence of infection whether or not there was also a significant increase in leukocyte count.

2. The presence of any other mastitis causative organism (such as streptococci other than *Streptococcus agalactiae*, hemolytic staphylococci, *Pseudomonas* spp., *Klebsiella* spp., and coliform bacteria *(5, 8, 11)* when accompanied by a leukocyte count of 500,000/ml or greater *(6, 13)* was considered evidence of infection. Since the potential pathogens could be air-borne contaminants, it was judged there should also be evidence of an inflammatory reaction.

3. A leukocyte count of 1,000,000/ml or more *(3, 8, 10, 12, 13)* was considered evidence of infection whether or not a potential pathogen was also isolated.

The samples were cooled and held at 40 F until tested. The interval from collection to test did not exceed four hours. Each sample was mixed and cultured by streaking .01 ml on one-fourth of a bovine blood agar plate, the blood for which had been tested previously for the absence of staphylococci antibodies. The plates were incubated for 24 hr at 37.5 C, removed and held at 10 C for 12 hr. (Samples with negative cultures but with leukocyte counts of over 1,000,000/ml were re-cultured to confirm the

absence of bacteria.) Then colonies of streptococci were streaked onto CAMP plates. Colonies showing typical CAMP reactions were classified as *Streptococcus agalactiae (13)* and those which did not produce typical reactions on the CAMP plate were classified as streptococci other than *agalactiae*. Colonies of staphylococci with *alpha* or *beta* hemolysis were classified as hemolytic staphylococci and those without hemolysis as non-hemolytic staphylococci. Confirmations of other bacterial isolates were made by conventional tests.

For leukocyte counts, milk films from the same samples as were used for the cultures were stained by the Newman method *(16)* and a direct microscopic count was made.

Simultaneously on these same samples, the California Mastitis (CMT), Whiteside, and catalase tests were made. The CMT tests were performed in the laboratory using the standard paddle and were conducted in accordance with the instructions contained with the reagent *(14)*. To assure uniformity of results, all CMT and Whiteside tests were read by the same person. The Whiteside tests were made by the tube method and results were graded in the usual categories of Negative, Trace, 1, 2, and 3, based on the amount of cloudiness and precipitation *(17)*. The catalase test was also conducted in the laboratory by placing 0.66 ml of hydrogen peroxide (3%) plus 6 ml of milk and 3.33 ml of sterile water into 10-ml screw-cap tubes. The tubes had caps containing a hole 1/16th inch in diameter. These tubes were then inverted and held at room temperature (72 F) for three hr and read for per cent gas by measuring the volume of gas and original milk column *(15)*.

The strip plate tests were made at the side of the cow using a black plate and checking the fore-milk, duplicating as much as possible the method normally employed by dairymen. Whenever the strip plate test was made on a quarter, the 10-ml sample mentioned above was taken immediately afterward. Following this, the cow was milked in the usual manner with the milk passing through a filter in a disk type *(9)* in-line holder[1] placed in the milk hose between the milking machine and the milk pipeline. After each cow was milked, the filter disk was removed and examined for the presence of flakes, clots, or strings which had been filtered from the milk by the disk.

RESULTS

Cultures and leukocyte counts were made on samples from 4,542 quarters. Of these, 1,969 samples fulfilled one or more of the three conditions of the definition of "Laboratory Mastitis" and hence were classified as LM positives. The CMT was conducted on the same 4,542 samples, and the results were grouped in order of descending sensitivity levels: 653 samples with a CMT score of 3; 814 samples with a CMT score of 2; 1,153 with a score of 1; and 610 with a score of Trace. The remaining 1,312 samples tested CMT negative. Of the 653 samples detected at Level 3, there were 652 which agreed with LM positive readings (33.2% of the 1,969 LM positives) and only 1 which disagreed as an LM negative, *i.e.*, "false positive" reading (.2% of the samples at this level). Of the 1,467 samples detected at Levels 2 and 3 combined, there were 1,369 which agreed with LM positives (69.5% of the LM positives) and 98 which disagreed as LM negatives or false positives (6.7% of the total for these two levels). Of the 2,620 samples at Levels 1, 2, and 3 combined, there were 1,773 which agreed with LM positives (90% of the LM positives) and 847 false positives (32.3% of the total for the three levels). Of the 3,230 samples at Levels Trace, 1, 2, and 3 combined, there were 1,861

TABLE 1. COMPARISON OF CMT AND "LABORATORY MASTITIS" TEST RESULTS ON 4,542 QUARTERS

CMT positive samples[a]	Sensitivity level, CMT score	Agreement with LM test results: LM positives	% of 1,969 LM positives	False positives	% False positives
653	3	652	33.2	1	0.2
1,467	2 & 3	1,369	69.5	98	6.7
2,620	1, 2 & 3	1,773	90.0	847	32.3
653 3,230	Trace, 1, 2 & 3	1,861	94.5	1,369	42.4

[a]1,312 samples tested CMT negative, and 108 of these were LM positive.

TABLE 2. COMPARISON OF WHITESIDE AND "LABORATORY MASTITIS" TEST RESULTS ON 965 QUARTERS

Whiteside positive samples[a]	Sensitivity level, Whiteside score	Agreement with LM test results: LM positives	% of 510 LM positives	False positives	% False positives
102	3	102	20.0	0	0.0
215	2 & 3	210	41.1	5	2.3
385	1, 2 & 3	334	65.5	51	13.2
533	Trace, 1, 2 & 3	398	78.0	134	25.3

[a]432 samples tested Whiteside negative, and 112 of these were LM positive.

[1]RAPID-FLO filter holder manufactured by Johnson and Johnson, 4949 W. 65th St., Chicago, Illinois.

TABLE 3. COMPARISON OF CATALASE AND "LABORATORY MASTITIS" TEST RESULTS ON 2,033 QUARTERS

Catalase positive samples[a]	Sensitivity level, Catalase score (% of gas)	Agreement with LM test results			
		LM positives	% of 886 LM positives	False positives	% False positives
151	50	147	16.6	4	2.6
198	45 & over	189	21.3	9	4.5
241	40 & over	229	25.8	12	5.0
299	35 & over	282	31.8	17	5.7
347	30 & over	327	36.9	20	5.8
422	25 & over	388	43.8	34	8.1
537	20 & over	467	52.7	70	13.0
735	15 & over	582	65.7	153	20.8
1,158	10 & over	736	83.1	422	36.4

[a]875 samples tested catalase negative, and 150 of these were LM positive.

which agreed with LM positives (94.5% of the LM positives) and 1,369 false positives (42.4% of the total for all four levels). The data are shown in Table 1.

The Whiteside test was made on 965 of the samples and the comparisons of results are presented in Table 2. In Table 3 the data from the catalase test on 2,033 of the samples are given. Both of these sets of data are compared at several sensitivity levels in the same manner as previously described in detail for the CMT results.

A strip plate test was made on 962 samples. From culture and count tests, 510 of these were classified as LM positive. There were 27 positive strip plate tests, of which 24 agreed with LM positives (4.7% of the 510 LM positives) and 3 disagreed as LM negatives or false positives (11.1% of the 27 strip plate positives). Since the strip plate tests were made immediately prior to the milking operation, only flakes, lumps or strings constituted a positive strip plate reading. For the purpose of comparing these figures to a similar study which is discussed below, 572 quarters out of the 962 tested with the strip plate were found to have infectious organisms present. The strip plate detected 21 of these samples, or 3.67%.

The filter disk test was conducted on 664 cows. From culture and count tests 440 of these were classified as LM positive cows, since each cow had one or more LM positive quarters. Abnormal secretion was observed on the filter disks from 212 cows, of which 198 agreed with LM positives (45.0% of the 440 LM positives) and 14 disagreed as false positives (6.6% of the 212 filter disk positives).

TABLE 4. DETECTION OF "LABORATORY MASTITIS" BY 5 SCREENING TESTS

Test and level of reading	% of LM positives detected	% false positives
CMT score of 2 and over	69.5	6.7
Whiteside score of 1 and over	65.5	13.2
Filter disk	45.0	6.6
Catalase score of 25% gas and over	43.8	8.1
Strip plate	4.7	11.1

TABLE 5. NEW YORK STATE MASTITIS RESEARCH AND CONTROL PROGRAM RESULTS FOR MASTITIS PATHOGENS ASSOCIATED WITH ABNORMAL SECRETION[a]

Organism	Total No. of infected quarters	Infected quarters detected by strip plate test with two types of abnormal secretion			
		Flakes, clots or pus		Watery secretion	
		No. of quarters	%	No. of quarters	%
Streptococcus agalactiae	32,773	1,836	5.60	2,064	6.30
Streptococci other than *S. agalactiae*	70,522	1,446	2.05	1,798	2.55
Hemolytic staphylococci	53,541	1,228	2.29	2,038	3.80
Coliforms	2,333	126	5.40	112	4.80
Pseudomonas	497	46	9.25	47	9.46
Paracoli	1,012	34	3.36	50	4.94
C. pyogenes	191	144	75.39	14	7.33
Multiple infections	20,964	446	2.13	707	3.37
Miscellaneous	455	29	6.37	32	7.03
Totals:	182,288	5,335	2.92	6,862	3.76

[a]Data from Table IX of 1962 Annual Report of the New York State Mastitis Control Program.

DISCUSSION

For those screening tests which have degrees of reactions it was found that the percent agreeing with LM positive results increased as the sensitivity level decreased. At the same time, the per cent false positive results increased. Therefore, to make a comparison of these tests it was necessary to choose the sensitivity level which was most efficient. For the CMT, a reading of 2 and over was considered the most efficient because of the large increase in

per cent false positive results at the next lower sensitivity level. The Whiteside test was felt to be most efficient at a level of 1 and over, since the per cent false positive results again increased greatly at the next lower score. The same method was used to determine the most efficient level of the catalase test, which was at 25% or more of gas. These results are compared in Table 4. The strip plate and filter tests did not have levels of sensitivity; therefore, these tests could only be scored as positive or negative.

For many years, the strip plate has been widely recommended as an essential element of good mastitis control programs, with the consequence that dairymen have expected the strip plate to be a reliable test. On the contrary, this study revealed the test to be unreliable, and an effort was made to locate other studies which correlated strip plate tests with the presence of mastitis. One such study has been conducted in New York State *(7)* and Table 5 shows data taken from the 1962 Annual Report of the New York State Mastitis Control Program.

According to the report, bacteria known to cause mastitis were found in 182,288 quarter samples when cultures were made. Strip plate test results in the same study showed that 5,335 quarters had flakes, clots, or pus. Therefore, the per cent detection of infected quarters by means of the strip plate test was 2.92, which compares reasonably well with the 3.67% detection of infected quarters by use of the strip plate found in the present study. In the New York study, the strip plate test was made two to four hours after milking instead of immediately prior to milking as in the present study. This accounts in large measure for the fact that a watery discharge type of milk abnormality was found in the New York study as indicated in Table 5 and was not found in the present study. Hence, comparison of the two studies could be made only in terms of the occurrence of flakes, clots or pus.

When the filter disk was used as a detector of abnormal milk, results were comparable to those obtained with the CMT, Whiteside, and catalase screening tests. The relatively low detection efficiency of the strip plate test is undoubtedly due to the very small amount of milk examined for flakes, clots or pus as compared to the total milk produced by each cow examined in the filter method.

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THE EFFECTS OF PROCESSING AND STORAGE OF DAIRY PRODUCTS ON CHLORINATED INSECTICIDE RESIDUES

II. ENDRIN, DIELDRIN, AND HEPTACHLOR[1, 2]

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Summary

The effects of processing and storage of butter, ice cream, Swiss-type cheese, condensed milk, and dry whole milk powder manufactured from milk containing dieldrin, endrin, heptachlor, and dieldrin and heptachlor in combination were studied. There was loss of heptachlor epoxide and dieldrin during condensing and loss of all insecticides studied during spray and drum drying. Butter and cheese in most cases contained less insecticide than the raw milk on a fat basis, because some insecticide separated into the skimmilk and whey. The rest of the finished products contained essentially the same amount of residue as the raw milk when expressed on a fat basis.

In a previous paper *(1)*, the authors reported on the effects that processing and storage had on DDT and lindane and how these residues were partitioned during the manufacture of butter, ice cream, Swiss-type cheese, condensed and dry whole milk powder.

As a continuation of this study, the effects of processing and storage of dairy products manufactured from milk containing endrin, dieldrin, heptachlor and dieldrin and heptachlor in combination were also studied.

The results obtained during this study are presented in this paper.

Method

Milk with the desired concentration of insecticide residue for the manufacture of dairy products was obtained as follows:

1. Insecticides were added directly to milk. The desired insecticide was dissolved in 75 ml ethanol and then added to 10 gal of milk. The milk was heated to 90 F and agitated for 15 min. Both 0.1 and 1.0 ppm concentration of insecticides were added to milk in this way.

2. Insecticides were incorporated into milk by feeding to Holstein cows. Capsules containing the desired insecticide were fed to the cows daily. Two different Holstein cows were used for each inseoticide.

a. Heptachlor – technical grade (72%) was fed at the rate of 1,000 mg per animal per day.

Table 1. Distribution of Endrin and Dieldrin During the Manufacture and Storage of Butter

	% Milk fat		ppm (wt. basis) Dieldrin		ppm (fat basis) Dieldrin	
	(1)	(2)	(1)	(2)	(1)	(2)
Raw milk	3.5	3.7	0.92	0.17	26.14	4.68
Pasteurized milk	3.5	3.7	0.94	0.18	26.80	4.81
Cream	31.5	46.5	8.21	1.69	26.03	3.63
Butter	83.1	84.8	10.20	4.50	12.24	5.26
Buttermilk	1.4	8.0	0.50	0.30	35.72	3.70
Butter after storage	83.0	84.8	10.72	–	12.86	–

1 = Milk which had dieldrin added.

2 = Milk from cows fed endrin.

b. Dieldrin–technical grade (95%) was fed at the rate of 500 mg per animal per day.

c. Endrin–technical grade was fed to two animals at the rate of 475 mg per day for the whole experiment while two other Holsteins were fed 1,000 mg per animal per day for six days and 750 mg per animal per day for the rest of the experiment.

d. Dieldrin and heptachlor–the same amount of each insecticide was fed when used in combination as fed alone.

The milk was processed when the residue reached concentrations of 0.6 to 0.8 ppm.

The methods and procedures described in the first paper in this series *(1)* were used for the manufacture and storage of the dairy products.

All samples were analyzed by the method of Langlois, et al., *(2)*.

Results and Discussion

A portion of the heptachlor was converted to heptachlor epoxide by the cow. Approximately 50% of the heptachlor present in the milk was epoxide. This change in structure was greater than found for DDT *(1)* where DDE accounted for approximately 25% of the residue. No significant conversion was observed for the other insecticides which were fed.

Typical results for the various dairy products manufactured and analyzed are presented in Tables 1, 2, 3, and 4. All results are expressed on a fat basis for easier comparison.

The amount of insecticide present in the buttermilk was greater than that which would be found

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[2]Presented at the 59th meeting of the American Dairy Science Association, University of Arizina, June, 1964.

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TABLE 2. DISTRIBUTION OF DIELDRIN AND HEPTACHLOR DURING THE MANUFACTURE OF CONDENSED MILK AND WHOLE MILK POWDER

	Percent milk fat[a]	ppm (wt. basis)			ppm (fat basis)		
		Heptachlor	Heptachlor epoxide	Dieldrin	Heptachlor	Heptachlor epoxide	Dieldrin
Raw milk	4.60	0.17	0.97	0.89	3.72	21.15	19.26
Condensed milk	9.40	0.37	1.03	1.07	3.96	10.96	11.38
Sterilized milk	9.40	0.36	1.18	1.05	3.79	12.56	11.19
Spray dried	27.46	0.05	2.11	2.33	0.18	7.39	8.48
Drum dried	25.09	0.01	2.03	2.28	0.21	8.09	9.10
Sterilized milk storage	9.40	0.28	1.23	1.09	2.96	13.09	11.60

[a]Milk from cows fed heptachlor and dieldrin.

TABLE 3. DISTRIBUTION OF ENDRIN AND HEPTACHLOR DURING MANUFACTURE OF A SWISS-TYPE CHEESE

	Percent milk fat		ppm (wt. basis)		ppm (fat basis)	
	Endrin	Heptachlor	Endrin	Heptachlor	Endrin	Heptachlor
	(1)	(2)	(1)	(2)	(1)	(2)
Milk	3.5	4.7	0.70	0.84	19.91	17.82
Milk after setting	3.5	4.7	0.68	0.74	18.17	15.67
Whey after cutting	—	—	—	0.17	—	—
Whey after dilution	—	—	0.06	0.07	—	—
Whey after cooking	—	—	0.06	0.12	—	—
Curd	31.0	34.0	5.48	3.77	17.53	11.78
Cheese	31.0	34.0	5.89	3.74	19.02	11.69
Cheese after curing	—	34.0	—	3.36	—	10.50

1 = Milk which had endrin added.

2 = Milk which had heptachlor added.

TABLE 4. DISTRIBUTION OF ENDRIN AND DIELDRIN DURING THE MANUFACTURE OF ICE CREAM

	Percent milk fat		ppm (wt. basis)		ppm (fat basis)	
			Dieldrin	Endrin	Dieldrin	Endrin
	(1)	(2)	(1)	(2)	(1)	(2)
Raw mix	11.43	9.8	0.20	0.48	1.75	4.89
Pasteurized mix	11.43	9.8	0.13	0.34	1.12	3.42
Mix, 1 day old	11.43	9.8	0.14	0.38	1.23	3.87
Ice cream	11.49	9.8	0.14	0.40	1.23	4.03

1 = Milk which had dieldrin added.

2 = Milk from cows fed endrin.

under commercial buttermaking conditions. This was due mainly to the method used to remove the buttermilk from the churn and the inefficient churning action of the butter churn.

Heptachlor and heptachlor epoxide were the only insecticides detected in skimmilk after separation of wholemilk, whereas endrin and dieldrin were found only in the cream. If some insecticides were in the skimmilk, the amounts were too small to be detected. Since heptachlor and heptachlor epoxide were present in both the cream and skimmilk, this would suggest that heptachlor and heptachlor epoxide are

not associated with the fat as strongly as the other chlorinated insecticides studied.

There was loss of both heptachlor epoxide and dieldrin during condensing. This loss represented about one-half of the insecticide present in the raw milk when expressed on a fat basis. Heptachlor and endrin were not affected by condensing. There was some loss of heptachlor, heptachlor epoxide, dieldrin, and endrin during spray and drum drying. Heptachlor showed the largest loss during the drying operations.

Except for heptachlor, there were no detectable changes in the amount or structure of the other insecticides during the manufacture of ice cream. Some of our results seemed to indicate that some heptachlor was being converted to heptachlor epoxide when the mix was frozen into ice cream.

Detectable amounts of all insecticides were present in whey during the manufacturing of Swiss-type cheese. The amount of insecticide in the whey increased during cooking of the curd. More heptachlor was found in the whey than the other insecticides studied.

No significant changes were observed in the structure or amount of insecticide during storage of butter, cheese, ice cream, and sterilized milk.

In general, except for some loss of insecticide during condensing and drying, the results indicate that the insecticides studied are essentially stable under the conditions used during the study. The amount of insecticide in butter and cheese is less than that in the raw milk when expressed on a fat basis. This is due to loss of some of the insecticide in skimmilk and whey.

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1964.

INFANT FORMULA PLANT SANITATION[1]

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It is estimated that during 1963, over 600,000 infants will be fed formulas prepared by commercial formula services. Although this service was originally established in San Francisco 16 years ago, it is only within the past few years that it has become an important factor in the feeding of infants. There are now 13 such plants in operation in New York City, Miami, Florida, Philadelphia, Allentown and Lancaster, Pennsylvania, Baltimore, Maryland, Chicago and Peoria, Illinois, Kansas City, Missouri, Phoenix, Arizona, Los Angeles and San Francisco, California, and Seattle Washington. Two additional plants one in Cincinnati, Ohio, and one in Detroit, Michigan, are in process of completion. It is estimated that at least five more plants will be completed within the near future.

Their growth has been spurred by many hospital factors, including problems of contamination, limitation of variety, lack of consistency, and staff problems. In commercial formula preparation, the ever-present danger of outbreaks, due to contamination by pathogenic organisms or by careless use of toxic chemicals, can be completely eliminated. The many types of infant formulas available widen the scope of infant feeding. An accuracy and consistency in methods of preparation that cannot be equalled in hospital formula rooms is in itself a tremendous advantage. Hospitals no longer will be required to maintain and staff the qualified personnel so important to the growth of the newborn.

The inconsistencies and public health dangers involved in home preparation of infant formulas have been described in detail by an American Public Health Association Committee *(1)*.

To public health administrators, this can mean the assurance of safe formulas every day of the year *(2)*. In some cases, it reduces the necessity of policing 100 hospitals to control of one establishment under supervision of the public health authority. Although hospitals have had standard equipment available for the autoclaving of formula, the safety of this equipment varies with the personnel and other hospital activities. As an example, although autoclaves are

[1]Presented at 50th Annual Meeting of the International Association of Milk and Food Sanitarians, Inc., Toronto, Ontario, Canada, on October 24, 1963.

used in most hospitals, the time of autoclaving varies from 5 to 15 minutes in actual hospital practice. Furthermore, the accuracy of thermometers is seldom tested, and it is not unusual to find variations as high as ±20 F.

A small number of public health authorities have anticipated the establishment of commercial formula services and, as a result, only a few regulations have been promulgated to insure the safety of the product.

These regulations vary from the important and overly stringent to the lackadaisical. Consistency is not evident. Ordinances and regulations that do exist have, to a great extent, been written by medical personnel, and exhibit a lack of knowledge of environmental sanitation problems involved. There is an urgent need for a governmental public health agency, with a background in the field of environmental sanitation, to develop a model ordinance and code for enforcement on a state or local level.

Although many features of the code can be borrowed from either the Milk Ordinance and Code, 1953 Recommendations of the Public Health Service, or the Food Service Sanitation Ordinance and Code, 1962 Recommendations of the Public Health Service, there are a number of significantly different operations for which specific details for control must be written.

An attempt at establishing such a standard code was made by the Committee on Nutrition of the American Academy of Pediatrics. To date, this has not gone beyond the tentative stage.

At the request of a number of processors and some local health departments, such a code has been prepared[1].

The pattern varies from the existing Public Health Service Codes in that there is a separation between operational requirements and fixed significant items.

This is best described by the following list of section headings:

Cleanliness of Equipment and Utensils
Ingredients, Food and Water
Formula Preparation Room Procedure
Formula Protection
Sanitary Design, Construction, and Installation of Equipment and Utensils
Personnel
Sanitary Facilities and Controls
Structural Requirements
Vehicles

An inspection form has been prepared (reproduced herein) for self-policing by infant formula processors and enforcement agencies. In order to facilitate inspections, it follows the flow of the containers and product through the plant and is sufficiently detailed to be fully explanatory.

[1]Copies may be obtained from the author.

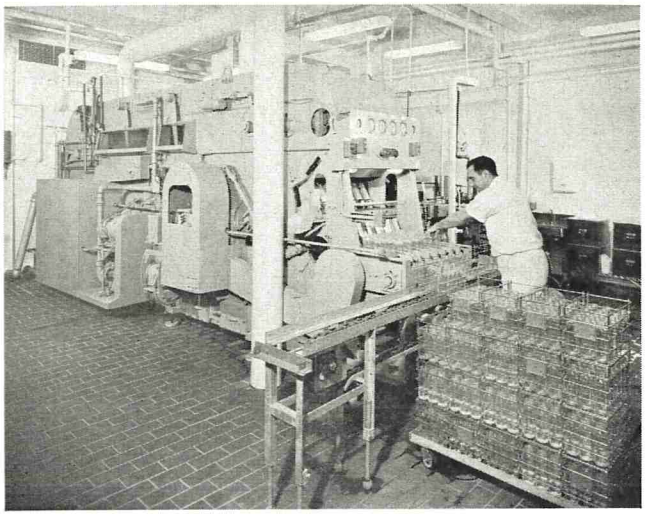

Figure 1. Bottle rack washer.

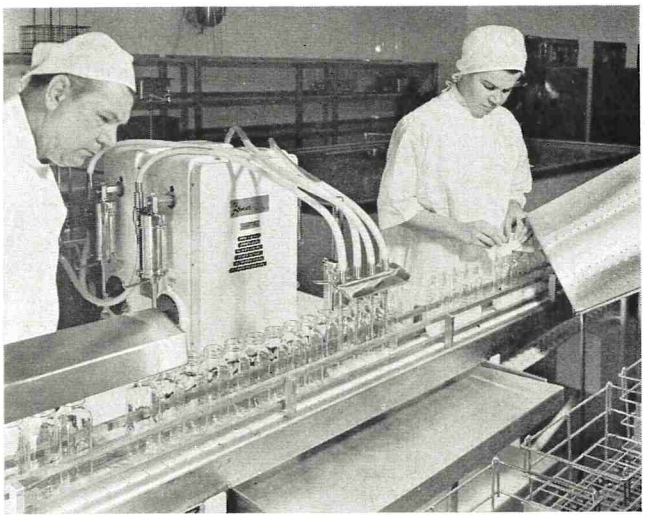

Figure 2. Automotic filling of house formulas.

There are specific recommendations for the storage of formula during and after autoclaving, and the establishment of standards of time and temperature for autoclaving, as well as for instrument control. Autoclaving the product does not eliminate the necessity for sanitation controls during processing, since it is extremely important to insure that every bottle of commercially prepared infant formula is safe at all times. Much attention is paid to personal cleanliness and health of employees.

Sanitary design of food handling equipment, to a great extent, follows the requirements of the Milk Ordinance and Code, 1953 Recommendations of the Public Health Service, and the 3-A Standards for Dairy Equipment. Methods for cleaning and sanitizing bottles, nipples, rings, caps, and all utensils are spelled out in detail. The use of all potentially toxic materials is restricted, and sanitization is limited to methods employing steam under control conditions, and water at a minimum of 180 F, or heated air.

INSPECTION FORM
for
PLANTS PREPARING INFANT FORMULAS

NAME _____

ADDRESS _____

Bottles per Day _____

No. Hospitals Served _____

Date _____

Section C - Cleanliness of Equipment and Utensils

1. Bottle Washing:
   a) Mechanical, 180°F. final rinse... ( )
   b) Manual, 3-comp. sink, final rinse, 170°F. for 5 min. .... ( )
2. Nipple Assembly Washing:
   a) Mechanical washer..... .... ( )
   b) Autoclaved at 230°F. for 10 min.. ( )
3. Bottle Racks:
   Washed and sanitized..... .... ( )
4. Utensil Sanitization:
   a) Small, 170°F. for 10 min. .. .... ( )
   b) Large, steam at 200°F. for 5 min..... .... ( )

D - Ingredients, Food and Water

1. Fluid milk source complies with State requirements..... ( )
2. Readily Perishables:
   a) Stored at 45°F. max..... ( )
   b) Open containers discarded daily.. ( )

E - Formula Preparation Room Procedure

1. Personnel:
   a) Scrub before entering..... ( )
   b) Clean clothing..... ( )
   c) No jewelry..... ( )
2. Work surfaces cleaned and sanitized ( )
3. Formula Processing:
   a) Autoclaved, 230°F. for 10 min.. ( )
   b) Recording and indicating thermometers..... ( )
   c) Recording chart data complete... ( )

F - Formula Protection

Formula Storage Room:

1. Max. temp., 45°F..... .. ( )
2. Thermometer installed and properly located..... ( )
3. Racks wrapped and delivered 72 hrs. max..... ( )

Section G - Sanitary Design, Construction, and Installation of Equipment and Utensils

1. Food Contact Surfaces:
   a) Accessible for cleaning..... ( )
   b) Corrosion-resistant, non-absorbent, non-toxic..... ( )
   c) Smooth, free of breaks, open seams, etc. ..... ( )
   d) No "V" threads. ..... ( )
   e) Free of lubricants..... ( )
2. Single-service articles non-toxic..... ( )

H - Personnel

1. Pre-employment medical examination.. ( )
2. Free of communicable disease... ..... ( )
3. Smoking prohibited..... ( )
4. Clean hands..... ( )

I - Sanitary Facilities and Controls

1. Water Supply:
   a) Safe, sanitary quality..... ( )
   b) System complies with Plumbing Code ( )
2. Sewage:
   Approved by State authority..... ( )
3. Toilet Facilities:
   a) Adequate, convenient... ..... ( )
   b) Self-closing doors..... ( )
   c) Clean, good repair..... ( )
   d) Well-lighted, ventilated..... ( )
   e) Handwashing - warm water, soap, and disposable towels..... ( )
   f) Handwashing signs posted..... ( )

J - Structural Requirements

1. Floors:
   a) Smooth, impervious, good repair .. ( )
   b) Coved joints..... .. ( )
   c) Clean..... .. ( )
   d) Trapped floor drains .... ( )
2. Walls and Ceilings:
   a) Smooth, washable, light-colored. . . ( )
   b) Clean, good repairs..... ( )

Section J - Structural Requirements (Continued)

3. Doors and Windows:
   a) Outside openings, screened, and/or protected..... ( )
   b) Sloped, coved sills in prep. rm.( )
   c) Doors self-closing..... ( )
4. Lighting:
   a) Production rooms, 20 ft. candles ( )
   b) Storage rooms, 10 ft. candles.. ( )
   c) All other areas, 5 ft. candles.. ( )
5. Ventilation:
   a) Sufficient to prevent odors and excessive condensation.... ( )
   b) Preparation Room:
      (1) Positive pressure..... ( )
      (2) Separate air-conditioning system..... ( )
      (3) Air supply treated to remove dust, dirt, etc. ..... ( )
6. Dressing and Locker Rooms:
   a) Adequate, outside produc. or storage areas..... ( )
   b) Clean..... ( )
7. Housekeeping:
   a) Clean, free of litter and rubbish.( )
   b) Living and sleeping quarters separated from production.....( )
   c) Wet pick-up in general cleaning. ( )
   d) Cleaning compounds mixed outside preparation room.....( )
   e) Containers for soiled linen .....( )

L - Vehicles

1. Closed body, 2-compartment.....( )
2. Refrig. compartment, 45°F. max.. ( )
3. Clean.....( )

Inspected by _____

Title _____

REMARKS: _____

_____

_____

_____

Control of possible air-borne contamination can be assured by the establishment of a positive pressure system in the formula preparation room.

In order to minimize hospital errors, each container or rack of formulas is specifically labeled, and formulas are prepared only on order of a licensed physician.

FORMULA PREPARATION[2]

In normal operation, the bottles are pre-rinsed, washed in a detergent-caustic solution at 140 F, then thoroughly rinsed with clean water to remove any trace of caustic solution, and subjected to a final sanitizing rinse at a minimum of 180 F. A modified milk bottle washer or specially converted flight type dishwasher can be used for this purpose.

Bottle racks are either concurrently washed and sanitized, or they may be treated together with the bottles (See Figure 1). Nipples, caps, and rings are washed in an automatic device. This consists of a clear water rinse, two detergent washes, and a series of final rinses with clear water.

At the conclusion of this operation, the nipple assemblies are placed in baskets and autoclaved at 230 F for 10 minutes. A pass-thru autoclave is used to eliminate additional openings and the necessity of employees from the area entering the preparation room.

Bottles and racks are conveyed into the preparation room where "house" formulas are filled automatically (See Figure 2). Special formulas are prepared in sterile equipment and filled either by small mechanical fillers or sterile graduates.

Nipples, nipple rings, and protective caps are immediately applied, and the formulas placed in racks prior to autoclaving.

The formulas are autoclaved at a minimum of 230 F for 10 minutes. Each autoclave is equipped with both an indicating and a recording thermometer, and is completely automatic.

After autoclaving, the bottles are cooled to 90 F and transferred to a walk-in refrigerator. Here, they are packaged in polyethylene bags and removed to a refrigerated truck for delivery to the hospitals.

Upon return from the hospitals, the bottles are stripped of the cap, ring, and nipple assemblies and this completes the cycle.

A separate "scrub" room is an integral part of these plants. Employees first change their clothing in the dressing room and proceed to the "scrub" room. Here all water and drain valves, soap dispensers, and waste containers are foot-operated. After thorough washing, the employees change to sterile caps and gowns before entering the preparation room.

[2]In addition to Figures 1 and 2 several other photographs that further illustrate the processing steps and equipment used are available on request from the author (510 N. Dearborn St. Chicago Ill. 60610).

TABLE 1. BACTERIOLOGICAL ANALYSIS OF 27 TYPES OF COMMERCIALLY PREPARED INFANT FORMULAS AUTOCLAVED AT 230 F FOR 10 MINUTES (JANUARY 1, 1963 - AUGUST 31, 1963)

Number of samples examined	Standard plate count per ml	Percent of samples
725	Less than 1	76
106	1	11
62	2	7
9	3	1
25	4	3
2	5	.2
6	6	.6
7	8	.7
2	10	.2
1	14	.1
1	17	.1
1	36	.1

Why are all these precautions necessary if the formulas are autoclaved?

Autoclaving at 230 F for 10 minutes, may not always produce complete sterility, although it will produce a safe product. Those codes adopted to date permit bacterial counts as high as 25 per ml when the samples are plated on Standard Methods agar and incubated at 32 C for 48 hr *(3)*.

There are very few public health laboratories capable of conducting bacteriological analyses for sterile products. Some communities have permitted plate counts up to 15 per ml because they conscientiously feel that this is the limit of accuracy within the existing laboratories.

An analysis has been made for an eight-month period of each autoclaved lot of infant formula from a plant using the minimum of 230 F for 10 minutes. Five samples per day were taken during this period, for a total of 947 samples. These include each of the 27 types of formulas prepared during that period. Table 1 indicates the results. Plate counts of 5 or less accounted for 98.2% of all samples, and it is possible that the few remaining counts may be attributed to errors either in sampling or analysis.

In a few cities, home deliveries have been inaugurated, and this aspect of formula preparation and delivery is expected to have its greatest growth in the next few years.

In 1960, there were over 4,000,000 births in hospitals in the United States. It is estimated that by

1964, over 1,000,000 of these infants will be fed by commercial formula services in at least 25 states.

The future of this industry will depend, to a great extent, on the continued adherence by formula plant operators to exacting standards of environmental sanitation, and complete public health protection can be attained only through the establishment and enactment of a uniform code by federal, state, and local authorities.

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CHLORINATED ORGANIC INSECTICIDE RESIDUES IN MILK[1]

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Editorial Note: Much concern and confusion exists relative to the pesticide problem in milk, milk products and other foods. Dr. Henderson, a member of the Technical Advisory Committee on Pesticides of the Dairy Industry Committee, presents an authoriative account of the background, significant developments and current situation relative to this problem.

The concern of the dairy industry with respect to pesticides in milk and dairy products began with an announcement of Mr. John Harvey of the Food and Drug Administration at the Dairy Conferences at Miami Beach in October 1959 *(3)*. He stated that it was apparent that education would not solve the pesticide problem alone and that the time for positive action and perhaps product seizures was here. This announcement was followed by seizures of evaporated milk and butter in January 1960.

Two surveys of milk supplies in 1955 and 1959 by the Food and Drug Administration indicated that pesticide residues were fairly common in milk *(1, 2)*. A new technique, paper chromatography, was used in these surveys. This technique was not generally available to the public until Paul Mills' paper was published in the November 1959 issue of the Journal of Official Agricultural Chemists *(7)*. The dairy industry has been criticized for its delay in being concerned with the problem. I do not think this criticism is justified—it required the availability of a fairly simple screening test before progress could be made in this field. The seizures and the availability of the Mills test did stimulate the dairy industry and the state and other regulatory agencies to tackle the problem and to attempt to determine the sources of contamination and to try and reduce pesticide residues to the lowest possible levels. The Dairy Industry Committee, composed of the eight secretaries of the dairy trade associations, appointed a Technical Advisory Committee to explore and find solutions if possible for various aspects of the pesticide problem.

The DuPont Company filed a petition in 1957 for a tolerance of 0.25 ppm methoxychlor in milk under the Miller Amendment of the Food, Drug and Cosmetic Act *(5)*. A Committee of the National Research Council, National Academy of Science, appointed to advise the Secretary of Health, Education and Welfare on the evaluation of the scientific data contained in the petition, recommended that a finite tolerance be denied. The denial of this petition appears to be the basis of the Food and Drug Policy that no finite tolerances be given for pesticide residues in milk and dairy products, or the so-called "zero" tolerance.

In order to determine the presence of residues in milk it was necessary to use a specific test and preferably, an official test published in AOAC analytical methods. The AOAC colorimetric test was available for this purpose. The test is specific for DDT and its analogues and is reported to be not reliable to less than 2.5 ppm on the basis of the fat. This is, of course, not zero in the absolute sense but was an "administrative zero" based on a specific test and apparently was used to determine compliance with the law which prohibited pesticide residues in milk.

The Mills' paper chromatographic test was more sensitive than the AOAC or Schechter-Haller modification of the test and it was not limited to the detection of the DDT series of chlorinated hydrocarbons; lindane, methoxychlor, aldrin, dieldrin, heptachlor, endrin and many others could be detected if they were present in sufficient amounts. The Mills paper chromatographic test was extremely useful in the early stages of the problem, but it is a qualitative and only a semi-quantitative test. It received first action by AOAC as a qualitative test but not second

[1]Presented at Dairy Products Institute and Sanitarians Conference, University of Minnesota, September 8, 1964.

action for an official test.

In late 1960 and early 1961 the Food and Drug Administration had considerable interest in the microcoulometric-gas chromatographic procedure for determining pesticide residues. The Dohrmann equipment used for this procedure was developed by Dr. Dale Coulson of the Stanford Research Institute. In this procedure the organic chlorine is titrated as chloride ion and thus it is a quantitative test. The graph obtained from the recorder provides information for determining the amount of residue in the sample and establishes an emergence time that can be compared with the standard compound. The microcoulometric equipment can be equipped with a titration cell for sulphur and is thus valuable for use for many organic phosphorus insecticides.

Early in 1961 and in 1962 interest was shown in a new technique that was announced in 1960 — the electron-capture or electron-affinity gas chromatographic procedure *(6)*. This procedure was reported to be sensitive to many pesticides at very low levels — one part per billion or lower. The development of the equipment for use in milk was doubtless delayed due to the impression that it was not necessary to require a good "clean up." For milk products, the Mills or other, efficient "clean up" is essential. A collaborative study reported in November 1962 indicated that more work was necessary for this procedure to reach its potential *(4)*.

Since mid-1962 great strides have been made in this procedure. New packed columns, better understanding of parameters and adherence to efficient "clean up" procedures have contributed to the progress. At the present time I think it is safe to predict that when an official AOAC test is announced it will probably be an electron-capture gas chromatographic procedure. The microcoulometric equipment is valuable in the hands of a skilled operator and results comparable to electron-capture are possible. The following data indicate results that may be obtained (data in ppm in the fat):

	DDT	DDE	DDD	Dieldrin	Total Residues
Laboratory D (microcoulometer)	0.16	0.35	0.09	0.03	0.63
Laboratory L (electron-capture)	0.12	0.41	0.055	0.05	0.635

A new technique, thin-layer chromatography, is also being developed to a point where it is a valuable screening tool and for confirmation of questionable results obtained by the electron-capture procedure. The spots on the plate can be removed manually and checked by chemical or other techniques.

The above methodology has been discussed since the change in "administrative tolerance" is based on the sensitivity of methodology. The "zero" or administrative tolerance remained at 2.5 ppm on the fat basis until October 11, 1963 when the Food and Drug Administration announced that improvements in methodology had made it possible to positively identify residues at the following levels:

	Separately or in total
DDT, DDE, DDD	0.05 ppm in milk 1.25 ppm in fat

On January 16, 1964 lindane, BHC and methoxychlor were added to the list at 0.05 and 1.25 ppm in milk and fat respectively.

The October 11, 1963 announcement added 5 other residues that previously had not received much attention outside of FDA:

Aldrin Dieldrin Heptachlor	0.01 ppm in milk
Heptachlor-epoxide	0.25 ppm in milk
Endrin	

In determining compliance or action levels the following interpretations are made:

Aldrin or dieldrin, individually or as an aggregate, total at levels of 0.01 ppm in whole milk or 0.25 ppm on a fat basis.

Heptachlor or heptachlor-epoxide, individually or as an aggregate, total at levels of 0.01 ppm in whole milk or 0.25 ppm on a fat basis.

Endrin total at levels of 0.01 ppm in whole milk or 0.25 ppm on a fat basis.

The above group of toxic compounds was referred to in the "President's Report on Pesticides" (Wiesner Report) and their toxicity was emphasized *(8)*. This report and perhaps Rachel Carson's "Silent Spring" apparently stimulated the recent concern for this group which is now receiving special attention in pesticide residue analysis. I suspect that FDA tests every sample of milk and dairy products for this group and that their findings, together with the improved methodology, prompted the announcement of October 11, 1963.

A survey made by FDA showed that of approximately 3,000 samples of milk analyzed during the period July 1, 1963 through March 10, 1964, 49 or 1.6% had actionable levels of residues. Only 8 samples exceeded 1.25 ppm in DDT whereas 29 samples exceeded 0.25 ppm in dieldrin and 16 samples exceeded 0.25 ppm of heptachlor epoxide. The "actionable level" samples were largely confined to three areas — 20 in Denver, 14 in Baltimore and 10 in the Minneapolis district. The Baltimore area has recently received considerable publicity because of heptachlor epoxide values in milk that exceeded current "actionable level". It has been reported that farmers treated alfalfa with heptachlor as recommended in

the USDA Handbook 120. This treatment, using tests available at the time of approval, did not produce "actionable" residues. The current more sensitive methods used by regulatory authorities showed that residues present exceeded 0.25 ppm of heptachlor epoxide. The question is: Should the government indemnify farmers for milk denied a market because of pesticide residues occurring in milk after the cows were fed hay treated according to the recommendations of USDA? An amendment to the Anti-Poverty Bill provides for payment for value of milk lost in the Baltimore area due to residues. The expiration date for payment is January 31, 1965.

WHERE DO RESIDUES COME FROM?

The USDA and FDA each have a responsibility at the Federal level to regulate the use of insecticides to the degree that they will not create a public health hazard and at the same time permit their use on agricultural crops and on animals. The USDA administers the Federal Insecticide, Fungicide and Rodenticide Act of 1947. This Act requires that insecticides shipped in interstate commerce be registered with USDA. Before an insecticide product can be registered, the manufacturer must submit proof that the chemical will safely and effectively accomplish the purpose for which it is manufactured when used in accordance with directions developed for its use. The burden of proof is placed on the manufacturer.

The Food and Drug Administration administers the Federal Food, Drug and Cosmetic Act of 1938. The Miller Amendment of this Act (Section 408), often referred to as the Pesticide Amendment of 1954, is specifically concerned with tolerances. When a pesticide chemical is to be used on a food crop, both agencies may be involved. If the compound leaves a residue, the USDA delays registration until a tolerance has been established by FDA. In order to secure a tolerance the manufacturer must file a petition under Section 408e of the Food, Drug and Cosmetic Act. The manufacturer must furnish experimental evidence on toxicity to establish what tolerance, if any, will be safe.

When a tolerance has been set by FDA, the USDA registers the insecticide which can then be marketed interstate with approved labeling. Most states have a "uniform state act" or other legislation requiring that pesticides conform to Federal Standards.

With controls established at Federal and some state levels why do we have the pesticide residues now found in milk? When electron-capture procedures are used it is doubtful that any milk will show "zero" or negative tests – a trace at least can usually be found.

Prior to the current interest in chlorinated hydrocarbons in milk, that is, before 1960, much of the contamination was due to improper use on the dairy farm. The spraying in barns, in milk houses and on cows with insecticides that should not be used for these purposes has resulted in residues in the milk. It was the contention of many regulatory personnel that this was the principal source of contamination and that since it was under the control of the dairyman, it like the antibiotic problem, could be quickly solved. The feeding of "trash" materials, such as apple pumice, trimmings of lettuce, cabbage and other plants, sweet corn stover, etc., contributed much to the contamination. An educational program that began in 1960 and warned against the mishandling of sprays on the dairy farm and the dangers from feeding trash materials, resulted in a marked reduction in pesticide levels but not the incidence. As methodology improved, fewer and fewer "zero" or negative tests were reported.

The residues persisted at lower levels and much research indicated that feed, contaminated by drift from aerial application of insecticides on fields of other crops resulted in contamination of forage and pastures, was one of the major sources of residues. The relationship of low level ingestion of insecticides in feed to the levels of residues in milk has not been well established by research work. Trials conducted at the University of California on feeding DDT at low levels indicate the relationship between DDT in the feed and DDT in the milk *(9)*. Pairs of dairy cows were fed 0 to 5 ppm DDT based on the feed intake. The regimes were maintained for six weeks. The results indicated that the maximum level of DDT in the feed that did not produce detectable residues in the milk was 0.5 ppm. The State of California requires that alfalfa offered for sale have less than 0.5 ppm DDT. This level was established when the FDA "actional level" was 2.5 ppm on the basis of the fat. The 0.5 ppm in hay provides for some safety factor but with an "actional level" of 1.25 ppm a lower level in the feed is indicated, perhaps 0.25 ppm.

Dr. Witt of the University of Arizona has reported that when DDT dust is applied at the rate of two pounds per acre, the spray applied as dust can contaminate feed with 0.25 ppm approximately 3½ miles downwind from the border of the target crop. In the form of a spray, the same concentration of DDT was found at little less than one-half mile from the border of the target crop. Of course the drift found in any one trial will be affected by wind direction, wind velocity, temperature inversion, humidity, type of formulation, particle size, dosage rate and many other factors.

The feeding of contaminated feeds to growing heifers will result in residues in the milk when she

freshens. In California a new law prohibits the sale of heifers fed contaminated feed or milking cows that have pesticide residues in their milk. The DDA test of urine is used to administer the law. In Los Angeles where the cow replacement rate is high it is important that heifers purchased from other areas do not have residues in the milk when they freshen.

The heptachlor epoxide problem on alfalfa has indicated that because of the improved sensitivity of analytical methods all recommendations of the USDA and the University Extension Departments should be re-examined.

WHAT CAN BE DONE TO REDUCE RESIDUES?

1. Since most of the control must occur at state levels, it is essential that state programs be designed to control the use of spray materials.

a. A law governing the registration and sale of insecticides is essential.

b. The licensing of applicators, both private and commercial, and continued inspection of their performance is necessary.

c. Many toxic insecticides should only be applied after a permit is secured indicating the composition of the material, the crop to be treated, the rate of application, list of adjacent crops and the name and license number of the applicator. For administrative purposes it is desirable that the County Agricultural Commissioner or similar authority issue the permits.

d. A state agency (usually the Department of Agriculture) should maintain an inspection force to secure milk samples and work with the dairyman to assist in locating sources of contamination. A laboratory or laboratories should be maintained to test the samples supplied by the inspectors.

e. Samples of hay and grains offered for sale in markets should be tested at intervals for compliance with residue tolerance where established.

f. A tolerance level (usually the current FDA "actionable level") should indicate the point where corrective action will be taken.

The above program is best administered by one state agency. A strong Department of Agriculture is recommended with the Department of Public Health acting in an advisory capacity.

2. Restrict the use of chlorinated hydrocarbons if residues cannot be controlled in other ways.

a. Two states have taken steps to restrict the use of DDT as a dust. In October 1963 California adopted a law that required a permit be secured from the County Agricultural Commissioner for *each* application. Arizona held a hearing August 6, 1964 to make legal a voluntary prohibition on the use of DDT as a dust for one year.

b. Cancel the approval of compounds such as chlordane, heptachlor, dieldrin and endrin when they are used on any crop that could cause residues when fed to dairy cattle. Restrictions are now in effect on many crops normally fed to cows.

3. Prohibit the sale of heifers or dairy cows that have been exposed to insecticide contaminated feeds until tests prove the milk will not contain residues in excess of "actionable levels".

WHAT ABOUT TOLERANCES?

The new "actionable level" issued by the Food and Drug Administration on October 11, 1963 alerted the dairy industry to the fact that further improvements in methodology could result in levels that could not be met by prevailing agricultural methods even when the best practices were followed. The Food and Drug Administration Commissioner, Mr. George Larrick, when testifying at the Ribicoff Senate Committee meeting indicated that as methodology improved, it will be necessary to establish finite tolerances — even for milk, he added. The Miller Amendment provides a mechanism under Section 408e for securing tolerances. The dilemma is: At what level shall tolerances be set? What is "safe" and what is below "pharmacological insignificance"? At one time 2.5 ppm DDT in the fat must have been considered "safe". Is 1.25 ppm "safe" or below "pharmacological insignificance"?

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INCREASING POPULATIONS AND FUTURE FOODS[1]

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The development of civilization is in a sense a measure of man's success in providing himself with food. Early man devoted his primary effort in stalking and acquiring food. His successors developed the knowhow of domestication of plant and animal. The surpluses resulting from this organization relieved men and their talents for other purposes, from which evolved the arts, the religions, the sciences; the organizations of commerce, cities, nations, governments.

The development of civilization of man was not always easy. Wars, famine, pestilence, and revolutions are matters of recorded history. These were factors affecting and affected by food supplies. Major famines occurred in Europe very frequently after the year 1000; presumably, also before. Biblical record admonishes the use of systems of food storage against famine plague and pestilence.

Increase in production of food supplies followed major inventions of the times; the trace, the horse collar, the wheel, the team, the row, the hill, the plow, fallow, rotation, irrigation. Other developments have followed. Among these may be cited the pioneering of new land frontiers, mechanical and power developments for food production, improved techniques of food preservation and of its storage, improved understanding of the role of food in health, of biological knowledge and its application in plant and animal agriculture, and in educational systems for extending knowledge to producers of foods.

Through these means man has improved his health, his sufficiency, his pleasures and his numbers. Periodically, there have been threats, and jeopardy to this sequence of developments. Wars, famines, pestilence or plague do intervene. Malthus, in the 18th century, reasoned man could not keep up in providing the food needs for projected increases in population, and that the alternate to starvation would be plague, pestilence and war, thus rebalancing the food-man balance sheet.

It is evident that populations have increased since Malthus, and that food supplies in total have increased. But it is not so clear that Malthus was incorrect. For example, the estimates of the world population over the centuries are:

In Christ's time	200-300 million
1700	500 "
1850	1,000 "
1960	3,000 "
2000	6,000 "

But it is clear that while the population and the world food supply have increased, the availabilty of food in some parts of the world is wholly inadequate. Relatively few nations have food supplies, or economies that provide diets balanced or adequate in terms of the newer knowledge of nutrition. Many nations have inadequate supplies, and a great imbalance of dietary components. Both severe hunger, and severe malnutrition exist for many millions.

Thus, there is in the minds of men much concern about the abilities of the world to increase its food supply sufficiently to complement the current rapid rate of population increase.

It is believed that on the basis of current knowledge, world food supplies must be tripled by the turn of this century to meet population food and nutrition requirements.

Populations have increased because like begets like, obviously, but in perspective many factors have played a role in the zooming of the rate of population increase. Among these are:

1. A decline in mortality; historically, relatively few survived to maturity. Today, 90% survive to maturity.

2. The health of man has steadily increased because of the works of men like Hippocrates, Leeuwenhoek, Pasteur, Lister, Koch and their followers. Before 1920 there were plagues of cholera, smallpox, diphtheria, influenza. Since 1920 there have been no major pandemics.

3. There has been development of previously untouched and highly productive land frontiers in the Americas, Oceanic, Australia, and South Africa.

4. Transportation has improved from the camel and burro to air flight.

5. There has been tremendous application of power, from coal, fuel oil and water supply reserves.

6. There has been a fascinating revolution in agriculture, from Jethro Tull's "Horse Hoeing Husbandry," to applications of every facet of science in production of food plant and animal. It is recognized that the increase in productivity per man hour in agriculture has been greater than in other industries.

There are a number of potentialities that have been suggested for increasing the production, and

[1]Presented at the meeting of the Middle States Branch American Public Health Association at Milwaukee, Wisconsin, April 23, 1964.

the efficiency of use of foods to minimize malnutrition, and to meet the requirements of the forthcoming doubling of population. Among them are:

1. Increasing tillable acreage by development of new lands—some 1.2-2.5 billion acres conceivably might be adapted—but this admittedly will be difficult to do.

2. Increase productivity of current operable land by irrigation; fertilization, agronomic developments, greater use of improved pesticides, improved livestock and livestock management practices, by fisheries developments, and so on. The production of many major crops in the United States (such as corn, hay, oats, vegetables, etc.) has doubled since 1933. But 827,000 tons daily of America's topsoil currently is lost at the outlet of the Mississippi River.

3. Shift agriculture from livestock to grain economy; it is estimated 94% of the world food supply is used directly as such, and that some 6% is derived indirectly from animals. In the U. S. some 35% of crop is fed through animals yielding one-third the available energy as food. It has been estimated that if this nation's corn crop (4 billion bushel) were fed directly as human food, the energy would be sufficient for 250 million people; also, that by further intensified production, and efficiency in use of food, this country could feed 1,000 million people, but on much more restricted diets. However, animal agriculture does utilize efficiently forage crop not otherwise useful to men.

Increase in food production from available, or from contemplated new lands, requires a combination of conditions or qualities: favorable temperatures, adequately distributed water supplies, tolerable soils, properly balanced and available nutrients, and suitable topography. Scientifically developed plants and animals are highly sensitive to environmental conditions. Such combinations, in proper balance or distribution, are not easily achieved, and limit probabilities of frontier lands. Much of the increased production of food in the world is the result of intensification of agriculture on available lands.

Food, in the quantities and forms as we know it, is the result of a fascinating revolution in agriculture. In the U. S. one man provides enough food for twenty others, and the average outlay for food is only 20% of income. In Russia, one man provides enough for 7 others, and 50% or more of income for food is necessary. In other areas, virturally all work is expended for food, and in some, there is not enough food.

In the recent decade there has been much consolidation and enlargement of food production, food processing and distribution facilities. Marginal farms have been absorbed or abanded; marginal processes have been replaced. The total number of farms operated in 1962 was about 2 million less than in 1950, present numbers are 3,688,000. It appears such consolidation and development will continue for a significant period. Current annual capital investments in food processing average 800 to 1,000 million dollars annually. From 1941 to 1961, the man-hour input required for production of foods decreased 14%, while product output increased 35%; the productivity per man-hour thus rose 56%.

Consumers spent $319 per person for food in 1947-49, and $392 in 1961, representing an increase in cash outlay of 23%. In the interim, disposable income increased 59%, from $1,248 to $1,987. The proportion of income spent for food declined from 25.6% in 1947-49 to 19.7% in 1961. It is estimated the quantity and type of foods purchased in 1935-39 would cost only 14.5% of current disposable income. Currently consumers fare better with much improved foods, at relatively less cost.

Thus, we must examine not only the developments which have enabled the modern foods, but consider potentials and problems of the future. Foods processing, the conversion of raw inedible forms of food into something edible and useful at another time and place, has undergone tremendous change in recent years. Some 10,000 food plants employ every conceivable form of engineered operation for the processing of foods. There has been both reduction in the numbers of plants, and increase in their size. There has been installation of automation and precision controls for the multitudes of treatments. It has been suggested shortly some 90% of the nation's poultry requirements could be produced on 50 commercial poultry farms; that in each of coadjacent selected plants process rates of 10,000 birds or 27,000 pounds ready to cook poultry per hour are feasible. Bird ranches already are in operation handling 200,000-500,000 birds continuously. The application of the processes, the efficiency required for their operation, requires large investments and large volume operation and distribution. Thus, most certainly we can look forward to greater intensification in agriculture, and fewer plants geared to larger scale engineered operations for foods.

Increased crop production economically justified and enabled control of predatory insects, diseases and weeds. Uncontrolled, such pests could destroy 30-50% of the total food crop. DDT was followed by chlorinated hydrocarbons, organic phosphates and systemic insecticides. Disease control was improved by compounds such as the organic mercurials, dithiocarbamate fungicides; weeds have been suppressed by 2-4 D and other phenoxyacetic derivatives, and substituted urea compounds. Increased animal production has been obtained by use of feed ration supplements of urea, methionine, antibiotics, and vitamins. Animal diseases have been much suppressed by a host of veterinary drugs and by chemi-

cally modified sanitation practices. The storage carry over of foods has been improved by diverse processes: controls of temperature and gas conditions, treatments with spoilage inhibitors, and improved means of protection against insect and rodent damage.

The efficient and low cost production of foods of the future will involve increased use of balanced feeds, with additives and supplements which increase gain/feed ratios and minimize costs of handling. Application of Mendelian principles has upgraded quality and potentials of meat, vegetable, and fruit lines. Management and housing have made significant differences in animal population increase rates, and weight gains. Utilization of genetic principles has enabled development of disease resistant strains of many crops, with nutritive qualities, processing qualities, and improved yields. Early application of low cost soil nutrients, principally nitrogen, following Hafer's work on N fixation, and subsequent use of nitrates, ammonia, and deposit sources of mineral fertilizers, has been important in sustaining yields from various soils.

Thus, the geographic and climatic advantages in America of climate, soil, distributed rainfall, transportation, technology and agricultural education have been important in our population/food ratios. The rapidly expanding fund of knowledge by which more, and better foods can be produced, and which must be produced, is essential. The average American eats 4.66 pounds food per day; the average Indian across the world consumes 1.23 pounds per day.

Food supplies are of world-wide, as well as national origin. Many organizations deal extensively with raw food, and processed food components from distant places. Few individuals consume a meal without some imported component. Significant too, is the utilization of specially processed functional ingredients or components of foods. These have special built in qualities which enable controlled uniform processing of foods; in many instances they are essential to bioengineered foods operations. Examples are modified fats or oils, flours, starches, sweeteners, eggs, milks. It includes functional items such as emulsifiers, stabilizers, leaveners, enzymes, bleaching and curing agents, acidulants and so on. Literally thousands of products and blends have been developed for improved food operations, and foods. Unquestionably the development of improved functional ingredients will continue, since they are essential. There are inherent problems in their use which must be faced in the future: the effects of multiprocessing, multihandling, and widespread, as well as large-scale utilization imply potential health hazards.

The decrease in numbers, and the increase in size of food plant operations have involved water, and waste problems. Land water tables have dropped seriously in many areas, requiring deeper pumping, and transported waters. Water supplies are often derived from vast drainage areas, where waste and water comingle. Such waters, when purified, are potable, but frequently unsatisfactory for food process operations. They require further purification. Food operations require 300-15,000 gallons water per ton of raw material; line flow capacities often scale 10-50 ton of food per hour.

Larger food plants generate large waste disposal problems. Output waste may range from 10-70% of input of raw material in the plant. New systems of land sprays, and lagooning have been developed to meet this problem. In all probability, the problems of water and waste for food processing will become more serious, with the increase in population and pressure for foods.

The early American diet of bread, meat, and potatoes has given way to a new system of foods. The winter larder of the cellar, so aptly described by Herbert Hoover, has given way to but a few days supply in the modern kitchen. Over 30% of all married women are employed for wages. About 25% of all food produced is consumed in institutional operations. The average American eats one meal away from home, daily. Some component of his meal, if not several, has come from a distant place, and has been stored for a period of time, and has been multiprocessed. Modern food must have convenience of form, shape, package, use or preparation. The average supermarket holds some 6-8,000 items, with 100 new ones daily being offered for place on the shelves. There currently is tremendous increase in hot/cold vending systems, industrial and social feeding or catering systems. These are in part the result of changing concepts of the social systems of man. Continued change may be anticipated for the future. American man has abandoned the cracker barrel, the pickle barrel, the flour barrel, the potato bin, the butter crock, the cheese wheel for convenience, variety, reduced spoilage, better nutrition, at less cost.

There has been a noticeable lag in the development of sanitary standards in many foods industries, in comparison with those in the past decade in the dairy industry. This has been due, possibly to three causes: a) the want of a satisfactory yardstick with which to make acceptance valuations; b) the great diversity of type and of origin of materials in foods; and c) the continuing process of invention. While great strides have been made in concepts of sanitary design of equipment, as for dairy, bakery and certain restaurant facilities, and in certain sanitary survey codes, as for milk, restaurant, shell fish, much remains to be done in other segments of the food industry. The understanding of the profit advan-

tages of aesthetic as well as protective and preventative sanitation in modern food production of the future probably will become widespread because competition will require it. Automation will be an essential part of these operations. These plants will require managers with advanced technical training. The operations will be controlled and monitored by continuously operating automatic analyzing techniques.

The continued intensification of production, processing and distribution of foods in the forthcoming America of a doubled population brings light on the current archaic inadequacy in the monitoring of food borne illness. Real impact of contaminated food cannot now be properly evaluated. Few individuals escape occasional intestinal upset; the migrant habits of a large percentage of the population make tracing of significant, but dispersed, outbreaks, difficult. In spite of apparent improvement in process and handling techniques, the number of food borne epidemics has at least doubled in the past 10 years. There is great need for, and there probably will become available, but only with great effort, comparative data on the microbiological, chemical, nutritional, toxicological and related qualities of principal food items. There probably will be perfection and application of systems of surveillance through statistical sampling and monitoring equipment. There probably will be greater reliance on monitored attributes, and less on aesthetic minutiae.

It is difficult to contemplate the nature of foods of the future. Currently modern foods embody principles of process and preservation known long ago: salting, heating, smoking, drying, freezing, fermenting, concentrating. Modern foods simply embody refinements, and control of these procedures.

There undoubtedly will be intensification of agriculture for more food, with understanding and control of calculated hazards of adjuncts. In all probability, the production of more food, even on the best of land, will require greater use of machinery, fertilizer, soil fumigants, pesticides and related treatments. Most certainly there will be needed greater security against disastrous crop failures. There undoubtedly will be new systems of preservation of foods by chemicals, antibiotics and by physical means. There will be extensive use of adjuncts in process and distribution of foods, in order to reduce costs. There will be synthesis of foods, biological and chemical. There will be pressures toward cereals and fisheries type foods.

Perhaps we shall ultimately follow the predictions of Edward Bellamy, made in 1890 in his book "Looking Backwards 2000 Years," in which he depicts community production and utilization of foods in a different way of life.

Sir William Slater has pointed to the world's dilemma: "that having found the means of overcoming early death, it must take steps to prevent the creation of life in excess of that for which food can be provided. Both the limitation of reproduction and the expansion of food production are hedged around with beliefs and prejudices, religious and emotional, which have to be overcome." The foods of the future will depend upon our understanding of these factors.

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FROM YOUR PRESIDENT

To IAMFES Membership:

As President of IAMFES, I feel I have a responsibility to the membership to present my views on a number of items that affect the entire association. Members may agree or disagree, but I hope that in either case they will make their position known.

The association membership elects officers, who in turn employ a staff to conduct the day-to-day affairs of the association. It is a responsibility vested in the officers by the membership that I would like to discuss. This discussion will not necessarily cover these responsibilities in order of their importance.

A professional group is often recognized by the importance of the association to which they belong, so it is certainly a prime duty of the officers to build a strong organization that will be recognized and respected by as many people as possible.

The voice and image of any organization is the type of material they publish in their regular publication — in our case, the Journal of Milk & Food Technology. It is the duty of officers to do everything in their power to see that a strong effective journal is provided for the membership. This journal must not only provide the technical basis for many activities of the practicing sanitarian, but also must provide material that will be of interest to him and that can be used in his daily work.

Many of the members will have only a casual interest in the highly technical material, and will be looking to the Journal for material that is useful to them in their daily activities.

Currently, this journal must be provided from the dues of $5 per year per member, despite the fact that the physical cost of publishing our journal is $4.80 per member.

The officers of an association have a responsibility to carry out the official policy and attempt to move in the direction desired by the membership — even when this desire is highly obscured due to lack of interest on the part of membership. They must constantly avoid the voice of a loud minority being mistaken for the will of the majority.

The officers are responsible for the administration of the fiscal policy of the association to assure its financial ability to carry on its activities. This is often a thankless task, as dues are never popular items — even when the cost per month is less than the average person spends on his coffee break for one week.

The officers of the association must constantly seek ways and means of improving the stature and importance of the association, so it may speak more authoritatively on behalf of the practicing sanitarian. This can be done by cooperating with the wide range of other technical and scientific groups on projects of mutual interest. It is through this cooperation that the association becomes recognized by its contempories.

I will be interested in hearing the views of the entire membership on the responsibilities of the officers of the association — either through these pages or by personal communication.

It is a privilege to serve as your president, and I hope that in the months ahead I will be able to bring other thoughts to you to stimulate an interest in your association.

Sincerely,
W. C. Lawton, *President*, IAMFES

ANNOUNCEMENT CONCERNING THE SANITARIANS AWARD FOR 1965

Announcement is made that nominations will be accepted for the annual Sanitarians Award until June 15, 1965, and the members of the International Association of Milk, Food and Environmental Sanitarians, Inc. are requested to give consideration to the nomination of individuals whose professional work in the field of milk, food, or environmental sanitation in their communities has been outstanding.

The Award consists of a Certificate of Citation and $1,000 in cash, and is sponsored jointly by the Diversey Corporation, Klenzade Products, Inc., Pennsalt Chemical Corporation, and the Olin Mathieson Chemical Corporation. It is administered by the International Association of Milk, Food and Environmental Sanitarians, Inc., and is presented annually. The next presentation of the Sanitarians Award will be made at the 52nd annual meeting of the Association which is to be held at Hartford, Connecticut in September 1965.

The Executive Board of the Association has established the following rules and procedures governing the Sanitarians Award.

Eligibility

The rules concerning eligibility of candidates for nomination are:

(1) Any living citizen of the United States or Canada who, at the time of nomination, is employed as a professional milk, food or environmental sanitarian, by a county or municipality, is eligible for the Award, except members of the Executive Board and members of the Committee on Recognition and Awards of the International Association of Milk, Food

and Environmental Sanitarians, Inc. Employees of State or Federal agencies and of industry are not eligible for the Award. Membership in the International Association of Milk, Food and Environmental Sanitarians, Inc., is not a prerequisite of eligibility, and there are no restrictions as to race, sex, or age.

(2) A candidate shall have made a meritorious contribution in the field of milk, food or environmental sanitation to the public health and welfare of a county or municipality within the United States or Canada.

(3) The achievements and contributions on which the Award is to be based, must have been completed during the five-year period immediately preceding January 1 of the year during which the Award is to be made. Under special circumstances, consideration will be given to related work accomplished by the candidate during the seven-year period preceding January 1 of the year during which the Award is to be made.

(4) Co-workers are eligible for nomination if both have contributed equally to the work upon which the nomination is based.

(5) No person who has once received the Award shall be eligible for nomination.

Nominations

Nominations of candidates for the Sanitarians Award may be submitted by the Affiliate Associations of the IAMFES, or by any member of the Association in good standing except members of the Executive Board, members of the Committee on Recognition and Awards, and employees of the sponsoring companies. Nominations from persons who are not members of the Association cannot be accepted. No member or Affiliate may nominate more than one candidate in any given year.

Each nomination must be accompanied by factual information concerning the candidate, a resume of his work and achievements, evidence supporting his achievements and if available, reprints of publications. A form for the submission of nominations may be obtained upon request from H. L. Thomasson, Executive Secretary, International Association of Milk, Food and Environmental Sanitarians, Inc., P. O. Box 437, Shelbyville, Indiana.

Deadline for Submission of Nominations

The deadline for submission of nominations is set annually, and all nominations and supporting evidence must be postmarked prior to midnight of that date.

Selection of the Recipient

The Committee on Recognition and Awards of the International Association of Milk, Food and Environmental Sanitarians, Inc., has full responsibility for selecting from among the candidates nominated the recipient of the Sanitarians Award. In judging the contributions of each candidate, the Committee will give special consideration to (a) originality of thought, mode of planning, and techniques employed, (b) the comprehensive nature of the candidate's achievements, and (c) their relative value as they affect the health and welfare of the candidate's community. The Committee will give consideration also to the efforts of the candidate to establish professional recognition in the community in which he serves, as well as to his research, administrative development, program operation and educational achievements. Additional information or verification of submitted information will be requested when considered necessary by the Committee. Testimonial letters in behalf of a candidate are not desired.

If after reviewing the nominations and supporting evidence, the Committee decide that the work and achievements of none of the candidates have been significantly outstanding, the Award shall not be made. In this connection, it is fundamental that if meritorious professional achievement cannot be discerned the Award shall be omitted for a year rather than to lower the standards for selections of a recipient.

1965 Committee on Recognitions and Awards.

R. A. BELKNAP, Chairman — WM. KEMPA, Canada
FRANK L. KELLY, Kansas — JIM WHITE, New York
WM. SANDINE, Oregon — JOHN FRITZ, Maryland

MINNESOTA ASSOCIATION HONORS J. J. HANDY

Mr. J. J. Handy, Director of the Division of Environmental Sanitation, Minneapolis Health Department, was the recipient of the Minnesota Sanitarians Association Outstanding Achievement Award for 1964. The award presentation climaxed the annual meeting of the association held in connection with the recent Minnesota Sanitarians Conference.

Mr. Handy has been with the Minneapolis Health Department since 1947; however, during the eight years prior to his actually joining the department, he was on special assignment to the department by the Minnesota State Department of Health. During all of this period, Mr. Handy's leadership in developing and improving environmental health programs has been outstanding. He played a major role in developing Minnesota's first State Plumbing Code. Largely through his efforts and influence, the Minneapolis City Council revised the Minneapolis Milk Ordinance in 1949, which, as a result, was brought in conformance with the U. S. Public Health Service Milk Ordinance and Code. Through his leadership, the ordinance has continually been maintained and

rigorously enforced.

Mr. Handy is a member of the Minnesota Dairy Technology Society and is a Past President of this organization. He also served as a director of the Minnesota Public Health Conference and is a member of the American Public Health Association and the National Association of Municipal Engineers.

Mr. Handy graduated from the University of Iowa in Civil Engineering and has been in public health work during almost all of his professional career.

PAPERS PRESENTED AT AFFILIATE ASSOCIATION MEETINGS

Editorial Note: The following is a listing of subjects presented at recent meetings of Affiliate Associations. Copies of papers presented may be available through the Secretary of the respective Affiliate Association.

MINNESOTA SANITARIANS ASSOCIATION

Nineteenth Annual Meeting
St. Paul, Minnesota
September 10, 1964

(Program sponsored jointly by the Department of Dairy Industries and the School of Public Health, University of Minnesota.)

(*Secretary*, O. M. Osten, Minn. Dept. of Agriculture, State Office Bldg., St. Paul)

FIELDMEN'S SECTION

USDA Milk Grading Standards—Interrelationships Among Grading Methods—*J. C. Olson, Jr.*
Control of Abnormal Milk in Milk Supplies—*Wayne Burch*
Mastitis and Machine Milking Practices—*William Mudge*
Preview of Changes in the 12th Edition of "Standard Methods"—*W. C. Lawton, J. C. Olson, Jr., J. J. Jezeski*
Effective Use of Fieldmen—*V. S. Packard, Jr.*

FOOD AND ENVIRONMENTAL SANITATION SECTION

Panel on the Interrelationships of Governmental Regulatory Agencies
- The Problem at the Local Level—*Robert Mood*
- The Role of the State Health Department—*Robert E. Hunt*
- The Role of the State Department of Agriculture—*George Steele*
- The Role of the State Railroad and Warehouse Commission—*Ronald L. Anderson*
- The Role of the Public Health Service—*Harold E. Thompson, Jr.*
- The Role of the Food and Drug Administration—*A. Harris Kenyon*
- The Role of the U. S. Department of Agriculture—*H. J. Osterhaultz*
- Maintenance of Swimming Pool Water Quality—*Walter H. Jopke*

GENERAL SECTION

Preview of the Milk Ordinance and Code—1964 Recommendations of the Public Health Service—*D. W. Taylor*
Protection of Ground Water Supplies for Dairies and Food Plants—*Gerald F. Briggs*

NEW YORK STATE ASSOCIATION OF MILK SANITARIANS

Forty First Annual Conference and
Twelfth Joint Conference With Cornell University Department of Dairy and Food Science
Rochester, New York
September 28-30, 1964

(*Secretary*, Richard P. March, 118 Stocking Hall, Cornell University, Ithaca, New York.)

GENERAL SESSION

Whole Milk Around the World—*Don Tuttle*
What Will be the Sanitation Problems in Milk and Food Tomorrow—*V. W. Green*
The Future of Sterilized Dairy Products—*Thomas E. Wiley*

FOOD SESSION

Panel: Development by U.S.P.H.S., Milk and Food Branch, of a New Procedure for Evaluating the Effectiveness of State and Local Food Service Sanitation Programs—*James Reed, M. P. Kloser, John Vorperian*
Recent Developments in the Canning Industry—*James Bell*
Local Health Problems with Vending Machines—*David E. Bigwood, Jr.*
Botulinus and Food Protection—*Edwin Ludewig*
Frozen Foods and Bakery Sanitation—*H. M. Rich*
Motivation of Food Service Establishments Toward Better Sanitation—*Harry Steigman*
Salmonellosis in Eggs—*James Clise*

LABORATORY SESSION

Problems in Certification of Laboratories in New York State—*Mrs. Ann E. Hohenstein*
Running a Laboratory under Standard Methods—*Elmer George*
Instrumentation in the Laboratory—*John W. Sherbon*
Panel: Problems of Industry Milk Control Laboratories—*Arthur B. Quencer, Robert N. Durand, Austin J. Fayette*

FIELDMEN'S SESSION

Conclusions of Cattle Feeding Experiments for Removal of Radionuclides in Milk—*N. Irving Sax*
What I Expect of a Dairy Fieldman—*John W. Dean*
The Qualified Milk Inspector Program in New York State—*Claude H. Colvin*
Preparing for an Interstate Milk Shipper Rating—*R. H. Bliss*
Pipeline Milking Machines and Milk Transfer Systems—A Review of Progress—*James C. White*
Engineering Problems in Milking Cows—*Richard W. Guest*
Milking Methods and Mastitis—*Glenn H. Schmidt*
USPHS Code Revision—*Robert W. Wilson*
Elements of a Good Quality Program—*W. C. Lawton*
Report of New York State Mastitis Council Activities—*Christian J. Haller*
Panel: Free Choice Stall Housing—
- Experiences with Free Choice Stall Housing—*Martin Jewert*
- The Future of Free Choice Stall Housing—*R. O Martin*
- A Word of Caution—*R. E. Nichols*

PLANT SESSION

What Does the Consumer Want?—*W. F. Shipe*
A Sanitarian Looks at the Plant—*F. H. Fischer*
A Report of the National Labeling Committee Activities—*R. M. Parry*
Plant Compliance with the USPHS Code—*Robert W. Wilson*
Panel: Silo Tanks—Three Points of View—
Manufacturer—*Paul Orme*
Industry—*Larry Cushing*
Inspection—*Larry M. Parry*

THE GEORGIA SOCIETY OF REGISTERED PROFESSIONAL SANITARIANS

Annual Conference
Athens, Georgia
September 17-18, 1964

(Sponsored jointly by the Georgia Society of Registered Professional Sanitarians and the Dairy Department, University of Georgia.)
(*Secretary*, John J. Sheuring, Dairy Department, University of Georgia, Athens, Georgia)

Panel: Environmental Health Planning in Georgia—*J. W. Fanning, Joel C. Beall, King Memory*
Panel: Revision of the Standard Milk Ordinance—*Joseph O'Brien, Craig Gay, H. W. Anderson*
The National Mastitis Council and Its Program—*George Willits*
Potentially Pathogenic Staphylococci Isolated From Grade A Raw Milk—*Ronald Jones*
Protective Features Required for Automatic Pasteurizers and Related Equipment—*Joseph O'Brien*
Current Status and Future Outlook of the State Food Sanitation Program—*Garnett DeHart*
Problems Associated with Licensing Day Care Centers—*Miss A. L. Nancy Edwards*
Georgia's Water Resources—*R. H. Byers*
A Look Ahead at Environmental Sanitation Activities in Georgia—*W. A. Hansell*
Detergents for the Food and Dairy Industries—*Lee Rather*

WISCONSIN ASSOCIATION OF MILK AND FOOD SANITARIANS

Twentieth Annual Meeting
Elkhart Lake, Wisconsin
September 10, 1964

(*Secretary*, L. Wayne Brown, 4702 University Ave., Madison)

What's Current in the Food Field—*John McClellan*
Processing Sterilized Dairy and Food Products—*H. E. Calbert*
The Mastitis Program in Wisconsin—*A. A. Erdmann*
Pesticides as They Relate to Foods and Crops—*H. E. Halliday*
Report on the Revisions of the U.S.P.H.S. Milk Ordinance and Code—*W. R. McLean*

ASSOCIATED ILLINOIS MILK SANITARIANS

Twenty-third Annual Conference
Chicago, Illinois
December 14, 1964

(*Secretary*, James A. Meaney, 8948 S. Laflin St., Chicago)

Bacteriological Problems in Cottage Cheese—*Lloyd D. Witter*
Sanitation in Ice Cream and Soft Serve Products—*Dean Fraseur*
Pharmaceutical Research Looks at Dairy Industry—*C. W. Pettingo*
Comments on the Proposed 1965 U.S.P.H.S. Milk Ordinance & Code—*W. R. McLean*
Panel: Milk Sediment Testing—*Paul Hanger, J. C. Flake, E. E. Kihlstrum*

NEWS AND EVENTS

OHIO STATE TO HOLD 32ND ANNUAL DAIRY INDUSTRY CONFERENCE

Approximately 50 University and Industry leaders will participate in the Annual Dairy Industry Conference to be held on the Ohio State University campus February 2-4, 1965. The conference theme will be "Potentials for Profits", and six sections will be featured: Milk Supply, Engineering, Management and Operations, Frozen Dairy Desserts, Quality Control and Cultured Products, and a new section on Manufactured Products.

The Milk Supply section will feature discussions on Herd Health and Milking Pratices, Raw Milk Quality and Sanitation, Efficiences for more Profits in Milk Production, and Trends in Public Health Demands and Challenges.

The Laboratory Control and Cultured Products Section will be highlighted by discussions on Sanitary Design for Silo-Type Storage Tank, Selecting Methods for Meeting the New USPHS Standards, and on Fully Automated Cottage Cheese Production.

Featured in the Management Section will be discussions on The Value of Reports, Finding the Elusive Dollars in the Plant, and the Roles of the Management Consultant in the Dairy Industry.

The Engineering and Processing program will include topics on the pros and cons of the Plastic Milk Bottle, Reducing Truck Fleet Operating Costs, and the use of computers for Cost Control.

Included in the Frozen Dairy Desserts Program will be discussions on Tailor-Made Ingredients for Frozen Desserts, the Application of Facts in Selecting Stabilizers, and Valuable Guidelines in Choosing and Using Vanilla Flavoring.

The Manufactured Products program will feature talks on Regulations for Manufacturing Milk, Milk-Product Relationships as Viewed at the Federal Level, and a one-half day program on The Tools and Approaches to Quality Cheese Manufacture.

CORNELL STRENGTHENING DAIRY TECHNOLOGY TRAINING

Dairy Science and Technology at Cornell University, Ithaca, New York, now entering its 85th year, is gaining strength from a young, active staff, new student recruits, and interesting challenges.

An ambitious program to help alleviate the nation's growing shortage of dairy scientists and managerial executives and to assist milk programs in Asia, Africa, and Latin-America is under way at this center for dairying, one of the country's oldest.

Plans are to train more outstanding young men specializing in Dairy Science and Technology for highly responsible positions in industry, government, and international U.N. agencies, both as undergraduate and graduate students.

The Graduate Field of Dairy Science at Cornell, active in applied and basic research, this year is represented by a full complement of students from the United States and many foreign lands, seeking the Ph.D. degree. It has a ten-member faculty, averaging only 45 years of age, and offers instruction in Dairy Technology, Dairy Management, Dairy Engineering, Dairy Bacteriology, Dairy Chemistry, and International Dairy and Food Development. Seventy per cent of the faculty have seen service abroad.

In a unique gesture the Graduate Field of Dairy Science has indicated its willingness to work together as a technical advisory team and to assist several developing countries engaged in long range plans to build a modern dairy technology.

U. S. PUBLIC HEALTH SERVICE ANNOUNCES PUBLICATION OF 1965 PASTEURIZED MILK ORDINANCE

The Pasteurized Milk Ordinance—1965 Recommendations of the U. S. Public Health Service is now being put in final form for printing and will be sent to the government printing office February 1, 1965. Final printed copies should be available for distribution and purchase by late spring.

February 1, the Public Health Service will distribute to their regional offices a very limited supply of mimeographed copies. These will be available to states and communities who want to adopt the ordinance while their legislatures are in session.

SUGGESTED ITINERARY FOR INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS, INC.[1]

Day 1—enroute—Depart New York by Scandinavian Airlines System Transatlantic Flight to BERGEN, NORWAY.

Day 2—BERGEN—Arrive Bergen in the morning. You will be met and transferred to the Hotel Terminus.

Day 3—BERGEN—a morning sightseeing tour is planned today.
Afternoon at leisure.

Day 4—OSLO—Depart Bergen by morning flight to Oslo, where you will be met and transferred to the hotel Viking.
Special arrangements will be made to meet your counter-parts in Oslo either for dinner or lunch.

Day 5—OSLO—Today you will have an all day tour of Oslo by bus and fjord Launch.

[1]See ad page V.

DR. HUBERT SHULL

Dr. Hubert Shull, 72, 944 Locust St., Texarkana, Texas, died of a heart attack December 29, 1964. Dr. Shull had been a loyal member of International Association for many years. The following editorial in the *Texarkana Gazett* expresses most adequately the high esteem in which Dr. Shull was held by the people in Texarkana:

"The unexpected death of Dr. Hubert Shull was a vielent shock to the citizens of Texarkana, most of whom knew him well and appreciated the work he had done for the business and commercial life of Texarkana, for the boys and girls of the city, for the Methodist Church and for club and fraternal circles.

The most significant work that Dr. Shull did was in the realm of public health. Through his efforts the city of Texarkana has been declared by the United States Public Helath Service to be the highest graded milk shed in the entire nation.

Dr. Shull was a perfectionist in the sanitation standards he demanded on both milk and meat and for that reason his life and work were not always pleasant. He literally worked himself to death in the interests of the health of the people of Texarkana. He quite often got up at 4 o'clock in the morning in order to ride on and inspect the huge milk tank trucks in which milk is transported.

Dr. Shull exhibited the same full measure of devotion to his church and civic life. It would take many columns of type to tell of his activities in behalf of the Boy Scouts, the Girl Scouts and the Lions Club. As far as we know, he never turned down a civic responsibility that was laid upon him.

To say that Dr. Shull will be missed is one of the great understatements of the year. It will take our community many years to recover from the shock and sincere grief of his passing. He was a good citizen in all phases of his life."

Day 6—STOCKHOLM—Depart Oslo by morning flight to Stockholm, where you will be met and transferred to the hotel Malmen.
An afternoon city tour will be arranged for today.

Day 7—STOCKHOLM—Morning Free. Lunch arrangements will be made to meet your counter-parts in Stockholm.
Afternoon excursion to Drottningholm.

Day 8—COPENHAGEN—Depart Stockholm by morning flight to Copenhagen, where you will be met and transferred to the Hotel Codan.
Afternoon city and harbour tour.

Day 9—COPENHAGEN—A full day tour of the North Zealand will be scheduled for today.

Day 10—COPENHAGEN—Morning tour of the city.
Afternoon visits with counter-parts.

Day 11—PRAGUE—Depart Copenhagen today by air for Prague, where you will be met and transferred to the Hotel Yalta.

Day 12—PRAGUE—Morning city tour. In the afternoon arrangements will be made for you to meet your counter-parts.

Day 13—VIENNA—Depart Prague by morning flight for Vienna, where you will be met and transferred to the Hotel de France.

Day 14—VIENNA—Morning tour of the city.
Afternoon tour of the Vienna Woods.

Day 15—VIENNA—Depart Vienna by afternoon flight for Zurich, where you will be met and transferred to the hotel Glockenhof.

Day 16—ZURICH—a morning tour will be scheduled.
Afternoon Free. Visits with your counter-parts will be arranged.

Day 17—ZURICH—Morning Free. Afternoon tour of the city.

Day 18—ZURICH—Morning Tour. Afternoon depart Zurich by air for Frankfurt, where you will be met and transferred to the hotel Baslerhof.

Day 19—FRANKFURT—Morning city tour. Afternoon at leisure.

Day 20—BERLIN—Depart Frankfurt by morning flight to Berlin, where you will be met and transferred to the Hotel Berlin.
A tour of the Eastern Section of Berlin will be made today.

Day 21—BERLIN—A morning tour of the Western Section of Berlin will be made today.
This evening you will have a "gala" Farewell Party at your hotel.

Day 22—NEW YORK—Depart Berlin by morning flight to Hamburg, where you will connect with Scandinavian Airlines System Transatlantic flight to New York.

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Cost from New York — $919.00.
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NEW USDA POULTRY MOVIE

Progress made by the modern American poultry meat industry, and the inspection and grading services provided for the public by the U. S. Department of Agriculture, are dramatized in a new sound color movie just completed by USDA.

This look at America's poultry industry is seen through the eyes of a woman editor of a foreign women's magazine. The movie is designed to acquaint the public both here and abroad with American poultry and with the inspection and grading programs provided by USDA's Agricultural Marketing Service.

The 27½-minute movie traces the steps in the production of poultry meat — from the large-scale hatching of eggs, through modern chick rearing practices in large poultry houses with today's scientifically complete rations and highly mechanized feeding systems, to the typical efficient, assembly-line processing plants, and out to modern supermarkets in a great variety of nutritious products in attractive, colorful packages.

Compulsory Federal inspection of each bird on the processing line for wholesomeness, inside and out, is pictured in action, as is the voluntary Federal-State grading of individual birds for quality.

Prints are being distributed to State film libraries and may also be purchased or borrowed from USDA's Motion Picture Service in Washington, D. C.

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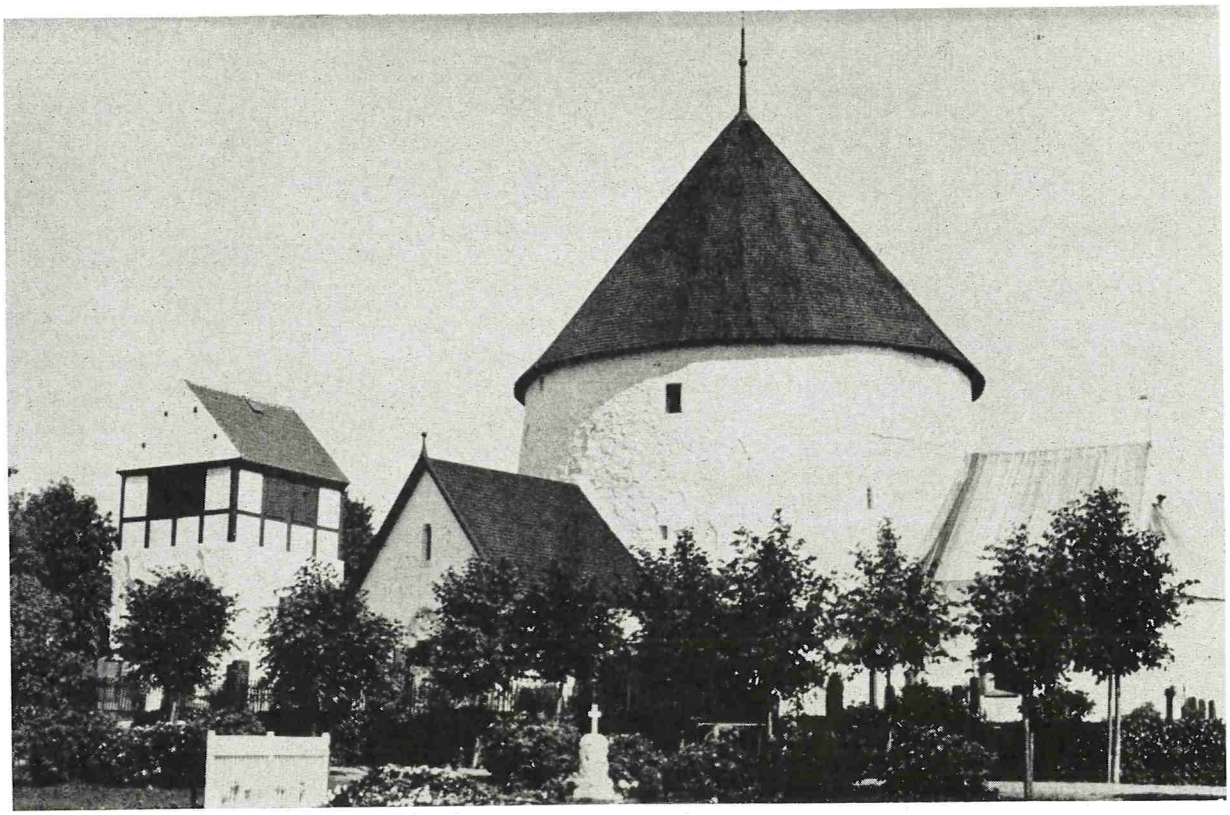

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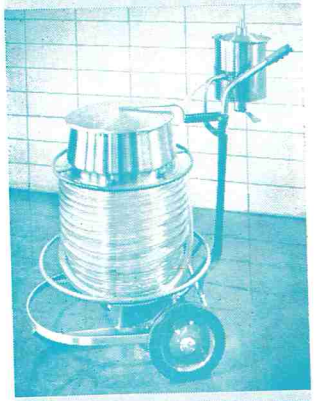

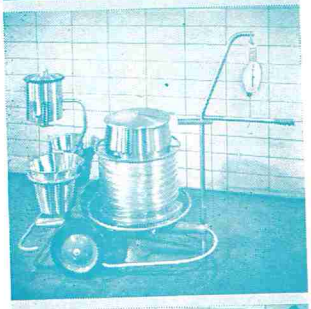

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Aside from the fact that carrying milk to the cooler is costly in time and labor, it exposes milk to a wider range of contamination . . . lowering the milk value as a result of a higher bacteria count.

To provide an economical, practical means of transporting milk directly from the stalls to the bulk cooler, Weco Milk-Veyors were created. They were tested, proved efficient. Engineered to be practically "foolproof" in operation so that their low cost and low maintenance would be added incentives to the dairy farmer.

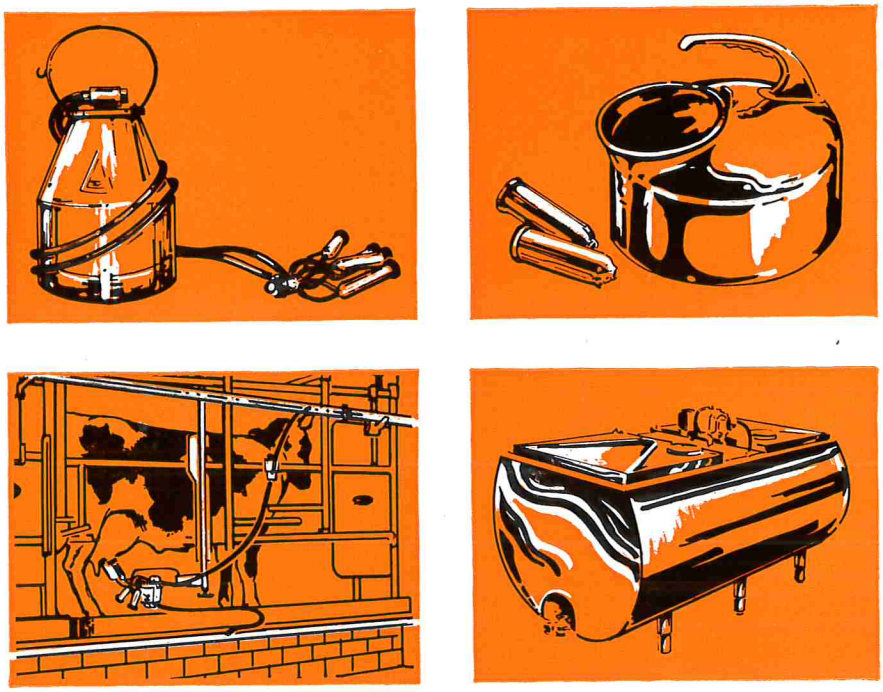
Weco Milk-Veyors are designed to keep MILK CLEANER—to speed milk directly to the bulk cooler for continual chilling. The stainless steel receiver unit which rolls along the milking line has a foot operated cover that closes automatically when milk has been poured into the receiver. Milk flows through seamless, heavy-duty M34R Transflow tubing—is released air and foam-free by the stainless steel releaser unit which fits tightly atop the bulk tank inlet.

Because the Weco greatly exceeds the minimum CIP velocity, cleaning and sanitation is most thorough—a fact that's been proved in the field with over 1000 units. Milk is not once exposed to air-borne contamination (dust, insects, spray residue, lint, hair, etc.) from the time it is poured into the Weco receiver! This means cleaner milk—proved by over a thousand successful dairy farmers who report LOWER BACTERIA COUNT since using a Weco Milk-Veyor!

FOR MORE DETAILS ABOUT THE WECO MILK-VEYOR WRITE US FOR ILLUSTRATED FACT FOLDERS.

eco
ilk-veyor Corp.

1765 Alpine Ave., N.W., Grand Rapids 4, Mich. U.S.A.



This Milk Handling Equipment Must Be Kept Clean

Most SURGE DEALERS have this box* . . . This box doesn't guarantee that milk handling equipment will be kept clean, but without it chances are the equipment won't be clean!

***Surge Water Analyzer** complete with black lite provides laboratory condition testing right on the dairy farm.

BABSON BROS. CO.
2843 WEST 19th STREET • CHICAGO, ILLINOIS 60623

SURGE