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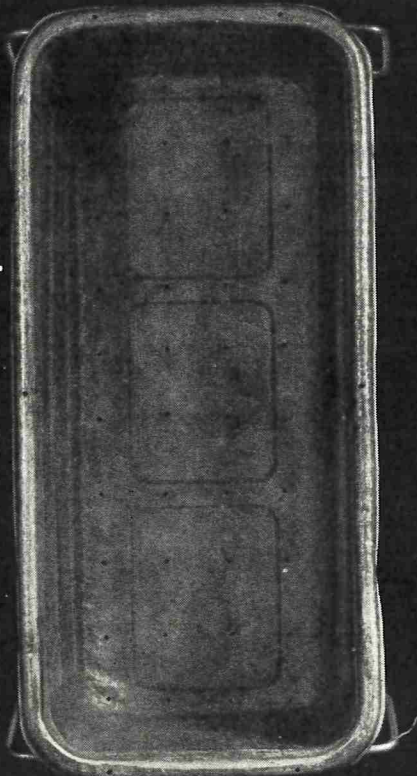
MILK and FOOD TECHNOLOGY

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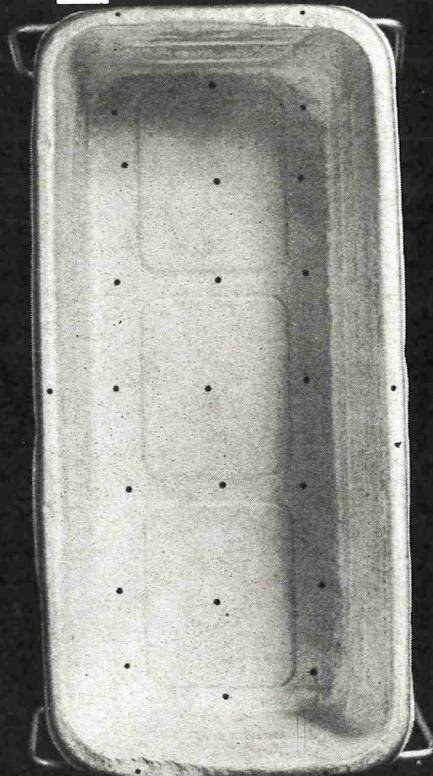
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Vol. 32

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No. 1

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DEGRADATION OF ADENINE NUCLEOTIDES IN THE MUSCLE OF THE DUNGENESS CRAB (*CANCER MAGISTER*) AND KING CRAB (*PARALITHODES CAMTSCHATICA*) DURING STORAGE AND COOKING

H. S. GRONINGER AND K. R. BRANDT

Bureau of Commercial Fisheries Technological Laboratory
Seattle, Washington 98102

(Received for publication September 25, 1968)

ABSTRACT

The adenine nucleotide content of king and Dungeness crab was determined on muscle before and after storage and on heat-processed or cooked crab meat. As a result of both storage and heat processing, adenosine triphosphate (ATP) and adenosine diphosphate (ADP) are degraded to adenosine monophosphate (AMP) and inosine and hypoxanthine. Only small amounts of inosine monophosphate (IMP) are found in cooked crabmeat. Flavor evaluation of IMP-treated king crab showed that IMP plays only a minor role in the flavor of crab.

The relationship of certain nucleotides to flavor has been discussed recently (7, 8). The nucleotide content of scallop (1), abalone (1), lobster (2), king crab (9), shrimp (13), and oyster (15) has been studied. The role of the nucleotide in fish flavor has been examined by Spinelli and Miyauchi (12). Since less than flavor threshold amounts of inosine monophosphate (IMP) was found in king crab muscle, Porter (9) concluded that there is little likelihood that IMP plays a significant role in the flavor of king crab.

The objectives of this present study on Dungeness and king crab are the determination of changes in nucleotide content resulting from processing and the determination of the effect of added IMP on the flavor of king crab meat.

MATERIALS AND METHODS

Samples, storage, and cooking

Muscle was excised from freshly killed crabs and chilled in ice for a brief period until it was placed in storage containers, extracted, or heat processed. Cooking was carried out in heat-and-serve plastic bags that were suspended in a water bath. Storage tests were made by holding preweighed portions of muscle in glass containers at 0 C.

Extraction of nucleotides

Raw or cooked samples were immersed in 2 volumes of chilled 3% perchloric acid, homogenized for 1 min, and filtered. The filtrate was immediately adjusted to pH 6.5-6.8 with 10% KOH, then held at 32 C for at least 1 hr before the insoluble potassium chlorate was removed by filtration. The clear filtrates were stored at minus 12 C until analyzed.

Ion-exchange chromatography

Samples representing approximately 5 g of muscle were placed on a multibore column (4.5x1.8, 4.5x1.0, 4.5x0.2 cm) (11) of Dowex 1x8 (formate) 200-400 mesh. The columns

were washed with water until the effluent was free of material absorbing at 260 m μ . The nucleotides were eluted according to the procedure of Jones and Murray (5). The column effluent was continuously monitored at 260 m μ with a Vanguard model 1056 UV analyzer. Fractions common to individual peaks were pooled, the absorbance measured, and the amount of nucleotide calculated by using the molar extinction coefficient.

Sensory evaluation

Commercially processed king crab meat was thawed at about 0 C and the pieces divided into two groups. One group was treated with 1 μ M/g of IMP together with 0.25% NaCl. A second or control group was treated with only 0.25% NaCl. Samples of treated crab meat were stored overnight at 0 C before carrying out the flavor evaluation tests. Triangle tests were made to determine whether a difference could be detected between IMP-treated and untreated meat. Also, each panel member was asked to give his preference for the odd or paired samples.

RESULTS AND DISCUSSION

Storage of uncooked crab

Crab is not normally stored commercially in the uncooked condition. These storage tests were carried out to determine the rate of nucleotide degradation in raw muscle, since these rate values are important in evaluating the effect of different cooking methods on nucleotide degradation.

During storage at 0 C, adenosine triphosphate (ATP) and adenosine diphosphate (ADP) are degraded to adenosine monophosphate (AMP) in king crab and to both AMP and IMP in Dungeness crab muscle (Table 1). It appears that the rate-limiting step of nucleotide degradation in king crab is the conversion of AMP to IMP. In Dungeness crab muscle both the conversion of AMP to IMP and of IMP to inosine appear to be rate limiting. In contrast, the rate-limiting step of nucleotide degradation in fish muscle is the conversion of IMP to inosine.

Effect of cooking

The degree of nucleotide degradation during cooking is determined by the activity of the enzymes, the effect of environmental factors such as pH, and the duration of time that the muscle is maintained at or near the optimum temperature (for enzyme activity) before the enzymes are heat inactivated. During

TABLE 1. CONTENT OF NUCLEOTIDES IN STORED CRAB MUSCLE ($\mu\text{M}/\text{G}$ WET MUSCLE)

Species	Days at 0 C	AMP	IMP	ADP	ATP	Total
King	0	0.1	0.1	0.5	3.8	4.5
King	1	0.9	0.1	0.7	2.2	3.9
King	6	2.9	0.2	0.2	0.1	3.4
Dungeness	0	0.35	0.65	0.3	7.0	8.3
Dungeness	6	2.6	2.3	0.4	0.2	5.5

cooking, ATP and ADP are degraded to AMP and inosine and hypoxanthine. The cooked muscle of both Dungeness and king crab had only very small amounts of IMP (Table 2). Storage prior to cooking did not greatly affect the nucleotide content of the cooked product (Table 2).

Since two general cooking procedures, a single and a double cook, are used commercially for king crab, a laboratory version of each of these was used to determine the effect of cooking on the nucleotide content of crab meat. It was shown that there were only minor quantitative differences in nucleotide content between crab meat samples processed by the two cooking methods (Table 2). As might be expected, the double cook resulted in a greater proportion of the total nucleotide being degraded to inosine and hypoxanthine.

EDTA treatment

Since it has been demonstrated that EDTA treatment will control the IMP dephosphorylation in the muscle of some species of fish (4), the effect of EDTA was tested on uncooked muscle. Both in king and

Dungeness crab muscle the EDTA treatment produced a significant amount of IMP, a nucleotide that is found in very small amounts in cooked muscle and raw king crab muscle (Table 3). This result is explained as an EDTA inhibition of the phosphomonoesterase which catalyzes the dephosphorylation of IMP to inosine. In the absence of EDTA, the dephosphorylation rate of IMP is greater than the rate of formation of AMP, which makes it appear as if AMP accumulates.

TABLE 3. CONTENT OF NUCLEOTIDES IN EDTA-TREATED CRAB MUSCLE ($\mu\text{M}/\text{G}$ WET MUSCLE)

Species	Treatment	Days at 0 C	AMP	IMP	ADP	ATP	Total
King	none	0	0.1	0.1	0.5	3.8	4.5
King	none	6	2.9	0.2	0.2	0.1	3.4
King	EDTA ¹	6	1.6	1.1	0.2	0.1	3.0
Dungeness	none	0	0.35	0.65	0.3	7.0	8.3
Dungeness	none	6	2.6	2.3	0.4	0.2	5.5
Dungeness	EDTA ¹	6	0.2	3.4	0.3	0.1	4.0

¹Muscle was treated at a level of 600 $\mu\text{g}/\text{g}$ wet weight

TABLE 4. SENSORY TESTS (TRIANGLE) ON IMP-TREATED KING CRAB

No. of Comparisons	No. of Incorrect Selections	Significance ¹	No. of Panel Members Who Preferred Sample
20	12	5%	5

¹Reference No. 6

TABLE 2. CONTENT OF NUCLEOTIDES IN COOKED CRAB ($\mu\text{M}/\text{G}$ WET MUSCLE)

Species	Type of Cook	AMP	IMP	ADP	ATP	Total
King	none	0.1	0.1	0.5	3.8	4.5
King	single ¹	1.9	0.1	1.1	0.4	3.5
King	single ²	1.7	0.1	1.5	0.8	4.1
King	double ³	1.6	0.1	0.54	0.2	2.4
Dungeness	none	0.25	0.1	0.6	8.1	9.0
Dungeness	single ⁴	2.75	0.1	1.25	0.5	4.6

¹Cooked 20 min at 100 C

²Muscle was stored 1 day at 0 C before cooking

³Cooked 10 min at 68 C plus 4 min at 100 C

⁴Cooked 15 min at 100 C

Effect of IMP addition to crab meat

It has been shown that there is a preference from a flavor standpoint for fish that contain IMP over fish that do not contain IMP (12). Since crab meat normally contains little IMP it appeared important to determine the effect of IMP on crab flavor. It was found that the addition of 1 $\mu\text{M}/\text{g}$ IMP to king crab meat did not significantly change the flavor or make these samples more acceptable to the panel members (Table 4).

Certainly the relationship of flavor potentiators such as IMP to flavor is complex. In the crab it is not known what flavor components, if any, are potentiated by IMP. Also, crab contains nucleotides other than IMP and these may provide sufficient flavor potentiation to make it difficult or impossible to detect the effect of IMP.

There have been, of course, conflicting reports on the relationship of flavor to IMP content of a food.

Terasaki et al. (14) studied nucleotide degradation in chicken, pork, mutton, and horse and found that these meats were preferred when the IMP content was maximum. With mackerel (3) a decrease in flavor was correlated with the degradation of IMP. Rhodes (10), however, studied the nucleotide degradation during the storage of lamb and beef and concluded that the disappearance of IMP did not correlate with the changes of flavor acceptability of these meats.

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THE DAIRY INDUSTRY, PAST AND PRESENT, IN JAPAN

BY YUZO INOUE, PRESIDENT
Yokohama Milk Industry, Ltd.

(Subsidiary of Morinaga Milk Industry Co., Ltd.)

This review of Japanese dairy development was prepared for delivery at Dairy Society International's 22nd Annual Meeting, but was presented only in summary since a film on Morinaga's new automated plant "Tama", which was to accompany it, had not arrived. The 16mm film, shipped by Morinaga president, Isamo Ohno, through the cooperation of Agricultural Attache Elmer Hallowell, reached Chicago a few days after the meeting. It is being shown to several interested groups in the Washington area and is available on loan through the DSI office for the next few weeks. Mr. Inoue, an executive of one of Japan's largest milk operations, is a long-time member of DSI.

I would like briefly to discuss the development of dairy production in Japan. It dates back to some 1,300 years ago that the Japanese tasted milk for the first time when a man named Zenna from China dedicated milk to the Emperor of Japan. This happened to initiate the Japanese into the world of dairy products. The Emperor highly commended Zenna's service and awarded him the title of "Yamato Pharmacist" which means the supreme pharmacist. Then groups of scholars were organized and dispatched to foreign countries to study a method of preserving milk, namely condensing milk. They actually de-

veloped some dairy products quite similar to condensed milk, butter, cheese, and yogurt as we know them today. These events constitute the dawn of Japan's dairy production. Also milk production had been encouraged locally up until about 650 years ago. However, unfortunately, continued civil wars ruined these endeavors and made them completely in vain.

In 1650, Holland began to trade with Japan, when she was exposed to Western civilization for the first time. The dairy production revived. Three head of white cows imported were introduced to Chiba in Honshu Island and soon multiplied to 70. In the beginning of the 19th Century many foreigners came to Japan and settled as a result of signing up temporary commerce treaties with those countries. The settlers raised dairy cows to supply milk and dairy products for their own use.

During this period a Hollander named Pero happened to instruct a Japanese, Maeda by name, how to manage a dairy farm and pasteurize milk. Maeda

(Continued on Page 15)

BACTERIOLOGICAL METHODS FOR EVALUATION OF RAW MILK QUALITY. A REVIEW¹.

II. BACTERIAL TESTS USED TO MEASURE MILK QUALITY

J. C. HARTLEY, E. R. VEDAMUTHU AND G. W. REINBOLD

*Department of Dairy and Food Industry,
Iowa State University, Ames*

(Received for publication July 5, 1968)

Comprehensive evaluation of bacterial milk quality tests as guides to or indicators of farm production conditions is lacking in recent literature. This paper examines the individual merits and inadequacies of several routine and special tests. Routine tests (agar plate count, coliform count, and reduction tests) will be reviewed first, followed by the special tests (thermoduric bacterial count, psychrophilic bacterial count, enterococcus count, and preliminary incubation).

ROUTINE TESTS

Agar plate count

The first official laboratory quality test recognized by the American Public Health Association was the agar plate count. But this test had many disadvantages: it was costly and time consuming, reliability was questioned because of limitations of the growth medium and the specific temperature and oxygen requirements of different groups of microorganisms, and the count was not an accurate measure of bacterial numbers present because of cell clumping (163). Errors induced by clumping are especially significant since bacteria from unsterile utensils mainly occur in clumps (156). In addition, the plate count does not reveal the physiological activity of the organisms as do reduction tests. Correlation between the plate count and sanitary conditions of production was found by Wilson et al. (163) to be low. Recognizing these disadvantages and that earlier cooling facilities for milk were not efficient, many laboratories preferred reduction tests to determine milk quality. Changes in production methods brought about by efficient cooling and longer farm storage have favored psychrophilic and thermophilic flora. These organisms possess poor reducing activity and hence are not completely accounted for in the reduction tests. As a result, it has become necessary to abandon reduction tests and turn again to the plate count. The plate count generally has been relied upon to evaluate high-quality raw and pasteurized milk.

Comparisons of different agars and incubation

temperatures to obtain maximum enumerating efficiency with the plate count have been made by Pederson and Yale (114), Bradfield and Ellenberger (20), Abele (2), Thomas and Jenkins (144), Nelson and Baker (106), Atherton (11), and Samagh and Dudani (121). These articles may be consulted for further information.

This reference material indicates there is yet no one medium completely inclusive for all bacterial groups found in milk. Although 37 C was originally the recommended incubation temperature, better recovery was obtained at lower temperatures. Therefore, an incubation temperature of 35 C and later the current recommendation of 32 C was adopted. A thorough discussion of the Standard Plate Count as a milk quality test can be found in *Standard Methods for the Examination of Dairy Products* (5). Earlier editions of this manual give the evolution of present day methods through a series of amendments and corrections applied to the original Standard Plate Count to obtain maximum efficiency.

Coliform count

Although coliforms constitute a specific group in milk, the count is generally used as a routine test to indicate the general care taken in production and processing. Breed and Norton (23) suggested the term "coliform" to designate gram-negative, lactose-fermenting, aerobic bacteria. An inclusive definition as applied to the dairy industry given by *Standard Methods for the Examination of Dairy Products* (5) is as follows: all aerobic and facultative anaerobic, gram-negative, non-spore-forming rods capable of fermenting lactose with the production of acid and gas at 32-35 C within 48 hr on solid or in liquid media. For a comprehensive review pertaining to coliform bacteria the reader should refer to Parr (113).

The coliform group of microorganisms has been officially used as an indicator of possible pollution in water supplies since 1904 when an enumerative procedure was published in the first edition of *Standard Methods of Water Analysis* (4). Lattanzi and Mood (85) said that the coliform index, despite its known limitations, was generally accepted for determining pollution of water supplies. Taylor (137) emphasized

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that *Escherichia coli* was a more delicate indicator than the fecal streptococci for water supplies. Leininger and McCleskey (86) recommended the coliform test for treated water supplies.

On the other hand, several other authors consider that coliform organisms are not reliable indicators of pollution in swimming pools, irrigation waters, streams, and sewage because of: ubiquity in nature; ability to multiply outside the animal body; and, the nonfecal habitat of *Aerobacter* (*Enterobacter*) and "intermediates" (26, 46, 56, 61, 86, 88, 89, 94, 95, 101, 104, 164); also, since they persist in soil and water for long periods of time, they do not indicate recent pollution (26, 46, 86, 89, 95, 101, 164). While coliforms frequently have been used as sanitary indexes in fresh foods (27, 61, 65, 82, 98, 162), they should not be used with frozen foods because of their low survival rate (27, 83, 162).

Complete information of a food product, which permits an explanation of sources and routes of contamination, is as important as identifying the coliform organisms determined in or on it (64). The history of sanitary control of water, oysters, and milk has shown that significance of coliform bacteria in the commodity must be evaluated on the basis of their source and the methods of preparation and handling. In 1961, Machala (92) questioned the use of a limit of 10 coliform organisms per ml as a measure of sanitation and contamination of frozen foods without proof of their fecal origin or of their relationship with some other dangerous source. Hartman (58) said that until nonfecal coliforms are shown to indicate contamination from a "dangerous source", these types should not be considered any more important in pot-pies than other innocuous microorganisms.

The importance of coliforms in milk was recognized as early as 1920, when coli-aerogenes determination was first officially suggested in the *Report of the Committee of Milk Supply*, published by the American Public Health Association. However, quality control laboratories were slow in adopting the practice (99).

The literature contains conflicting views on the significance of coliforms as indexes of fecal contamination in dairy products. Rogers, Clark, and Evans (118, p. 379-380) said in 1916, "It is difficult to avoid the conclusion that, while the presence of fecal bacteria in milk may be determined with great certainty, the ordinary presumptive tests and even the usual confirmatory tests do not necessarily prove the contamination of the milk with fecal matter." In 1918, Ayers and Clemmer (15) said that *Bacillus coli* in fresh milk indicates fecal contamination directly or indirectly. *Bacillus aerogenes* may indicate indirect fecal contamination occasionally but is usually

an index of nonfecal contamination. Wilson et al. (163) reported that a considerable proportion of coliform organisms in raw milk is not of the true coli type but belongs to intermediate aerogenes-cloacae types. They said the true coliform organisms found in milk appear to come directly from manure or indirectly from unsterilized milk utensils in which bacterial multiplication has occurred. If coliforms are derived from the latter source, they clearly afford no index of direct excretal pollution. Griffin and Stuart (56), in 1940, isolated 6,577 coliform organisms from milk, water, soil, grains, and feces. They reported that *Aerobacter* and "intermediates" were normal inhabitants of water and soil but not of feces and that *Escherichia* were normal inhabitants in feces but not in other sources. They said these results suggest that the *Aerobacter* and "intermediates" were of questionable sanitary significance.

The contribution of the udder of the cow to the coliform population of raw milk has also received considerable attention in the literature. In 1939, Rowlands (119) reviewed several articles on the udder as a source of coliform bacteria. He reported that, in a few instances, coliform infection of the udder was not accompanied by a disease condition or abnormality in secretion. Injuries to the teats or quarters were, in some instances, responsible for the presence of coliform organisms in milk. In 1955, Thomas (139) reviewed the literature on coli-aerogenes bacteria in the bovine udder. In a 1-year study, Olsen (110) found 6 of 367 cows from 10 certified herds to be chronic secreters of coliform organisms. Smillie (132), 1953, found after the foremilk had been discarded, over 7% of 1,177 handdrawn milks from individual cows gave positive coliform tests.

Extensive surveys concerning presence of coliforms in raw milk are available in the literature. Dahlberg, Adams, and Held (33) reported, from a U.S. market study, that no city made coliform counts or had any standard for numbers of coliform bacteria in raw milk. Johns (73) said the coliform test for raw milk is rarely used in North America except for "certified" milk. He mentioned that several persons in Europe regard it as the best indicator of clean milking conditions, particularly where farm bulk tanks are used. Sherman and Wing (129), Thomas (140), Johns (75), and Fay (44) suggested, if the milk was adequately cooled, the coliform count might be valuable as a sanitary indicator. *Standard Methods for the Examination of Dairy Products* (5), 1960, states if milk is kept at 4.4 C or below and proper sanitary procedures are used, present information indicates that good quality raw milk contains less than 100 coliforms per ml.

In the authors' opinion it is necessary to know the history of the sample before the coliform test can

be applied to raw milk. For example, it is critical whether proper milk-storage conditions were maintained because coliform organisms multiply rapidly at temperatures above 10 C, compared to microorganisms enumerated by most other methods. However, the coliform count of a properly stored sample does not give a more accurate indication of production conditions than other bacterial tests.

The literature emphasizes that the presence of coliforms in pasteurized products is significant because of their relative lability to this treatment, and their connotation of probable post pasteurization contamination.

In 1932, McCrady and Langevin (99) recommended the coli-aerogenes determination as a supplemental laboratory control method in preventing milk-borne epidemics. Levowitz (87), 1939, discussed the use of the coliform test in a pasteurization plant as a check on proper pasteurization or post-pasteurization contamination. Sackett and Gralak (120), 1950, recommended a routine coliform count for all samples of pasteurized milk since milk having a low plate count could still contain an undesirable number of coliform organisms. They believed the coliform count was a better indicator of milk sanitary quality than the Standard Plate Count. Newman (108), 1951, emphasized the presence of *E. coli* in pasteurized milk can indicate many things. Its mere presence in milk does not and cannot mean anything unless it is traced back to its source, and its significance, if any, determined. The use of the coliform test on pasteurized milk is discussed in *Standard Methods for the Examination of Dairy Products* (5). Briefly, it states this test may be more sensitive than the phosphatase test in detecting trace amounts of contamination with raw milk.

For additional information on the presence and significance of coliforms in milk and dairy products see Bartram and Black (16), Thomas (140), Johns (75), and Rowlands (119).

Reduction tests

Reduction tests are indirect indicators of microbial populations in a sample and are dependent upon the relative metabolic rates of the various microorganisms under the test conditions. These tests have been used with a fair amount of success in screening manufacturing-grade milk. In some countries, the methylene blue test is still used to measure acceptability of milk for fluid consumption.

After an extensive study of different bacterial tests, Wilson et al. (163) recommended the methylene blue reduction test, with inversion of the tubes every 30 min, as the most accurate method of determining milk quality. Ellenberger et al. (39) and Thornton and Hastings (155) also found the methylene blue

test the most accurate measurement of keeping quality. But Robertson and Frayer (117) and Wilson et al. (163) emphasized that the methylene blue test was best suited for average and poorer quality milks.

Johns (69) reported the methylene blue test was adopted officially by England in 1937 for regulatory purposes. Charlett (30) gave a brief historical description of the test.

The test also had disadvantages, which appeared with increased storage time. Various workers observed that reduction was retarded when milk samples were stored several hours at 4.4 C or less (47, 48, 49, 93). This results from physiological dormancy of the bacteria which accounts for the reduction tests' unsuitability for evaluating bulk-cooled milk. Some workers did not believe the original methylene blue test was accurate when the incubation time was greater than 5.5 hr (50, 163). The test's accuracy, however, was improved by periodically inverting tubes during the incubation period to redistribute the bacteria (50, 67, 163). In an attempt to improve accuracy, Johns (67, 68) preincubated milk samples at 12.8 C for 18 hr to shorten testing time. Wilson et al. (163) also preincubated the milk samples.

The temperature dependency that would limit the test's use with bulk-cooled milk was recognized when it was observed that methylene blue reduction times were influenced by the season (72, 93, 146, 147). Correlations with other test results were lower on winter milk samples. Johns (72) reported high correlation with the methylene blue reduction test and the plate count; correlations were lower during the winter months. Brazis and Black (21) reported good agreement between the methylene blue reduction time and the Standard Plate Count when psychrophilic counts were less than 100,000/ml.

The resazurin test, which was introduced in the United States by Ramsdell, Johnson, and Evans (116), replaced the methylene blue test in many laboratories because of the shorter incubation period required. Although the initial procedure specified a 1-hr incubation time, Johns and Howson (79) recommended the 3-hr triple-reading method which was generally adopted. Little (90) observed that resazurin was more sensitive than methylene blue to weakly-reducing bacteria. The resazurin test can detect physiologically abnormal milk (19, 51, 78, 97, 106, 116, 143, 147). Leucocytes rapidly reduce resazurin, but have less or no effect on methylene blue (136, 143, 147, 156). The role of leucocytes in resazurin reduction is not clearly understood. Campbell and Phelps (29) believed that the resazurin test's ability to detect mastitic milk was based on an agent other than leucocytes or that sufficient serum in the milk would keep the leucocytes in strong reducing activ-

ity. To demonstrate this, Campbell and Phelps centrifuged leucocytes from raw milk, and observed little influence on the milk's resazurin reducing activities. Johns (68) observed that the resazurin test could not be relied on to detect high leucocyte counts in market milks.

Generally, most workers have found the resazurin reduction test and the methylene blue test equally effective in detecting poor quality milks (31, 34, 70, 90). Many workers have shown preferences when considering the two tests, however. Little (90) pointed out that since incubation time for the resazurin test was only half as long as with the methylene blue test, the final bacterial population was more representative of the initial population. Keenan, Barrett, and Rutan (81) obtained more information as to sanitary quality of milk in 1 hr with the resazurin test than in 6 hr with the methylene blue test. Frayer (51) and Johns (70) reported poor correlation between the methylene blue reduction time and the results of the 1-hr resazurin test. And Frayer (51) recommended the resazurin test only as a screening procedure to be supplemented by microscopic examination. Collins et al. (31) and Golding and Jorgensen (55) reported good agreement between the plate count and the resazurin reduction test.

Increased use of mechanical refrigeration forced a re-evaluation of reduction tests. A disadvantage of the resazurin test is that it does not estimate thermophilic or psychrophilic microorganisms (12, 43, 71, 84, 102, 145, 147). Atherton (12) concluded that the resazurin test was of no value in measuring bulk-milk quality. Since high counts were required before reduction occurred, Orr, McLarty, and Baines (111) said the resazurin test was not suitable for assessing the production methods of bulk milk. Watt (159) recognized that the resazurin test bore no relationship to the plate count on pasteurized milk and that it allowed many unsanitary practices to escape detection. Smillie, Orr, and McLarty (133) reported dye-reduction tests were of little value in assessing high-quality milks. LaGrange and Nelson (84) found the resazurin test failed to detect 33% of 670 samples of manufacturing-grade milk shown inferior by the Standard Plate Count.

For additional information on the resazurin reduction test, consult reviews by Davis (35), Thomas and Davies (147), Watson (158), Johns (75), and *Standard Methods for the Examination of Dairy Products* (5).

It is evident that reduction tests can no longer be used for satisfactory quality control work with well-cooled milk. The Standard Plate Count, or a modification thereof, will give a more accurate appraisal of production and handling conditions.

SPECIAL TESTS

Thermophilic count

Taylor (138), in 1924, was evidently the first to use laboratory pasteurization of milk from individual farms to control high counts in commercially pasteurized milk. He found improperly sterilized milk-contact surfaces were common sources of thermophilic organisms. And it is now universally recognized that high thermophilic counts are caused by *consistent* failure to clean and sanitize milk-contact surfaces (7, 18, 100, 105, 145, 150). But since dairymen now usually clean and sanitize their equipment, their production lapses may not be detected by using the thermophilic bacterial count. Nevertheless, it is important to recognize certain facts about thermophilic bacteria in milk.

There are conflicting reports regarding the cow's udder as a source of thermophilic bacteria. In 1940, Hileman (63) said that on the basis of studies by Harding and Wilson (57), Evans (42), and Breed (22) showing micrococci as the predominant udder microflora, it seemed evident that heat-resistant micrococci composed a significant proportion of the udder flora of normal cows. Fabian (43) reported in 1946 that 40 to 75% of the bacteria found in aseptically drawn milk were thermophilic micrococci. He said that milk drawn from most cows' udders with aseptic precautions contained from 300 to 500 bacteria per ml but that there may be as many as 3,500,000 bacteria per ml.

Abdel-Malek (1) reported in 1943 that of over 200 strains of micrococci isolated from aseptically drawn milk not one survived laboratory pasteurization (63 C for 30 min) or was identical with types encountered in pasteurized milk. He said the cow's udder was not a source of thermophilic bacteria and if milk was produced without contamination, it could be practically sterilized by pasteurization. Abdel-Malek rejected the conclusions of other researchers that the udder is one of the main sources of thermophilic micrococci in pasteurized milk because their assertion was based merely on isolation from pasteurized milk of species previously reported in udder milk. Abdel-Malek (1) did not accept this evidence because the heat resistance of the organisms was not determined and the methods available for the identification of micrococci were far from reliable. Gibson and Abdel-Malek (53, 54), in studies published in 1940 and 1957, did not find any thermophilic bacteria in a series of udder samples, concluding the micrococci of pasteurized milk were derived from other sources.

Bryan, Bryan, and Mason (25) reported a high count for pasteurized milk was caused by thermophilic bacteria from cows' udders. An unclean milking machine contributed heat-resistant bacteria to

the milk both directly and indirectly during the milking process by inoculating the cows' udders with these bacteria. One to four months after the milking equipment was properly cleaned and sanitized, cows had rid themselves of the heat-resistant bacteria. Laboratory pasteurization of a sample of the farm's water supply revealed 75% of the bacteria present were capable of withstanding laboratory pasteurization. Thomas and Roberts (148), reported that 21% of water samples taken from sources representative of dairy-farm supplies in Wales had thermophilic colony counts exceeding 100/ml. None were entirely free of these organisms. The thermophilic microflora was mainly composed of sporeformers with occasional micrococci, *Actinomycetes*, and gram-negative rods. Results of this survey indicated that surface water, commonly found on dairy farms, may act as persistent carrier of thermophilic and thermophilic organisms from soil and sewage to dairy utensils.

The major sources of thermophilic microorganisms in milk are unclean milk contact surfaces, contaminated water supplies, and, possibly, the udder of the cow. Since large numbers of thermophilic microorganisms will not be present unless there is continual neglect of farm sanitation, it should not be necessary to routinely determine the thermophilic bacterial count of grade-A raw milk. When high Standard Plate Counts occur in freshly pasteurized market milk, the thermophilic bacterial count should be determined on the producer samples to identify the responsible farm or farms. The reader is referred to reviews by Hileman (63), Thomas et al. (152), Foster et al. (45), Cuthbert, Egdell, and Thomas (32), Thomas et al. (153), and Johns (75) for additional literature on thermophilic microorganisms.

Psychrophilic bacterial count

In the past, much emphasis has been placed on the presence of psychrophilic bacteria in pasteurized milk and milk products. With extended storage periods on the farm, now made possible by efficient mechanical cooling, psychrophilic growth will be a problem in raw milk if contact surfaces are not adequately cleaned and sanitized. While very important, the psychrophilic bacterial count is not being routinely determined in all laboratories because of the long incubation time and low incubation temperature required.

The psychrophilic group includes a complex variety of microorganisms comprising species of true bacteria, yeasts, and molds. Their growth patterns and metabolic activities are very versatile causing spoilage of the raw and pasteurized product.

In 1941, Sherman, Cameron, and White (130) identified the microorganisms responsible for spoilage

of milk held near the freezing point. Most were gram-negative non-spore-forming rods of the *Pseudomonas* group. In 1951, Erdman and Thornton (40, 41) discussed the numbers and kinds of psychrophiles found in Edmonton milk and cream. They isolated *Pseudomonas*, *Lactobacillus*, *Streptococcus*, *Aerobacter*, *Flavobacterium*, *Escherichia*, and *Alcaligenes*. In an earlier work they found that high psychrophilic counts resulted from growth of bacteria on the utensils rather than in the milk. This is understandable since the utensils might be stored at the optimum growth temperature of the psychrophiles. Gibson and Abd-El-Malek (54), 1957, studied the predominant bacteria in different classes of milk before and after storage of the samples in the temperature range of 10-22 C. Marth and Frazier (96) found that the predominant bacteria in raw milks at farm bulk cooling temperatures were gram-negative rods of the following genera: *Achromobacter*, *Aerobacter*, *Alcaligenes*, *Flavobacterium*, and *Pseudomonas*. They determined growth rates at 3.3 C. Andrey and Frazier (9) examined 174 samples of every-other-day bulk tank milk from 12 farms. Most of the isolates belonged to the following genera: *Aerobacter*, *Alcaligenes*, *Arthrobacter*, *Flavobacterium*, *Micrococcus*, and *Pseudomonas*. Thomas et al. (154) found that the percentage of gram-negative rods was highest in higher count milks. Weber (160) identified and studied physiological activities of psychrophilic microorganisms in milk. Higginbottom (62), 1962, compared the flora of fresh and stored milk produced with the can and the bulk tank system. He found little difference in counts of samples collected just before and after converting to the bulk tank system. Nearly all growth in samples stored at 5 C resulted from gram-negative non-coliform rods.

Johns (74) pointed out that many of the contaminants from soil and water are psychrophiles. Psychrophiles are seldom found on efficiently washed and sterilized dairy equipment (151). Unsterile equipment constitutes the main, direct source of milk contamination.

Overcast and Adams (112), 1966, found excessive psychrophilic growth before pasteurization had a stimulatory effect on the initiation of growth after pasteurization by certain microorganisms. An example of this phenomenon was shown with *Brevibacterium lipolyticum* and an unidentified psychrophilic isolate. Inhibitory effects were noted on the growth of a *Pseudomonas fragi* culture.

Reviews by Doetsch and Scott (38), Thomas (141, 142), Witter (165), Baumann and Reinhold (17), and Johns (75) may be consulted for additional information on psychrophilic microorganisms.

Enterococcus count

The enterococcus group of streptococci, defined by

Sherman (126), has been suggested by many research workers as a sanitary index of household, swimming pool, and irrigation water supplies. The enterococcus count has also been related to production and handling conditions of various food products.

The literature on the enterococci is exhaustive. Sherman's (127) authoritative review of the enterococci and related streptococci was published in 1938. Shattock (125) discussed the identification of group D streptococci and their use as indicators of fecal pollution in 1962. Hartman, Reinbold, and Saraswat (59, 60), 1966, published two separate reviews on the media and methods for isolation and enumeration of the enterococci and the taxonomy of the fecal streptococci.

Enterococci are widely distributed in nature. In 1906, Andrewes (8) reported that streptococci, except for the form then known as *Leuconostoc*, did not grow and multiply for any length of time outside the animal body. He found them in water in proportion to contamination with sewage; hence, they were being used as a test organism for recent sewage pollution of water or soil. In 1915, Broadhurst (24) reported that streptococci, natural inhabitants of the alimentary tract of man and certain domestic animals, were only temporarily present away from the body. Smith (134) reported that *Streptococcus zymogenes* occurred frequently in the intestinal tracts of domestic animals. Shannon (124) determined that 18% of the average total count of cow manure (200 x 10⁵/g) was enterococci. He found approximately 1,100 to 350,000 enterococci per g of feed. Turner and Smith (157) isolated hemolytic enterococci from water, soil, the udder of a seemingly normal cow, and from bovine feces. They also said enterococcus types may occur in the udder without causing pathological changes.

Sherman and Niven (128) reported *S. zymogenes* and *Streptococcus durans* were only isolated rarely from raw milk since they did not appear to occur in the udder; consequently, the enterococci gained access to milk in much smaller numbers than other hemolytic streptococci. Frost and Engelbrecht (52) stated that *Streptococcus faecalis* and *Streptococcus liquefaciens* were isolated occasionally from udders; so they thought it quite likely they were accidentally present. The researchers found no evidence that these microorganisms could establish themselves or become implanted in the bovine udder. Smith and Cameron (135) reported the isolation of hemolytic enterococci from the udder. Little (91), Slanetz and Naghski (131), and Auld and Parker (13) reported isolating *S. faecalis* from mastitis-infected quarters.

Since fecal streptococci survive for only a short time in environments other than the alimentary tract, they have been recommended as sanitary indicators

for water supplies, streams, irrigation water, and swimming pools (6, 10, 85, 86, 88, 94, 95, 164). Tentative methods for their detection and enumeration were included in the 12th edition of *Standards Methods for the Examination of Water and Wastewater* (6). In 1958, however, Taylor (137) said the fecal streptococci did not provide as delicate an indicator of contamination as did *E. coli* because failure to find them in a water was not a safe guide to the sanitary quality of the supply. He recommended the test for fecal streptococci in conjunction with the coli-aerogenes test, but never as a substitute for it. The test was of greatest value when all other coliforms but *E. coli* were isolated and if there was some doubt that they were of fecal origin.

Many workers in the food industry have proposed enterococci as satisfactory indicators of plant sanitation. Niven (109) reported in 1963 that fecal streptococci, along with total counts, could serve effectively as indexes of food quality, particularly among the precooked frozen foods, as well as useful supplemental indexes in evaluating other foods and drinks. In discussing the relative merits of *S. faecalis* and *Escherichia coli*, Allen and Fabian (3), reported that *S. faecalis* was more viable than *E. coli* in high-acid foods. In 1959, Buttiaux (28) recommended that group D streptococci be used as sanitary indicators of fecal contamination in foods. He said their specificity as an index of fecal contamination was high since their enumeration was easy with the selective media available. Burton (27); Kereluk and Gunderson (83); and Wilkerson, Ayres, and Kraft (162) reported enterococci were a more reliable indicator for frozen food than coliforms since they survived frozen storage better.

The use of enterococci as sanitary indicators in water and foods suggested they might also be good indicators for dairy products, and so studies on their incidence and usefulness were initiated. Hashimoto (61), in his studies on the incidence of enterococci and coliforms in milk and milk products, meat, and feces, found that coliforms predominated in raw materials and enterococci in heat-treated milk products. He also found that enterococci had a higher longevity than coliform bacteria and survived from 15-17 months in dried milk held at room temperature. Mossel (103) reported in 1963 that group D streptococci could be useful indicators of bacterial growth in milk and processed dairy products. In examining 25 samples of dried milk products, he found when a count exceeded 100/g, mishandling of the commodity could be detected by retrospective record examination. Saraswat (122) reported the enterococcus count was a better indicator than the coliform count for grade-A milk. Saraswat, Reinbold, and Clark (123) recommended the enterococcus count for microbio-

logical control of butter manufacturing. They found enterococci to be frequent contaminants in Iowa creameries and were not resistant to the pasteurization commonly given to cream used in buttermaking. Further, enterococci were more resistant to salting, freezing, and the microenvironment of butter than coliform bacteria.

In 1939, Smith (134) stated that *S. zymogenes* commonly occurred in the bovine intestine and because of its extreme viability and resistance to unfavorable conditions outside its natural habitat, it could be expected to find its way indirectly into milk. Therefore, its mere presence in milk in small numbers, could not be regarded as having a sinister sanitary significance. White and Sherman (161) questioned the value of the enterococcus count as an index of milk quality because of the large variations in the numbers and percentages of enterococci in different milks.

In general, the enterococcus organisms are recognized as good indicators for water and as measures of plant sanitation in butter and some other food products. And it is quite possible they may also be a meaningful measure of grade-A dairy farm production procedures. Much work, however, remains to be done before the enterococci could be regarded in this light. In any event, their use as indicator organisms in food products must always be related to specific product practices, handling procedures, and the microenvironment because in some products their presence is meaningful, in others meaningless.

Preliminary incubation

Preliminary incubation tests provide a useful tool in rapid determination of the psychrophilic load in milk products. In comparison, the psychrophilic bacterial count requires a long incubation period and does not yield as much information on the handling of the product after processing. The method involves the determination of a differential Standard Plate Count or reduction time on a sample before and after incubation at a specified temperature. There are conflicting reports of the effectiveness of the procedure with raw milk. With pasteurized products, it is a commonly accepted practice to store products at elevated temperatures before determining the bacterial content. The preliminary incubation test supplemented by other routine tests provides a close check on product handling at the processor's end and should be used as a quality control test in all fluid milk processing plants.

In 1918, Ayers, Cook, and Clemmer (14) stored milks produced under three different levels of sanitation at 4.4, 10.0, and 15.6 C and analyzed them after 24, 48, 72, and 96 hr. The ratio of the count after incubation compared to the count before incubation was greater in milk produced under dirty

conditions with unsterilized utensils. In samples of milk produced under clean conditions with sterilized utensils a similar count ratio was much smaller. This observation also was true for incubation of the milk samples at 21.1 C for 12 hr. It seemed evident from these and other comparisons that bacteria introduced from unsterilized utensils grew faster at temperatures near 15.6 C than those in low-count milk from sterilized utensils. Johns (74) said it has been recognized in Britain that in carefully produced milk the count did not increase in 20-24 hr provided the temperature did not rise above 15.6 C. Consequently, in the clean milk competitions instituted in England and Wales in 1920, samples were held at atmospheric temperature for about 24 hr before testing. This practice was then carried over into official sanitary control.

In 1930, Johns (67) stated the methylene blue test was not reliable for high-grade milks because of the long incubation period. To improve test results, he recommended incubation of high-quality milks at 12.8 C for 18 hr prior to testing by the methylene blue test. Wilson et al. (163) recommended holding morning samples of milk 12 hr and evening samples 18 hr at atmospheric shade temperature after milking. Samples should then be examined directly or be stored at 0-5 C until examination. They claimed this method distinguished between the farmer who produced his milk under clean conditions and took trouble to cool it properly, and the farmer who concealed dirty production conditions by efficient cooling. They recommended separate bacterial standards for summer and winter. In 1939, Powell, Jenkins, and Thomas (115) recommended preliminary incubation of milk samples before conducting methylene blue tests. Thomas, Thomas, and Griffiths (149), 1946, recommended preliminary incubation of winter milk samples at atmospheric shade temperature prevailing during the summer before using the resazurin test. In 1958, Johns (74) recommended preliminary incubation of raw bulk tank samples by storing at 12.8 C for 18 hr to encourage growth of saprophytic contaminants from improperly cleaned equipment.

Davis and Killmeier (36), 1959, used preliminary incubation for producer bulk tank milk samples from a Kentucky market. They reduced the number of substandard samples from 25 to 11% by applying the practice of routine preliminary incubation examination of producer samples and farm visits. Johns (76) cited a speech by Meany, on the application of preliminary incubation at 15.6 C for 24 hr to a series of samples from selected farms in the Chicago area. In these tests, differences in increases were related to conditions of production; smaller increases in counts were noted when milking equipment was cleaned thoroughly.

Smillie et al. (133), 1958, said because certain samples (with initial counts under 10,000/ml) showed a hundredfold increase following preliminary incubation, there would seem to be little correlation between production methods and the relative increase in count. Their preliminary incubation treatment consisted of holding the samples at 10-15.6 C for 24 hr. Johns (78) determined the results of preliminary incubation of 182 samples, a large number of which were substandard quality. The milks varied greatly in their behavior following preliminary incubation. Johns (76) did not contend that preliminary incubation would detect every type of unsanitary condition or practice. But he believed it furnished more information regarding care taken in production and handling than could be obtained from analyzing a freshly taken sample of milk by any of the usual testing methods. Johns et al. (80), 1964, conducted a 2-year study at Edmonton, Winnipeg, and Guelph. In contrast to previous experience, preliminary incubation failed to show any significant advantage. However, subsequent studies revealed results would have been more favorable had samples been taken from full tanks rather than of the first two milkings. Desai and Claydon (37), 1964, obtained 194 milk samples from 35 bulk tank grade-A milk producers in the Manhattan, Kansas milkshed. Farms were ranked I, II, or III in general sanitation on the basis of visible conditions, with rank I most desirable. With Standard Plate Counts, when no consideration was given to initial count level, there was no statistically significant relation between preliminary incubation counts and sanitation rank. When data were grouped on the basis of initial count range, preliminary incubation counts and growth ratios increased with increased sanitation rank in the lower count ranges. When the initial count was >50,000/ml, the relationship between growth ratio and sanitation rank declined.

Jackson and Clegg (66) studied the effect of preliminary incubation on the microflora of raw bulk tank milk. They found an increase in numbers of bacteria in raw milk, following preliminary incubation, was more closely related to the presence of certain microorganisms growing at the temperature of preliminary incubation rather than to sanitary condition of the milking equipment used in milk production. However, the presence of microorganisms capable of growth under the test conditions would be influenced by various factors including the type of sanitizing agent used. When chlorine or iodine was used, micrococci predominated; when quaternary ammonium compounds were used, gram-negative rods predominated. According to Johns (77), gram-negative rods are more likely to be associated with unsanitary conditions. At one test center,

the average percentage of these bacteria isolated from milk samples rose from 13.8%, when milker rubberware was reported as "clean" to 31.4%, when it was reported as "fair."

When the several recommended bacterial tests are considered, the disparate attributes of a "quality" product become apparent. No one bacterial test can tell all that is needed to be known to determine bacterial quality. Even the use of all known bacterial tests would not tell the full story since esthetic as well as bacteriological criteria determine product acceptability. Consequently, we must still rely upon the time-honored combination of laboratory examination of product with inspection of equipment and procedures.

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THE DAIRY INDUSTRY

(Continued from Page 3)

became the first Japanese who ran milk pasteurization and bottling plant, thus market milk was introduced into Japan in 1863.

Although an immediate popularity was not acquired, milk and dairy products gained in Japanese diets gradually. The importation of dairy products followed. This spurred Japanese farmers to raise their own cows and produce dairy products, especially butter and condensed milk. Some typical dairy-ying areas also developed.

In the Meiji Era, the Government took initiative measures to promote and protect the dairy industry in its infancy. Importation of stock breeds and exemption of tax on the sugar which was used for dairy products were among them. The consumption of milk was more or less limited to babies, the ailing or use in coffee and tea. Introduction of ice cream into the domestic market resulted in a substantial increase in popularity of dairy products among Japanese.

After the end of World War II, the dairy industry,

which had suffered from the disaster, was reconstructed and has made an epoch making advance. The adoption of Western-style living has spread swiftly over the country. Rice no longer remains the principal staple food. Milk is now generally recognized as an essential food for good health.

The increased demand for milk and dairy products stimulated cattle breeding and the manufacture of dairy products. The yearly rate of increase of milk consumption in Japan is about 20 per cent but still very low, being only 8.1 gallons per capita a year, as compared to 76.3 gallons in the United States. Yearly output of raw milk is about three million, four hundred thousand tons. Three hundred sixty thousand dairy farms have a total of one million five hundred thousands head of dairy cows. Holstein is the main breed in Japan. With regard to the average chemical composition of raw milk in Japan, fat is about 3.3 per cent, SNF 8.1 percent and protein 2.8 per cent. Accordingly, considering from the nutritional and manufacturing stand-points, it is an urgent

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CAN COWS CAUSE HIGH COUNTS?

C. K. JOHNS

Lazarus Laboratories, Inc., Long Island City, N. Y.
and

Lazarus Laboratories (Canada) Ltd., Toronto, Ontario, Canada

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ABSTRACT

Repeated high plate counts on milk from a 377-cow herd were traced to infected cows; a foremilk sample from one cow showed over 100 million bacteria per ml. A number of other cows shed excessive numbers of leucocytes. With an improved milking procedure, counts fell to an acceptable level.

A number of fieldmen and sanitarians told the author that cows could be responsible for high counts in bulk tank milk samples, but this he found difficult to believe. However, a recent experience has satisfied him that occasionally this may be true.

A dairy farm in Southwest Florida milking 377 cows had had two official counts of around 200,000/ml. Inspection of the equipment had failed to reveal the cause. The plant to which the milk was shipped had been most co-operative, and counts were made on samples taken from the bulk tank at the end of each hour during milking. Counts were low until the 4th or 5th hr, when they rose to around 600,000/ml. Samples taken as the milk entered the tank (Mueller Type C, 3661 gal.) near the start, middle and end of milking, were low. Suspicion was thus directed to the bulk tank, it being thought that milk might be leaking through a crack in the wall, the bacteria multiplying there, then high count milk seeping back to contaminate the milk in the tank when it reached that level. A careful examination revealed two hair-line cracks about 3 inches each where the refrigerated plate joined the unrefrigerated one. However, a simple calculation revealed that in order to add 200,000 bacteria/ml to 4,800 lb. of milk at each milking would require the addition of 440 billions! This would mean 440 ml. of milk containing 1 billion bacteria/ml., a most unlikely possibility.

The possibility was suggested that the tank walls were the source. Close inspection revealed that although they looked clean when wet, the unrefrigerated lining carried a film which could only be demonstrated by vigorous rubbing with the finger. A swab count from an area which had been rubbed vigorously showed 2 million/ft². While this was surprisingly high, if the milk removed a similar number—which is most unlikely—it would require an area of 220,000 ft² to contribute 440 billion, so this was ruled out.

If contamination was coming from the milking equipment, one would expect the count to be highest at the start, falling off as the milk washed the contaminants off. This left the cows as the remaining possibility. While it seemed unlikely that cows shedding extremely high count milk should all be milked during the same period (4th or 5th hr) and that the contamination should continue at such a uniform rate over a period of several months, this possibility was investigated by obtaining drip samples from the pipeline beyond the pump. At the end of each hour an aliquot was taken and analyzed

in the plant laboratory. Counts were 5,000-6,000/ml until the 5th hr, when they rose to 570,000 and then decreased to 6,000 for the 6th hr. Thus there was positive evidence that the high counts were coming from the cows being milked between the 4th and 5th hr.

The following day sampling was started at the 4th hr, and drip samples taken from each string of 10 cows. That from the 9th string rose to 1,400,000/ml, Standard Plate Count; the direct microscopic leucocyte count was 2,800,000/ml and the direct microscopic count was 2,000,000/ml, almost a pure culture of long-chain streptococci. Next day foremilk samples were taken from 51 cows; smears showed only one (cow 103) to be high—it was typical of streptococcal mastitis, with numerous long chains and an estimated 40 million leucocytes per ml. A petri plate could not be counted at the 1:100,000 dilution, and was estimated to contain over 1,000 colonies. Of equal significance was the fact that 11 other cows showed leucocyte counts of over 1,500,000/ml! This despite the fact that only 4 quarters from around 100 cows had shown a definite CMT reaction when tested the previous day!

The owner was advised that while the elimination of milk from Cow 103 should reduce the count level appreciably, the finding of so many samples with excessively high leucocyte counts indicated a high degree of irritation of the udder tissue. Any one of these udders could flare up and contribute large numbers of bacteria to the milk. The pipeline milker (Conde) with a 2 inch stainless steel line had been installed in January, 1967; a recent check had shown proper vacuum at the teatcup.

A more likely source of the high leucocyte counts was believed to be the milking procedure. Far too much time elapsed between washing the udders and putting on the teatcups. Current practice was to run in 10 cows at a time; after being hosed down to remove mud, etc., udders of all 10 were washed one after another with an iodophor solution and a sponge. Two persons were each operating two machines; they would wait until cows were milked out on the other side of the barn, then bring the units over and place them on the washed cows. In no instance was the unit on the cow in less than 3 min, and with the last two cows it was often well over 10 min. With so much delay, the value of the hormonal secretion, oxytocin, in expelling milk from the alveoli was almost entirely lost, and a much longer time was required to obtain the milk. This prolonged milking could easily give rise to considerable irritation of the

secretory tissue and make it easier for mastitis organisms to establish an infection.

To improve udder health^a and avoid further trouble with high bacteria counts, it was recommended that each milker wash only two cows at a time, and aim to get the teatcups on these cows in approximately one min. Then the next two should be washed shortly before the first two were milked out. This should not only cut down on irritation but also speed up the milking process.

As a further step in establishing better udder health it was recommended that steps be taken to reduce the transfer of mastitis organisms from infected to healthy quarters by following a Milking Hygiene Program patterned after the one developed by the National Institute for Research in Dairying in Britain, which has proved to be so successful in reducing new infections (1). This program includes careful washing of the udder and teats, and disinfection of milker's hands, using a suitable cleaner-sanitizer¹ compound and individual paper towels; dipping of teatcups between cows in a suitable solution¹ (preferable after an initial dip in clean water to remove as much infected milk as possible); then, most important of

all, dipping each teat in a suitable solution² immediately after removing the teatcups.

A recent letter from the sanitarian of Lee County Health Department (2) states: "*I am happy to report that the two counts we have had on the milk from X Dairy since your work with him have been very satisfactory. One count was 40,000 and the other 17,000. His white cell count is still abnormally high but as you pointed out to him he still has some work to do on his other animals.*" So it would appear that in this case, at any rate, the high bacterial counts on bulk tank samples were coming from the cows.

Where high counts are encountered and the source is not evident, many fieldmen and sanitarians blame the cows. This is much simpler than making an exhaustive check of the milk-handling equipment. Besides, the cows cannot talk back while the producer can! Probably 99% of the time trouble comes from the equipment. As in the case just described, the cows should only be considered *after every other possible source has been ruled out*. Only then can a time-consuming investigation of the cows be justified.

²Bovadine," a ready to use teat dip developed by Lazarus Laboratories (Canada) Ltd., Toronto, Ontario.

^aThe turnover in this herd last year was 42%, mostly from udder trouble.

¹"Iosan" or Supersan", a product of Lazarus Laboratories, Inc., Long Island City, N. Y.

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CORRELATION OF FOUR MASTITIS DETECTION TESTS WITH RESPECT TO THE LEUCOCYTE COUNT

CHRISTEN JENSEN AND LYLE D. BECK

*Department of Animal Science
North Dakota State University, Fargo 58102*

(Received for publication July 5, 1968)

ABSTRACT

A descending order of correlation with respect to the Microscopic Leucocyte Count was obtained as follows: Feulgen-DNA > California Mastitis Test > Modified Whiteside Mastitis Test > Strip Tray Test.

The average overall sample per cow and the composite sample correlations were statistically significant at the 1% level of significance, but many individual composite relationships were not significant. The bulk tank correlations, which represent the entire herd, were not significant. Results indicate that intermixing of raw milk from different sources lowered the concentration of reactive nuclear material to such a level that it was not measurable by the mastitis screening tests employed in these trials.

The presence of deoxyribonucleic acid in normal, cell-free milk has not been reported. Carrol, et al. (2), studied the nature of the California Mastitis Test (CMT) reaction and their findings strongly suggest that DNA in milk is the active principle responsible for a CMT+ reaction, and it originates in the nucleated cells which constitute the inflammatory exudate. Subsequently, their observations were substantiated by Paape, et al. (6) who adapted the standard Feulgen-DNA test to milk for detection of udder irritation. It was claimed that this test possesses certain advantages over the CMT, as a laboratory method.

Smith and Schultze (10), compared the CMT with the Microscopic Cell Count on quarter milk samples. Despite high correlation with the cell count, almost one-half of the samples were classified incorrectly by CMT scores on the basis of a single quarter sample. Thus, they questioned the validity of the test for the evaluation of udder inflammation. In a subsequent report Schultze and Smith (9), observed that a CMT score of one or less could be regarded as good evidence that the sample contained less than one million cells per ml. CMT scores of 2.2 or more provided good evidence that the cell counts were greater than one million. Intermediate CMT scores did not relate significantly to the cell counts.

The importance of a practical and reliable mastitis screening test in controlling udder inflammation among dairy cows is well recognized. The purpose of this analysis is to determine the reliability of certain mastitis detection tests, based on correlativity with respect to the Microscopic Leucocyte control.

MATERIALS AND METHODS

Milk samples were collected over a 22 month period, from the University dairy herd consisting of about 60 Brown Swiss, Guernsey, and Holstein cows. The herd was randomly divided into three groups of 20 cows each, so that one sample per cow per week was tested. Aliquot portions of milk from each of the 20 individual cow samples were combined into a composite sample. Periodically, a sample was collected from the bulk milk tank; this represented the total daily production of the herd.

Samples of milk also were collected from individual cows, belonging to five private dairy herds; these were tested on a sample per cow per herd basis.

A small sample of foremilk from each quarter was milked directly into a black plastic strip tray for visual examination.¹ The balance of a milking was sampled directly from the weigh-can. The samples were cooled promptly in an iced water bath and transferred to a laboratory refrigerator maintained at 3 to 4 C. Within 4 hr from the time of sampling a duplicate set of smears from each sample of milk was prepared by means of 0.01 ml volumetric syringe pipette for transferring the test portion (1). The smears were dried on a warming plate thermostatically controlled at 45-46 C with a single thickness of paper towel placed between the plate and the slides.

The dried smears were stained according to the Levowitz-Weber modification of the Newman Methylene Blue, single stain method (1, 4). Two technicians, working independently, examined and counted the leucocytes. Fifty fields per smear were enumerated with oil immersion objective: (Field diameter: 0.160; working factor: 10,000.)

The California (8), Feulgen (6) and the Modified Whiteside (5) tests were performed in accordance with the procedures specified by the respective authors. In this analysis simple correlation coefficients were calculated using the raw, untreated data. The qualitative test data were evaluated on the basis of minus (-) and plus (+) symbols designating normal and abnormal milk, respectively.

Correlation coefficients were calculated by the IBM 1620 -.06.028 computer² and Daniels Batch Processing Stepwise Multiple Linear Regression Program 1620-.06-.0.251³.

RESULTS AND DISCUSSION

A simple correlation analysis was applied to four mastitis detection tests on 4,945 individual and 300 composite milk samples collected over a period of

¹Strip Tray Test.

²R. Robinson, Marquette University, Milwaukee, Wis.

³K. Daniels, N. Dakota State University, Fargo.

TABLE 1. CORRELATION OF CERTAIN MASTITIS DETECTION TESTS WITH THE MICROSCOPIC LEUCOCYTE COUNT

Test	Correlation vs. Leucocyte Count		
	Herd	Type of Sample	
		Composite	Bulk Tank
Feulgen-DNA	0.691	0.391	0.146
Calif. Mas.	0.602	0.345	0.328
Whiteside	0.552	0.345	0.429
Strip Tray	0.365		
N	4945	300	30
1% level Significance	0.081	0.148	0.463

TABLE 2. CORRELATION OF CERTAIN MASTITIS DETECTION TESTS WITH RESPECT TO THE MICROSCOPIC LEUCOCYTE COUNT APPLIED TO FIVE PRIVATE HERDS

Test	Correlation vs. Leucocyte Count					
	Herd:	A	B	C	D	E
		r	r	r	r	r
Feulgen	0.647	0.666	0.845	0.852	0.793	
California	0.625	0.635	0.801	0.748	0.688	
Mod. Whiteside	0.449	0.634	0.752	0.642	0.489	
N	253	89	81	96	201	
1% Level of Significance	0.165	0.267	0.283	0.260	0.181	

22 months from the University herd. Data given in Table 1 show the average correlations with respect to the Microscopic Leucocyte Count are such that Feulgen-DNA > California Mastitis Test > Modified Whiteside Mastitis Test and the Strip Tray Test for the individual and the composite samples. The average overall sample per cow and the composite sample correlations coefficients are statistically valid at the 1% level of confidence. However, many individual composite and all of the bulk sample correlations are not significant. The substantial differences between the average sample per cow, composite and bulk sample correlations suggest that intermixing milk from different sources may lower the concentration of reactive material in the reaction

mixture to such a level that it is not detectable by means of some qualitative mastitis detection tests. A similar effect was noted by Konz (3), with respect to the cell count, catalase test, sediment volume, and the Whiteside Mastitis Test. Such dilution effects may be expected to limit the usefulness of these tests as presumptive screening methods.

A correlation analysis also was applied to the three gelation type mastitis detection tests on milk samples collected from private dairy herds on a sample per cow basis. Data involving five herds and a total of 719 cows are recorded in Table 2. The average test correlations in descending order of correlativity with respect to the Microscopic Leucocyte Count are Feulgen, CMT and MWST. This is the same order of correlativity observed with the University herd samples.

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A METHOD FOR MEASURING DISH TEMPERATURE IN COMMERCIAL DISHWASHERS

A. M. SCALZO, R. W. DICKERSON, JR. AND R. B. READ, JR.

U. S. Department of Health, Education, and Welfare
Consumer Protection and Environmental Health Service
Cincinnati, Ohio 45202

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ABSTRACT

Paper thermometers that change, irreversibly, from white to black at a critical temperature were evaluated for measuring maximum surface temperature of dishes during commercial dishwashing in a single-tank, conveyor-type unit. A thermocouple, taped to a dish, was used to determine the maximum temperature attained at the surface of the dishes and this result was compared with a measurement obtained from a paper thermometer affixed to the dish. Temperature measurements by the two methods were within the 10 F span of the paper thermometer. Paper thermometers were found satisfactory for measuring the maximum temperature of the dish surface during dishwashing and also appear useful for routine checking of dishwasher performance.

Both the U. S. Public Health Service (5) and the National Sanitation Foundation (1) recommend that a single-tank, conveyor-type dishwasher be operated with a minimum wash temperature of 160 F at no less than 140 gallons per min for 15 sec, and a minimum rinse-water temperature of 180 F at no less than 7 gallons per min (20 psi pressure) to ensure soil removal and inactivation of microorganisms. From a public health standpoint, dish temperature is the best criterion of sanitization; however, no convenient method of measuring it has been devised (2). With present procedures, a maximum self-registering, mercury-in-glass thermometer is placed in the rack and passed through the dishwasher to measure temperature, but the results are unreliable because these thermometers require more than 10 sec to respond to a temperature change and will not give an accurate indication of the sanitizing effect within the machine.

Paper thermometers that change, irreversibly, from white to black upon reaching their critical temperature are now available commercially. The manufacturers state that response time is less than 1 sec and accuracy is within $\pm 1\%$ of the stated temperature. These specifications suggest that paper thermometers may be suitable for measuring dish surface temperature. The objectives of this study were (a) to measure maximum dish temperature in a dishwasher operated under controlled conditions and compare the performance of paper thermometers with that of a thermocouple attached to the dish surface and (b) to identify the peak dish temperature

to be used in a field test as a criterion of acceptable dishwasher performance.

MATERIALS AND METHODS

Dishes

Ovenware and plastic dishes were used along with a stainless steel tablespoon and three grades of vitrified china. The china dishes were representative of the different types used in most restaurants and differed in quality according to pattern, thickness, alumina content, and glaze.

Dishwasher

The dishwasher was a Hobart[®], single-tank, conveyor-type, Model XM-4, capable of handling 194 racks per hr at a conveyor speed of 5.4 ft. per min. The tank capacity was 32 gallons, and the pump capacity was 215 gpm.

Because of the brief residence time and lack of a power rinse, this machine operates at a minimum acceptable level of performance recommended by the National Sanitation Foundation (4). Since a dish processed in this type of machine will attain a lower peak temperature than in other types, it permits identification of the minimum dish temperature to be regarded as a criterion for dishwasher performance.

Thermocouples

The temperature on the dish, and at various points in the wash and rinse compartments, was measured with No. 24 American Wire Gauge copper-constantan thermocouples and continuously recorded on a multiple-point, strip-chart recorder.

Paper thermometers

The operating principle of paper thermometers is based on a melting point phenomenon (5). A thin sheet of black absorbent paper is overlaid with a material of known melting point, and, when the critical temperature is reached, the material is absorbed into the paper so that the indicating paper remains black after the material resolidifies.

The paper thermometers used in this study were supplied by the Paper Thermometer Company, Natick, Massachusetts. It was necessary to keep them dry during dishwashing, and Scotch Brand plastic tape, No. 471, was found to be satisfactory for this purpose. A paper thermometer, coated with plastic to exclude moisture, is available from William Wahl Corporation, Los Angeles, California, and these were used in selected tests to compare performance of the two types.

*Mention of a commercial product does not imply endorsement by the U. S. Department of Health, Education, and Welfare.

Mounting of thermocouples and paper thermometers on the dish surface

Four methods of mounting thermocouples were investigated to determine the most accurate means of measuring dish temperature for comparison with paper thermometers. The most desirable mounting of a thermocouple would be to make it an integral part of the dish surface. To approach this condition, we attached a thermocouple to a plate, using Sauereisen No. 1 ceramic cement. The thermocouple was encapsulated in a small mound of cement, about three-eighths of an inch in diameter and one-eighth of an inch high with only the surface of the thermocouple exposed. A second thermocouple was fixed to the dish surface by a single layer of plastic tape to prevent a false measurement that might occur with direct impingement of hot water on the thermocouple. To determine the insulating effect of the tape, a thermocouple was installed on the dish surface with ceramic cement and covered with a layer of plastic tape. A bare thermocouple was also installed on the dish to determine the need for the layer of tape over the thermocouple junction. All four thermocouples were mounted on one dish, and a preliminary test was performed to determine which method should be used for this study.

The nonsensitive (black) side of small strips of paper thermometers, ranging from 140 to 190 F in 10 F increments, was affixed to the adhesive side of a 2-inch x 0.75-inch strip of plastic tape. The tape was then mounted on the test surface adjacent to the thermocouple, thereby placing the sensitive side (white) of the indicators in contact with the test surface, and sealing them from the atmosphere and water (indicator must be kept dry).

Test procedure

The dish or utensil being tested was placed vertically in the front of a rack and the thermocouple connector was passed through the dishwasher unit and plugged into a recorder. Wash-water temperature was measured by a thermocouple wrapped around the thermometer bulb built into the unit, and rinse-water temperature was measured by a thermocouple placed in the supply line. Thermocouples suspended in the water sprays and manifolds indicated no differences in water temperature. The potentiometer was a 24-point recorder (one point per second) with the capability of continuous single-point operation. With the dishwasher running and supplied with soap and the recorder on 24-point operation, the wash-water and rinse-water temperatures were recorded. When these registered 160 F and 180 F, respectively, the rack was pushed into the feed side of the dishwasher, and the potentiometer was switched to single-point printout, thereby registering the temperature of the dish throughout the dishwashing cycle. When the temperature reached a maximum on the recorder chart and started to decay (dish coming out to atmosphere), the potentiometer was switched to multi-point printout to register final wash and rinse temperatures. After the dish was allowed to cool for about 1 min, the 2-inch strip containing the paper thermometers was peeled off the dish and the test results recorded. The five different types of dishes and one spoon were each instrumental with a thermocouple and set of paper thermometers and tested at normal operating conditions (minimum 160 F wash and 180 F rinse) as well as under purposeful malfunctions. Two malfunction schemes were employed: (a) wash temperature normal (160 F), rinse temperature abnormal (165 F); and (b) wash temperature abnormal (150 F), rinse temperature normal (180 F). All tests were repeated, but, because temperature could not be precisely controlled with the

industrial-type controls used on the dishwasher, we were unable to duplicate operating conditions for every test.

Accuracy

For calibration purposes, paper thermometers (The Paper Thermometer Company) were mounted on glass slides with the plastic tape and immersed in a bath set for an initial temperature of 135 F. The bath was heated at a rate of 0.5 F per min and the temperature at which the color changed was noted for each indicator. The paper thermometers labeled 140, 150, 160, 170, 180, and 190 F turned completely black at temperatures of 139.5, 148.5, 157.5, 165.0, 172.0, and 185.0 F, respectively. Five replicate tests were performed and the results differed by less than 0.5 F. In the above tests, the paper thermometers remained in the water bath during the entire calibration. Additional tests were performed in which a cold paper thermometer was immersed in a bath, set at the critical temperature. The result for the 160 F thermometer was less than 2 F higher than the data obtained by continuous immersions. Commercially assembled paper thermometers from the William Wahl Corporation exhibited calibration data that differed by less than 0.5 F from the data cited above.

RESULTS

Since a method of accurately measuring the surface temperature of a dish was needed for comparison with the paper thermometers, four different thermocouple mountings on the same dish were tested (Table 1). All but the bare thermocouple recorded the temperature, during a 9-sec-rinse interval, to within 1 F. The bare thermocouple indicated a temperature 6 degrees higher than the others, showing that it tended to register impinging water temperature rather than dish surface temperature. The taped thermocouple indicated temperature as accurately as did the thermocouple encapsulated in ceramic cement (within 0.5 F), and, therefore, the taped thermocouple (Figure 1) was used in all subsequent tests. The insulating effect of the layer of tape was negligible for the thermocouple mounted with ceramic cement and, therefore, is also negligible for the taped thermocouple.

The temperature history of the surface of a china

TABLE 1. MAXIMUM ATTAINED SURFACE TEMPERATURE OF A DISH DURING DISHWASHING AS MEASURED WITH THERMOCOUPLES MOUNTED FOUR DIFFERENT WAYS^a

Thermocouple Mounting	Maximum Recorded Temperature °F
Exposed	166
Covered with Ceramic	159.5
Covered with White Film Tape	160
Covered with Ceramic and Tape	159

^aWash-water temperature was 160 F and rinse-water temperature was 182 F.

TABLE 2. MEASUREMENTS OF DISH TEMPERATURE WITH A TAPED THERMOCOUPLE AND PAPER THERMOMETERS

Type Dish	Wash-water Temperature °F	Rinse-water Temperature °F	Maximum Attained Dish Temperature ^a °F	Paper Thermometers °F				Type Test
				150	160	170	180	
China								
1st quality	160	180	158	+ ^b	+	-	-	Normal
	160	164	154	+	-	-	-	Rinse-water
	159	163	155	+	-	-	-	Malfunction
	149	180	152	+	+	-	-	Wash-water
	151	176	155	+	-	-	-	Malfunction
China								
2nd quality	160	184	164	+	+	-	-	Normal
	159	166	157	+	i	-	-	Rinse-water
	160	162	156	+	+	-	-	Malfunction
	160	162	153	+	-	-	-	Malfunction
	150	177	152	+	-	-	-	Wash-water
153	178	157	+	i	-	-	Malfunction	
China								
3rd quality	160	180	158	+	+	-	-	Normal
	160	164	154	+	i	-	-	Rinse-water
	159	165	156	+	+	-	-	Malfunction
	150	180	150	+	-	-	-	Wash-water
	151	182	151	+	i	-	-	Malfunction
Ovenware								
160	180	162	+	+	-	-	Normal	
	160	162	158	+	+	-	-	Rinse-water Malfunction
	150	180	160	+	+	-	-	Wash-water Malfunction
Plastic								
160	180	162	+	+	-	-	Normal	
	161	166	159	+	+	-	-	Rinse-water Malfunction
	153	178	159	+	+	-	-	Wash-water Malfunction
Stainless steel spoon	160	182	168	+	+	+	-	Normal

^aInitial dish temperature below 90 F prior to feed into the dishwasher.

^b+ (Color change), - (No color change), i (Incomplete color change).

dish during a full dishwasher cycle is shown in Fig. 2. Initial dish temperature prior to feed was 84 F. The dish temperature rose steadily after feeding and attained a maximum temperature of 158 F during the rinse cycle. The results of tests, employing the five different dishes and the stainless steel spoon, are shown in Table 2. In all the normal tests the maximum attained dish temperature, measured by the taped thermocouple, was at or near 160 F for all types of dishes, and all 160 F paper thermometers indicated this temperature. The stainless steel spoon was the best conductor of heat and at-

tained higher temperatures than did the dishes.

Sometimes, paper thermometers do not turn completely black. This happens when the exposure temperature is close to the critical temperature of the paper thermometer, as shown in Fig. 3. Stage "a" shows an unexposed set of paper thermometers, and stage "b" depicts a set that was exposed to a temperature in excess of 190 F. In stage "c", the exposure temperature was between 170 and 180 F, and in stage "d", the 160 F strip exhibits an incomplete color change, indicating a temperature near 160 F. Stage "e" depicts a commercially assembled

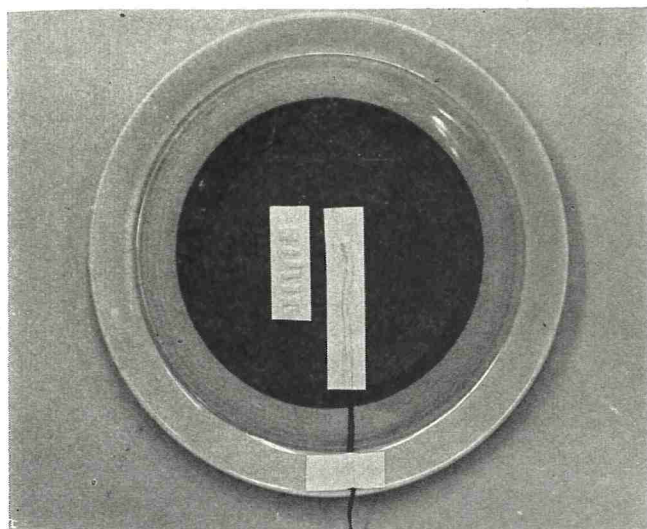


Figure 1. A thermocouple and a set of paper thermometers mounted on a china dish.

strip of paper thermometers that was exposed to a temperature between 170 and 180 F.

In addition to measuring dish temperature, we wanted to know whether dishwasher malfunctions could be detected with paper thermometers. Tests were performed in which wash and rinse temperatures were purposely set below the minimum values recommended by the National Sanitation Foundation. Wash-water and rinse-water malfunctions were not detected with the paper thermometer on overware and plastic because these dishes attained temperatures in excess of 158 F, which was high enough to activate the 160 F paper thermometer. When china dishes were used, wash-water and rinse-water malfunctions were sometimes detected and sometimes not. Because of this, we have shown the results of repeated tests. The malfunctions were detected with the paper thermometer in 10 of the 13 tests performed on china dishes.

In the remaining three tests, the paper thermometer indicated a temperature above its calibrated temperature of 157.5 F even though the correct surface

temperature of the dish (measured by the thermocouple) was below 157 F. In one test, the 160 F paper thermometer changed color when the maximum surface temperature was only 152 F. This suggests a problem of reliability of the paper thermometers and/or the method of mounting them on the dish. Any water leakage under the tape that is used to hold the paper thermometer against the dish surface will cause the thermometer to turn black. To increase the reliability of the method, two paper thermometers were mounted side-by-side on the dish and additional trials were made with dishwasher malfunctions (Table 3). The additional paper thermometer was needed in two of the tests to detect the malfunction.

Results of a test comparing the two brands of paper thermometers, affixed adjacent to the taped thermocouple on a china dish, showed that the 160 F taped paper thermometer turned black, but the 160 F commercially assembled paper thermometer remained white when the maximum attained thermocouple reading was 158 F (wash-water at 160 F, rinse-water at 180 F). The slower response of the preassembled

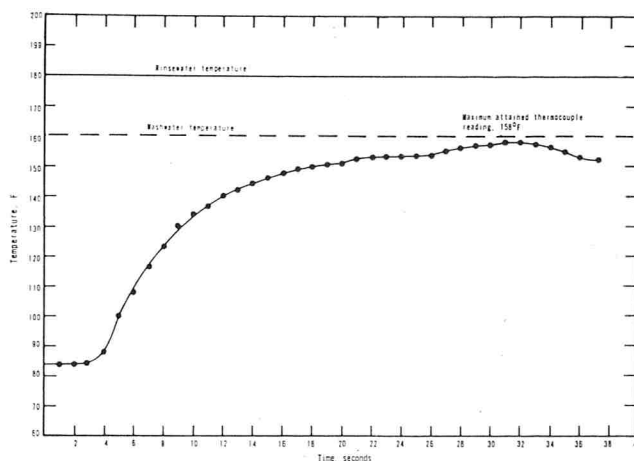


Figure 2. Typical temperature history of a china dish passing through the dishwasher as measured by a continuous-recording taped thermocouple.

TABLE 3. TEST WITH TWO PAPER THERMOMETER SETS AFFIXED TO THE SAME DISH

Type Dish	Wash-water Temperature °F	Rinse-water Temperature °F	Maximum Attained Dish Temperature ^a °F	Paper Thermometers °F				Type Test
				150	160	170	180	
China 1st quality	150	185	156	+	+	-	-	Wash-water Malfunction
China 2nd quality	150	179	155.5	+	i	-	-	Wash-water Malfunction
China 3rd quality	160	164	158	+	+	-	-	Rinse-water Malfunction

^aBy taped thermocouple.

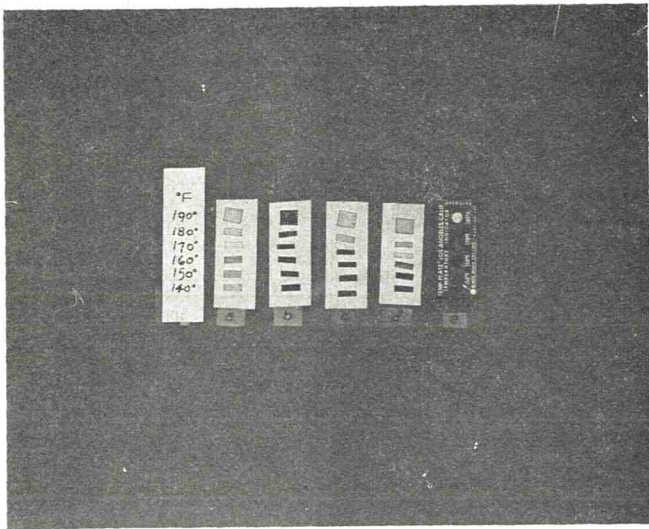


Figure 3. Interpreting paper thermometers.

thermometer results from separation of the thermosensitive side from the test surface by an encapsulating layer of plastic and an additional layer of adhesive material. Accordingly, taped paper thermometers as used in this study provide the more accurate temperature measurement because this arrangement yielded the faster response time.

DISCUSSION

Paper thermometers were found suitable for measuring maximum surface temperature of utensils in dishwashers. When used with a china dish, they also may be used to detect improper dishwasher performance. Small pieces of four temperature indicators ranging from 150 to 180 F in 10 F increments can be easily mounted on the adhesive side of plastic tape as previously described. The paper should be handled with clean fingers or tweezers and the thermosensitive surface touched as little as possible. The thermometers must be kept dry because moisture will cause a color change.

At least two sets of paper thermometers should be placed on the same dish before sending it through the dishwasher in order to obtain reliable data. If the two sets do not give the same results, the test should be performed again with the use of two newly prepared sets.

Our tests showed that the ovenware, a plastic dish, or a stainless steel spoon cannot be used to detect dishwasher performance malfunctions. The dish must be a vitrified china type with a thickness of at least 0.22 inch, have a diameter of 7 inches or greater, and weigh 20 ounces or more. The Health Officer should bring such a dish on routine investigations since some eating establishments do not have dishes of this type.

The china test-dish should be clean and should

be introduced into the dishwasher at room temperature. In preliminary tests, a dish was heated significantly prior to entry into the machine because of its proximity to the dishwasher, and this resulted in a higher maximum attained temperature during dishwashing than would be reached if the dish were initially at room temperature. In one test on a china dish, during which the dishwasher was operated with a wash-water malfunction (150 F) and with initial dish temperature at 120 F prior to washing, the dish reached 159 F (by thermocouple) in the dishwasher, and the paper thermometer indicated proper performance despite the malfunction. Consequently, the test-dish should not be placed in the rack until the rack has been started through the dishwasher. The paper thermometers did not always give white or black results. Various shades of grey were observed in some of the tests where the temperature approached but did not reach the stated paper thermometer temperature. These were called "incomplete" readings. If light shades of grey are encountered in the field, they should be interpreted as a temperature below the labelled temperature, and, if dark, they should be interpreted as a temperature at or above the labelled temperature.

Under normal minimum operating conditions, 160 F is the minimum sanitizing temperature of the dish surface and should be adopted as the criterion for a field test of dishwasher performance. If the 160 F indicators do not change color on both sets of thermometers, one should suspect a dishwasher malfunction, whereas, if both paper thermometers change, the dishwasher can be considered to be performing satisfactorily. The 160 F test should not, however, be the only criterion for gauging dishwasher performance. For example, a wash-water temperature of 170 F (10 F higher than the recommended minimum temperature) will obviate the effect of a substandard rinse-water temperature by heating the dish to a temperature above 160 F. Consequently, other field evaluation procedures recommended by the National Sanitation Foundation must be employed.

The capability of ascertaining effective washing and sanitizing by use of the paper thermometer technique in conjunction with other field inspection recommendations of the National Sanitation Foundation will ensure adequate performance of dishwashers used in food service establishments.

Samples of paper thermometers will be supplied on a limited basis, upon request, to anyone in the field of public health interested in evaluating this method for use in field applications.**

**Address requests to A. M. Scalzo, 222 E. Central Parkway, Cincinnati, Ohio. 45202.

ACKNOWLEDGMENTS

We are grateful to the Disabled American Veterans for use of the mechanical dishwasher and kitchen facilities in their building at 5555 Ridge Avenue, Cincinnati, and in particular to Mr. Charles Abner of that organization for his assistance; to Mr. William Bower, DHEW, Consumer Protection and Environmental Health Service, for his assistance; and to Miss Miriam Rotbart and Miss Elizabeth Kellner who typed the manuscript.

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THE DAIRY INDUSTRY

(Continued from Page 15)

problem to increase the SNF, particularly, the protein.

There are about 2,000 milk pasteurization plants throughout Japan. A modern automated plant can deal with 600 tons of fluid milk daily, whereas a small family-operated-plant puts out less than one ton per day.

The Morinaga Milk Industry Co., one of the three biggest, initiated homogenized milk in 1952. Plate heaters and clarifiers were introduced. An H.T.S.T. system was employed for pasteurization. Vitamin D was added to fluid milk. In 1956, Morinaga shifted to an ultra high temperature system in which milk is held at 130°C (266°F) for two seconds.

Each milk pasteurization plant sells its products through supermarkets, terminal shops and vending machines and delivers to individual homes, hospitals and factories. About 60 per cent of fluid milk is delivered to homes. Fluid milk is sold almost totally in

glass bottles in sizes roughly equal to half-pint, pint, and quart. The half-pint glass bottle is most popular. Paper containers such as Pure Pak and Tetra Pak are available but not so popular in Japan.

The Japanese consumer prefers a glass bottle to a paper container because of the psychological effect of seeing the milk through the container. Of course, using the glass bottle, a re-usable container, requires more handlings and washing. Yet the Japanese figure that this is cheaper than the single-service paper container.

With aid of subsidy, pasteurized fluid milk is provided to junior high schools. This is delivered to schools directly from milk processing plants every morning. The School Milk Program has been successfully maintained for about ten years and it has helped boys and girls build health and strength—even beauty, as evidenced by the fact that one "Miss Universe," Miss Akiko Kojima, came from Japan, and was born in postwar days and enjoyed drinking milk.

Milk is playing a bigger and bigger part in modern Japanese dietary life.

EFFECTIVE COMMUNICATIONS MUST BE TWO-WAY¹

L. S. WILLSON

Film Department

E. I. du Pont de Nemours & Co., Inc.
Wilmington, Delaware 19898

ABSTRACT

The subject of communications is very much like the weather; everybody talks about it and nobody does anything about it. Today we have the hardware for communicating with each other from any spot on earth and even from outer space. But in our correspondence, our letters, our advertising, and our face-to-face contacts we run into great difficulties because we think too much in terms of one-way communication.

A human communications system is very much like an electrical circuit: until the current flows in both directions, there cannot be the green light of understanding. There are three specific areas where we fall down when we try to communicate: (a) words, (b) inferences we make, and (c) appreciation of people.

Good two-way communications can exist when we question each other, when we make sure that we both mean the same thing when we use a certain word. And when we stop talking and start listening, the understanding curve goes shooting upward.

All of these things can be remembered if we think in terms of the familiar VIP initials: "V" for vocabulary, "I" for inferences, and "P" for people. Two-way communication is after all a "people problem." If we put ourselves in the other fellow's shoes, if we think less of ourselves and more of him to whom we are communicating, we'll start putting on the green light.

The subject of communications is very much like the weather: everybody talks about it and nobody does anything about it. Today we have the hardware for communicating with each other from any spot on earth and even from outer space. But in our correspondence, our letters, our advertising, and our face-to-face contacts we run into great difficulties because we think too much in terms of *one-way* communication.

A human communications system is very much like an electrical circuit: until the current flows in both directions, there cannot be the green light of understanding. Webster's definition: (a) to share with others, have in common, impart, and (b) to impart or interchange thoughts, ideas, opinions, etc., by speech, writing, or visuals.

"Man" it has been said, "is the only creature on earth who can *talk* himself into trouble." After several million years of practice, we've become pretty good at it—don't you agree?

Just think back over the last few days—if you can bear to do so—and chances are that you'll find that at least some of your tensions, anxieties, and frustrations arose from situations in which you really did not understand what someone said or wrote or vice versa.

Perhaps: (a) a customer's order was improperly filled, (b) a letter or memo was addressed to the wrong person or place, (c) a lot of time was wasted on the wrong assignment, and (d) at home; you're probably inclined to agree with the man who said, "There are only three races—men, women and children, and none of them speak the same language."

What is upsetting about all this is that you may feel that you are a pretty good communicator—it's just that everyone else seems to do such a lousy job of it. After all, it should be perfectly easy for us to understand each other in our every day home and business life. What can be the matter?

Is it not at least possible that we have taken our ability to communicate with each other for granted? Perhaps we have felt that it is a rather simple, natural process and "once we learn the language," we should be able to understand each other pretty well.

Our modern world is often referred to as a "jungle of competition" but it is more like an "ocean of cooperation." The cooperation that makes human society possible is almost wholly dependent on the skill with which we communicate. If we do not understand each other's needs, we cannot very well fill them.

COMMUNICATIONS MUST BE TWO-WAY

We feel that all business ultimately comes down to a transaction between individual human beings. The success of that transaction depends almost entirely on how well *they* understand each other, thus effective communications must be *two-way!*

Evert Landon, Chairman of the Board, Nalley's, Inc., Tacoma, Washington, had this to say, "What is so complicated about a communication—written or spoken? The complications arise from the fact that the communication that is *sent* is not the important one; it is the communication which is *received* that is important. Making sure that the message *received* is the *same* as the one *sent* is the technique of the downward communication".

There are three specific areas where we fall down

¹Presented at the 55th Annual Meeting of the International Association of Milk, Food, and Environmental Sanitarians, St. Louis, Missouri, August 18-22, 1968.

when we try to communicate: (a) words, (b) inferences we make, and (c) the appreciation of people.

DIFFICULTY WITH WORDS

First of all, we have difficulty with words. As the late Professor Irving Lee of Northwestern University once said, "Words don't have meanings; people do." Take the short words, run, love, and stock. Most people can think of at least a half dozen definitions for each of these words. Generally speaking, the longer the word, the more specific the meaning becomes. While we don't champion the use of polysyllabic words all the time, we do suggest that there be more precision in our choice of words.

People's ideas on words change as time goes by. If we say a man's report is "amusing, awful, and artificial" he would probably be offended. And yet when King James looked at St. Paul's Cathedral and uttered these words, he meant them as an accolade. In his day "amusing" meant "amazing"; "awful" meant "awe inspiring"; and "artificial" meant "artistic".

Down South, a man might offer to carry you back to your motel; in Chicago we would probably receive an offer of a lift. In England, lift means elevator. So we see that words don't have meanings; people do. People's ideas on words vary with place and time.

FAULTY INFERENCES

Second, the faulty inferences we make, the conclusions we reach, are barriers to good communication. What we see certainly affects what we say. An individual's background, his previous training, his habits will cause him to make faulty inferences and break down the circuit of good communications. Our eyes are prejudiced. We understand things because of the way we physically see them, and we fail to realize that someone else may look at the same object and interpret it in an entirely different fashion.

ONE-WAY COMMUNICATION INEFFECTIVE

Third, it is a miracle when one-way communica-

tion is completely effective. Through the use of the Communimeter, developed by L. K. Jonas of College Station, Texas, this point is easily and dramatically demonstrated. Your industry deals with a specific vocabulary and vernacular. You in the industry should be able to communicate well with each other because you have your own special jargon. But it is the simple words which upset the apple cart. We get the red light and warning bell which mean that we have not communicated properly.

Good two-way communications can exist when we question each other, when we make sure that we both mean the same thing when we use a certain word. And when we stop talking and start listening, the understanding curve goes shooting upward.

VIP

All of these things can be remembered if we think in terms of the familiar VIP initials: "V" for vocabulary, "I" for inferences, and "P" for people. Two-way communication is after all a "people problem." If we put ourselves in the other fellow's shoes, if we think less of ourselves and more of him to whom we are communicating, we'll start turning on the green light.

TEN BAD LISTENING HABITS

1. Calling the subject uninteresting.
2. Criticizing the speaker's delivery.
3. Getting over stimulated during the speech.
4. Listening only for the facts.
5. Trying to outline the talk as it is given.
6. Faking attention to the speaker.
7. Tolerating or creating distractions.
8. Avoiding difficult or technical presentations.
9. Letting emotion laden words throw you out of tune with the speaker.
10. Wasting the differential between speaking speed (100 words/min) and hearing speed (400 words/min).

CONCENTRATION TECHNIQUES

1. Anticipate the next main point.
2. Identify what is used for evidence.
3. Mentally recapitulate every 5 minutes.

THE ENVIRONMENTAL HEALTH PRACTITIONER TODAY— AND TOMORROW¹

HERMAN KOREN

*Department of Health and Safety
Indiana State University, Terre Haute 47807*

Environmental health, an old and well established profession, is rightfully seeking a new identity. As conceived in the era following the turn of the century, the Sanitarian was expected to participate with other public health workers in the elimination of horrifying outbreaks of contagious diseases by using sound epidemiological principles and preventive measures such as chlorination, pasteurization, and control of mosquitoes and other disease vectors. However, the recognized success early in the current century were followed by slow stagnation, and the role of the Environmental Health worker is now too frequently one which involves well-worn and safe emphasis on basic sanitation programs. From the 1920's until the end of the World War II, the typical Sanitarian was a politically appointed inspector with little or no training, who served under an engineer or health officer. He inspected milk supplies, checked complaints, and placarded premises when someone had a communicable disease. The Sanitarian was a true sub-professional.

Beginning with the World War II era, man's interaction with his environment has been complicated by mass rapid transportation, great population mobility, increased wealth, increased knowledge, new chemical processes, greater demand for goods and services, inner city decay, an explosion of subdivisions on the rural fringes of cities, and intense air and water pollution. This new and rapidly changing environment has created the need for control of the physical, chemical, and non-human biological forces that affect basic survival, and protection against disease and injury which reduce man's potential for full enjoyment of his life. Furthermore, leadership has become more and more essential in assisting mankind with environmental problems related to these several factors and forces.

Perhaps, with regard to the foregoing, Environmental Health Practitioners should ask themselves some serious questions. (a) What are we doing to assure ourselves an active role in dealing with these newer public health matters? (b) In what ways are we preparing ourselves, professionally, to be recognized as having the competencies to participate as

members of the modern-day community and public health team? (c) What cooperative and collaborative means are we emphasizing in order to mobilize and pool our knowledge and skill resources for maximum contributions and due recognition for same?

Only 71 men were graduated, as Environmental Health Specialists, from all of our colleges and universities in 1967, when we will need 18,000 additional Environmental Health Specialists by 1970. Many of our trained professionals now assume the administrative and managerial functions that the engineer or physician used to perform in Health Departments. Our other colleagues, who have been trained as general scientists, have either been inadequately prepared or not trained at all!

Apparently, we have not done an effective job of selling our profession to young people in high schools and colleges. We have not adequately informed the public of our existence and of our skills to aid man to live within his environment. *To many individuals, the term Sanitarian still means trash collector, garbage collector, cleaning man, or privy sniffer.*

We provide fragmented services with considerable duplication of effort instead of pooling our resources. In this modern day, why is it still necessary to have 5, 10, or more Health Departments inspect a dairy plant, a farm, or a major food distributor when reciprocity would eliminate this pathetic waste of time? Why is it still necessary for each new Health Department and each new Sanitarian to struggle on, and stumble into solutions to problems? Why should we struggle with techniques of program planning, administration, supervision, record keeping, and complaint handling, when trained professionals exist and systems could be developed and used by most practitioners, if properly modified for the area of concern.

Let us resolve to find solutions to the problems. Let us, as professional Environmental Health workers and as enthusiastic interested individuals, recruit young people into our profession by working with school and college administrators, counselors, civic groups, and leaders of youth serving agencies. Let us emphasize organized and pertinent graduate study programs, four year college degree programs, and two year associate degree preparation. Furthermore, let us develop and participate in special courses to be offered by our universities and, likewise, use the excellent Public Health Service home study courses

¹Presented at the 18th Annual Meeting of the Indiana Association of Sanitarians, Terre Haute, Indiana, September 25, 1968.

as a means of in-service education for established Environmental Health Practitioners.

Let us share our knowledge and pool our resources. We could improve communications between professionals by conducting seminars on special problems, by continuing to strengthen our annual conferences with strong educational approaches, and by developing regional associations of practicing professionals constituted of areas such as Illinois, Indiana, Michigan, and Ohio, with headquarters based at one of our state institutions—such as Indiana State University.

Services could be improved by developing a resources consulting pool composed of experienced Environmental Health practitioners, administrators, and university personnel who could be available for assistance with problem solving by telephone as well as in person. We should develop model environmental health programs for rural, suburban, and urban communities and then establish effective means of helping communities implement these programs. We should develop effective tools of evaluation of environmental health programs and establish an accreditation council to carry out this evaluation.

We must obtain membership in organizations such as the Governor's Health Council of the State of Indiana. Other specialists can neither represent the needs of the Environmental Health Practitioner nor provide adequate counsel to this select group on matters dealing with environmental health technology.

Our qualified health departments must participate in summer internships needed by colleges and universities as part of the culminating experiences of Environmental Health majors and to assist them in entering the profession.

We must join our two mighty Sanitarian associations into a firmly working and united brotherhood of Environmental Health professionals.

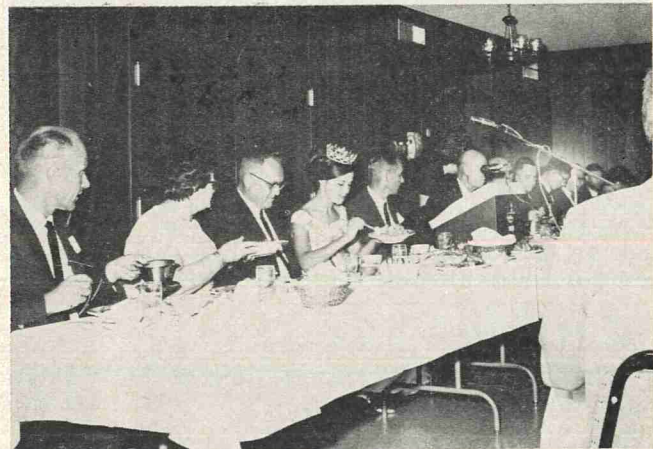
The decisions we make today, the approaches we use to solve the perplexing environmental health problems, the enthusiasm we exhibit, the assistance we give to each other, the education and training we obtain; has the potential of aiding a distinct majority of our population to live with their fellow men in good health and to more effectively achieve full enjoyment of life.

ASSOCIATION AFFAIRS

WISCONSIN AFFILIATE HELD ANNUAL MEETING AT WAUSAU

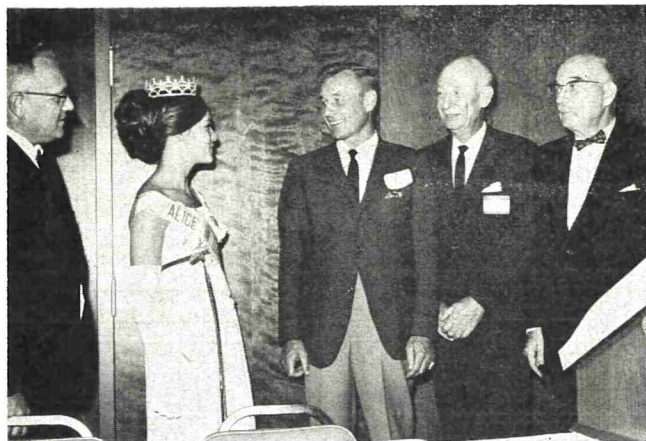
The Wisconsin Association of Milk and Food Sanitarians (WAMFS) held its 24th annual meeting in conjunction with the 5th annual meeting of the Wisconsin Dairy Plant Fieldmen's Association (WDPFA) at Wausau, Wisconsin, September 12-13, 1968. Business meetings of both associations preceded the program which began on the afternoon of September 12th and concluded at noon on September 13th. This year's program, given below, was arranged by Glenn Weavers and his program committee which consisted of: Robert T. Anderson, Harlan Barth, Lyle Cuff, Myron P. Dean, Joe Disch, Glen Drake, Joe Du Four, Harold Edge, Gale Kasler, Mike MacCarthy, Charles Montgomery, Norman F. Olson, Don Raffel, Alton Schroeder, Jerry Skinrud, Don Snow, Leonard Sommerfeldt, and William E. Stallard.

Professor Myron P. Dean, Department of Food Science and Industries, University of Wisconsin, served as the toastmaster at the banquet on the evening of September 12th. The WAMFS presented its "Sanitarian of the Year" award to Dr. L. Wayne Brown,



Some of the more than 160 persons at the banquet held in conjunction with the 1968 annual meeting of the Wisconsin Association of Milk and Food Sanitarians and the Wisconsin Dairy Plant Fieldmen's Association.

Madison, Wisconsin, who is a long-time employee of the Wisconsin Department of Agriculture and has served WAMFS as its secretary for many years. Cletus J. Engebose of Casco, Wisconsin was awarded a \$300 scholarship by the WDPFA. Engebose is attending the Wisconsin State University at River Falls



Personalities at the banquet. Left to right: Mr. William Stallard, President, National Association of Dairy Plant Fieldmen; Bobbie Thoreson, 1968 Wisconsin "Alice in Dairyland"; Myron P. Dean, Professor of Food Science and Industries, University of Wisconsin; Mr. H. L. Thomasson, Executive Secretary, International Association of Milk, Food and Environmental Sanitarians, Inc.; and Bill Hanson, the "Norwegian Philosopher" and banquet speaker.



Speakers gathered after one of the sessions of the 1968 annual meeting of the Wisconsin Association of Milk and Food Sanitarians and the Wisconsin Dairy Plant Fieldmen's Association. Left to right: Dr. E. H. Marth, Dr. C. K. Johns, Mr. Glenn Weavers, Mr. Robert Semerad, and Mr. L. A. Penn.

where his major is Dairy Science.

The program at the joint meeting of the WAMFS and WDPFA is given below.

The Corporation Farm—Steven Renk, Sales Manager, Wm. F. Renk and Sons, Sun Prairie, Wisconsin.

Dairy Farmers' Goals of Tomorrow—Dr. Russell Johannes, University of Wisconsin Experimental Farm, Marshfield, Wisconsin.

Current Trends in Dairy Substitutes—Dr. T. M. Hoersch, Manager, Nutriproducts, U. S. Division, Swift and Company, Chicago, Illinois.

Wisconsin Meat Inspection Laws—Dr. Edward Baker, Administrator, Meat Inspection Division, Wisconsin Department of Agriculture, Madison.

Rats—L. A. Penn, Director of Technical Services Division, Milwaukee Health Department, Milwaukee, Wisconsin.

The Food Industry and Salmonellosis—Dr. Elmer H. Marth, Associate Professor of Food Science and Bacteriology, University of Wisconsin, Madison.

Regulatory View Points on Salmonellosis—Robert Semerad, U. S. Dept. of Agriculture, Chicago, Illinois.

Psychrophilic Contamination in Raw and Pasteurized Milk Products—Dr. C. K. Johns, Consultant, Lazarus Laboratories, Inc., Toronto, Ontario, Canada.

ACKNOWLEDGEMENT OF ASSISTANCE PROVIDED BY REVIEWERS

Review of manuscripts by several scientists is necessary to insure that published papers are accurate, well-written reports which correctly interpret research findings. Members of the Editorial Board provide most of the help needed to complete this task. Some members of the Board were especially busy reviewing manuscripts during the past 12 months. The Editor expresses his appreciation to members of the Editorial Board for their help and cooperation in promptly reviewing manuscripts. The willingness of Drs. J. C. Olson, Jr., W. E. Sandine, and E. A. Zottola, all of which have been appointed to the Editorial Board during this past year, to assist in the review of manuscripts is also gratefully acknowledged.

During this past year manuscripts were also reviewed by persons not on the Editorial Board. Their help was enlisted when the subject of a manuscript was markedly different from that of the specialties represented by members of the Editorial Board. Appreciation for their assistance is extended to:

Dr. R. L. Bradley, Jr.
Dr. R. H. Deibel
Dr. O. R. Fennema
Dr. J. M. Goepfert
Mr. Frank McKee
Dr. R. P. Niedermier
Dr. J. C. Olson, Jr.
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Dr. H. L. A. Tarr
Mr. D. I. Thompson
Mr. Leon Tumerman
Dr. J. H. von Elbe
Dr. W. C. Winder

REPORT OF THE COMMITTEE ON BAKING INDUSTRY EQUIPMENT, 1967-1968

This committee has had one meeting with the Baking Industry Sanitation Committee (BISSC) since our 1967 report.

Baking exposition

The usual Fall meeting was omitted because of the Baking Exposition held at Atlantic City, New Jersey, in October 1967. The Baking Exposition featured the manufacturers' latest and most improved models of baking equipment. The trend, as in other food industries, is to completely automated systems, accenting increased production and cleanability of equipment. Bakery equipment manufacturers are well aware of the need for equipment that can be easily and quickly

cleaned. This thinking was reflected in the design and manufacture of the equipment displayed. Many items of equipment carried the BISSC Seal of Approval, certifying that the equipment was in compliance with the BISSC Standard.

Spring meeting

The Spring meeting was held in Chicago, February 28-March 2, 1968. Much of the committee time was devoted to revising and updating existing standards. The meeting was productive as seven were approved for publication. This brings the total of standards either published or approved for publication to 27. Members of this organization may obtain copies of the revised standards free by writing to: Ray Walter, Exec. Sec'y., BISSC, 521 Fifth Avenue, New York, New York 10017.

BISSC standards

Sanitarians everywhere should know that BISSC certified baking equipment carrying the BISSC Seal is now available. Food Sanitarians can request all bakery equipment to meet BISSC Standards, just as Milk Sanitarians do with 3A Standards, being confident that BISSC equipment is the most sanitary equipment available. The end result will be a vast improvement in the use of sanitary equipment, and thereby forging another link in the chain of consumer protection measures for wholesome food, manufactured in clean plants, with clean equipment, which has been designed to be easily cleanable.

VINCENT T. FOLEY, *Chairman*, City Health Dept., 21st Fl., City Hall, Kansas City, Missouri 64106.

A. E. ABRAHAMSON, City Health Dept., 125 Worth St., New York, 13, N. Y.

LOUIS A. KING, JR., American Institute of Baking, 400 E. Ontario St., Chicago, Ill.

FRED R. VITALE, Continental Baking Co., Inc., P. O. Box 731, Rye, New York 10580.

HAROLD WAINESS, Wainess & Associates, 510 N. Dearborn St., Chicago, Ill.

REPORT OF THE COMMITTEE ON DAIRY FARM METHODS, 1967-1968

The International Association of Milk, Food and Environmental Sanitarians Farm Methods Committee is made up for 1968-69 of eight task committees. We have 23 members, 11 state affiliate Farm Methods committees as members, and 5 consultants.

The task committee chairmen listed below were very active this year with their committee members preparing reports for our 1969 annual meeting which we all hope will be beneficial to the dairy industry. Our 1968 report is an interim report and we intend to show only that progress is being made.

Antibiotics, pesticides and adulterants. D. K. Summers, *Chairman*.

Chairman Summers and his committee have spent 1967-1968 on fact finding as it pertains to antibiotics, pesticides and other adulterants. They would appreciate hearing from anyone who has definite information on adulteration of milk through water, detergents or sanitizers. Also the feeding of medicated feed.

C.I.P. cleaning and sanitizing of dairy farm equipment. R. Rintelmann, *Chairman*.

This committee has been very active through its members in

accumulating data to aid our membership in better cleaning and sanitizing at the dairy farm level. We have to date the thinking in factual form sufficient material to make a very interesting report. With another year before our final report is to be published, we should be able to give IAMFES membership some very useful ideas.

Education. Vernon Nickel, *Chairman*.

Vernon Nickel reports that his committee members have educational material now coming in from many areas. This type of material, with the Journal printing its availability was well accepted last year. At its present incoming rate, Mr. Nickel's committee will keep Dr. Marth well supplied for the next year.

Plastics. Bernard Saffian, *Chairman*.

This committee was continued to search out new applications and to answer the questions which were incomplete in the 1966-1967 report. We have answers to 15 of the questions now and have 19 more to answer. To date, there are 50 plastic items which have been identified with probably more in use as this is written. We would appreciate any information on plastics from anyone reading this report to help us make our final report in 1969 complete.

Sediment in fluid milk. Elmer Kihlstrum, *Chairman*.

Data is being accumulated by this committee showing the necessity of initiating programs to improve taste and quality of milk. The dairy industry has nothing to sell until we have a dependable supply of high quality milk. Sediment control plays a very important role in quality milk production.

Compatibility of detergents to farm water supplies and effect of solution temperature on C.I.P. cleaning of farm equipment. Stephen B. Spencer, *Chairman*.

Much has been done this year in preparation for our final report next year. It is becoming more and more apparent that a potable water supply does not necessarily assure a water for satisfactory washing of milk handling equipment. We are well on the way to being able to supply a table of different types of water which are not satisfactory for use and what can be done to correct the problem. We will spend more time this coming year on solution temperatures in relation to C.I.P. cleaning.

Relation of Farm Water Supplies to the Quality of Milk. Henry Atherton, *Chairman*.

Information received to date from subcommittee members indicates little new activity in the evaluation of farm water supplies as they affect milk quality. On the other hand, repetition of problems discussed in past reports emphasizes that these problems still exist and that more people are becoming aware of the validity of this concern. We are sure we will have much to report in 1969.

Dairy farm management. William L. Arledge, *Chairman*.

The Dairy Farm Management Sub-Committee was formed by combining the sub-committees on Relation of Dairy Cattle Housing to Quality Milk Production and Dairy Farm Milk Management. The new sub-committee's assignment for this year was to survey and attempt to determine what is being done nationally from the time a cow enters the barn until she leaves. Recommendations and practices vary from state to state but basic recommended practices are very similar throughout the country. As a result of these similarities it was felt a basic survey could be followed to establish national patterns or trends of comparison between what is recommended and what is actually practiced on the dairy farm. What happens to the cow from the time she enters a barn until she leaves is of prime significance in relation to milk produc-

tion, milk quality, abnormal milk, cow health, etc. was indicated in the 1967 Dairy Farm Management sub-committee report. Our committee has been very responsive to date. We should, from what we already have, be able to present a very informative report in the final report for next year.

A. K. SAUNDERS, *Chairman*, De Laval Separator Company, 5724 North Pulaski Road, Chicago, Illinois 60646.

A. E. PARKER, *Western Asst. Chairman*, Chief Milk Section, City of Portland Health Dept., Portland, Oregon 97204.

J. B. SMATHERS, *Eastern Asst. Chairman*, Maryland and Virginia Milk Producers Association, Inc., 1530 Wilson Boulevard, Arlington, Virginia 22209.

WILLIAM L. ARLEDGE, Southeast Milk Sales Assn., Inc., 283 Bonham Road, Bristol, Virginia.

DR. HENRY ATHERTON, Dairy Science Department, University of Vermont, Burlington, Vermont.

GLENN CAVIN, Cedar Valley Coop. Milk Assn., 1936 Hawthorne, Waterloo, Iowa 50704.

DR. CLIFFORD J. COSGROVE, University of Rhode Island, Woodward Hall 212, Kingston, Rhode Island 02661.

DR. J. C. FLAKE, Evaporated Milk Association, 910 17th Street, N.W., Washington, D. C. 20006.

CLARENCE C. GEHRMAN, Dairy Inspection Section, Dairy and Food Division, Department of Agriculture, Olympia, Washington.

DR. W. J. HARPER, Department of Dairy Technology, Ohio State University, Columbus, Ohio 43200.

KENNETH HARRINGTON, Babson Bros. Company, 2100 S. York Road, Oak Brook, Illinois.

M. W. JEFFERSON, Dairy Products Sanitation Section, 1308 Franklin Street, Richmond, Virginia 23219.

C. O. JOHNSON, 2831 Iron Street, Bellingham, Washington 98225.

ELMER E. KIHLSSTRUM, Johnson and Johnson, Dairy Division, 4949 West 65th Street, Chicago, Illinois 60638.

WILLIAM MCCORQUODALE, Ontario Milk Producers, 409 Huron Street, Toronto, Ontario, Canada.

VERNON NICKEL, Milk Control Section, St. Louis Dept. of Public Health, 416 Tenth Street, Crystal City, Missouri.

WILLIAM PICKAVANCE, Universal Milk Machine Division, Albert Lea, Minnesota 56007.

D. G. RAFFEL, Wisconsin State Department of Agriculture, Dairy, Food and Trade Division, Hill Farms State Office Bldg., Madison, Wisconsin 53702.

RICHARD RINTELMANN, Klenzade Products, Beloit, Wisconsin 53512.

BERNARD SAFFIAN, Chamberlain Laboratories, P. O. Box 624, Fishcreek Road, Stow, Ohio.

STEPHEN B. SPENCER, Pennsylvania State College, University Park, Pennsylvania 16802.

D. K. SUMMERS, Dept. of Health, Education and Welfare, Public Health Service, Regional VIII Office, Federal Office Building, 19th & Stout Streets, Denver, Colorado 80202.

LEON TOWNSEND, 2205 Brent Drive, Madisonville, Kentucky.

STATE AFFILIATES WITH PARTICIPATING FARM PRACTICE COMMITTEE

RAY CARSON, State Department of Agriculture, 2505 S. McClellan Street, Seattle, Washington 98144.

VERNE CAVANAUGH, Indiana State Board of Health, 205 Harrison Street, La Porte, Indiana 46350.

DEAN POTTER, Carnation Milk Company, 3342 S.E. Morrison, Portland, Oregon 97214.

DR. CHARLES W. LIVAK, Penn Dairies, Inc., 1801 Hempstead Road, Lancaster, Pennsylvania 17601.

DAVID MONK, Wichita-Sedgwick County, Public Health Department, 1900 East Ninth Street, Wichita, Kansas 67214.

ALBERT R. PERNICE, 355 Benton Street, Stratford, Connecticut 06497.

DON RACE, Dairymen's League, 402 Park Street, Syracuse, New York 13208.

EMMETT FINCHER, 2614 Waunona Way, Madison, Wisconsin 53713.

JAMES F. KENNEDY, Missouri Division of Health, Popular Bluff, Missouri.

WILLIAM D. MCCORQUODALE, 31 Wellesly Street, East Toronto 5, Ontario, Canada.

H. E. HANSEN, Milk Sanitation Section, State Health Department, State Office Building, Des Moines, Iowa 50319.

FARM METHOD CONSULTANTS

C. G. ASHE, 215 Mott Road, Kendal-Fiber Products Division, Fayetteville, New York 13066.

SYDNEY E. BARNARD, 213 Borland Laboratory, The Penn. State University, University Park, Pennsylvania 16802.

SYDNEY H. BEALE, Michigan Milk Producers Assn., 24270 West Seven Mile, Detroit, Michigan 48219.

ALBERT R. PERNICE, 355 Benton Street, Stratford, Connecticut 06497.

WILLIAM TROBAUGH, Denver Milk Producers, Inc., 945 11th Street, Denver, Colorado 80204.

BREAKDOWN OF COMMITTEES

Antibiotics, Pesticides and Adulterants. D. K. Summers, Chairman; M. W. Jefferson, Wm. J. McCorquodale, C. O. Johnson, Stephen B. Spencer, Henry Atherton, Washington Farm Methods Committee, Indiana Farms Methods Committee, New York Farms Methods Committee, Ontario Farm Methods Committee, Iowa Farm Method Committee, and Consultants: Sydney H. Beale and William Trobaugh.

C.I.P. Cleaning and Sanitizing of Dairy Farm Equipment. Richard Rintelmann, Chairman; Clarence C. Gehrman, M. W. Jefferson, William L. Arledge, Kenneth Harrington, D. G. Raffel, William Pickavance, Glenn Cavin, Iowa Farm Method Committee, Pennsylvania Farm Methods Committee, Indiana Farm Methods Committee, Wisconsin Farm Methods Committee, Ontario Farm Methods Committee, Kansas Farm Methods Committee, Oregon Farm Methods Committee, Washington Farm Methods Committee, Missouri Farm Methods Committee, and Consultants: Sydney H. Beale, Albert R. Pernice, and William Trobaugh.

Education. Vernon Nickel, Chairman; Henry Atherton, C. O. Johnson, Stephen Spencer, Clifford Cosgrove and Wm. McCorquodale.

Plastics. Bernard Saffian, Chairman; R. G. Raffel, William Pickavance, Kenneth Harrington, Wm. McCorquodale, C. O. Johnson, Leon Townsend, Kansas Farm Methods Committee, Washington Farm Methods Committee, Pennsylvania Farm Methods Committee, Wisconsin Farm Methods Committee, Iowa Farm Method Committee, and Consultants: Sydney E. Barnard, Sydney H. Beale, William Trobaugh, and Leon Townsend.

Sediment in Fluid Milk. Elmer Kihlstrum, Chairman; J. C. Flake, William Arledge, William McCorquodale, C. O. Johnson, New York Farm Methods Committee, Indiana Farm Methods Committee, Connecticut Farm Methods Committee,

Wisconsin Farm Methods Committee, Ontario Farm Methods Committee, and Consultants: C. G. Ashe and Sydney H. Beale.

Compatibility of Detergents to Farm Water Supplies and Effect of Solution Temperature on C.I.P. Cleaning of Farm Equipment. Stephen Spencer, Chairman; Henry Atherton, Richard Rintelmann, Bernard Saffian, Wm. L. Arledge, W. J. Harper, New York Farm Methods Committee, Pennsylvania Farm Methods Committee, Washington Farm Methods Committee, Ontario Farm Methods Committee, Iowa Farm Methods Committee, and Consultants: Sydney E. Barnard, Sydney H. Beale, and William Trobaugh.

Relation of Farm Water Supplies to the Quality of Milk.

Henry Atherton, Chairman; Stephen Spencer, W. J. Harper, Wm. McCorquodale, D. K. Summers, Kansas Farm Methods Committee, Oregon Farm Methods Committee, Missouri Farm Methods Committee, Ontario Farm Methods Committee, and Consultant: Sydney E. Barnard.

Dairy Farm Management. William L. Arledge, Henry Atherton, Stephen Spencer, Glenn Cavin, J. C. Flake, M. W. Jefferson, Clarence Gehrman, D. G. Raffel, Kenneth Harrington, New York Farm Methods Committee, Washington Farm Methods Committee, Kansas Farm Methods Committee, Indiana Farm Methods Committee, Wisconsin Farm Methods Committee, Ontario Farm Methods Committee, and Iowa Farm Methods Committee.

NEWS AND EVENTS

NEW BULLETINS ON FOOD-BORNE ILLNESSES

Two new bulletins, one entitled *Salmonellosis* (Extension bulletin 339) and the other *Staphylococcus Food Poisoning* (Extension bulletin 354), have been authored by Dr. E. A. Zottola and published by the Agricultural Extension Service of the University of Minnesota. Zottola is an Extension Food Microbiologist and Associate Professor of Food Science and Industries.

Both bulletins provide information on symptoms, foods commonly associated with outbreaks, and ways to avoid the respective ailments. Covers on the bulletins are dramatic (vivid shades of blue, purple, and orange are used) and live drawings in the texts make them interesting to read. Both bulletins are written so that they should find widespread use in providing basic information on these common food-borne illnesses to persons with varied educational backgrounds.

Single copies of the bulletins cost 10 cents each and are available from: The Bulletin Room, Institute of Agriculture, University of Minnesota, St. Paul, Minn. 55101. There is a quantity discount of 10% on orders of 100 or more copies.

APPLICATIONS FOR ENVIRONMENTAL HEALTH FELLOWSHIPS

Applications for Environmental Health Fellowships are now being accepted for the 1969-1970 academic year at the Consolidated University of North Carolina (Chapel Hill and Raleigh campuses). Recipients participate in multidisciplinary programs designed to prepare graduate students for careers in research, teaching, and practice in the various specialized fields in environmental health. This program is sponsored jointly by the Departments of Environmental Sciences

and Engineering, Biostatistics, and Epidemiology of the School of Public Health; the Departments of Botany, City and Regional Planning, Geology, and Zoology of the School of Arts and Sciences; the School of Medicine and the Department of Food Science at North Carolina State University at Raleigh. Students generally enroll in the department of their basic specialty for training in depth in that area and then elect courses in other departments in order to obtain a broad understanding of the problems of the environment and the relation of their specialty to the solution of these problems.

Fellowships are available for masters and doctoral candidates. They provide for tuition, fees and a stipend, including a dependency allowance. Post-doctoral fellowships are also available.

Further information may be obtained by writing the Institute of Environmental Health Studies, Box 630, Chapel Hill, North Carolina 27514 or the head of any of the departments mentioned above.

TWO WEEK COURSE IN FOOD MICROBIOLOGY

A 2-week course in Food Microbiology is being offered beginning April 14, 1969 in Cincinnati, Ohio by the Training Program of the Environmental Control Administration, USPHS.

The course provides technical information to laboratory personnel concerned with the bacteriological examination of foods. It is designed to enable the trainee to undertake surveillance of the sanitary quality of food with emphasis on prevention of disease outbreaks or to examine food implicated in a food-borne disease. Lectures and discussions are supplemented with considerable laboratory practice.

The laboratory work will include sampling procedures, detection of staphylococci, salmonellae,

shigellae, fecal streptococci and coliform organisms in food. Work with *Clostridium perfringens* and *Clostridium botulinum* will also be included.

Other topics to be included are: tests for staphylococcal enterotoxin, recent developments in the etiology of foodborne disease, viruses in food, anaerobic techniques and differentiation of poisons of marine animals from botulinal toxin.

All applicants for this course must present evidence of immunization against *C. botulinum* Types A, B, and E. The immunization program requires 12 weeks, and the entire series must be completed prior to the course.

For further information write to: Chief, Training Program, National Center for Urban and Industrial Health, 222 E. Central Parkway, Cincinnati, Ohio 45202.

RESEARCH GRANT TO STUDY WATER POLLUTION BY DAIRY FARM WASTES

The Department of Dairy Science of Auburn University, Auburn, Alabama, has a new research grant to study water pollution by dairy farm wastes as related to method of waste disposal. The three-year study, supported by an \$82,000 grant from the Office of Water Resource Research, Department of Interior, Washington, D. C. is designed to study: existing waste disposal systems on Alabama farms; four systems of farm waste disposal—"dry" manure accumulation and periodic spreading with conventional equipment, semi-liquid manure collection in underground tanks and spreading from tractor-drawn equipment, liquid spreading via irrigation systems, and aerobic lagoons; chemical and bacteriological studies of runoff water and soil receiving the manure; and to develop guidelines on acceptable waste disposal systems for commercial dairy farms.

Problems of dairy farm waste disposal in the southeast are aggravated by the trend to large dairies in which more confinement feeding is practiced. Many dairy herd concentrations are in the vicinity of cities around which land values are high. It is likely that such dairies contribute to water pollution, as well as to fly and odor problems.

Facilities used in the research include modern microbiological and chemical laboratories at Auburn University as well as four Experiment Station dairy farms in various parts of Alabama.

Project leaders are Dr. Tom. A. McCaskey, microbiologist, and Dr. Gilbert H. Rollins, dairy animal nutritionist. Dr. Ronald E. Hermanson, soil and water engineer is cooperator.

DAIRYING MUST ADAPT TO CONSUMER DEMANDS

Although considered as a threat to the dairy industry, imitation milk products can be regarded as a challenge offering several possibilities provided the challenge is met realistically, says Myron P. Dean, University Extension milk specialist. Our experience with oleomargarine has shown that the dairy industry can't fight synthetic milk products through legislation. Probably the most realistic way to contend with the situation is for the dairy industry to move into the manufacture of synthetic food products derived from milk. The basic lesson here is that the dairy industry must be willing and ready to change with the changing consumer wants. If consumers prefer milk synthetics, the dairy industry must be able to deliver the goods. This approach will help the dairy industry not merely to survive, but to remain profitable and competitive. Of course, some federal regulation would be required in the manufacture of synthetics, so that they don't entirely crowd out natural milk from the market.

The dairy industry should also turn to more intensive research for new uses for natural milk both for home consumption and food processing. These efforts should be combined with more serious consumer research and greater sensitivity to consumer demands.

Due to ever improving technology, we're living in an age of synthetics. The dairy industry must not only be able to face up to this reality, but must also find its rightful place in it. Furthermore, consumers are becoming increasingly aware that imitation products are not necessarily inferior to natural products. An example of this is synthetic fibers. The dairy industry should thus be able to adjust to this changing consumer attitude toward synthetics.

AUTOMATIC BURET WITH AN ALL-TEFLON BODY

Veteran glassworkers at the Fisher Glass Apparatus Division have produced the laboratory world's first automatic buret with all-Teflon valve-body assembly. No glass-to-glass seals to jam, no need for valve lubrication, ever. Buret, valve and reservoir come apart for easy cleaning (there is 100% demountability), and the Teflon design well-nigh eliminates possibility of breakage. The new Fisherbrand buret comes in two sizes, with 10-ml and 25-ml burets. Each has its own 500-ml reservoir, so that you can use the apparatus out in the field or in plant tests without having to set up a support. A gentle squeeze on the filling bulb, and the buret fills automatically through a central column. Release the pressure and

the liquid drains back to the zero mark—and you're ready to titrate. The 2-position all-Teflon valve controls everything. The self-zeroing buret is made from precision-bore tubing controlled to 0.0002 inch.

The dark blue graduations are permanently fused into the glass. The reservoir is airtight, so you can use the burets for standard solutions with no risk of contamination. A plastic cap keeps out dust. And at no time does the liquid contact anything but borosilicate glass or inert white Teflon. It is not limited to a 500-ml reservoir. The unique cap that locks on the buret assembly will also take most 1-quart reagent bottles, all standard 5-pint acid bottles, and many 1-gallon polyethylene jugs of standard solutions. No adapter needed. For more information write Fisher Scientific Co., 418A Fisher Building, Pittsburgh, Pennsylvania 15219.

NEW CLEAR PLASTIC TRANSFLOW INFLATIONS



New clear plastic inflations and shells which let the operator see how each individual quarter is milking are announced by Norton Plastics & Synthetics Division (formerly U. S. Stoneware, Inc.) Akron, Ohio, manufacturer of Transflow M-34R raw milk and vacuum tubings. In addition, the new inflations, which meet all Food and Drug Administration requirements and those of the 3-A Plastics Standard, speed milking and are gentler on the cow's teats. Designated Transflow "See-Through" inflations and shells, the new companion products make it possible to see when a

quarter is milked out, preventing over-milking, protecting delicate tissues and reducing the incidence of mastitis. In addition, this visibility lets the operator check to see that the milk is flowing away properly and not backing up around the teat. It greatly reduces the time necessary for manual stripping.

The inflations are non-aging and non-oxidizing, will not flake and contaminate milk, have a longer service life than rubber. Their smooth, dense surface is easy to clean, does not absorb butterfat. The shells are more comfortable to the cow, easier for the operator to handle.

A single size Transflow inflation fits all normal cows and all makes of milking machines. Easy to slip onto the teat, Transflow inflations take a positive hold with no tendency to slip off or crawl up the teat. Complete information on Transflow inflations and shells will be sent upon request to Mr. James Petit, Manager, Dairy Products, Norton Plastics & Synthetics Division, Akron, Ohio 44309.

NEW CLEANER FOR MILKING EQUIPMENT EXTERIORS MAKES IT EASIER FOR DAIRYMEN TO COMPLY WITH RECENT U. S. PUBLIC HEALTH SERVICE ORDINANCE AND CODE!

Dairymen who are anxious to comply with the recent U. S. Public Health Service Ordinance and Code—requiring that exterior surfaces of dairy farm milking equipment be kept clean at all times—will be glad to know about a new time and labor-saving product developed especially for this purpose. It's called "GAIN S.V.P." And has been developed and put on the market by FRM-CHEM, Inc. of St. Louis, Missouri. It was developed especially to remove water stone, milk stone, grease, fat, dried milk, iron stains and water spots from exterior surfaces of bulk milk tanks, milker units, pipelines, dump stations, wash vats and other milking equipment. It removes these residues in one easy wash—eliminating the usual double washing with an acid cleaner followed by a general detergent. For full information—write: FRM-CHEM, Inc.; Box 9903; St. Louis, Mo. 63122.

DAIRY FIELDMEN MEET

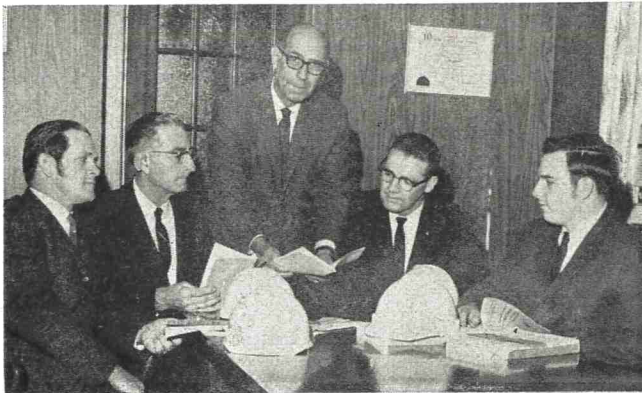
The 1969 Annual Wisconsin Dairy Plant Fieldmen's Conference was held January 22 and 23 at the Dining Hall, Dane County Fairgrounds. Some 300 dairy plant fieldmen and other dairy plant personnel from Wisconsin attended.

The conference featured speakers from the University of Wisconsin, the Wisconsin Department of Agriculture, the State Division of Health, related industries, and other agencies who discussed some of

the latest developments in the dairy processing industry.

Among topics covered were: new programs for agribusiness short courses and conferences at the University of Wisconsin; fieldmen experiences with the 1965 Grade A Pasteurized Milk Ordinance; meeting U. S. Public Health Service guidelines for the control of abnormal milk; communicating with producers; technical and legal aspects of imitation dairy products; industry viewpoints on one grade of milk; and credibility gaps in milk inspection and certification.

Information about the conference is available from Evert Wallenfeldt at Babcock Hall, University of Wisconsin, Madison, Wis. 53706.



MARYLAND MEAT INSPECTORS ASSIGNED—The first four inspectors for the new Maryland meat inspection program are assigned to duty by Program Supervisor Dr. Robert J. Lee (center), following completion this month of their special training course. The Maryland meat inspection program is "moving rapidly to full implementation," according to State Board of Agriculture officials. The new inspectors are (left to right) Edward Sibold, of Laurel; Bruce Kepler, of Frederick; Dr. Lee; Howard Brode and Thomas Hutter, of Cumberland.

17TH ANNUAL NATIONAL DAIRY ENGINEERING CONFERENCE

The program for the 17th Annual National Dairy Engineering Conference to be held February 25-26, 1969 at the Kellogg Center for Continuing Education on the Michigan State University campus, is nearly finalized. The plans include four half day sessions devoted to the following themes:

1. Refrigeration Principles and Applications
2. Packaging Materials and Container Design
3. Tools for Efficient Handling of Plant Wastes
4. New Concepts in Cleaning and Sanitation

The program is designed to bring out the latest engineering developments in each area.

If you wish to obtain additional details contact: D. R. Heldman, Ass't. Prof. Agric. Eng. and Food Science Depts., Michigan State Univ., East Lansing, Michigan 48823.

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NOTICE OF PAGE CHARGE FOR PUBLICATION OF RESEARCH PAPERS

The Journal Management Committee recommended and the Executive Board voted to establish a page charge for research papers published in the Journal of Milk and Food Technology. Institution of the page charge is necessary to compensate for higher publication costs, to insure a continually expanding journal which will be of maximum benefit to its readers, and to make possible continued prompt publication of research papers.

A charge of \$25.00 per printed page will become effective for all research manuscripts received after January 1, 1969. Most institutions accept the page charge as a necessary cost of conducting research and communicating the results. Nevertheless, it is realized that some authors may not have funds available for this purpose and hence exceptions can be made when necessary. Inability to pay the page charge shall not constitute a bar to publication of an acceptable manuscript.

NEW! CLEANER FOR EXTERIORS OF MILKING EQUIPMENT REMOVES RESIDUE IN ONE WASH!

Help producers comply more easily and efficiently with the current U. S. Public Health Service Ordinance and Code—which requires that exterior surfaces of milking equipment be kept clean at all times—by suggesting the use of FRM-CHEM GAIN S.V.P. EXTERIOR CLEANER.

It's the only cleaner on the market that removes water stone, milk stone, grease, fat, dried milk, iron stains and water spots from exterior surfaces of bulk tanks, pipelines, milker units, wash vats, etc. in one easy wash. Eliminates double washing with an acid cleaner followed by a general detergent. Developed by a former sanitarian. Write for full information!

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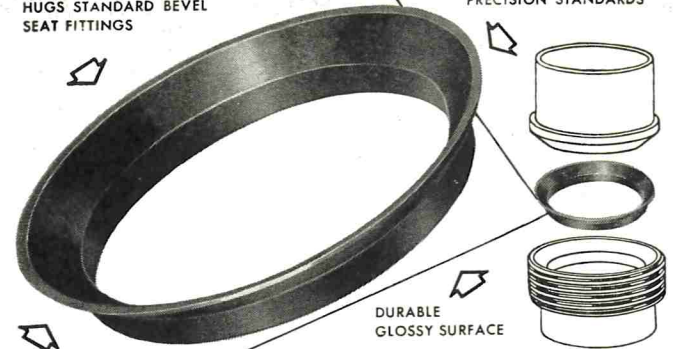
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SNAP-TITE self-centering gaskets of TEFLON are designed for all
standard bevel seat sanitary fittings. They SNAP into place provid-
ing self-alignment and ease of assembly and disassembly.
HAYNES SNAP-TITES of TEFLON are unaffected by cleaning solu-
tions, steam and solvents. They will not embrittle at temperatures
as low as minus 200° F. and are impervious to heat up to 500° F.

FOR A FITTING GASKET THAT WILL OUT-PERFORM ALL OTHERS...

Specify . . . **HAYNES SNAP-TITES of TEFLON**

• TEFLON ACCEPTED SAFE FOR USE ON FOOD & PROCESSING
EQUIPMENT BY U. S. FOOD AND DRUG ADMINISTRATION

* Gaskets made of DuPont TEFLON[®] TFE-FLUOROCARBON RESINS

THE HAYNES MANUFACTURING COMPANY
4180 LORAIN AVENUE • CLEVELAND, OHIO 44113

A HEAVY DUTY SANITARY LUBRICANT



Available in both
SPRAY AND TUBE

All Lubri-Film ingredients are
approved by F.D.A. and can be
safely utilized as a lubricant for
food processing equipment when
used in compliance with an exist-
ing food additive regulation.

ESPECIALLY DEVELOPED FOR LUBRICATION OF FOOD
PROCESSING AND PACKAGING EQUIPMENT

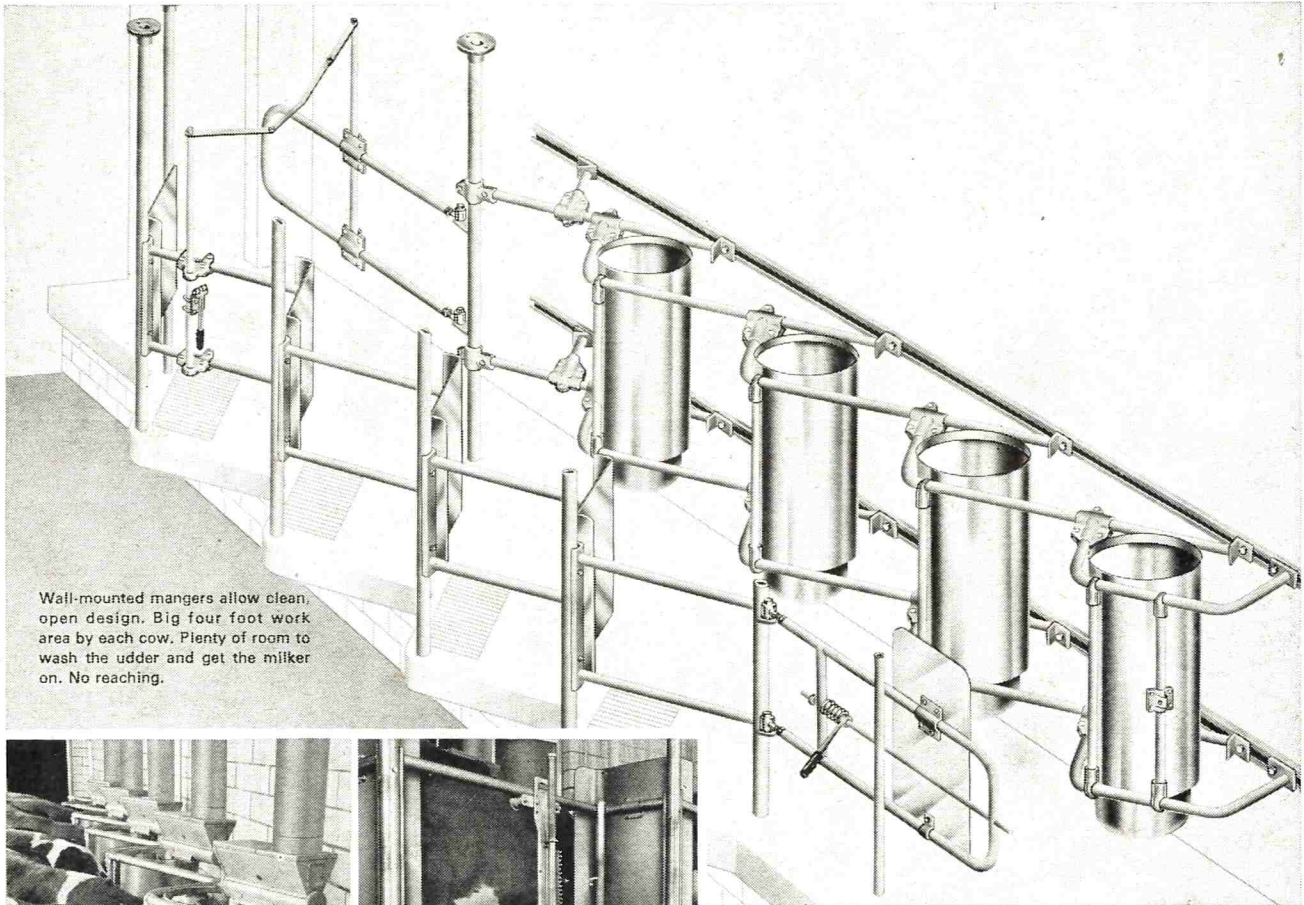
For Use in Dairies—Ice Cream Plants—Breweries—
Beverage Plants—Bakeries—Canneries—Packing Plants

SANITARY • NON TOXIC • ODORLESS • TASTELESS

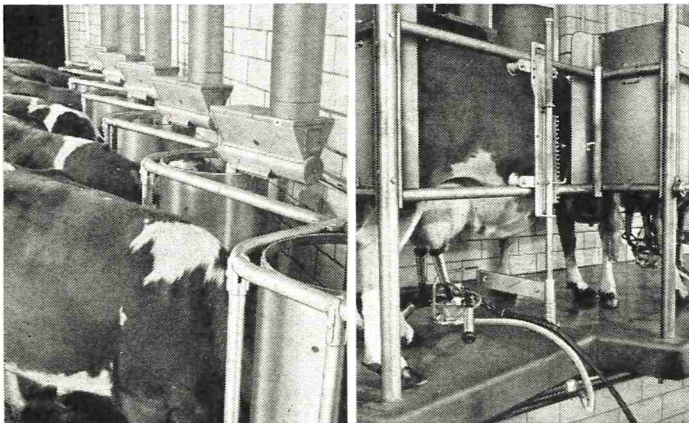
SPRAY—PACKED 6—16 OZ. CANS PER CARTON
TUBES—PACKED 12—4 OZ. TUBES PER CARTON

THE HAYNES MANUFACTURING CO.
CLEVELAND 13, OHIO

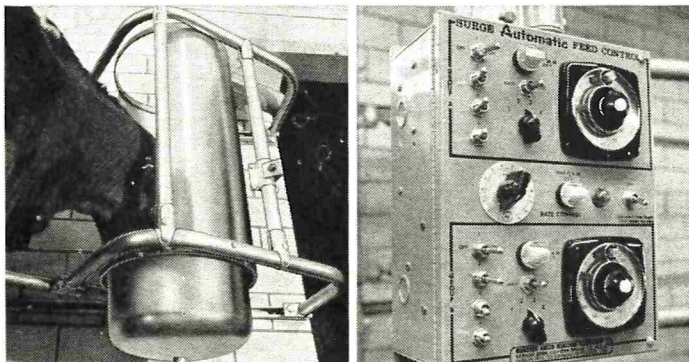
NEW **SURGE** SAWTOOTH Herringbone STALLS



Wall-mounted mangers allow clean, open design. Big four foot work area by each cow. Plenty of room to wash the udder and get the milker on. No reaching.



Handle cows in groups. Note how the design positions cows positively. Big stainless steel rear shields . . . gently curved at each end . . . reaches well above the pinbones . . . no sharp corners to injure the cow.



Big, heavy-duty, stainless steel manger. Cows can't waste feed. Rounded bottom . . . no corners for feed to lodge. Cleans easily with a hose. Stainless, won't rust. Wrap-around feed shield screens cows, tends to quiet them.

Here's a new optional feature. A Group Feed Control Panel. It's all automatic. Push a button. Deliver a predetermined amount of feed at a predetermined rate in each manger. Want to feed heavy producers a little extra? Just flip a switch.

...better from every angle

Stainless steel . . . clean, streamlined design . . . automation. These are the elements that make the new SURGE Sawtooth Stalls better for Herringbone Parlors. Gives you a lot of advantages . . . like push-button, automatic feeding . . . stainless steel rear shields, gate shields and mangers . . . high-carbon, steel tubing with acrylic-epoxy enamel or dichromated electrogalvanized finish. For more details see your SURGE dealer.



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