

# JOURNAL of MILK TECHNOLOGY

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Volume 8

March-April, 1945

Number 2

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## Editorials

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### Cattle Infected with Tuberculosis by Owner

THE infection of human beings with tubercle bacilli of bovine origin has been a well-recognized and, in the past, fairly common occurrence. An authentic instance, however, in which a dairyman apparently was infected by his own herd and, himself, subsequently infected three "clean" herds, appears to be unique. Such an instance was reported by Dr. F. J. Tice, veterinarian for Chenango County, New York, at the annual meeting of the New York State Veterinary Medical Society, at Albany, in July, 1944. This report is to be published in full in *Veterinary News*, official organ of the Society.

In 1929 Dr. Tice was doing a tuberculin re-test on a herd belonging to a milk peddler. Tests on the adult animals gave negative results but some calves were positive. It developed that the owner had been buying milk from an untested herd, separating it and feeding the skim milk to the calves.

The herd from which the milk came was tested, all twenty-two animals gave positive reactions and the entire herd was destroyed, a new and "clean" herd being acquired. From 1929 to 1942 annual re-tests of this herd gave negative results for all animals. In January, 1942, however, 5 of 24 animals gave positive reactions. Two months later the remaining 19 animals and one calf were tested, with 7 positive. Upon re-test about two months later, all of the remaining 13 animals in the herd were positive.

In the summer of 1942 a new herd of 12 tuberculin-negative animals was acquired and, on tests in October, two of these were positive. By March, 1943, all of the animals remaining had given positive reactions. In June another new, "clean" herd was installed and before winter all of the new cows were reactors.

After each test all reactors were removed promptly and slaughtered and the stables were cleansed and disinfected. Postmortem examinations of animals destroyed showed no generalized tuberculosis but localized lesions were found in many.

For about two months, early in 1942, this dairyman was a patient in a State tuberculosis hospital, suffering from active, moderately advanced pulmonary tuberculosis, his sputum containing tubercle bacilli. At the end of that time, upon his insistence, he was discharged and returned to his farm work. In the

Spring of 1944, when Dr. Tice called attention to the apparent connection between the infections of the dairymen and the cattle, tubercle bacilli from the dairymen's sputum and from lymph nodes from the cattle were studied and all found to be of the bovine type.

It was Dr. Tice's conclusion, on the basis of the known facts and circumstances, that the dairymen had acquired his infection from the herd found, in 1929, to be heavily infected and later, after he had developed active pulmonary tuberculosis, had communicated his infection to the three "clean" herds.

P. B. B.

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## Public Health Service Disease Outbreak Reports, 1943

THE Public Health Service reports, for the year 1943, on disease outbreaks conveyed or possibly conveyed through specified vehicles, including milk and milk products, are now available for study. To collect, analyze and tabulate the mass of data involved is a large and time-consuming undertaking. One does not have to be a Sherlock Holmes to deduce that the Service is handicapped by incompleteness of many reports and by difficulty, in more than a few instances, in evaluating the character of the epidemiological work upon which stated conclusions are based.

These tabulations always have been interesting. They are gradually becoming more valuable as reporting becomes more general and, more particularly, as they become more informative and dependable. An important step in the latter direction was taken when provision was made for separate classification of outbreaks "possibly conveyed" by the specified vehicles. It would appear, however, from the meagerness of information relating to some of the reported outbreaks, that a still larger proportion should be in the "possibly conveyed" classifications.

Our first interest, naturally, is in the outbreaks attributed to milk and milk products, of which there were 30. Of these 17 were classified as food poisoning or gastroenteritis, 5 were typhoid fever, 4 undulant fever, 3 hemolytic streptococcus infection (scarlet fever or septic sore throat) and one diphtheria.

Comment on the outbreaks of food poisoning and gastroenteritis will be deferred until we consider those attributed to other foods, except for the observation that the numbers of these outbreaks have little statistical significance, since only a relatively small proportion of such outbreaks are investigated and reported. All of the five typhoid outbreaks were small, the largest number of cases in any one being 12. The fact that undulant fever outbreaks (4) were reported from only three states suggests the need for a better general understanding as to what, in the case of undulant fever, should be considered an outbreak.

It is of interest to note that the only three outbreaks of hemolytic streptococcus infection (scarlet fever and septic sore throat) recorded were reported by Massachusetts and New York. For a number of years these and a few other states have reported a relatively large proportion of such outbreaks recorded by the Public Health Service. Since diphtheria occurs relatively infrequently in milk-borne outbreaks, it is regretted that the report does not contain more information concerning the outbreak of 20 cases recorded as having occurred at Hood River, Oregon.

The voluminous report on outbreaks attributed to foods other than milk and milk products is made up very largely of records of outbreaks of food

poisoning and gastroenteritis: about 250 of them. Here we find New York City and "up-state" New York running neck and neck, with 36 and 38 outbreaks, respectively, reported. In approximately 108 of the total number of food poisoning—gastroenteritis outbreaks—staphylococci are mentioned as having been the cause or probable cause. In connection with about 46 reference is made to inadequate refrigeration of the foods involved. The combination of contamination with staphylococci and inadequate refrigeration is appearing with increasing frequency, with increase in extent and thoroughness of investigations.

New York State reported the two outbreaks of hemolytic streptococcus infection traced to foods other than milk and milk products. Tapioca pudding, prepared by a cook who had sore throat, and left overnight at room temperature was responsible for 55 known (100 estimated) cases of scarlet fever. Thirty-three cases of septic sore throat were attributed to salad, with mayonnaise dressing, served at a church luncheon. It was prepared by a woman with an infected toe and stood at room temperature for about three hours before being served.

Of the four small outbreaks of botulism, three occurred in California and all were traced to home-canned food. Included also in this tabulation were 14 outbreaks the food vehicles for which are not given. These were five typhoid outbreaks, seven of food poisoning or gastroenteritis and two extensive outbreaks of dysentery. It would seem that these should have been in the list of outbreaks conveyed through *undetermined vehicles*. This and our one or two other criticism of the reports are designed to be constructive and helpful. The Public Health Service, in preparing and publishing these reports, is rendering a service which most of us greatly appreciate.

P. B. B.

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## A "Co-Op" That Cooperates

A STRIKING example of the type of cooperation of which milk sanitarians frequently dream is that developed by a milk producers' cooperative in Wisconsin. This co-op operates several plants, and condenses skim milk, dries whole milk, and sells milk and cream in a municipal market. During the past several years the annual dividends to the nearly 3,000 members of the co-op have been issued in the form of Improvement Bonds, which may be redeemed only by certified dealers for the purchase of the following:

1. Materials and labor for the construction or repair of a milk house.
2. Materials and labor for the construction of a milk-cooling tank.
3. Material and labor for the whitewashing of the milking barn.
4. Improvement of the well structure.
5. Construction of a hog or poultry house, not to exceed \$300, if hogs or fowl are currently housed in the milking barn.
6. Construction or repair of the privy.
7. Concreting of the barn floor, or installing of additional windows.

These proposed improvements must have the approval of the fieldman, and must be constructed under his supervision.

The holder of an Improvement Bond who wishes to use it presents it to a certified dealer as a draft on the Cooperative for the cost of the improvement planned. The dealer records the cost of the purchase on the face of the Bond, and prepares an invoice therefor; this, after being signed by the Bond-holder and the dealer, is presented to the Cooperative for payment.

If the dairy farm structures already satisfy all sanitation requirements of the Cooperative, a card of approval is issued to the owner by the fieldman. The owner may then use his Improvement Bond to:

1. Purchase Preferred Stock in the Cooperative.
2. Install plumbing in his home to eliminate the need for a privy.
3. Purchase a cow-clipper.
4. Purchase an electric water heater.
5. Purchase a milk-house stove of an approved type.
6. Concrete the barn-yard.
7. Pay for breeding fees.

According to a statement of the Cooperative, the following improvements have been effected on the farms of its members, through October 1, 1944, with Improvement Bonds:

Three hundred ninety-seven milk-houses built or remodeled; 24 milk-cooling tanks built; 29 wells protected; 45 hog or poultry houses built; 7 privies rebuilt; 223 barns improved by concreting or repairing concrete floors, and installing additional windows.

On "approved" farms,

Forty-three inside toilet plumbing systems were installed; 28 cow-clippers purchased; 27 electric water heaters installed; 53 barn-yards concreted; and stanchions and drinking cups were installed in 64 barns.

The value of Improvement Bonds issued in 1943 was \$167,000, and is expected to approximate \$400,000 in 1944. In 1943 \$69,000 worth of these bonds were used for improvements on "approved" farms, and at least ten percent more of the 1944 bonds will be so used. Since the unexpended value of the bonds draws interest for a period of five years, much construction and improvement is anticipated when materials and competent labor are more available.

This appears to be a program with multiple advantages: It is a novel manner of "putting profits back into the business"; it is providing a back-log of business and work for the period when returning veterans and war-workers will need it; and it is a concrete example of the type of cooperation needed to extend milk sanitation to the ultimate.

J. H. S.

## The Methylene-Blue Reduction Test as a Means of Estimating the Bacterial Content of Milk, to Determine its Suitability for Pasteurization or as a Basis for Grading

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THE United States Public Health Service Milk Ordinance fixes, for each of the grades into which raw milk may be classified, a maximum limit of average bacterial content, which may be determined by (1) the agar plate method, (2) the microscopic count, or (3) the methylene-blue reduction test. In the determination of the grades of pasteurized milk, only one method of determining bacterial content—the agar plate count—is authorized.

In a large majority of the communities in which the U.S.P.H.S. Milk Ordinance is currently being enforced, the bacterial content of both raw and pasteurized milk supplies is determined by the plate count, since the number of samples to be examined, and the cost, are not excessive. But, in the larger cities the number of dairy farms from which milk is obtained is so large, and the receiving stations are so distant, that the plate count determinations of the bacterial content of farm raw milk supplies, at sufficiently frequent intervals to effect control of bacterial quality, is not feasible because of the cost and personnel or transportation factors involved. Consequently, the third alternative method provided in the Milk Ordinance—the methylene-blue reduction test—is employed in some of these cities for determining the suitability of farm raw milk supplies for pasteurization, the plate count being employed for the determination

of the bacterial content of pasteurized milk supplies. This is the procedure followed by the Health Department of the City of Chicago, an average reduction time of 6 hours or more, of tests made at monthly or more frequent intervals, being the *sine qua non* for the retention of a Milk Producer Dairy Farm Permit.

Some years ago it became increasingly apparent that farm milk supplies which require 6 or more hours for reduction do not necessarily assure a pasteurized milk with a plate count within the 30,000 per ml. limit fixed by the Milk Ordinance for Grade A Pasteurized Milk. Since an average plate count not in excess of 200,000 per ml., or an average methylene-blue reduction time of 6 or more hours are fixed as bacterial quality specifications for raw milk for the production of Grade A Pasteurized Milk, these two figures—200,000 per ml. and 6 hours reduction time—have come to be considered synonymous by those concerned with the methylene-blue test in the enforcement of the U.S.P.H.S. Milk Ordinance. Since milk supplies meeting the 6 hours average reduction time requirement—and therefore presumed to have a bacterial content not in excess of 200,000 per ml.—did not, in Chicago experience, uniformly result in a pasteurized product having a plate count of 30,000 or less per ml., a series of studies, in which the two methods were

compared, was undertaken. This paper constitutes a report of these studies and the findings.

#### NATURE OF THE STUDIES

Beginning in January, 1942, samples of raw milk collected at random from tank trucks, from supplies received directly from producers at city pasteurizing plants, and from other sources the nature of which might be a contributing factor in high counts of the pasteurized milk, were examined by both the plate count and the methylene-blue reduction test. Some samples were held for varying periods in order to foster the development of high bacterial content.

The results were plotted on semi-logarithmic paper, the horizontal lines representing the magnitudes of the plate counts, and the vertical lines representing the time required for reduction. The result of each joint examination was plotted where the two lines corresponding to the count and the hours of reduction time intersect. The plate count-reduction time relationship promulgated by the U. S. Public Health Service. (See the table on page 31, *Milk Ordinance and Code, Public Health Bulletin No. 220, 1939 Edition*) is expressed graphically by the heavy diagonal line which passes through the intersections of the 200,000 per ml. and 6-hour lines, and of the 50,000 per ml. and 8-hour lines. The broken diagonal line on each chart is the "trend" of the points plotted, computed by the method of the least squares. Points on this trend line are most representative of the general situation presented by the points plotted.

The data presented on Charts I to V were obtained by making plate counts and reduction tests in accordance with the procedure as published in *Standard Methods for the Examination of Dairy Products, 8th Edition, 1941*. Charts V and VI are presented for comparison only. The data presented on Chart V were obtained by following Standard

Methods procedure; the reduction times involved in the data on Chart VI were obtained by modifying the test procedure by inverting the tubes at 30-minute intervals, to re-disperse the fat globules carried to the top by the creaming of the milk.

#### DISCUSSION OF THE CHARTS

The most striking feature of this chart is the wide "scatter" of the plotted points. This appears to indicate the absence of a significant relationship or correspondence between the plate count and reduction time of a given sample. Of greater interest to those who employ the reduction test to determine the bacterial quality of raw milk for pasteurization is the fact that the major proportion of the samples with reduction times of 6 or more hours had—contrary to the general assumption, founded upon the Milk Ordinance dual limitations—bacterial contents (plate counts) in excess of 200,000 per ml. Numerically, of the 163 samples with reduction times of 6 or more hours, 130 (79.8 percent) had plate counts of 200,000 or more per ml. Stated more dramatically, approximately 80 percent (4 out of every 5) of the supplies indicated by the methylene-blue test (6 or more hours reduction time) to be suitable for the production of Grade A Pasteurized Milk were actually unsuitable because of their high bacterial content, as determined by the plate count.

Of the 357 samples with plate counts in excess of 200,000 per ml., 130 (36.4 percent) had not been reduced within a period of 6 hours. Consequently, it must be granted that a conscientious program of rejection or elimination of all supplies which are reduced in less than 6 hours, if applied to these 357 samples with plate counts in excess of 200,000 per ml., would have resulted in the acceptance of over one-third of the supplies they represented. Fifty-four of the counts of these samples were 500,000 or more per ml., 15 were

CHART I

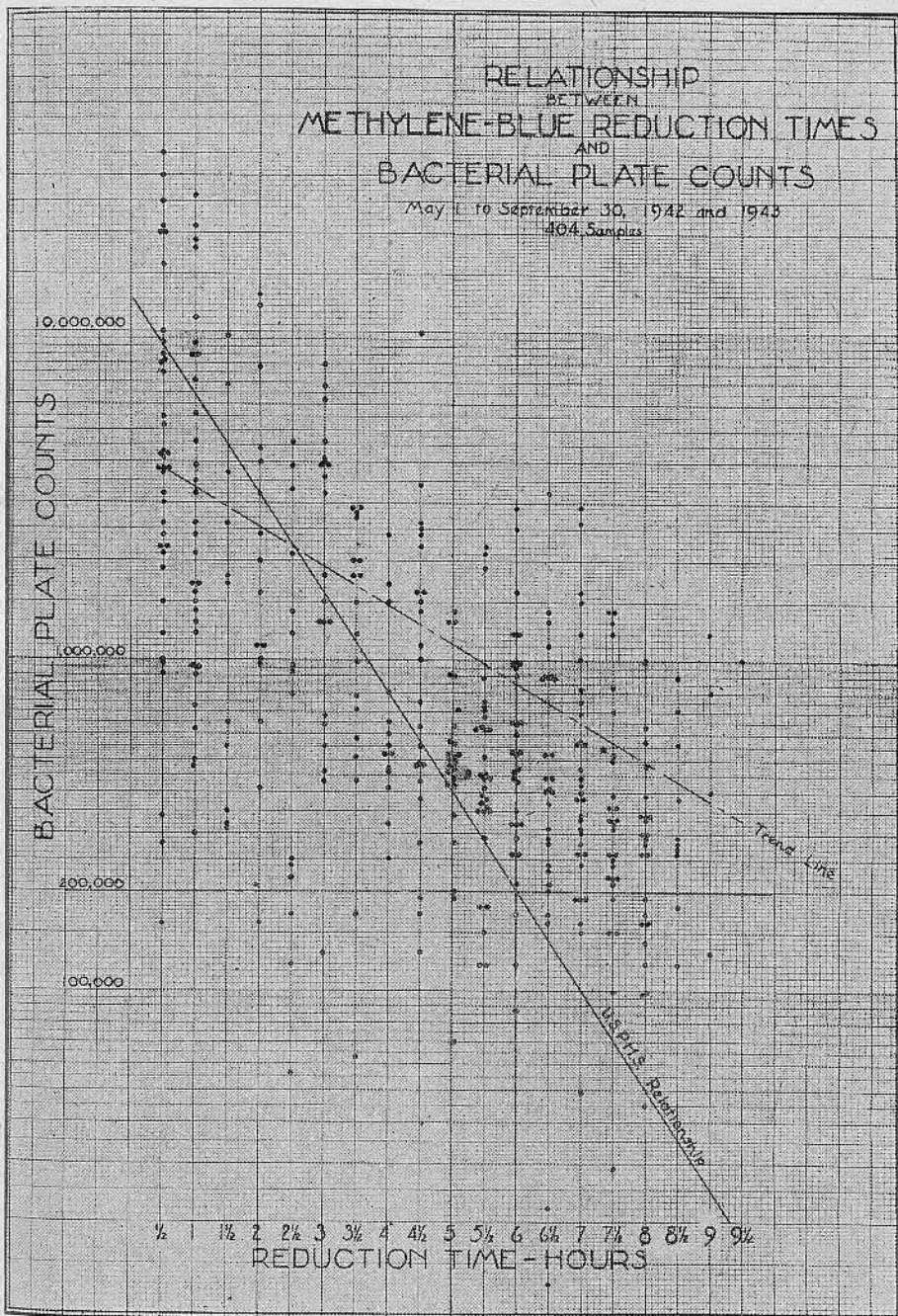


CHART II

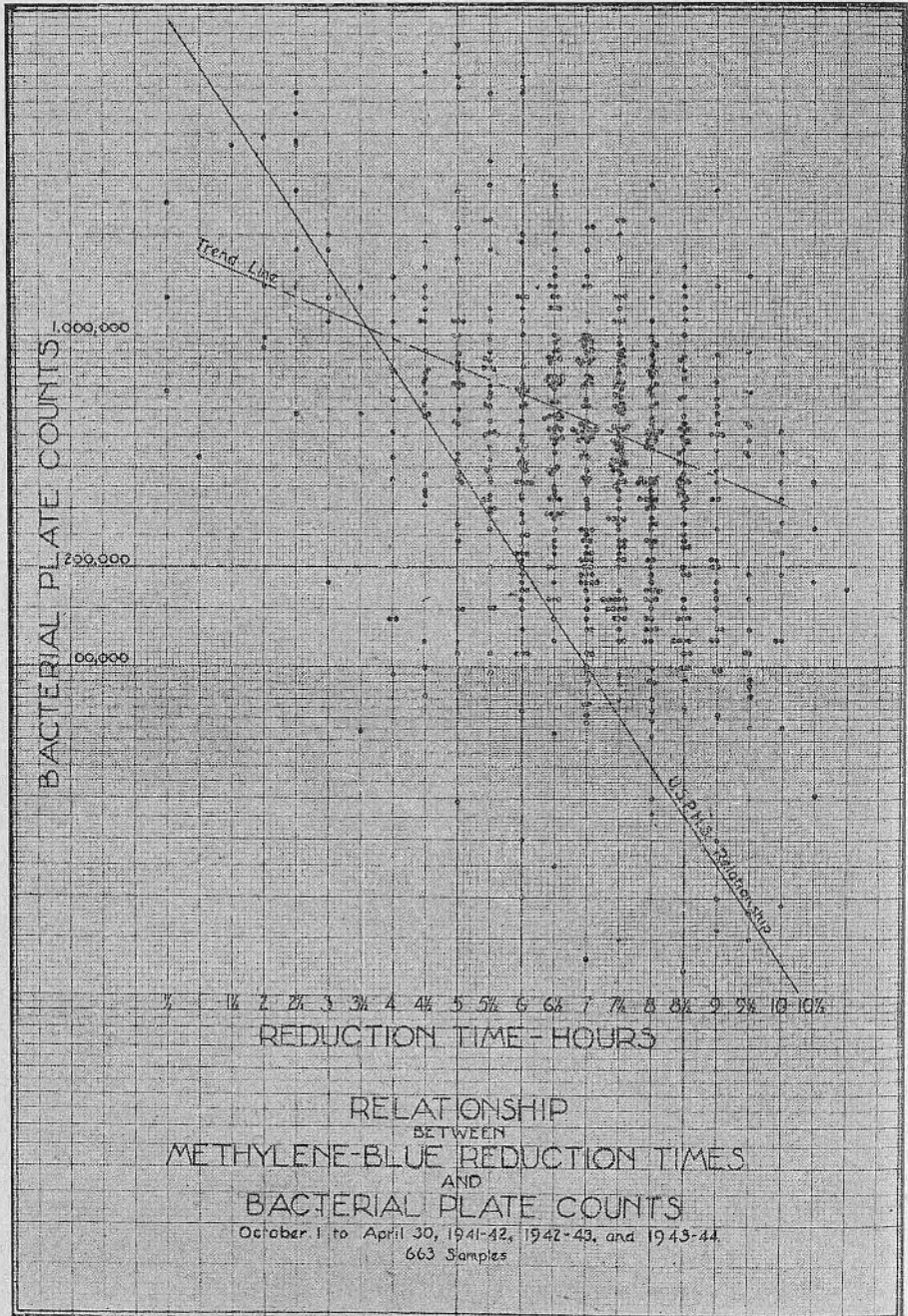




CHART III

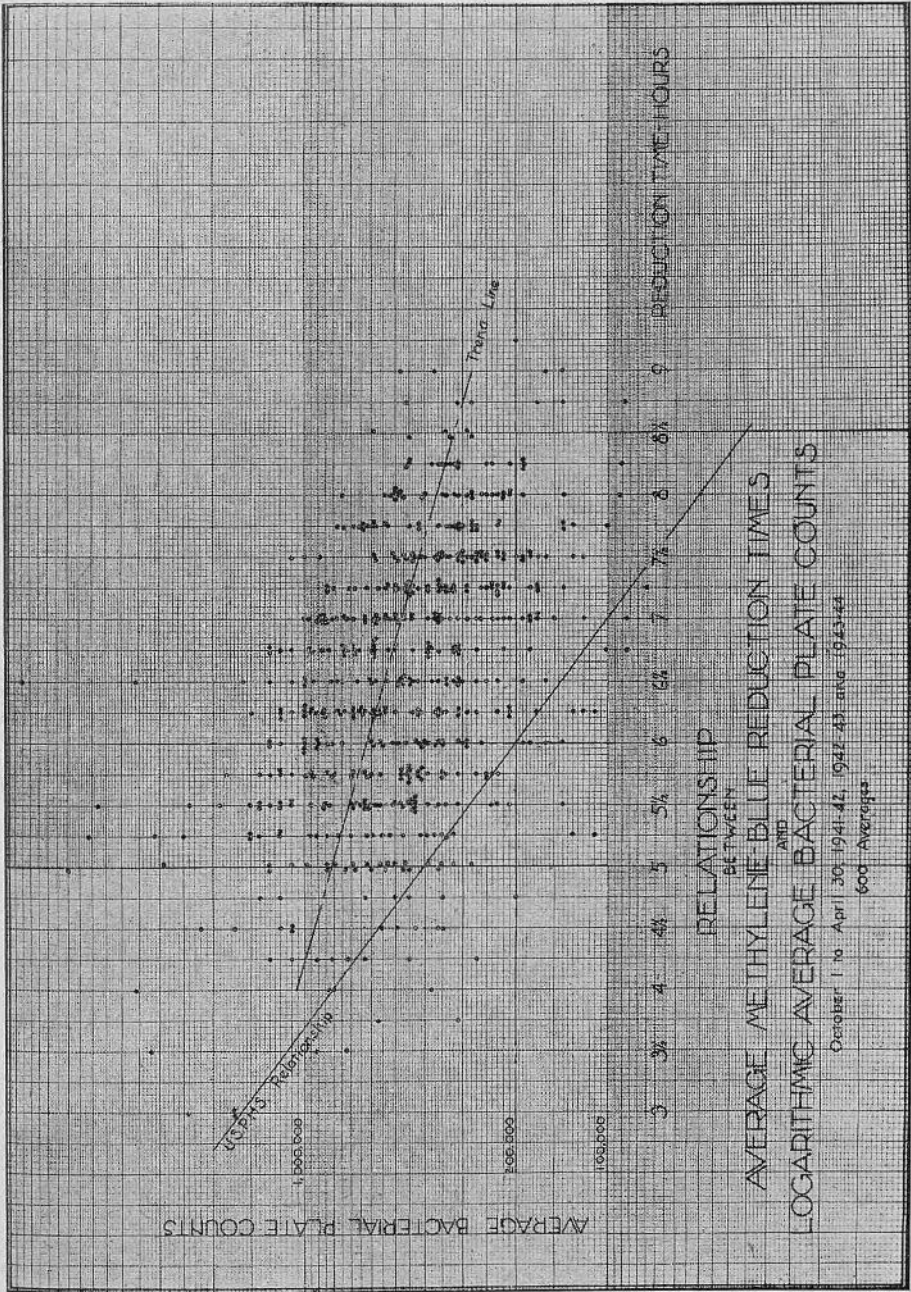


CHART IV

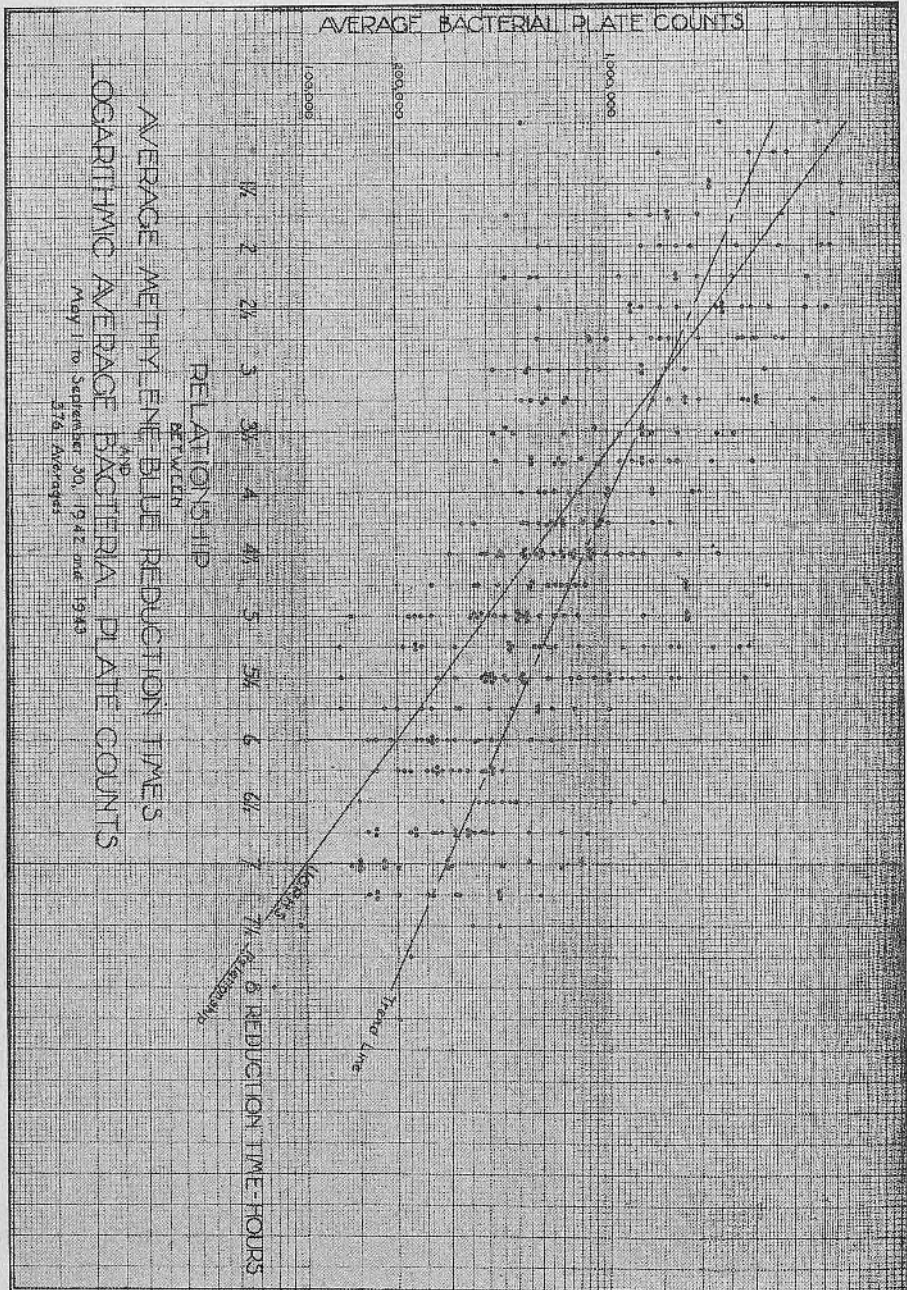
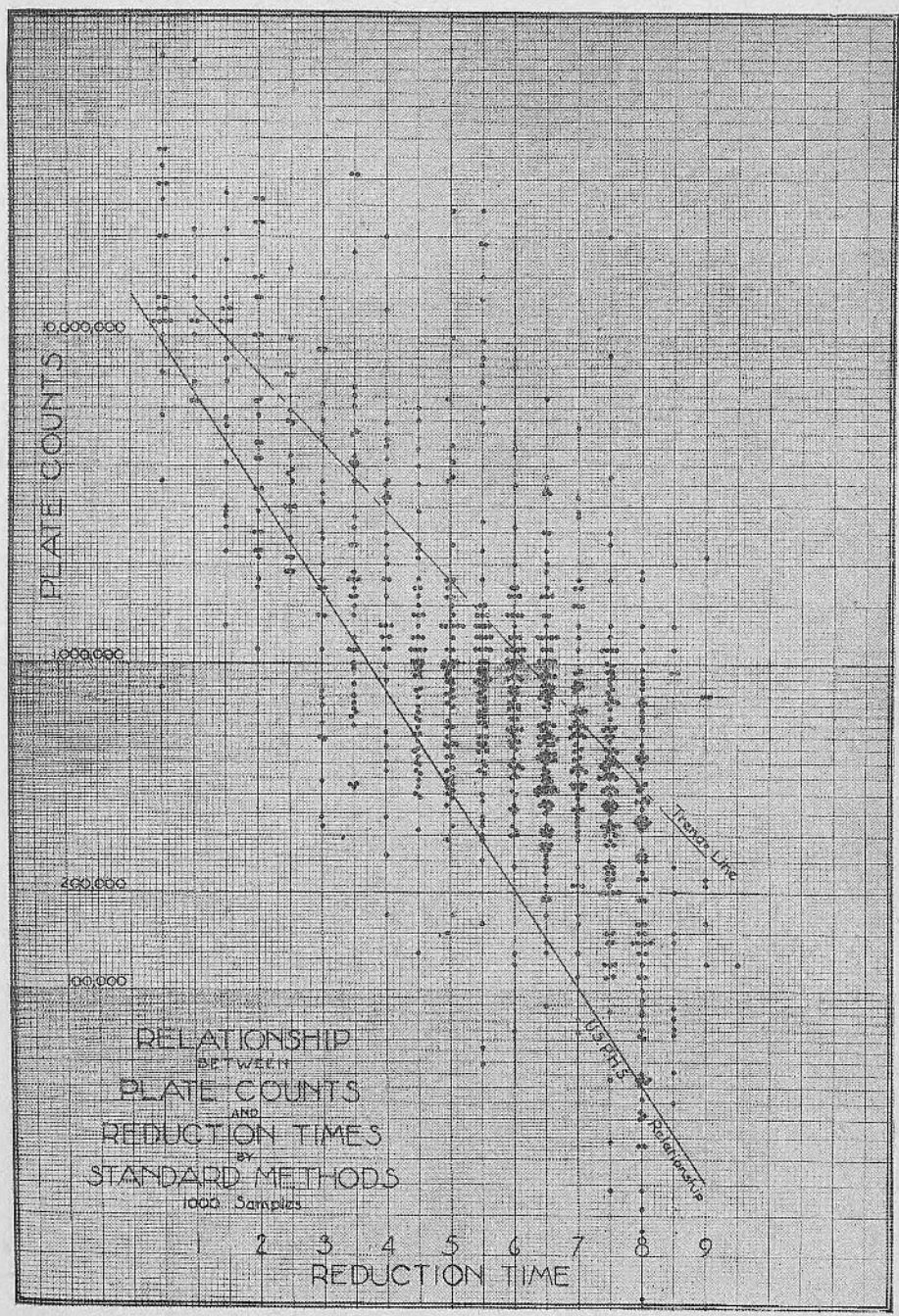


CHART V



1,000,000 or more per ml., and 5 were in excess of 2,000,000 per ml.

The "trend line" for this particular group of 404 sample results indicates that a reduction time of 6 hours was equivalent to a plate count of approximately 850,000 per ml. This deduction is, however, merely a mathematical generalization; the recorded counts of the 31 samples which were reduced at the 6-hour reading ranged from 86,000 per ml. to 2,900,000 per ml.

This chart depicts the effect of heat-resistant organisms upon the relationship between reduction times and plate counts. Approximately 50 samples examined during the three cold weather periods covered by this chart had not been reduced when the last reading was made, and the reduction times were therefore reported as 8+, 8½+, 9+, etc., hours. These indeterminate results have not been plotted, because their exact location on the chart, and their values for mathematical computation, could not be assumed. But, when the findings on these latter samples are included with the 663 results plotted, 72.6 percent of the samples not reduced in 6 hours had plate counts of 200,000 or more per ml. Of the 536 samples with plate counts in excess of 200,000 per ml., the reduction times of 78.3 percent were 6 hours or longer. These two percentage figures mean that approximately 3 out of every 4 raw milk supplies accepted for pasteurization (because of reduction times of 6 or more hours) had plate counts in excess of 200,000 per ml.; and that, of the samples with plate counts over 200,000 per ml., none of which (according to the plate count limitation) were suitable for the production of Grade A Pasteurized Milk, the reduction test passed approximately 4 out of every 5. This is equivalent to an efficiency of about 20 percent.

The "trend line" of the 663 results plotted indicates that a reduction time of 6 hours corresponds to a plate count of approximately 670,000 per ml. This

mathematically computed relationship is of no practical value, however, because it will differ for every group of sample results, and because, in this instance, the plate counts of the 57 samples which were reduced in 6 hours ranged from 20,000 per ml. to 5,900,000 per ml.

The U.S.P.H.S. Milk Ordinance predicates grading upon AVERAGE plate or microscopic counts, or reduction times. In the hope that LOGARITHMIC AVERAGE plate counts and AVERAGE reduction times might conform more closely to the promulgated relationship, Charts III and IV were constructed. Examination of these two charts makes it clear that the averages of plate counts and reduction times of raw milk supplies do not conform appreciably more closely to the promulgated relationship than do the results of the examinations of single samples. The "scatter" of the plotted points is still very striking, although the proportions of supplies erroneously passed as of suitable bacterial quality by the limitation of a minimum average of 6 hours reduction time are somewhat smaller than when individual sample results are considered.

The outstanding indications developed by the data presented on these four charts, and on Chart V, are presented in Table 1.

The percentages presented in Column 7 of this table are rather significant. When it is taken into consideration that the bacterial content—as indicated by plate counts—of these percentages of the samples having reduction times, or of supplies having average reduction times, of 6 hours or more may be in excess of 200,000 per ml., the difficulties and plight of milk sanitarians implemented with only the methylene-blue reduction test to screen out milk supplies unsuitable for pasteurization are readily apparent. The relatively low percentage figures in Columns 2 and 3 appear to justify the assumption that any milk sample re-

TABLE 1

	Number of results	Red't'n time under 6 hours			Red't'n time 6 hours or more			Over 200,000 ml.	
		Plate count under 200,000 ml.	Plate count 200,000 ml.	Plate count over 200,000 ml.	Plate count under 200,000 ml.	Plate count 200,000 ml.	Plate count over 200,000 ml.	Red't'n time under 6 hours	Red't'n time 6 hours or more
		1	2	3	4	5	6	7	8
Chart I	404	7.3	0.4	92.3	19.6	0.6	79.8	63.6	36.4
Chart II	711	12.7	0.7	86.6	25.5	2.0	72.8	21.6	78.4
Chart III	376	1.7	0.4	97.9	20.0	3.2	76.8	79.0	21.0
Chart IV	600	1.7	0.6	97.7	11.8	0.8	87.4	31.9	68.1
Chart V	1000	0.8	0.0	98.2	24.0	1.5	74.5	46.6	53.4

duced in less than 6 hours, or any supply with an average reduction time of less than 6 hours, is likely to have a plate count or logarithmic average plate count, respectively, in excess of 200,000 per ml. This is merely an index of the fact that, when the reduction test is conducted in accordance with the procedure of the eighth edition of Standard Methods, the rejection of milk having a reduction time of less than 6 hours is rarely an injustice to the producer. Such a program would not eliminate nearly all of the high-count milk, however, as is indicated by the percentages in Column 9, particularly when milk produced during cold weather is under consideration.

THE EFFECT OF FAT RE-DISPERSION IN THE REDUCTION TEST PROCEDURE

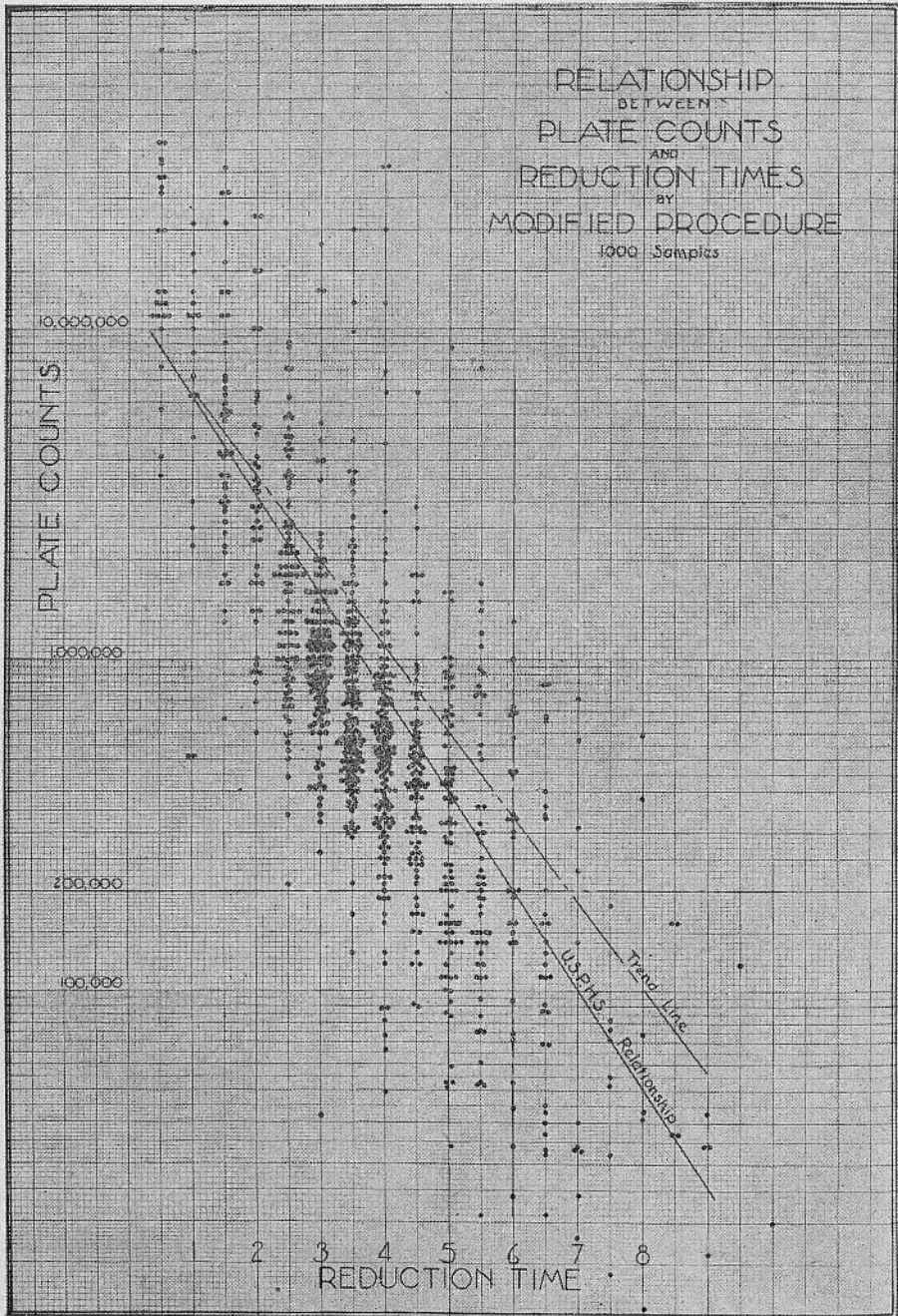
Those experienced in the conduct of the methylene-blue reduction test are aware, or will recall, that the cream layer which forms at the tops of the sample tubes soon after they are set is the first portion of the sample to be decolorized. This phenomenon results from the more rapid reduction of the oxygen in the cream layer because of the greater proportional number of organisms lifted into that area of the sample tubes by the rising fat globules. Since the color, or lack of color, in this area of the tubes is generally dis-

regarded in determining the end-point of decolorization of the samples, it follows that the test, as currently prescribed by Standard Methods, is really the determination of the period required for the reduction of the oxygen in the de-fatted portion of the sample BY THE NUMBER OF ORGANISMS LEFT THEREIN BY THE RISING CREAM. It is obvious that the proportionate magnitude of the numbers of these residual organisms is dependent upon factors entirely unrelated to the bacterial content of the sample, such as the percentage of butter fat in the milk, the relative sizes of the fat globules, the viscosity of the milk, and probably other physical and physiological properties or variations in chemical composition. It is not beyond the limits of probability, in extreme cases, that the residue of bacteria in the de-fatted portion of the sample constitutes no more than half of the number originally distributed quite uniformly throughout the sample.

In order to ascertain the effect of re-dispersion of the fat globules at regular intervals during the incubation period of the test, by gentle inversion of the tubes at each 30-minute reading, samples were split three ways: (1) for a plate count, (2) for a reduction test by Standard Methods procedure, and (3) for a reduction test by procedure modified by inversion after every reading.



CHART VI



The results of this study are presented graphically in Charts V and VI. Chart V does not differ markedly in its characteristics from Chart I, except that the samples with plate counts in excess of 200,000 per ml. are divided more nearly equally between those with reduction times less than 6 hours, and those with reduction times of 6 or more hours. The data on this chart might be considered an extension of the data appearing on Chart I, since the samples were collected during the summer months of 1944. Chart VI includes the same plate counts as appear on Chart V, but they are located differently because of different corresponding

during the warmer seasons—to diagnose nearly all of the supplies with bacterial contents too high for the production of Grade A Pasteurized Milk.

A comparison of the data of Charts V and VI appears in Table 2.

The inversion of the sample tubes after each reading constitutes a drastic innovation in the reduction test procedure. It necessitates the use of tubestoppers, or other means of closure of the tubes, which increases the number of pieces of equipment to be cleaned and sanitized for the conduct of the next tests. The Standard Methods methylene-blue reduction test procedure does not prescribe inversion of the

TABLE 2

	Number of results	Plate count under 200,000 ml.			Plate count over 200,000 ml.			Red't'n time under 6 hours		Red't'n time 6 hours or more			Over 200,000 ml.	
		2	3	4	5	6	7	8	9	Red't'n time under 6 hours		Over 200,000 ml.		
										%	%	%	%	
Chart V	1000	0.8	0.0	98.2	24.0	1.5	74.5	46.6	53.4					
Chart VI	1000	9.6	0.6	89.8	65.6	4.1	30.3	96.5	3.5					

reduction times. The "scatter" of the points on Chart VI is still very considerable, but not so pronounced as on Charts I and V. The most significant feature of Chart VI is the approach of the "trend line" toward the line of the relationship promulgated in the Milk Ordinance. From a practical milk sanitarian's point of view, Chart VI appears to present the solution which has been sought. It will be noted that the plate counts of a large majority (910) of these 1,000 samples were in excess of 200,000 per ml. THE REDUCTION TIMES OF 96.5 PERCENT OF THESE SAMPLES WERE LESS THAN 6 HOURS. This means that the use of the 6-hour reduction time, determined by the modified procedure, will serve—at least

test tubes after the incubation period has started, because, at the time the test was first included in Standard Methods, it was deemed that the difference in results obtained did not justify the additional operations in the conduct of the test. Now, however, data presented in Chart VI appear to indicate rather positively that re-dispersion of the fat in the samples, at regular intervals throughout the incubation period, materially augments the value of the test when it is used in lieu of the plate count. Results obtained in a series of nearly 2,500 sample tests, by Standard Methods procedure, and by the modified procedure, indicates that, in cases in which only one reading is made, to determine whether milk has been reduced in 3





for the Examination of Dairy Products give consideration to the inclusion of this modification in the recommended test procedure.

Since the degree of correspondence between reduction times and plate counts, obtained by the use of the modified test procedure during seasons when thermotolerant organisms are prevalent, or predominate, in milk supplies, has not been determined, it appears highly desirable that studies to that end be undertaken at a number of places, so that experience is not limited to one

type, or a small number of types, of heat-resistant organisms.

#### ACKNOWLEDGMENTS

The studies herein reported were made possible only by the cooperation and interest of Dr. Herman N. Bundesen, President, Chicago Board of Health, and Dr. John L. White, Chief of the Laboratories of the Chicago Health Department, and his staff, and the degree to which they may cover the subject is due largely to the assistance rendered and interest expressed by those who participated in or discussed the nature of the studies during their progress, to all of whom grateful acknowledgment is made.

Mr. A. W. Fuchs informs us that he will request the Advisory Board to reconsider the methylene blue standards in the Public Health Service Milk Ordinance.

—EDITOR.

## Observations Concerning the Methylene-Blue Reduction Test\*

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Since it was first advocated, the methylene blue reduction test has enjoyed increasing popularity as a means of measuring the sanitary quality of milk. While at first used largely for the rapid detection of the poorer grades of milk, its use has more recently been extended to the grading of the better milks as well. For example, the *Standard Milk Ordinance* of the U. S. Public Health Service (23) permits the use of either plate count, direct microscopic count, or methylene blue reduction time as alternative standards, as shown here:

lene blue reduction time has failed to show good correlation with the plate count on the better grades of milk.

It is generally recognized that the two most important sources of inaccuracy in the methylene blue reduction test are:

1. Different reducing intensities of different bacterial species.

2. The sweeping of varying proportions of the bacteria out of the milk by the rising butterfat during the test.

Little can be done to remedy the former; much can be done to minimize the latter by periodical inversion of the

Grade	Log. average plate count per ml. not to exceed—	Log. average direct microscopic count of individual organisms per ml. not to exceed—	Arithmetic average reduction time in hours to be not less than—
A consumed raw	50,000	200,000	8
A to be pasteurized	200,000	800,000	6
B " " "	1,000,000	4,000,000	3½

Again, in *Standard Methods for the Examination of Dairy Products* (2) the suggested standard for Class 1 milk is that it should not be decolorized in 8 hours.

It has been recognized by all investigators that the accuracy of the standard methylene blue test is directly proportional to the bacterial content of the milk. For this reason, Thornton and Hastings (19) stated that they "do not consider the test reasonably accurate after the 5½ hour period as laid down in *Standard Methods of Milk Analysis* (1928). Consequently, it is not surprising that there have been murmurings recently because the methy-

tubes to redistribute the bacteria (5, 7, 8, 19, 24). Where this is done, variations between replicate tubes practically disappear, reduction time of good milks is frequently shortened considerably, and decolorization is much more uniform.

While recognizing the above advantages of periodical inversion, Thornton and Hastings (19) felt that "the test will be most valuable as a control agent when kept as simple as possible." However, they went on to say: "The technique of mixing should probably be introduced in any attempt to correlate the reduction time of good milks with the results supplied by any other method of determining bacterial content." The necessity of minimizing the error introduced by creaming was recognized by Wilson *et al.* (24), and

\* Contribution No. 199 (Journal Series) from the Division of Bacteriology and Dairy Research, Science Service, Department of Agriculture, Ottawa.

their recommendation that tubes be inverted every 30 minutes was accepted by the Ministry of Health in England (11). In January, 1937, the modified methylene blue test replaced the plate count as the official method for testing graded raw milks. (Early in 1944 the same test, carried out on samples held at atmospheric shade temperature until 9 to 10 A.M. of the following day, was substituted for the plate count for heat-treated (pasteurized or sterilized) milks (12).

On this continent opinion as to the desirability of inverting the tubes has been divided. Thornton (17) opposed the adoption of the inversion technique on the grounds that (a) the accuracy of the test is not significantly increased thereby, and (b) the technique is complicated unduly. On the other hand, Frayer (5), Hastings (6) and Johns (7, 8) have all favored its adoption, feeling that it greatly increases the reliability of the test, especially when applied to the better grades of milk. Abele (1), in his recent studies in the Chicago area, has found that the modified method gives results in much better agreement with the equivalent plate count values set up by the U. S. Public Health Service (23). He has therefore recommended to the Standard Methods Committee of the American Public Health Association that hourly inversion of all tubes not showing signs of reduction be specified in the next (9th) edition of *Standard Methods*.

The lack of an exact correlation between plate count and reduction time has been reported by a number of workers during the past 20 years. This is not at all surprising, for although both methods have proven their value in milk control they do not measure the same thing. The methylene blue reduction time is essentially a measure of the reducing activity of the bacteria when grown at 37° C. Some species are known to be much more strongly reducing than others. (Unfortunately, many of the types which

resist pasteurization are weakly reducing.) Furthermore, 37° F. is not the optimum temperature for many of the bacteria found in raw milk. Again, the reduction time is influenced by the state of activity of the bacteria. Where the bacteria are dormant from prolonged refrigeration, they will take longer to reduce methylene blue than when in a more active stage of growth. The state of activity of the bacteria will not be reflected by the plate or direct microscopic counts (9, 24). The error caused by the sweeping of varying proportions of the bacteria to the surface by the rising butterfat has already been referred to.

On the other hand, the plate count merely indicates the number of colonies which develop on a specified medium when incubated at a specified temperature for a definite period. It has long been realized that by varying either the medium, the temperature, or the incubation period, marked differences in count may be obtained. Furthermore, and from the standpoint of milk control of much greater importance, a colony may result from the growth of a single organism or a clump of a hundred or more. Consequently, contamination from utensils, which usually occurs in the form of clumps or sheets of bacteria, is often inadequately reflected by the plate count (20). Thus complaints are sometimes made about the short reduction times of milks showing low plate counts. When such milks are examined microscopically, the inadequacy of the plate count is generally evident, as shown by the few examples from the author's files given in Table 1.

Because the plate count was first in the field, there is still a regrettable tendency to regard it as the infallible yardstick by means of which the accuracy of later tests should be assessed. Those who hold such a view might profitably study the findings reported by Wilson *et al.* in their monograph "The Bacteriological Grading of Milk,"

published in 1935 (24). They remark (p. 150) "After a careful review of the evidence presented in this paper, and of the results of other workers, it is impossible to avoid the conclusion that the plate count is an inaccurate and unreliable method of ascertaining the number of organisms in milk. The technique is complex, subject at every stage to errors, the importance of each

distribution of bacteria have much less effect than in the plate count.

Abele's studies (1) have shown very clearly that the general level of plate counts is much higher than in the equivalent values set up by the U. S. Public Health Service (23). While these equivalent values may have been valid when they were set up,<sup>1</sup> a number of changes have taken place since which have some bearing on the higher level of plate counts. First of all, the substitution of a tryptone-glucose extract milk agar for the old beef peptone agar has resulted in a significant increase in the count. Second, the concentration of dye in the methylene blue test has been increased from around 1:700,000 to 1:244,500 (3). This has prolonged the reduction time by 30 minutes or more compared with the weaker concentration (7, 10, 21). On the basis of the Public Health Service equivalent values, this alone would mean an increase in count of 50 percent or more for a given reduction time. Thirdly, as a result of the extensive studies on the influence of variations in incubator temperatures initiated at the Geneva, N. Y., Experiment Station (16), much greater care is now taken to see that temperatures do not exceed 37° at any point in the incubator. Consequently, unduly low counts due to "hot spots" in the incubators are much less frequently encountered than 10 to 20 years ago. Finally, we have the much greater number of milking machines in use today. While the milking machine, when properly cared for, can produce milk as low in count as the most careful hand milking, on all too many farms it fails to receive adequate attention. Such machines are responsible for a large proportion of the milk supplies containing excessive numbers of thermoduric organisms. As previously indicated, many of these are weakly

TABLE 1

RELATION BETWEEN PLATE COUNT, DIRECT MICROSCOPIC COUNT OF INDIVIDUAL CELLS, AND METHYLENE BLUE REDUCTION TIME OF PATRONS' MILKS

<i>Methylene blue reduction time in hours</i>	<i>Standard plate count per ml.</i>	<i>Direct microscopic count per ml.</i>
1¼	43,000	16,000,000
2¼	160,000	6,100,000
3	390,000	19,000,000
3¾	78,000	6,700,000
3¾	210,000	5,800,000

of which it has been the purpose of this inquiry to assess. The final result, which even with a standard technique is correct only within wide limits—estimated at  $\pm 90$  percent—bears no constant relationship to the total number of bacteria either alive or dead, in the sample. As a figure, therefore, it possesses no special significance, and its value is purely relative." Similar striking evidence of the variability of the plate count was presented by Tiedeman in 1933 (22). It should thus be evident that failure of the methylene blue reduction time to agree with the plate count may often be due to the inherent inaccuracy of the plate count itself.

One of the causes of variability in the plate count is the uneven distribution of the bacteria in the milk. When raw milk is plated out on a 1:1,000 dilution the count obtained is really based upon the examination of only 1/1000 ml. of milk. In the methylene blue reduction test, the results are based upon the examination of ten thousand times as large a quantity of milk, hence variations due to uneven

<sup>1</sup> Thornton (18) states they have never held good in Alberta, while Orla-Jensen's (15) classification regarded a reduction time of over 5½ hours as the equivalent of less than 500,000 per ml.

reducing, and thus take longer to effect reduction of methylene blue than do most species.

There appears to be little doubt that the factors referred to have distorted the previously accepted relationship between methylene blue reduction times and plate counts to a serious degree. It seems not unlikely that the lengthening of reduction time resulting from the increase in dye concentration will be more than compensated for by the shortening of the reduction time of the better class milks as a result of inversion (8). However, in view of the many changes which have occurred since the equivalent values for plate counts and reduction times were established by the Public Health Service, it would seem desirable that the latter organization investigate the situation with a view to establishing, if necessary, a new set of equivalent values.

Criticism has also been leveled at the methylene blue reduction test because milk which has been passed by this test has shown high plate counts after pasteurization. It should be remembered that the plate count on pasteurized milk is primarily an indication of the number of heat-resistant bacteria present in the raw milk, together with varying numbers picked up from the equipment, etc., subsequent to pasteurization. None of the tests available today can tell us which raw milks contain excessive numbers of heat-resistant bacteria. This can only be discovered by laboratory pasteurization and subsequent enumeration of the survivors by either the plate count or one of the modifications developed for this purpose (4, 13, 14).

The methylene blue reduction test has been extremely useful in bringing about improvement in the quality of milk. Unfortunately in some areas its use has been extended beyond the point where reasonable accuracy can be expected with the old technique. With the recent decision to adopt the inversion technique as the standard procedure the range of the test has been

appreciably extended, and it seems probable that much of the present dissatisfaction with the test will disappear.

## REFERENCES

1. Abele, C. A. Symposium on Methylene Blue Reduction Test. 32nd Ann. Conv., I.A.M.S., Chicago, Nov. 3, 1944. See this *Journal*, p. 67.
2. American Public Health Association. *Standard Methods for the Examination of Dairy Products*, 8th ed., 1941. New York, N. Y.
3. Breed, R. S. Report of Standard Methods Committee on Milk and Milk Products. *Amer. J. Pub. Health*, **34**, 894-895 (1944).
4. Dotterrer, W. D. Heat Resistant Organisms in Milk Supplies. *J. Milk Tech.*, **6**, 269-271 (1943).
5. Frayer, J. M. Dyes and Methods as They Affect the Methylene Blue Test. *Vt. Agr. Expt. Sta. Bull.* 424, 1937.
6. Hastings, E. G. Methylene Blue Test. *Wisconsin Circular* 316, 1941.
7. Johns, C. K. Concerning the Accuracy of the Methylene Blue Reduction Test. *J. Dairy Science*, **21**, 227-237 (1938).
8. Johns, C. K. Factors Influencing the Reduction of Methylene Blue in Milk. *Sci. Agr.*, **19**, 435-457 (1939).
9. Johns, C. K. Measuring the Bacteriological Quality of Milk. *J. Milk Tech.*, **2**, 175-180 (1939).
10. Johns, C. K. The Lengthening of the Reduction Time in Milk with the New Standard Methylene Blue Solution. *Can. Pub. Health Jour.*, **31**, 155-158 (1940).
11. Ministry of Health (England and Wales). Memo 139/Foods, 1937.
12. Ministry of Health (England and Wales). The Treated Milk (Prescribed Tests) Order, March 23, 1944.
13. Moldavan, A. Simple Multi-Loop Method Speeds Bacterial Counts. *Food Ind.* **5**(6), 56-57 (1943).
14. Myers, R. P., and Pence, J. A. A Simplified Procedure for the Laboratory Examination of Raw Milk Supplies. *J. Milk Tech.*, **4**, 18-25 (1941).
15. Orla Jensen, S. *Dairy Bacteriology*. London: J. & A. Churchill, 1921.
16. Pederson, C. S., Yale, M. W., and Eglinton, R. Temperature Variations in Bacteriological Incubators. *New York Agr. Expt. Sta. Tech. Bull.* 213, 1933.
17. Thornton, H. R. A Comparison of the Standard with the Modified Methylene Blue Reduction Technic. *J. Dairy Sci.*, **20**, 693-703 (1937).
18. Thornton, H. R. Personal communication, Oct. 10, 1944.
19. Thornton, H. R., and Hastings, E. G. Studies on Oxidation-Reduction in Milk. The Methylene Blue Reduction Test. *J. Dairy Sci.*, **13**, 221-244 (1930).

20. Thornton, H. R., *et al.* Milk Contamination and the Methylene Blue Reduction Test. *Can. Pub. Health J.*, 25, 284-294 (1934).

21. Thornton, H. R., and Sandin, R. B. Standardization of the Methylene Blue Reduction Test by the Use of Methylene Blue Thiocyanate. *Am. J. Pub. Health*, 25, 1114-1117 (1935).

22. Tiedeman, W. D. An Extensive Test

of Variations in Bacterial Counts on Identical Milk Samples. *Internat. Assoc. Dairy and Milk Inspectors, 22nd Ann. Rep.*, 225-236, 1933.

23. U. S. Public Health Service. Milk Ordinance and Code. *Public Health Bull.* 220, 1939.

24. Wilson, G. S., *et al.* The Bacteriological Grading of Milk. *Med. Res. Council (London). Spec. Rept.* 206, 1935.

### NEW FOOD RESEARCH INSTITUTE

A new service organization, the Institute of Nutrition, has been established at Michigan State College. The Institute's prime function is a close coordination and integration of instruction and research in nutrition and foods. This is being done by crossing departmental lines and by bringing all teachers and investigators in the field of food and nutrition together. The teaching and research program of the Institute includes all phases in the production, processing and consumption of foods by man and animal. The agricultural background of the staff, together with their basic training in the sciences, offers an excellent approach to all food problems. Many processing problems have their inception on the farm. The Institute has a staff trained for all phases of production to consumption.

The Institute supplies a contact between industry and college research groups to further research in foods and nutrition. It invites the food industry to bring their problems to the College, and it will bring the results of research to the food industry and to the public by direct contact and publications. It in no sense competes with or supplants the research of the Experiment Station but rather supplements the activities of the latter.

An administrative committee of seven directs the Institute. Its mem-

bers are R. C. Huston, Dean of the Graduate School; V. R. Gardner, Director of the Agricultural Experiment Station; C. L. Cole, Professor of Animal Husbandry; C. A. Hoppert, Professor of Biochemistry; Margaret A. Ohlson, Professor of Food and Nutrition; W. L. Mallmann, Professor of Bacteriology and Public Health; and C. F. Huffman, Professor of Dairy Nutrition, Chairman.

The objectives of the Institute are: (1) to better establish Michigan State College as a research center of foods and nutrition; (2) to provide an organization for graduate training in food, nutrition and food technology, and (3) to better serve the consumer, the farmer and the feed and food industries.

Several problems of interest to the dairy industry and the dairy sanitarians are already under way. The National Dairy Council has made a grant of \$13,750 for the current year to study the health and milk production of dairy animals and the nutritive value of the milk as influenced by the fertility of the soil on which the feed is grown. The direct object of this investigation is to determine the relative effect of feeds grown on depleted soil and on soil in a high state of fertility on the health, milk production, reproduction and nutritive value of the milk of dairy

(Continued on page 88)

## Efficient Refrigeration in the Dairy Plant

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THE dairy technologist is primarily and properly interested in the quality of dairy products. While quality control starts on the farm, we shall not concern ourselves with that phase of the problem in this article but rather with what takes place in the dairy, ice cream, butter, or cheese plant. It is here that refrigeration plays an important part in such processes as cooling after pasteurization and ice cream freezing as well as to provide refrigerated storage to prevent spoilage and to make ice for the transportation of the product. Adequate and properly controlled refrigeration is essential for low bacteria count, avoiding freezing of milk, and for the desired texture of ice cream. The refrigerating plant must be large enough and flexible enough to meet these various demands. Judicious staggering of different processes requiring cooling will keep the size of refrigeration plant and the energy demand to a minimum.

The dairy technologist is also interested in production costs of which refrigeration is a considerable item. The refrigeration cost is made up of fixed charges such as interest, depreciation, and insurance which are functions of the installation cost, plus labor, repair parts, and chemicals, and finally plus the cost of energy to run the plant. It is this last item that will now be discussed.

The curves in Figure 1 give the performance of an average ammonia compressor. Curves of similar shape but having different numerical values may be constructed for other refrigerants such as Freon 12. We can draw the following conclusion from these curves:

1. The HP/ton, i.e., the energy for a given quantity of heat removed, increases sharply as the evaporator temperature (the low temperature of the plant) is reduced.
2. The HP/ton increases sharply as the discharge pressure is increased.
3. The CFM\*/ton increases sharply as the evaporator temperature is reduced. This means for a given rate of cooling, a larger compressor and driving motor are required at low cooling temperature than at a higher cooling temperature.
4. The CFM/ton increases slightly as the discharge pressure increases.
5. As a corollary of No. 3, an increase in the refrigeration load will result in a higher cooling temperature, and a decrease in a lower cooling temperature, unless the plant capacity is readjusted by starting another compressor, by changing speed, or by other capacity adjusting means.

From the above conclusions the following simple basic rules are formulated for keeping energy requirements to a minimum:

1. Operate at lowest practical head pressure.
  - a. Provide adequate condensing surface.
  - b. Use coldest condensing water available in liberal quantity.

\* Cubic feet per minute.

- Scarcity of water, high cost, or inadequate drainage may dictate reduced quantity or use of cooling tower, spray pond, or evaporative condenser.
- c. Keep condensing surface clean and free from scale.
  - d. Keep system free of noncondensable gas. (Purge.)
2. Operate at highest possible evaporating temperature.
    - a. Provide adequate cooling surface.
    - b. Keep cooling surface clean of oil on ammonia side and clean of ice, etc., on other side.
    - c. Avoid restrictions in suction line. Back pressure valves may be employed for temperature regulation and are a most effective control means. They do, however, violate this rule for highest efficiency.
    - d. Balance compressor capacity closely to the load. (Refer back to conclusion number 5) —To attain highest efficiency with fluctuating loads, the plant must be very flexible. Capacity control means include multiple compressor units, speed adjustment, and control attachments to the compressor such as clearance control, cylinder by-pass, or holding suction valves open. Such attachments have rather large losses so that their use does not give the full saving one could expect from the rise in evaporator temperature. In practice it is not possible to provide enough flexibility for operation at optimum conditions at all times.
    - e. Use direct expansion equipment. The use of chilled water or brine entails an extra temperature split and results in lower evaporator temperature.
    - f. Where cooling to various temperature levels is required (example milk cooling and ice cream freezing), provide compressors for each level so as to operate at highest efficiency for each temperature.
    - g. Cool product or space to temperature no lower than necessary.
  3. Keep refrigeration requirements to a minimum.
    1. Provide adequate insulation.
    2. Cool product as low as possible by regeneration cycle in pasteurizing (incoming cold raw milk cools hot pasteurized milk) or by water before using mechanical refrigeration.

Power costs are usually not on an energy charge alone. Usually there are demand charges or connected horsepower charges and there may even be reductions for consumption during off peak periods. If power is made instead of purchased (steam or oil engine), the investment charges will tend to give a picture similar to that for purchased power. (Saving in labor cost by confining operations to one shift may modify the above cost picture.) There is therefore an inducement to leveling out the refrigeration requirements as far as possible over the 24 hour day or even carrying higher loads during off peak periods. This means scheduling various operations so as not to overlap. The nearer an even demand can be kept over long periods with no sharp peak loads, the smaller will be the needed refrigeration plant. As an aid to this end, such loads as milk cooling may be by chilled water stored in the form of ice frozen during off peak periods. The regular ice production may also be concentrated for the off peak load; however, while this saves in first cost of compressors and condensers it does call for a larger ice making tank.



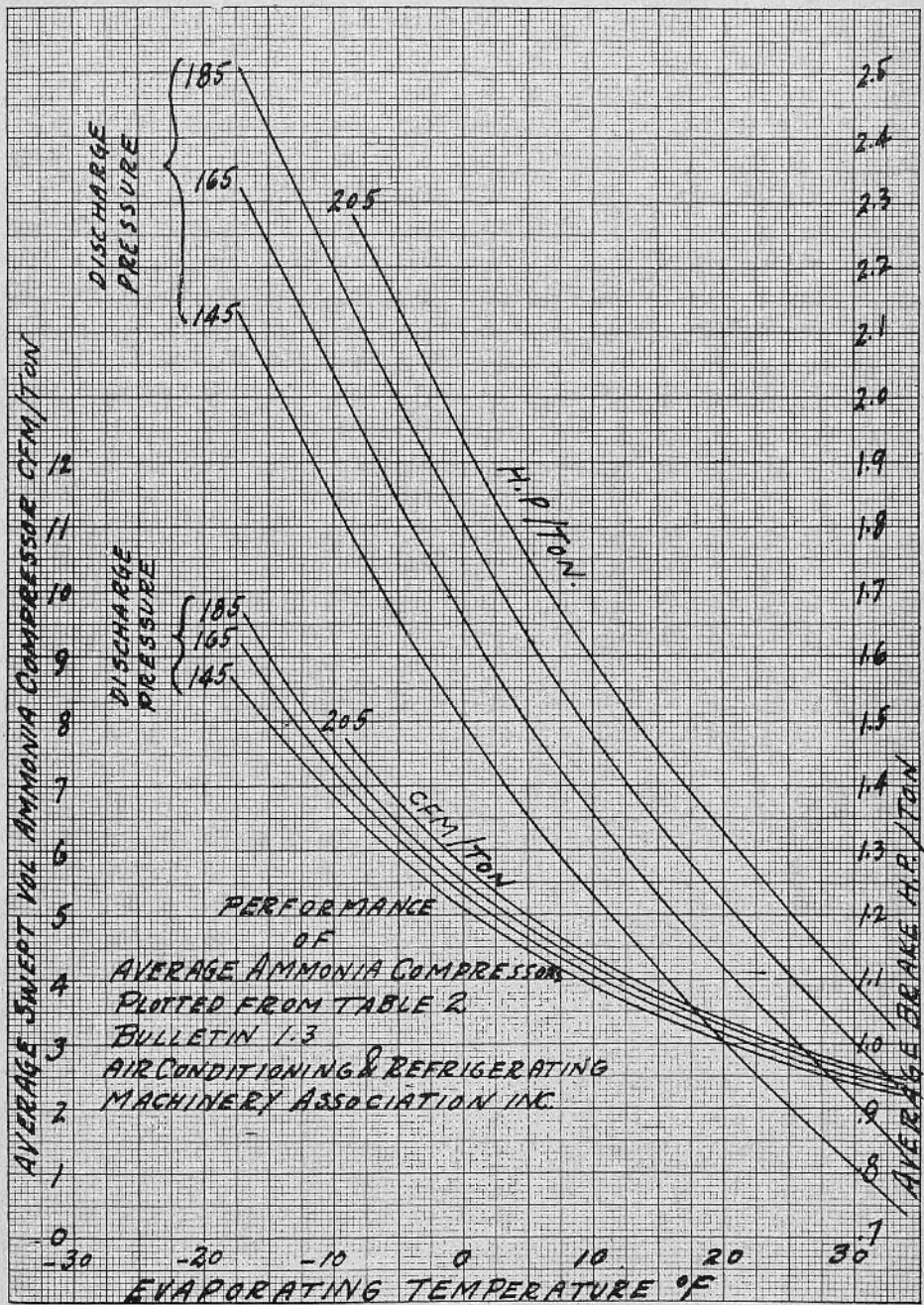


FIGURE 1

The above discussion is admittedly one-sided. The milk does not enter the plant in an even flow through the 24 hours nor are shipments made at such an even rate. The most economical employment of labor may dictate an entirely different working schedule. Quality control of the product comes before any consideration of slight savings. Cleanability or some considerations entirely aside from refrigeration may make chilled water cooling, for instance, preferable to direct expansion. The plate heat-exchanger for short-time pasteurization which is not available for direct expansion is a case in point. However, consideration of the problem from one viewpoint alone dis-

regarding all modifying factors may serve toward a better understanding of the problems involved. Finally, of course a compromise must be made considering everything. This compromise will not be the same for all plants. In a small installation, for instance, the same flexibility can hardly be provided as in a larger one.

One point deserves special re-emphasis. That is, that the refrigeration equipment should be balanced against the load. The plant of course must be large enough to handle the load else spoilage will result. An over-size refrigeration plant is very wasteful of power. Stand by equipment is always desirable.

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## NEW FOOD RESEARCH INSTITUTE

*(Continued from page 84)*

cows and of their offspring for several generations. A 208 acre farm has been rented for a ten-year period especially for these studies. Every facility of the research staff of the College will be brought into the picture through the Institute so that every phase of the problem will be handled by men trained for their particular phase of the study. This is evidenced by the personnel of the committee in charge which is made up as follows: C. E. Millar, Professor of Soil Science; James Tyson, Associate Professor of Soil Science; C. M. Harrison, Associate Professor of Farm Crops; S. T. Dexter, Associate Professor of Farm Crops; Earl Weaver, Professor of Dairy Husbandry; Margaret A. Ohlson, Professor of Foods and Nutrition; and C. F.

Huffman, Professor of Dairy Nutrition.

Another project of interest to the dairy sanitarian is a study of various chemical agents used in the sanitization of dairy utensils on the farm. Both machine and hand milking procedures will be studied under farm conditions. Comparative studies will be made of the various recommended procedures along with some new proposed methods. An industrial grant of \$2,500 has been made to aid in these studies.

The Institute receives aid for its maintenance from the College, and it is hoped that industry trade associations and agricultural organizations will provide grants for research and industrial fellowships so that the scope and extent of the work may be materially increased.

## Coliform Organisms in Dairy Products and Their Control\*

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THERE is a group of bacteria scientifically known as *Escherichia-Aerobacter* group and more commonly spoken of as the coli-aerogenes group or the colon group and in more recent years as coliform organisms. With the advent of inspection of milk and other dairy products by military agencies this group of organisms has assumed a significance never before attained in connection with their presence in dairy products. *Escherichia* and *Aerobacter* are both genus names and under each are listed several species. In order to clarify this division, the type species of each of the above genus will be discussed.

An organism was isolated from feces in 1886 by Escherich and it was later named *Escherichia coli* to honor the discoverer and to give some information regarding the organism. The organism is quite commonly present in the intestinal tract of man and most animals. Whether or not it ever occurs in nature without fecal contamination is an unsettled question. It will grow to some extent outside of the body, but it does not seem to be common in unpolluted soil and water. Its presence in water is universally regarded as being indicative of sewage pollution. Such water is considered unfit for human consumption, not because *Escherichia coli* itself possesses marked pathogenic powers but because its presence indicates sewage pollution and the possible presence of disease-

producing organisms, such as the typhoid bacillus.

*Aerobacter aerogenes* also was first described by Escherich in 1885. Like *Escherichia coli* it is frequently found to be present in the intestines of man and animals. It differs from *Escherichia coli*, however, in that it is not uncommon in nature outside the intestinal tract. It is commonly found in soils and grains. It is not known to cause disease. It is frequently confused with *Escherichia coli* and unfortunately so since it does not have the sanitary significance of *Escherichia coli*. At the present time it seems to be generally accepted that members of the genus *Escherichia* are significant in indicating fecal contamination while the presence of the *Aerobacter* is of doubtful significance in this respect since its presence may or may not indicate fecal contamination.

Acute infections of the udder caused by the colon organisms have been observed which cause the milk to become abnormal in appearance. The milk may contain millions of colon organisms per cubic centimeter. The coliform organisms grow well in milk. Milk pails, milking machines, and other equipment which have not been properly washed and sterilized provide excellent places for them to grow. There seems to be a close relationship between the number of coliform organisms in milk and its keeping quality. Milk of a relatively low bacterial count may show poor keeping quality due to a high proportion of the bacteria present being of the coliform group.

\* Paper presented at Florida Dairy Products Association War Problems Conference, Jacksonville, Florida, June 15-16, 1944.

Ropiness in milk and cream frequently is the cause of considerable loss in the dairy industry. In many instances this condition has been traced to coliform organisms, particularly *Aerobacter aerogenes*. Feeds are known to be the source of the organisms causing ropiness, and organisms of the *Aerobacter* group are almost always present in feeds.

Gasiness in cheese is a problem particularly in raw milk cheese. Organisms of the coliform type have been found to be the cause of this trouble in many instances and are responsible for certain off-flavors.

Organisms of the genus *Aerobacter* are practically always present in cream used for butter making. While these organisms are destroyed by pasteurization, recontamination is responsible for much defective butter. Experiments have shown that organisms of the *Aerobacter* type usually can be isolated from off-flavored butter. These same organisms put back into the cream before churning will cause the off-flavor to be reproduced.

In the manufacture of ice cream, the cream, milk, and butter used often contain large numbers of coliform organisms. While some few strains of these organisms resist pasteurization in ice cream mixes at 145° F. for 30 minutes, few can withstand the higher temperatures of 155°-160° F. commonly used for ice cream mix.

Improperly sterilized equipment often is a source of recontamination of mix after pasteurization. Fruits, nuts, colors, and extracts frequently are serious sources of recontamination unless special precautions are used. While it frequently is not done, it is desirable to treat all materials added to the mix after pasteurization in such a manner as to eliminate all danger of contamination from this source.

All dairy products in the raw or unpasteurized condition may show the presence of these organisms. Their numbers, however, should be small because good sanitary practices will

keep the total number of bacteria at a low point. That these organisms normally are present even in high quality raw milk is testified to by the fact that the regulations governing the production of certified milk permit up to 10 coliform organisms per cubic centimeter in the raw product.

The sanitary significance of coliforms in milk and other dairy products depends almost entirely on whether the milk is raw or pasteurized. Most workers on this subject are in agreement that the presence of coliform organisms in water indicates sewage pollution and that such water is unfit for drinking. Experience and research has shown that the presence of coliform organisms in raw milk in most cases simply means that there may have been a certain amount of contamination with animal feces.

Certain workers have shown that the growth of these organisms in milk and on utensils makes for an incorrect interpretation of the results of the test for these organisms and that more often than otherwise the high coliform counts in raw milk are due to growth on utensils and in the milk rather than from direct manurial contamination. While the coliform test is not an acceptable sanitary index for raw milk, the conditions which are responsible for the presence of these organisms in fresh raw milk are undesirable.

Organisms of this type in pasteurized milk present an entirely different view of the picture. There seems to be some disagreement in the results of various workers as to whether these organisms survive pasteurization. Some operators who are looking for excuses have welcomed the information that in certain experiments a small percent of the coliform organisms survived ordinary pasteurization exposures. In well managed and operated plants coliform organisms are seldom recovered from 1 c.c. quantities of freshly pasteurized milk.

Most workers on this subject agree that the presence of coliform organisms

in bottled samples indicates recontamination following pasteurization. The presence of the organisms in bottled samples may be due to heat-resistant strains, faulty pasteurization, recontamination, or growth in the bottled milk. When a positive test is obtained on bottled milk, a line test should be made in the plant where the milk was bottled. The number of these organisms may vary greatly in bottled milk. In case of contaminated equipment, the first milk bottled may show much greater counts than the milk bottled later in the run.

If tests on the bottled milk show the presence of the organisms then the next step is to find where the organisms are coming from in order to eliminate them from subsequent runs of milk. Samples should be taken from pasteurizer at the end of the holding period and at several other places after the milk has passed over or through the various pieces of equipment after pasteurization. With the results of these tests it usually is possible to detect the cause of the trouble and eliminate it. Naturally, the small plant without laboratory facilities can not make these tests and such plants must rely on extra effort in washing and sanitizing their equipment when a sample of their bottled milk has been found to be positive to the coliform test.

From the public health standpoint it is assumed when freshly pasteurized milk is positive to the coliform test that it was either improperly pasteurized or that it may have been recontaminated by careless handling after pasteurization.

The washing and sterilizing processes are of utmost importance. Thorough washing with hot water containing a good washing powder, using suitable brushes, followed by a good rinse prepares the equipment for sterilization. The sterilization process may be accomplished by any approved method and should be done just before

the milk is put into the system. Unfortunately, the most careful attention to sanitation and sterilization occasionally fails to produce milk which will react negatively to the coliform test. In some instances carelessness is the chief cause but more frequently a lack of knowledge by the operator or the use of faulty or worn equipment is responsible for the presence of the organisms in pasteurized milk. Pasteurizing vats, valves, pumps, coolers, pipe lines, and bottle-filler valves frequently are found to be the source of the contaminating organisms. In one instance a small pocket on the under side of a surface cooler due to faulty construction was found to be contributing large numbers of coliform organisms to otherwise properly pasteurized milk. A line test had traced the contamination to the cooler, and a careful examination of the cooler revealed the focal point of contamination. Repairs were made and the trouble disappeared.

Old style milk pumps often are sources of contamination and even the newer pumps must be properly cared for or they may cause trouble. Dust from a field where livestock is grazing may carry the organisms into the milk by way of an uncovered cooler. Draining the rinse water from the bottling valves with the hand just before bottling may contaminate an otherwise well sterilized bottle filler. A clean sterile bottle should be used for this purpose. When bottles are put on the machine by hand care should be taken that the hand does not touch the top of the bottle.

These are only a few of the many places to look when trouble occurs. Each plant will have slightly different problems depending on the equipment used. After every precaution has been taken for the proper handling of milk and trouble still persists, a thorough study should be made of the individual problem. A very small pocket of contamination can cause much trouble. Usually it can be located and remedied

if it is realized that so great a trouble can be caused by a small source of infection.

If the reader desires to learn more about the significance of this group of organisms or to learn the methods used to examine milk and other dairy products for their presence he is referred to the following book: *Standard Methods for the Examination of Dairy Products*, 8th Edition, published and sold by the American Public Health Association, 1790 Broadway, New York, New York.

The charts accompanying this article illustrate in a diagrammatic way the methods used in the laboratory to demonstrate the presence of coliform organisms in milk, cream, and certain other dairy products.

Figure 1 shows the steps necessary when the presumptive test is performed in such a way as to determine the probable number of organisms per 100 cubic centimeters of milk. In this test either of two methods may be used as illustrated. In one method a liquid

medium (broth) is used and gas formation (10 percent or more) indicates a positive presumptive test. In the second method the milk is plated on a solid differential medium. The plates are incubated and if typical colonies are observed a positive presumptive coliform test is indicated.

Figure 2 shows the steps necessary to complete the test for coliform organisms in these dairy products. If the liquid medium was used in the presumptive test then the test is completed by following the steps shown on the upper part of the chart. If solid medium was used in the presumptive test then the steps shown on the lower part of the chart are followed.

Perhaps it should be explained that in routine control work in the milk plant usually only 1 to 3 tubes are used and rarely is it necessary to complete the test for coliform organisms as illustrated in Figure 2. The technic outlined however is one that should be understood by every worker in a milk control laboratory.

Figure 1.

PRESUMPTIVE TEST FOR COLIFORM ORGANISMS IN MILK, CREAM, ETC.

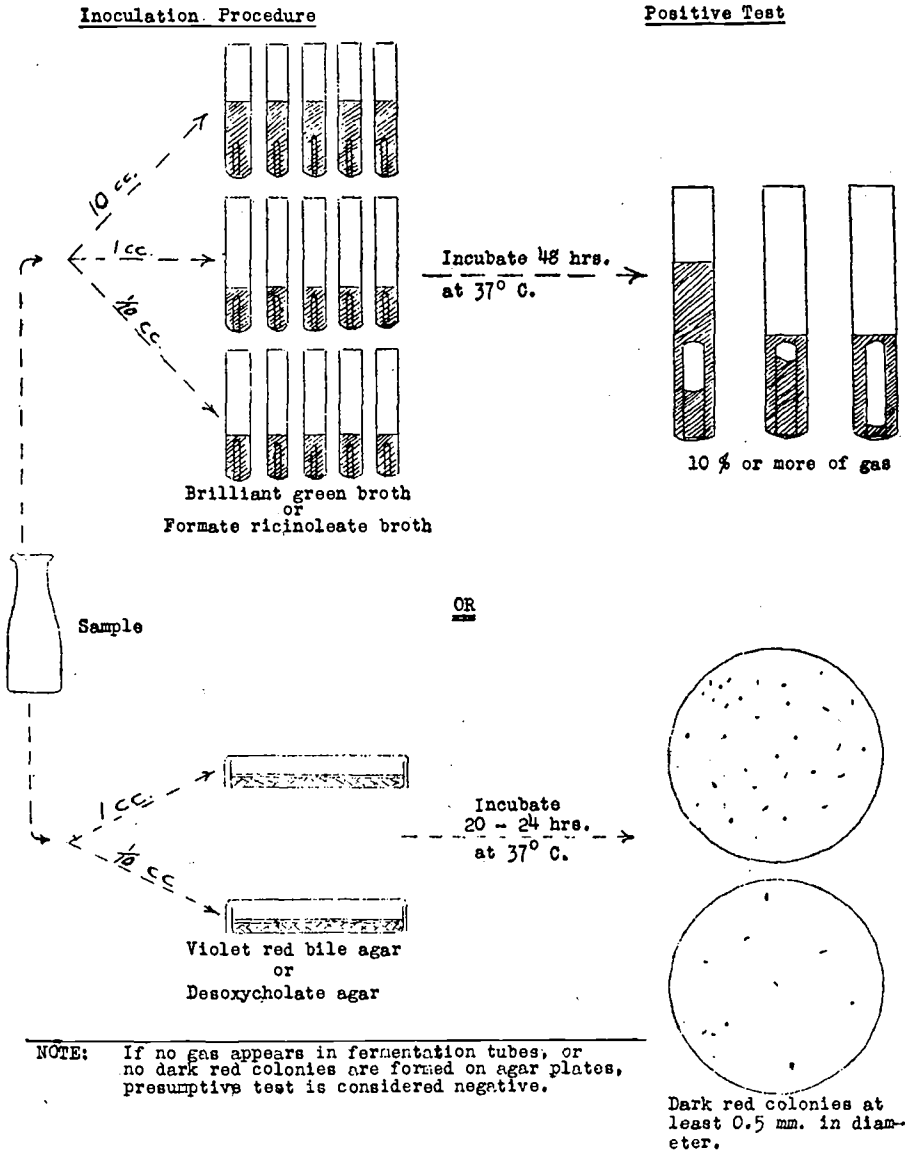
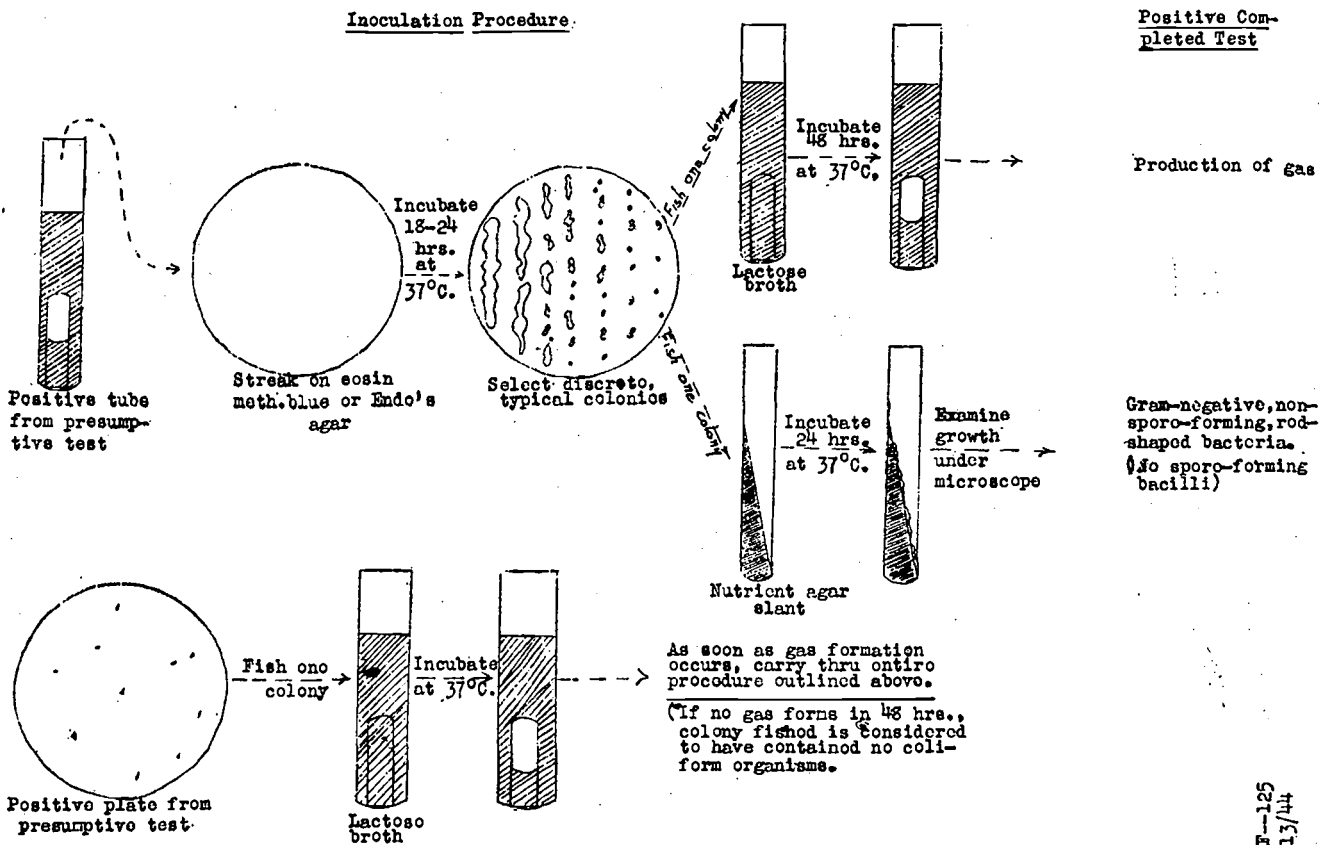


Figure 2.

COMPLETED TEST FOR COLIFORM ORGANISMS IN MILK, CREAM, ETC.

Inoculation Procedure.





## REPORT OF COMMITTEE ON DAIRY FARM METHODS

The Committee on Dairy Farm Methods has undertaken certain studies pertaining to the "cleaning and sterilization" of milking machines.

Over a period of many years, a great deal of research has been conducted by a number of our colleges, manufacturers of equipment and supplies, and others to determine proper procedures in care of milking machines.

Several methods have been developed which appear to give satisfactory results if properly carried out. Several members of the Committee feel that while new improved procedures are a definite possibility, a great improvement could be made if known procedures were followed more carefully.

In spite of proper directions, in many parts of the country one may find the milking machine hanging in one corner of a dirty barn with no facilities for its care. In many areas, perhaps the more urgent question is not lye vs. chlorine storage nor wetting agents vs. the usual cleansers, but rather a milk house equipped with wash vats, hot water, storage racks, brushes and any of the accepted cleaning and bactericidal agents vs. no facilities. If the only facilities are a dish pan in the kitchen, neglect is more likely. This situation is especially urgent in smaller communities having no milk control personnel and located in states with inadequate laws and personnel.

Satisfactory results are being obtained in many places where facilities are adequate, using the general run of cleansers followed by lye storage, chlorine storage, heat sterilization, or by dry storage.

Recent studies indicate that wetting agents are not a single, definite product but a group of products with many and varied chemical structures, properties and potentials. These studies offer defi-

nite possibilities that may change recommended procedures.

There is some apparent controversy over sanitization procedures as recommended by manufacturers of milking machine equipment. This is evidenced by recommendation, or lack of it, accompanying machines. It is further shown in instructions given purchasers by salesmen and local agents or dealers. Some of our more responsible manufacturers are doing a splendid job of instruction through schools and demonstrations conducted among salesmen, agents, and milk producers. This is not only helpful to the cause of milk sanitation, but is also sound merchandising and seems certain to reflect in the acceptance of their products. It is hoped that this type of service will be offered by all.

In spite of personnel shortages and overloaded schedules, a few members of the Committee have given study in the field to several aspects of milking machine sanitation. An outline of study was arranged by the previous chairman of the committee and assigned to members for field investigation. The following four items were suggested:

- Polyphosphates vs. Lye Storage
- Chlorine vs. Lye Storage
- Dry Storage vs. Certain Types of Wet Storage
- Wetting Agents vs. Ordinary Cleansers

The City Health Department of Des Moines conducted brief studies covering lye vs. chlorine storage. Ten producers cooperated in this series. Each was equipped with standard wash vats, adequate hot water facilities, brushes, and a balanced cleanser with wetting agent included.

For five consecutive days, each producer used lye storage. Following a

two-day interval, the same producer used chlorine storage for five days. The plate counts were so nearly even that the only conclusion that could be reached was that the methods were equally effective. Likewise, there appeared to be no advantage for either method insofar as thermoduric counts were concerned.

Assessing results of field studies conducted under direction of Dr. Hopson, of the DeLaval Company, covering about twenty farms, indicates satisfactory bacterial count results whether rubber parts are stored in chlorine, lye, or dry storage. Results are likewise comparable whether the bactericidal process is by hot water, chlorine, or lye. The bactericidal treatment and storage was preceded by the practice of cleaning with brushes and the usual available cleaning compounds. Bacterial counts were taken monthly during July, August, September, and October of this year, 1944.

L. E. Bober, Babson Company, has conducted extensive studies during the past several months covering various phases of milking machine sanitation. Because of the scope of his studies, tabulations are not complete for this report; but will be added later for publication. The over-all results, how-

ever, do coincide with the above conclusions. They further emphasize the importance of applying known recommended procedures. The simple procedure of disassembling, washing and brushing with available cleansing powder in hot water appears to be the most important single factor. It must be taken for granted that the milking operation be followed immediately by rinsing.

One especially interesting, and perhaps unexpected, result of these studies is indicated in the time element in cleaning. Better results were obtained by those doing the sanitization process in 20-30 minutes than by those taking 40-45 minutes.

Another important factor is the item of attitude. Those with the "just get by" attitude were invariably bad. The thermoduric rate was also high in this group.

Human nature being what it is, the paramount question seems to be, "How may milk producers be induced to follow known satisfactory procedures?"

A premium offered for quality milk is, of course, an incentive. For the greater proportion of producers, education is of prime importance. For those who "will not educate," rejection and revocation of permits may be the final answer.

## The Effect of Temperature on Coliform Organisms in Milk and Cream\*

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IN 1941 and 1942, Robinton, Borman, and Mickle (1, 2) made a study of market cream in Connecticut, and noted that not only were the total bacterial counts of this product extremely high, but also that coliform organisms were present in approximately 50 percent of the pasteurized samples. Further inquiry into this problem has revealed little experimental data within recent years. However, a study of the earlier literature has shown that in the period from 1896 to 1910 several investigators reported many interesting facts concerning bacterial counts of cream.

Conn (3, 4) was the first to contribute to this study, emphasizing the fact that cream even when held at ice box temperatures for short periods of time, showed considerable increase in the total numbers of organisms present. He stated that the numbers of bacteria in cream were far in excess of any other "natural medium." Pennington (5) in 1908 made a study of milk and cream held at ice box temperatures and reported that an increase in the numbers of organisms was obtained. Swithinbank and Newman (6) in 1903 reported that cream contained

more bacteria than the milk from which it was separated and suggested that this was due to a film of organisms acquired as the cream was exposed to the air or that as the fat globules rose they carried the organisms present to the top. Ravenal, Hammer, and Hastings (7) in 1910 reported that samples stored at 0° C. showed no increase in lactic organisms, but had a higher total count. Anderson (8) in 1909 stated that top milk often contained 50 to 100 times more bacteria per ml. than did skim milk. Torrey and Rahe (9) (1910) studied certified milk of high quality stored at 12° C. and found that during the first twenty-four hours there was a tendency toward a decrease in numbers, but after forty-eight hours the rate of growth in the cream layer was faster than in the milk portion.

For a period of several years (1910-1938) not much new information appeared concerning the bacteriological quality of cream. Many reports are found concerning the use, effect, and detection of neutralizing compounds in cream, on the effect of pasteurization temperatures upon the viscosity and creaming ability of the cream, and other similar physico-chemical problems. Milk plants received cream from sources often many miles distant. In

\* Presented before the Laboratory Section of the American Public Health Association at the 73rd Annual Meeting in New York, N. Y., Oct. 5, 1944.

spite of this growing need for careful control, the subject of bacterial counts of market cream was neglected for many years. Powell(10) (1938) investigated certain "off-flavors" in cream which developed during pasteurization. This renewed interest in the study of cream from the bacteriological point of view.

It is interesting to note that with but few exceptions any consideration of cream in recent years has been in connection with milk, investigators assuming that what holds for one must hold for the other. Thus, in *Standard Methods for the Examination of Dairy Products* (11) (1939) the determination of coliform organisms in milk and cream is discussed under a single heading and the general conclusions concerning the interpretation of results of these tests is considered to be the same.

ately following inoculation, samples were taken for standard plate counts to determine the initial count of the sample. Standard methods were followed in all details and plating was done in duplicate. One set of plates from the inoculated milk and cream was incubated at 37° C. for 48 hours, and the other set of plates was incubated at 20° C. for 48 hours. The inoculated samples of milk and cream were placed immediately following sampling into the ice box at 8° C. and platings were made in duplicate at the end of 3 and 6 hours.

Several series of such platings were studied, and although the results varied in actual figures the trend with regard to percentage deviation from the initial count was the same. A typical protocol is given in Table 1 for the development of coliform intermediates in

TABLE 1  
GROWTH OF COLIFORM INTERMEDIATES IN MILK AND CREAM

Standard Plate Count	20° C. 48 hrs.		37° C. 48 hrs.	
	Cream	Milk	Cream	Milk
Initial count	730,000	460,000	520,000	630,000
After 3 hrs.—8° C.	5,850,000	490,000	325,000	410,000
After 6 hrs.—8° C.	14,000,000	1,000,000	1,180,000	800,000
After 3 hrs.—20° C.	13,000,000	3,250,000	3,250,000	3,250,000
After 6 hrs.—20° C.	1,300,000,000	170,000,000	58,500,000	25,000,000

The purpose of this present study was to evaluate the use of a test for coliform organisms in cream in view of the previous recognition of the rapid growth of bacteria in this medium.

#### EXPERIMENTAL

Sterile heavy cream (30 percent) and sterile skim milk (Difco) were inoculated with strains of *Escherichia coli*, *Aerobacter aerogenes*, and intermediate coliforms which had been isolated from cream. The procedure was as follows: 5 ml. amounts of sterile cream and milk were inoculated with 0.01 ml. of an 18-hour broth culture of the organism under study. Immedi-

ately following inoculation, samples were taken for standard plate counts to determine the initial count of the sample. Standard methods were followed in all details and plating was done in duplicate. One set of plates from the inoculated milk and cream was incubated at 37° C. for 48 hours, and the other set of plates was incubated at 20° C. for 48 hours. The inoculated samples of milk and cream were placed immediately following sampling into the ice box at 8° C. and platings were made in duplicate at the end of 3 and 6 hours. Several series of such platings were studied, and although the results varied in actual figures the trend with regard to percentage deviation from the initial count was the same. A typical protocol is given in Table 1 for the development of coliform intermediates in sterile cream and milk. It will be noted that when the inoculated milk and cream were held at 8° C. for three hours there was a greater increase in cream than in milk and this became more marked when the samples were tested after a 6-hour storage period. When the bacterial counts were made following 37° C. incubation of the plates for 48 hours, the total counts obtained were lower than those obtained following incubation of duplicate sets at 20° C.

When a comparable series of inoculated milk and cream were set up, using 20° C. as a holding temperature in place of 8° C., within three hours the counts had increased tremendously

reaching still greater magnitudes at the end of six hours. These latter results stimulate speculation as to what occurs in both milk and cream when they are permitted to remain un-iced or at room temperature for even short periods of time.

Preliminary work indicated that *Aerobacter aerogenes* increased to a greater extent than did *Escherichia coli*, although this has not always been shown on repeat tests. Further investigation of this point is needed.

### DISCUSSION

Unless coliform determinations are made upon freshly pasteurized cream as stated in Standard Methods, it is doubtful that any quantitative procedure can be considered of value with regard to the degree of initial contamination. Coliform organisms have always been accepted as evidence of re-contamination and faulty handling of the product when present in pasteurized cream. If this assumption is true, then a relatively small proportion of cream samples are properly handled and the dairy industry is in need of improving its cream production methods. Before such a conclusion can be reached, however, the rapid growth of these organisms in cream even at ice box temperatures must be considered. In complete agreement with the earlier workers the present study has shown that active growth of coliforms occurs at 8° C. in both milk and cream. In all instances, however, cream has been a more favorable medium and some evidence has been obtained to indicate that the growth of these organisms is in direct proportion to the butter fat content of the product.

The mere presence of coliform organisms in cream should be of as much value as any quantitative procedure in determining its sanitary quality. A simple test such as the inoculation of one tube of brilliant green lactose bile broth with 1 ml. of the sample should be a sufficient test.

Whether or not cream contains some unusual growth promoting factor is not as yet known. However, on the basis of the work done by Palmer and Weise (12) (1933) on a study of milk fat in which they concluded that each fat globule was coated with a membrane composed of protein-lipids, it is possible that with an increase in butter fat content a greater surface of available food is present for bacterial growth. This is in order with Conn's earlier thought that the bacteria did not utilize the fat in cream or milk as a food, but rather used an albuminous material present.

### SUMMARY

1. In determining the sanitary quality of cream, this product must be considered apart from milk in the same way that butter is classed as a separate product. The common practice in public health laboratories of considering the results of bacterial studies of milk as applicable to cream is without foundation in fact.
2. The optimum temperature for the incubation of plates for the determination of coliform organisms in skim milk and cream was 20° C. in the present study.
3. Coliform organisms develop much more rapidly in cream than in milk and the former apparently contains either some accelerating growth factor or a greater surface area of available food materials.
4. The extraordinary ability of coliform organisms to multiply in cream indicates that these organisms may be responsible for many of the extremely high total counts obtained from this product.
5. A quantitative test for the presence of coliform organisms in market cream is of little value because these organisms develop so rapidly even at refrigerator temperatures. The mere presence of these coliforms in such a sample is a sufficient index to the sanitary quality of the cream.

## BIBLIOGRAPHY

1. Robinton, E. D., Borman, E. K., and Mickle, F. L. Preliminary Bacteriological Study of Market Cream. *J. Milk Tech.*, 4, 253 (1941).
2. Robinton, E. D., Borman, E. K., and Mickle, F. L. Bacteriological Indices of the Sanitary Quality of Market Cream. *Amer. Jour. Public Health*, 32, 5 (1942).
3. Conn, H. W. Bacteria in Milk, Cream and Butter. *Storrs (Conn.) Agr. Exp. Sta.*, 2nd Annual Report 52, 1890.
4. Conn, H. W., and Eston, W. M. The Ripening of Cream. *Ibid.*, 13th Annual Report, 1900.
5. Pennington, Mary. Bacterial Growth and Chemical Changes in Milk Kept at Low Temperatures. *J. Biol. Chem.*, 4, 353 (1908).
6. Swithinbank, H., and Newman, G. *Bacteriology of Milk*. London, John Murray, 1903.
7. Ravenal, M. P., Hastings, E. G., and Hammer, B. W. Bacterial Flora of Milk Held at Low Temperatures. *J. Inf. Dis.*, 7, 38 (1910).
8. Anderson, J. The Relative Proportion of Bacteria in Top Milk (Cream Layer) and Bottom Milk (Skim Milk) and Its Bearing on Infant Feeding. *Ibid.*, 6, 392 (1909).
9. Torrey, J. C., and Rahe, A. H. Distribution of Bacteria in Bottled Milk. *Ibid.*, 7, 377 (1910).
10. Powell, M. E. Flavor and Bacterial Changes Occurring During Storage of Sweet Cream Which Has Been Flash Pasteurized at Various Temperatures. *J. Dairy Sci.*, 21, 219 (1938).
11. *Standard Methods for the Examination of Dairy Products*. A.P.H.A., N. Y., 8th ed., 1940.
12. Palmer, L. S., and Weise, H. F. Substances Adsorbed on the Fat Globules in Cream and Their Relation to Churning. *J. Dairy Sci.*, 18, 41 (1933).

## INSTITUTE OF FOOD TECHNOLOGISTS

The Institute of Food Technologists was organized in Cambridge, Massachusetts, in July, 1939, at the close of the Second Conference on Food Technology held under the auspices of the Massachusetts Institute of Technology. Its 1944-1945 officers are: President, Dr. F. C. Blanck, Chief Research Chemist, H. J. Heinz Company, Pittsburgh, Pennsylvania; Vice-President, Dr. R. H. Lueck, Director of Research, American Can Company, New York, New York; and Secretary-Treasurer, Dr. George J. Hucker, New York State Agricultural Experiment Station, Geneva, New York.

Its growing membership consists of more than 1,600 chemists, bacteriologists, nutritionists, process engineers, and others trained or experienced in the manufacture, preservation, and industrial handling of food. Its previous Annual Conferences were held in Chicago, Illinois, May, 1940; Pittsburgh, Pennsylvania, June, 1941; Minneapolis, Minnesota, June, 1942; St. Louis, Missouri, June, 1943; and Chicago, Illinois, May, 1944.

Institute of Food Technologists Charters have been granted to six Regional Sections. Several other Regional Groups have been organized and are taking steps to meet the requirements for Section Charter recognition.

The Committee on Programs has been instructed to proceed with its invitations and negotiations for papers relating to food technology and particularly emphasizing methods and practices which contribute to the preservation of the nutritive value of processed foods. The Committee was also instructed to obtain consent of the authors to read their papers before meetings of the regional sections, and to have all the papers published in the I. F. T. Proceedings.

To make the carrying out of these instructions possible, some of the regional sections are making plans for an all-day or an afternoon and evening meeting in May to take care of the papers scheduled from their geographi-

(Continued on page 107)

## Routine Examination of Milk for Added Water

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IN a recent article, M. A. Nussbaum (7) discusses the identification of watered milk by means of cryoscopic examination alone. He states:

"On certain occasions a cow may give milk containing less than 8.0 percent solids-not-fat; is the milk abnormal or watered? The analyst should resort to an accurate quantitative technique to answer that question; butter-fat and total milk solids will not give sufficient information. Thus the only measurement necessary to determine added water is to find the freezing point of the sample.

"The cryoscopic method is both reliable and practical for routine use. The practice of watering milk is increasing during our present emergency. The frequent and intelligent use of an official quantitative use of an official method will help toward halting this adulteration."

The Massachusetts Department of Public Health collects and makes chemical examinations of from 5,000 to 6,000 samples of milk per annum. During the fiscal years, ending November 30, the Department prosecuted thirty-three persons during 1924, twelve persons during 1943, and eleven persons during 1944 for selling watered milk.

Although the cryoscopic method of examination is used, yet it is performed only as a confirmative test after other analytical results have segregated those samples which in all probability contain added water. If not more than half a dozen samples are to be examined and the only criterion involved is the presence or absence of added water, the freezing point is the quickest and possibly the best method to employ, but if fifty or more samples are to be examined, that

procedure is too time-consuming. The freezing point alone tells but one story. It will not detect skimming, neither will it ascertain if the milk conforms to the legal standards.

If any litigation is likely to be involved, additional proof of adulteration is absolutely necessary. Such additional proof may consist of the percentage of total solids and fat, the relation between the solids and the fat, the concentration of the milk serum, and the ash of the acetic or of the sour milk serum.

In our laboratories, the usual routine is as follows: Solids are first determined by evaporation on a steam bath in a counter-weighted platinum dish as described by Leach (2), and the fat is determined by the Babcock method. From these results those samples suspected of being skimmed or watered are set aside, the former for protein determination, the latter for the several special examinations for the detection of added water, such as the refractive index of the copper milk serum (4), the freezing point of the milk (1), and the ash of the sour milk serum, or more speedily, the ash of the acetic acid milk serum (5).

The percentages of fat and of solids can give considerable information to one well acquainted with the variability of these figures in normal milk. To aid in this a table has been prepared (3) by using two methods of obtaining the approximate protein content, one from the percentage of fat, and the other from the percentage of solids. Dr. Lucius L. Van Slyke (9) in his par-

ticularly fine study upon the relation between the proteins and the fat in cow's milk gave the following formula for the approximate calculation of the proteins,  $P = 0.4 (F - 3) + 2.8$ , where P equals the percentage of the proteins and F equals the percentage of fat. Subsequently, Olson (8) gave the following formula for the approximate calculation of the proteins from

$$P = \frac{T S}{1.34} \text{ where } P$$

equals the percentage of proteins and T S equals the percentage of total solids. If these formulae give reasonably approximate results, their combined use should show the fat percentage corresponding to the total solids in normal milk. This was found to be true when the proteins calculated by both formulae were in agreement (3). The approximate percentage of lactose was computed by subtracting from the total solids, the sum of the fat plus 0.7 estimated ash plus the computed proteins, for variations in the solids from 10.5 percent to 12.5 percent and from 2.5 percent to 4.5 percent in the fat. The sugar percentage calculated by both formulae was found to vary considerably except in a narrow zone, the width of which was determined by a variance of not more than 0.10 in the calculated lactose. The samples whose calculated lactose falls upon one side of this zone are suspected of being more or less skimmed, while if they fall on the other side of the zone, they may be more or less watered. A few of the computations are shown in Table 1.

Chart I shows the segregation of the milk analyses into zones of normality, of suspected skimming, and suspected watering from 10 percent to 14 percent solids, and from 2 percent to 4 percent fat. The greater the distance from the zone of normality, the more likely that subsequent analytical results will confirm the suspected condition. It is possible to combine watering with skimming and yet have a normal relation between the solids and the fat, but such milk is very likely to be below the legal standard.

When using the concentration of the milk serum as a means of detecting added water in milk, it is advisable to also determine the serum ash. Nurenberg (6) states:

"It is recommended in conjunction with the copper, acetic or sour serum refraction method that the determination of the ash of the sour serum or the acetic serum be made in all cases where the indices of refraction fall below the minimum limit so as to eliminate all possibility of the sample being abnormal milk from a sick cow."

This suggestion can also be found in the official methods of the Association of Official Agricultural Chemists (5).

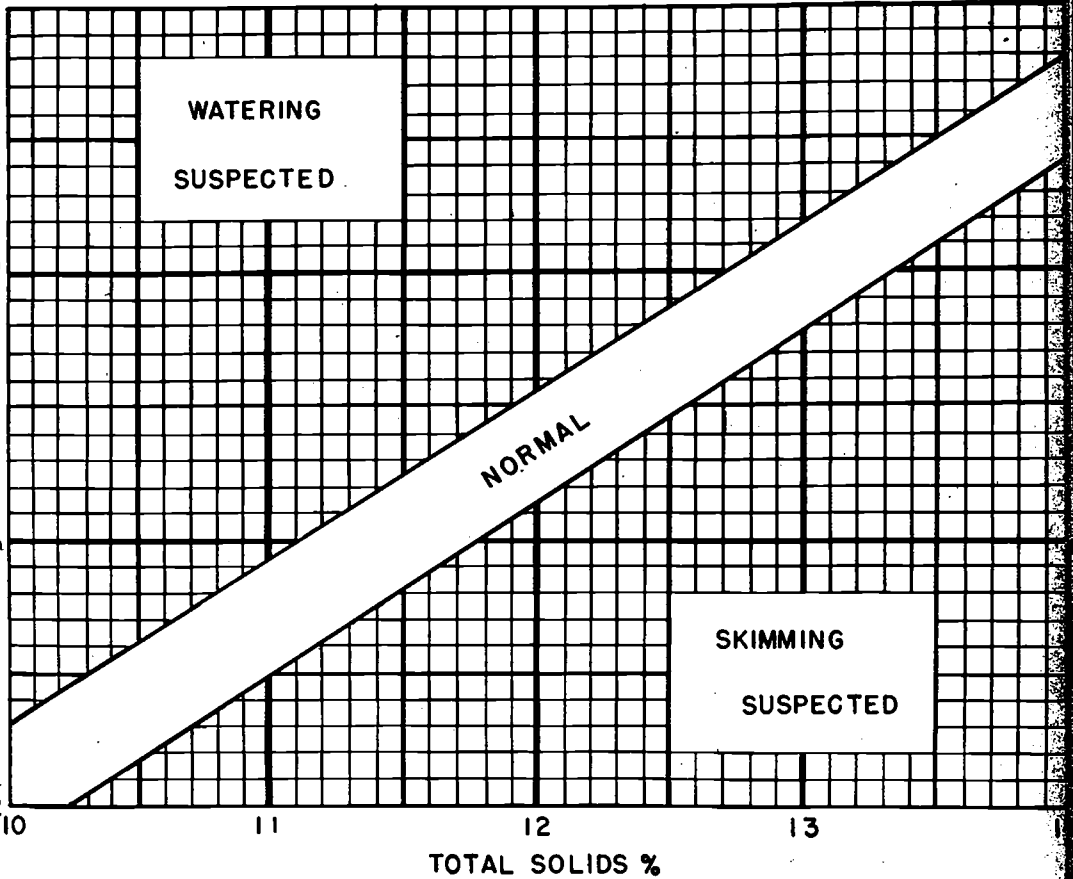
The Department has examined well over twenty-five hundred samples of milk of known purity obtained from individual cows and have found only a very few samples giving copper sera with refractive index of less than 36 on the scale of the Zeiss immersion refractometer, but in each instance, the serum ash was high, usually well above the average. In no instance were both figures below the usually accepted

TABLE 1  
CALCULATED LACTOSE PERCENTAGES  
Percent Lactose Calculated from

Solids %	Fat %	Fat	Solids	Classification
11.40	2.50	5.60	5.31	Skimming suspected
11.40	3.00	4.20	4.11	Probably normal
11.40	3.80	3.78	4.01	Watering suspected
12.50	3.30	5.58	5.33	Skimming suspected
12.50	3.80	4.88	4.83	Probably normal
12.50	4.40	4.04	4.25	Watering suspected



CHART I  
 CLASSIFICATION OF MILK  
 FROM SOLIDS AND FAT PERCENTAGES



minimum for pure milk. In doubtful cases, known purity samples are often of value to confirm one's opinion that the milk is watered.

Samples of known purity are also obtained when the producer who is accused of selling watered milk requests that we ascertain the quality of milk his cows are giving. When collecting these samples, it is advisable to have at least two persons, one of whom knows how to milk a cow,

and to witness the milking and the handling of the milk. During the past two years but few such samples have been obtained, principally because there has been but little watered milk for sale. There were collected in that period, 140 such samples. The refraction of the copper serum was determined upon all the samples, the acetic acid serum ash on 75 samples, and the freezing point on 73 samples. The figures varied as shown in Table 2.

TABLE 2  
MILK OF KNOWN PURITY FROM INDIVIDUAL COWS

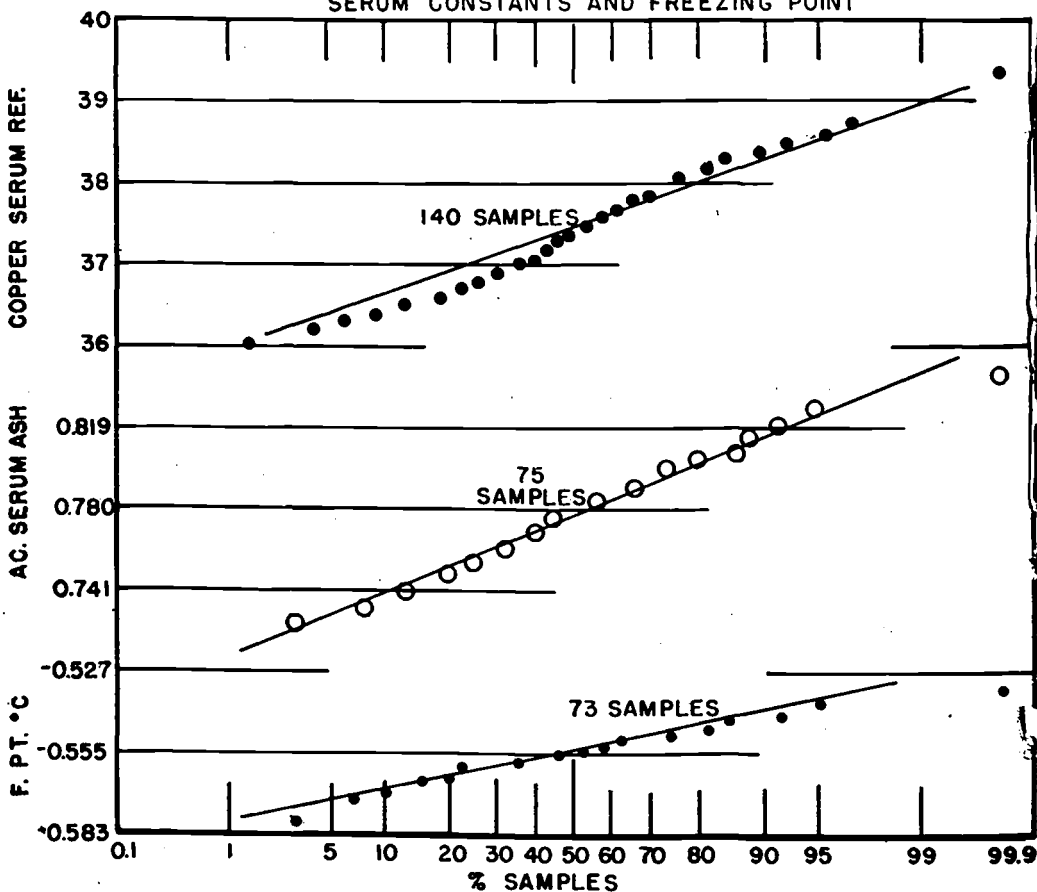
	<i>Freezing point Degrees centigrade</i>	<i>Copper serum refraction at 20° C.</i>	<i>Ash of acetic acid serum grams per 100 cc.</i>
Lowest	-0.578	36.0	0.727
Lower Quartile	-0.558	36.8	0.755
Median	-0.5535	37.43	0.773
Upper Quartile	-0.547	38.0	0.801
Highest	-0.532	39.5	0.849

Based upon the amount of added water to reduce the maximum to the minimum, the freezing point figures show a variance of 8.3 percent, the

serum ash 15.8 percent and the copper serum 17.5 percent.

These figures are shown in Chart II plotted on arithmetic probability scales,

CHART II  
MILK OF KNOWN PURITY, 1943, 1944  
SERUM CONSTANTS AND FREEZING POINT



the analytical dimensions being such that the three plots are comparable upon a "percentage of added water" basis. These figures indicate that the freezing point is capable of detecting a smaller percentage of added water than the other constants.

The freezing point, however, is subject to a greater variation than is shown in the above figures. From 1920 to 1925 the freezing point was determined upon a few of the many samples of milk of known purity collected during that period. The following figures give a summary of the results obtained from such samples:

perature scale being considerably greater than that on Chart II. The 1920-1925 figures plot in a straight line from -0.585 to -0.510. The two series are substantially the same from -0.580 to -0.550, but above this the 1943-1944 figures show relatively less samples. Five percent of the 1920-1925 samples had freezing points between -0.530 to -0.510, but none of the 1943-1944 samples was as high.

The abnormal figures from a few samples (Table 3) may be of interest since they illustrate the desirability of checking one figure with figures produced by different methods of analysis.

The low refractive copper serum in

	133 samples from pure- bred Holstein- Friesien cows	328 samples from pure- bred Holstein- Friesien cows	120 samples from pure- bred Guernsey & Jersey cows	138 samples from pure- bred Holstein- Friesien cows
	Freezing point		Copper serum refraction	Serum ash gms. per 100 cc.
Lowest	-0.585	36.0	36.5	0.728
Lower Quartile	-0.559	36.7	37.8	0.756
Median	-0.5525	37.2	38.25	0.778
Upper Quartile	-0.544	37.8	38.6	0.806
Highest	-0.510	39.6	39.9	0.892

The percentage in variance in respect to added water in the case of the freezing point was 13.5 per cent, in the case of the copper serum from the Holstein-Friesien cows it was 18 percent, and in the case of the serum ash it was 21.1 percent.

The two series of freezing points have been plotted on Chart III on arithmetic probability scales, the tem-

each case is compensated for by the high serum ash and in three instances by a normal freezing point. The high freezing point corresponding to 4.5 percent and 7.6 percent added water is compensated for by the high serum ash in one instance and by normal serum concentration and normal serum ash in the other samples.

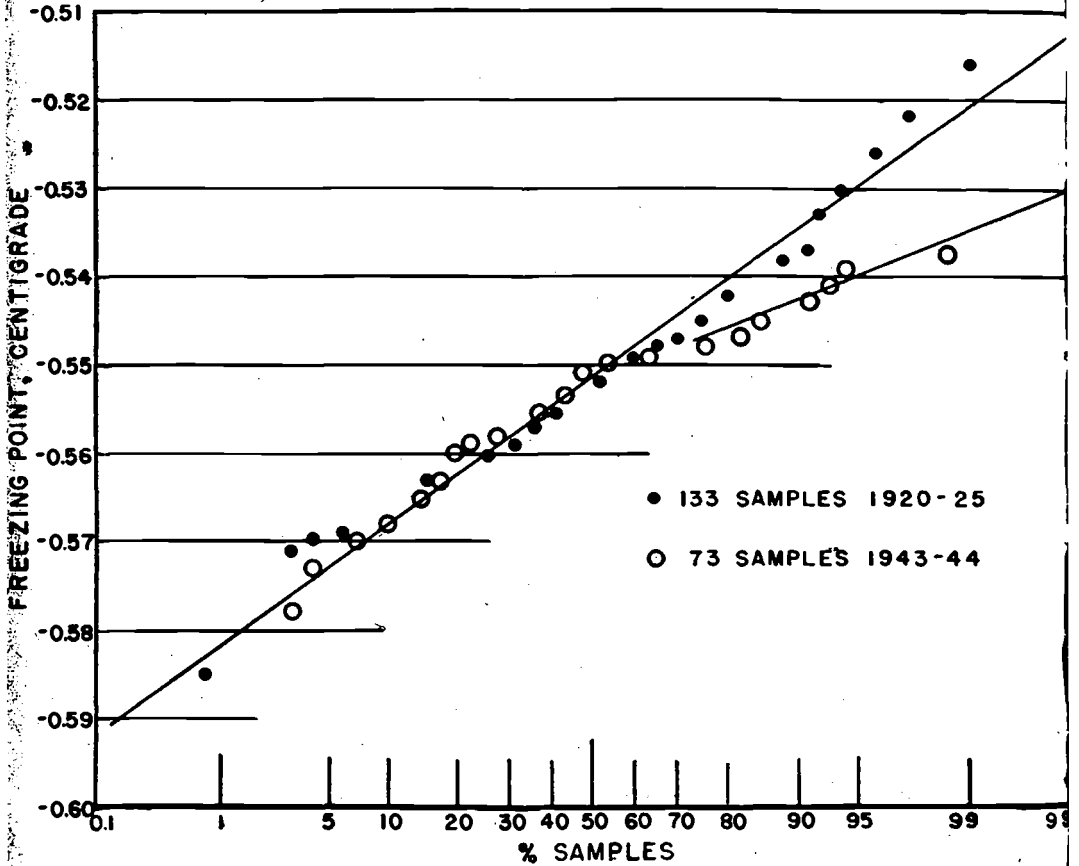
The following (Table 4) are the

TABLE 3

ABNORMAL RESULTS FROM SAMPLES OF MILK OF KNOWN PURITY FROM INDIVIDUAL COWS

Total solids %	Fat %	Solids not fat %	Copper serum refraction 20° C.	Serum ash grams per 100 cc.	Freezing Point centigrade
10.12	2.55	7.57	35.4	0.804	-0.554
11.36	3.40	7.96	34.9	0.830	-0.548
12.12	4.30	7.82	35.7	0.844	-0.558
12.20	4.10	8.10	35.9	0.784	-0.525
13.14	4.90	8.24	36.4	0.768	-0.508

CHART III  
MILK OF KNOWN PURITY  
FREEZING POINT



analyses of the mixed milk delivered by two milk producers to two milk dealers, and the analyses of the mixed milk of known purity obtained from each herd.

The samples of known purity were obtained within a few days of the delivery of the watered milk. Calculating the added water from the differences between the figures obtained from the

TABLE 4

Total solids %	Fat %	Solids not fat %	Copper serum retraction 20° C.	Acetic serum ash grams per 100 cc.	Freezing point C.	Character of sample
11.27	3.47	7.80	36.3	0.712	-0.499	As sold
13.12	4.41	8.71	38.3	0.781	-0.550	As produced
7.22	2.24	4.98	28.9	0.400	-0.306	As sold
13.15	4.14	9.01	36.6	0.770	-0.561	As produced

samples of known purity and the watered samples the following results were obtained. In the first of the above cases, added water from the solids equaled 14 percent, from the fat 21 percent, from the solids not fat and from the copper serum 10 per cent, and from the serum ash and from the freezing point 9 percent. In this instance the watered samples produced analytical results so close to normal that known purity samples were essential, otherwise the court might have found that a "reasonable doubt" existed. The milk delivered by the producer was both skimmed and watered.

In the second case known purity samples were unnecessary, but were obtained because the chemist was a recent graduate and it was to be her first appearance on the witness stand. The added water computed from the differences in the figures between the pure and watered was reasonably close, varying from 43 percent to 48 percent, averaging 45.6 percent. Each case resulted in conviction.

#### CONCLUSION

The freezing point of milk is more susceptible to changes by the addition

of water than are other constants; but if watering is suspected by this figure, further examinations should be made to confirm this by using other methods of analysis. In all cases where the figures are not far from normal, samples of known purity are desirable if not necessary.

#### REFERENCES

1. Hortvet, Julius. The Cryoscopy of Milk. *J. Ind. Eng. Chem.*, 13, 198 (1921). *Methods of Analysis*, A.O.A.C., 1940 edition, p. 275.
2. Leach, Albert E. *Food Inspection and Analysis*, 4th edition, p. 155.
3. Lythgoe, Hermann C. Composition of Milk of Known Purity. *J. Ind. Eng. Chem.*, 6, 910 (1914).
4. Lythgoe, Hermann C. Report on Dairy Products. *U. S. Dept. Agr., Bur. Chem. Bull.*, 132, 122 (1910).
5. *Methods of Analysis*, A.O.A.C., 4th edition, pp. 274-275.
6. Nurenberg, Lewis I. Report on Dairy Products. *Jour. Assoc. Offic. Agr. Chemists*, 2, 22 (1916).
7. Nussbaum, M. A. Laboratory Control of Added Water to Milk. *J. Milk Tech.*, 7, 255 (1944).
8. Olson, Geo. A. A New Method for the Calculation of the Proteins in Milk. *J. Ind. Eng. Chem.*, 1, 253 (1909).
9. Van Slyke, Lucius L. Conditions Affecting the Proportions of Fat and Proteins in Cow's Milk. *J. Am. Chem. Soc.*, 30, 1166 (1908).

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### INSTITUTE OF FOOD TECHNOLOGISTS

(Continued from page 100)

cal areas. In some instances additional papers by local authors will be arranged to provide a balanced program for these meetings. In no case will these meetings be publicized to other than members of the regional section or group holding the meeting.

One high-light feature of the banquet session of the Annual I. F. T. Conferences has been the presentation of the Nicholas Appert Medal award given by the Chicago Section for outstanding contribution to food technology.

Under temporary officers, food technologists in Florida have organized the Association of Florida Food Technologists and initiated monthly meetings at

Winter Haven. Their objective is compliance with requirements and attainment of qualifications for charter recognition as a regional section of the Institute of Food Technologists. Present officers are: President, John L. Heid, U. S. Citrus Products Station, Winter Haven, Fla.; Vice-President, J. J. R. Bristow, Citrus Concentrates, Inc., Dunedin; Secretary-Treasurer, M. K. Veldhuis, U. S. Department of Agriculture Experiment Station, Gainesville. Permanent organization officers are to be elected in May at which time application to the Institute for a regional section charter will be made.

## Sanitary Standards Program of the Evaporated Milk Industry

E. H. PARFITT, PH.D.

*Evaporated Milk Association, Chicago, Illinois*

OVER a period of years evaporated milk manufacturers have been maintaining their own programs on plant sanitation and milk quality. These programs had similar objectives but differed widely in approach. The companies manufacturing evaporated milk recognized these differences in approach and lack of coordination by formulating a Sanitary Standards Code. This code was then accepted voluntarily by a high percentage of the evaporated milk companies.

The objectives of the Sanitary Standards Code are the following: (1) to cause within the industry uniformity of approach to the problems of sanitation as related to plant, processing, and milk quality; (2) to establish definite goals and minimum sanitary standards for the industry; (3) to establish a trained sanitary standards staff to measure the progress that each plant and each company is making toward attaining these goals and to assist companies in maintaining minimum sanitary standards.

First emphasis was placed on equipment and over-all plant sanitation. The sanitary program was started, fortunately, prior to the W.P.B. limitations on equipment, making possible the procurement of much equipment of recent design. The plants that have been re-equipped have been better able to handle larger quantities of evaporated milk with less labor and with the minimum of equipment breakdown. The equipment replaced consisted principally of hot wells, vacuum pans, storage tanks, milk piping, and homogenizers. Many plants were remodeled

as to floors, walls, and toilet facilities. More than \$3,500,000 has been spent in re-equipping and remodeling plants in the first three years of the program.

Early in the industry program, the need arose for specifications pertaining to the sanitary design of equipment. Companies reported differences of opinion among manufacturers as to sanitary design of milk storage tanks, especially as to finish of stainless steel, knuckle radii, characteristics of welding, drainage, etc. The administrator of the Sanitary Standards program, with the aid of engineers and sanitarians, prepared sanitary specifications for such tanks. These specifications were adopted by the industry and accepted by milk storage tank fabricators. Over 250 milk storage tanks have been purchased by the industry conforming to these specifications.

The Sanitary Standards staff is consulted by evaporated milk manufacturers on remodeling of plants to be assured that the proposed work conforms to the best basic practices of modern sanitary design. The staff in turn cooperates with those regulatory officials who are qualified by experience in this field so as to insure the industry of the most recent trends in plant design.

Members of the sanitary standards staff make periodic inspections of all plants and stations. These inspections are made during the plant clean-up when the staff member can observe the cleaning practices, and the dis-assembly and sanitizing of equipment. Special attention is given to possible insect and rodent hazards.

Grading procedures for judging the quality of incoming milk are required at each plant. The supervision of these procedures has resulted in more accuracy of testing. In addition to the daily testing of milk for odor, sediment, and methylene blue, tests are made on the milk of each producer. These latter tests are made at least once a month. Producers who on initial tests are found to be below the industry standards are followed up by immediate retests. The function of platform testing of incoming milk is not only to measure milk quality but to determine those producers in need of field assistance.

The work done on the receiving platform is coordinated with the work to be done by the fieldman: His ability to secure cooperation of producers in the production of clean milk measures his success as a fieldman.

The procedure of methylene blue testing follows the same pattern as sediment testing, namely, monthly tests on each producer with immediate follow-up tests and field contacts in the case of all substandard producers.

The success of the Sanitary Standards program in improving milk quality can be attributed to the unbiased supervision of the industry by the Sanitary Standards staff. This supervision in

part consists of making sediment and methylene blue tests of milk from at least 25 per cent of the patrons' delivery to the plant and comparing the results obtained by this spot check with the results recorded by the manufacturer himself. While the Sanitary Standards staff member is making the spot check, the methods followed by the plant and the testing equipment used are examined.

To determine progress on farms of factors that affect milk quality, a random group of farms is visited by a staff member. Conditions found on these farms are checked against the fieldman's report for the same farms. The accuracy of fieldmen's work is thus determined and standardized for each plant that has elected the program.

All findings—plant, platform, field—are tabulated and submitted to the company executives with recommendations.

The success of this program is shown by the fact that 96 per cent of the industry has accepted the program and is actively following its provisions. Regulatory officials who have had occasion to visit plants under the program have in general made satisfactory reports and many have complimented the industry for its accomplishments that are a result of industry unified cooperative effort.

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#### Food Technologists Organize— Great Lakes Group

Food technologists in Michigan, Northern Indiana, Northwestern Ohio and Ontario, Canada, have organized a new regional group of the Institute of Food Technologists. It is identified as the Great Lakes Group and is the outgrowth of a breakfast gathering held May 30 at the Edgewater Beach Hotel in Chicago during the 5th Annual Conference of the Institute.

Elected officers of the Great Lakes Group are:

Chairman: F. W. Fabian, Michigan State College, East Lansing, Michigan.

Vice-Chairman: C. Olin Ball, Owens-Illinois Glass Co., Toledo, Ohio.

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Time and place of next meeting is being arranged for.

## Sanitary Measures Hold Restaurant Customers\*

A. W. FUCHS

*Sanitary Engineer Director, U. S. Public Health Service, Washington, D. C.*

RECENTLY, 150 passengers of three railway trains operating out of a southern city were made violently ill from food poisoning within a few hours after eating ham and cheese sandwiches purchased from the "news butch." Among the passengers were about 100 soldiers and sailors. An investigation was made by the Public Health Service and the State Board of Health to determine the cause of the outbreak and to prevent a recurrence. It was found that the sandwiches had been prepared in an unclean sandwich shop under insanitary conditions, and kept for several hours at summer temperature. They were then delivered to the train concessionaire who kept them in a warehouse at room temperature for several hours more before placing them on the trains. By the time they were sold to the passengers in the train coaches, the sandwiches had been kept for from 6 to 12 hours without refrigeration. Laboratory examination of left-over sandwiches showed contamination with a staphylococcus organism capable of producing enterotoxin. Proper refrigeration would have prevented the rapid growth of the organisms and the development of the toxin which caused the food poisoning.

This is only one example of the reason why the U. S. Public Health Service as well as state and local health departments are so greatly interested in proper restaurant sanitation. Needless to say, the restaurant industry is even more vitally interested, because sick patrons may mean damage suits

and certainly do not help a restaurant's reputation.

Outbreaks of the kind just described occur more frequently than one might imagine. They average one for nearly every day of the year. Each year the Public Health Service compiles reports of disease outbreaks submitted by state and city health departments. The number of epidemics from food is far greater than from water and milk combined. Thus, in 1942, 53 outbreaks were traced to water, 45 to milk and milk products, and 245 to other foods. These outbreaks involved several different diseases, but by far the commonest were gastroenteritis and food poisoning. The number of cases per epidemic ranged from a few to many hundred. The total number of cases reported traced to other foods in 1942 was 11,420 but there is no doubt that the reported cases represent only a fraction of those actually occurring.

A considerable portion of the outbreaks and the cases was traced to public or semi-public eating and drinking establishments. There can be no question, therefore, that we are faced with a serious threat to the public health from insanitary food establishments. Since the beginning of the war, each succeeding year has witnessed an increasing number of food-borne outbreaks and cases. The hazard of eating out is not confined alone to the civilian public; it is shared by the workers in war industries and by the men in uniform who are on furlough. It is a matter that affects the war effort now as well as the peace effort to follow, and none of us can afford to sit back

\* Presented at National Restaurant Ass'n Convention, Chicago, Illinois, October 12, 1944.



and blame these conditions on the other fellow or on the war.

Of course, we all recognize that the problem has been made more acute by wartime conditions. There is a shortage of good food. It has been difficult to get the equipment you need. The labor problem is a tremendous headache, with trained help as scarce as hens' teeth, and with the labor turnover at an unheard-of level. But these factors do not plague you alone; they affect your competitors as well. The fact that many of you can and are operating sanitary establishments in spite of wartime difficulties is a fairly good indication of what all can do, provided they really want to.

The U. S. Public Health Service is doing all in its power toward a solution of the problem. It has no legal jurisdiction in the enforcement of restaurant sanitation in any state or in any city; that is a function of the state and local agencies. The Public Health Service does, however, serve as advisor and consultant to state and local health officers. It has developed recommended sanitary standards for food establishments, and has promoted the voluntary adoption of such standards and their proper enforcement by state and municipal health departments.

The sanitary standards are contained in Public Health Bulletin No. 280, the Ordinance and Code Regulating Eating and Drinking Establishments. These are recommended for adoption as state regulations and city ordinances in order to encourage a greater uniformity and a higher level of excellence in the sanitary control of eating and drinking establishments. The recommended ordinance is only a few pages in length. The interpretative code which accompanies it gives in detail the public health reason for each item of the ordinance and details of satisfactory compliance. The code serves to unify the interpretation of the ordinance, and therefore, to minimize enforcement misunderstandings. While it represents the best information

available on restaurant sanitation, it should be considered subject to change as a result of research and experience. Suggestions for improvement are invited and given careful consideration by the Sanitation Advisory Board before new editions are prepared. Many proposals submitted by health officers, members of the industry, and your own Association are now being studied. Copies may be purchased from the Superintendent of Documents in Washington at 20c each.

This ordinance, or one based thereon, is in effect in all entire states and the District of Columbia, as well as in 108 counties and 178 municipalities located in 25 other states. It has been adopted as state regulations in 22 states. It has been our experience that the adoption of adequate standards is supported by the most enlightened members of the industry.

The mere adoption of such standards does not, however, guarantee proper enforcement. Much depends on the activity and intelligence of the enforcing agency and its inspectors. Accordingly, the Public Health Service has promoted the organization of an adequate restaurant sanitation program in the State Health Departments, with trained sanitarians qualified to exercise leadership and offer guidance to local inspectors. Advisory assistance is available to the states from the Public Health Service at Washington and the District Offices throughout the country. A training program for state and city inspectors is offered through field contacts and through regional restaurant sanitation seminars. During the past year, ten seminars of this kind were held throughout the country, with a total attendance of 1,067 inspectors. One of the features of these seminars is the presentation of a course of instruction for foodhandlers so that inspectors may be in a position to inaugurate such courses in their own communities. Such a training program is particularly useful during wartime when many experienced inspectors have

left for military duty. The Public Health Service has also developed a rating system whereby the state agency may measure the status of restaurant sanitation in any community. In addition, mobile trailer laboratories assist the health departments in examining restaurant utensils for bacteriological cleanliness. During the past year over 40,000 utensils from 4,000 establishments in 76 cities were examined by these laboratories. You will be interested to know that only 32 percent of the spoons, cups, and glasses examined complied with the standard of not more than 100 bacteria per utensil; and beer glasses were the worst offenders, with only 15 percent coming within the standard.

But the portion of our program to which we have devoted the greatest attention during the past year is that concerned with the education of food handlers. We believe that most food handlers will improve their methods and acquire sanitary habits if taught how; and that legal methods of enforcement may be reserved for the recalcitrant minority. The inspector who employs the educational rather than the policeman type of approach is the one who achieves the most permanent results.

Among the educational materials developed by the Public Health Service on restaurant sanitation are the following:

1. An outline of six lectures for use at food handlers schools.
2. More than 175 lantern slides, with descriptions of each.
3. A pocket size manual of instructions for food handlers entitled "From Hand to Mouth." Because of its simple language, its humorous illustrations, and its emphasis on the importance of the food handler's job, this booklet has achieved wide popularity. It may be purchased from the Superintendent of Documents in Washington at ten cents per copy, or six cents in lots of 100 or more. Many restaurants and cafe-

terias have furnished copies to all of their employees.

4. A series of four film strips entitled "Our Health Is in Your Hands." One of these, subtitled "Health Habits for Safe Service," was shown here yesterday morning, at which time a brief description of the others was also given. They are intended for use by health departments and the industry in the training of food handlers, and are accompanied by voice recordings. The entire series will probably be available in a few months for purchase from a commercial source at a reasonable price.

5. An article on "Dishwashing" for the guidance of inspectors and the industry. It is now available in mimeographed form, but also appeared recently in Public Health Reports, and will soon be purchasable as Reprint No. 2574 from the Superintendent of Documents at five cents.

6. A series of six posters entitled "For Our Patrons' Health," intended for display in restaurant kitchens and washrooms. They teach food handlers a few of the important aspects of food sanitation. They may be purchased from the Superintendent of Documents at 25 cents per set of six, with 25 percent discount for 100 sets or more. I shall return to a discussion of these shortly.

Some of these materials are available for free distribution, as long as they last, in exhibit booth 19 downstairs. They have been used at the food handlers schools conducted by the Public Health Service throughout the country in cooperation with local and state health departments, Chambers of Commerce, and local restaurant associations. Needless to say, much preliminary work is needed for successful schools, including advance meetings with restaurant operators to explain the purpose and secure their support. The schools consist of two or three sessions of one and one-half to two hours each, repeated as often as may be necessary. During the past year,

the Public Health Service held 41 schools, with a total attendance of 36,000 employees. These schools serve as demonstrations to state and city health officials.

At the suggestion of your educational director, Miss Macfarlane, I shall devote the remaining few minutes of my time to a discussion of the six posters which I hope are visible to all of you.

1. "*Wash your hands often.*" Fingers and hands touch numerous objects in the ordinary routine of the day's work—nose, mouth, handkerchief, body discharges, sores, soiled napkins, dirty dishes, mouthed silverware and glasses, etc. The fingers and hands may thus become contaminated with germs of various diseases of respiratory or intestinal origin. Many of you perhaps know that the organisms of dysentery and other diseases have been recovered with ease from the fingers and under the nails of known cases and carriers. These germs will in turn be transferred to everything that is touched, including food, clean dishes, clean tableware. Frequent handwashing is therefore essential for all food handlers, especially after each visit to the rest room. Forming this habit will help protect the health of the employee as well as of the customer. Besides, no patron likes to be served by a waitress with dirty hands or fingernails. This poster in the rest room will be a constant reminder to your employees.

But employees cannot be expected to wash their hands often unless adequate, convenient, and attractive lavatory facilities are furnished by the management. Facilities should include hot and cold running water, soap, and individual clean paper or cloth towels.

2. "*Use a fork—don't be a butter-finger.*" Frequent handwashing will greatly reduce the germ population of hands and fingers, but a waitress cannot stop to wash her hands every time she handles food or utensils. It is obvious, therefore, that manual contact with food and drink should be avoided

insofar as is possible. This poster is intended to drive home that lesson. Pick up sliced butter with a fork. Handle cracked ice with a scoop. Keep the thumb out of the soup. Use a spatula or knife to serve pie on a plate. Your customers will appreciate such service.

3. "*Keep these cold.*" Lack of prompt and adequate refrigeration is the major cause of staphylococcus food poisoning. This is the most frequent disease involved in food-borne outbreaks. Some people still call it "ptomaine poisoning," but that is a misnomer. Staphylococci are the organisms found in boils and infected sores and wounds. It is difficult to keep them out of foods. Many strains, when allowed to multiply at room temperature, produce an enterotoxin or poison which is the cause of food poisoning. Of the 245 food-borne disease outbreaks compiled by the Public Health Service for 1942, 210 or 86 percent were reported as food poisoning or gastroenteritis, with a total of 10,566 cases.

Usually bacteria in food are harmless, and if this were always true there would be no reason to refrigerate food except to prevent spoilage. There is, however, no way to be sure that pathogenic bacteria have *not* entered the food, even though sanitary practices will greatly reduce this likelihood. The chances of contracting disease may be increased when the food contains large numbers of disease-producing organisms or their toxins. For this reason, perishable foods should be kept cold so that any small number of such organisms that *may* have entered will not be permitted to multiply. It should be recalled that bacteria are microscopic plants and that most plants do not grow in cold weather.

The foods causing most illness are those which make good mediums for the growth of organisms, i.e., those of animal origin such as meat, fish, and dairy products. Outbreaks often occur when such foods undergo considerable

handling in the preparation following the initial cooking and are left at room temperature for several hours. Sliced, boned, hashed, or other cooked meats, especially ham and fowl, and pastries containing cream or custard filling are the most frequent offenders. They should be promptly cooled to well below 50° F.

The importance of prompt refrigeration of such foods in the prevention of food poisoning cannot be over-emphasized. Food heavily contaminated with staphylococci is not likely to be toxic if refrigerated, but may become toxic if left at room temperature for a few hours. That is what happened to the sandwiches involved in the outbreak mentioned at the beginning of my talk. The management must provide adequate refrigeration facilities and see to it that the types of food previously discussed are promptly placed therein. One more thing—I have seen food refrigerators presumably at 50° F. or less which, when tested with a thermometer, were found to register over 60° F. It is a good plan to have a thermometer in every refrigerator and to watch it often.

4. "*Keep these under cover.*" All food and drink should be so stored or displayed as to be protected from dust, flies, vermin, unnecessary handling, droplet infection from coughing and sneezing, and other contamination. Customers do not enjoy sharing their food with flies and roaches. Food should not be stored or prepared beneath overhead sewer or drain pipes unless such pipes are provided with suitable means to carry off possible leakage or condensation. Nor should it be stored on floors which are subject to flooding from sewage backflow. All rat harborages should be removed, and all openings in walls, floors and ceilings should be closed with rat proof materials. Every means should be used to keep out flies, roaches, and rodents, and to eliminate those that gain entrance. They may infect your food. All unwrapped or unenclosed food on

display should be protected by glass front and top from public handling.

5. "*Handle with care.*" It is of little use to clean utensils carefully if they are later stored and handled so as to be again contaminated. Containers and utensils should, therefore, not be handled by the surfaces which come in contact with food or drink or the lips of the user. Fingers should not touch the rims or inner surfaces of glasses and cups, the food surfaces of dishes, nor the bowls of spoons, the tines of forks, or the blades of knives. Do not imagine for a moment that your customers are not repelled by such practices.

6. "*Wash every piece carefully.*" Everyone realizes the importance of proper dishwashing. According to various investigators, eating and drinking utensils may be responsible for the transmission of a number of respiratory and intestinal diseases. The organisms may be coughed or sneezed on food, dishes, and utensils; they may be left on glasses, cups, spoons, and forks by mouthing; they may reach the dishwasher from washers or handlers or indirectly from dishes infected by users. But in addition to the public health aspect, there are esthetic considerations which attract or repel patrons. Who has not seen the irate customer rave about the lipstick on his glass or the egg on his fork?

These posters are intended for small establishments where dishes are washed by hand as well as large ones where dishwashing is done by machine. The fact that manual dishwashing methods are illustrated in the poster does not imply that they are superior to machine washing. It was easier for the artist to indicate the proper steps of sink washing than of machine washing. In either case, the same essentials apply: (1) scraping or prerinsing, (2) washing in warm water to which a good detergent has been added and which is changed frequently, (3) rinsing to remove the film of food and detergent particles, and (4) the final bacteri-

cidal bath in hot water at 170° F. or more, or in an approved chemical solution of sufficient strength. Manufacturers of dishwashing machines realize that improvements are needed; and the food equipment industry is many years behind the milk equipment industry in the production of easily cleanable equipment. Perhaps the greatest failure in dishwashing is the lack of an adequate supply of sufficiently hot water. The next most common failure is not having a large enough supply of glasses, dishes, and silverware to avoid rushing them through the dishwashing process at meal time. These

are responsibilities of the management.

So much for the posters. In closing, let me again call attention to the fact that sanitation of food establishments is of vital concern to health officers, to the public, and to the industry. The health officer wants your cooperation. If he gets it, everyone will gain. If he doesn't, his job will be more difficult, but it is his duty to protect the public health. I urge you, each in your own community, to work in harmony with your health department. Unless you are short-sighted, indeed, you will find it to be good business.

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#### Films Relating to Milk and Food Sanitation

Sources from which films may be available for loan or rent:

State Departments of Health  
District Offices of the U. S. Public Health Service  
State Departments of Education  
University Extension Divisions  
Health Officers News Digest, 1790 Broadway, New York 19, N. Y.  
Castle Films, Inc., R.C.A. Building, New York 20, N. Y.  
Y. M. C. A. Motion Picture Bureau, 347 Madison Ave., New York, N. Y.

#### Film catalogs:

One Thousand and One, 75c, The Educational Screen, 64 E. Lake St., Chicago, Ill.  
Health Films, 25c; supplements, 20c. Two supplements issued to date. American Film Center, Inc., Section on Health and Medical Films, 45 Rockefeller Plaza, New York 20, N. Y.  
Sound Films for the Classroom, Erpi Classroom Films, Inc., 1841 Broadway, New York 19, N. Y.

A partial list may be secured from the Sanitary Engineering Division, Milk and Food Section, U. S. Public Health Service, Washington, D. C.

# JOURNAL OF MILK TECHNOLOGY

*Official Publication of the*

## International Association of Milk Sanitarians

(Association Organized 1911)

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The JOURNAL OF MILK TECHNOLOGY is issued bimonthly beginning with the January number. Each volume comprises six numbers. It is published by the International Association of Milk Sanitarians, and is printed by The William Boyd Printing Co., Inc., Albany, N. Y., U. S. A.

*Subscriptions:* The subscription rate is \$2.00 per volume. Single copy, 50 cents.

All correspondence concerning advertising, reprints, subscriptions and all other business matters should be addressed to the Boyd Printing Company, 374 Broadway, Albany 7, N. Y., or to the Managing Editor, W. B. Palmer, 29 North Day Street, Orange, N. J.

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 Weindel, Milk Sanitarian, Lawrence, Kan.

## MASSACHUSETTS MILK INSPECTORS' ASSOCIATION

*President*, Thomas J. Travers.....Worcester  
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*President*, F. L. Seymour-Jones...New York, N. Y.  
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*President*, C. W. Drumgold, St. Louis City Health  
 Dept., St. Louis, Mo.  
*Vice-President*, J. K. Smith, Jackson County Health  
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*Secretary-Treasurer*, Glenn M. Young, State Board  
 of Health, Jefferson City, Mo.

**PACIFIC NORTHWEST ASSOCIATION OF DAIRY AND  
MILK INSPECTORS**

*President*, A. W. Metzger.....Salem, Ore.  
*Vice-President*, E. W. Soper.....Arlington, Wash.  
*2nd Vice-President*, R. D. Bovey.....Boise, Idaho  
*Secretary-Treasurer*, Frank W. Kehrli, Portland,  
 Ore.

**PHILADELPHIA DAIRY TECHNOLOGY SOCIETY**

*President*, Dr. Thomas Kelly, Scott-Powell Dairies,  
 Philadelphia.  
*Vice-President*, Jay D. Girard, Breuninger Dairies,  
 Philadelphia.  
*Secretary-Treasurer*, Mrs. Helen A. Sutton, Sylvan  
 Seal Milk, Inc., Philadelphia.  
*Assistant Secretary-Treasurer*, W. S. Holmes, Phila-  
 delphia Dairy Council, Philadelphia.

**TEXAS ASSOCIATION OF MILK SANITARIANS**

*President*, Taylor Hicks.....San Antonio, Texas  
*1st Vice-President*, F. C. Armstrong, Fort Worth,  
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*2nd Vice-President*, R. N. Hancock, McAllen,  
 Texas.  
*Secretary-Treasurer*, G. G. Hunter, Lubbock, Texas.

**WEST VIRGINIA ASSOCIATION OF MILK SANITARIANS**

*Chairman*, Donald K. Summers, Charleston 1,  
 W. Va.  
*Secretary-Treasurer*, J. B. Baker, Department of  
 Health, Charleston, W. Va.

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## Association News

**ANNUAL MEETING, October 18-20, 1945**

**Deshler Wallick Hotel, Columbus, Ohio**

**Associated Illinois Milk Sanitarians**

In view of the recent order of the O. D. T. pertaining to conventions, the Association is planning to substitute regional meetings in place of the annual spring meeting. These regional meetings are planned to be held in conjunction with the regional meetings of the Illinois Public Health Association in May. The tentative schedule calls for meetings in Chicago, Springfield, and East St. Louis.

**P. EDWARD RILEY,**  
*Secretary-Treasurer.*

**Wisconsin Conference Cancelled**

"In view of the recent request of the Director of War Mobilization and Reconversion covering the cessation of group meetings, our department is glad to cooperate by cancelling its annual Dairy Manufacturers' Conference. This Conference was scheduled for April 12 and 13, 1945."

**H. C. JACKSON,** *Chairman,*  
 Department of Dairy Industry  
 University of Wisconsin.



## New Members

### ACTIVE

- Aranda, Dr. Raul, Chief in Control in Food and Milk Sanitation, Public Health Service of Chile, 120 N. State St., Ann Arbor, Mich.
- Camirand, R., Minister of Agriculture, Department of Agriculture, Parliament Bldgs., Quebec.
- Clark, Harold O., Creamery Inspector, State Dept. of Agriculture, 64 Diamond St., St. Albans, Vt.
- De Felice, Miss Leone R., Laboratory Technician, Department of Health, 601 Glenwood Ave., Syracuse 7, N. Y.
- Downs, Major F. H., Jr., 0-195508, 2nd Civil Affairs Unit, A.P.O. 658, c/o Postmaster, New York, N. Y.
- Dubois, Dr. Norman A., Agent, Board of Health, Room 14, Town Hall, Brookline, Mass.
- Hillstad, A. C., Dairy Inspector, State Dept. of Agriculture, 411 N. Ingersoll St., Madison 3, Wis.
- Luchterhand, C. K., State Board of Health, State Office Building, Madison 2, Wis.
- Nakahara, James M., Milk Inspector, Board of Health, Hilo, Hawaii.
- O'Brien, James E., Division of Laboratories and Research, State Health Department, Albany, N. Y.
- Reeves, George F., Assistant to Supt., St. Louis Dairy Service, Room 64, Municipal Courts Bldg., St. Louis 3, Mo.
- Small, R. L., Senior Sanitarian, State Health Department, 422 State House, Boise, Idaho.
- Tirrell, Miss Kathryn R., Director, Div. of Laboratories, Dept. of Health, 835 Washington Ave., Bridgeport 4, Conn.
- Voigt, Max A., Jr., City Milk Sanitarian, San Antonio Health Department, 3510 W. Travis St., San Antonio 7, Texas.
- Warrick, Louis F., State Sanitary Engineer, State Board of Health, State Office Bldg., Madison 2, Wis.
- White, W. W., Supervisor, Bureau of Milk Sanitation, Pennsylvania Dept. of Health, Snedekerville, Penn.
- Widder, C. O., 1208 S. 8th St., Sheboygan, Wis.

### ASSOCIATE

- \*Allio, Fred A., Mgr., Guernsey Farms, 52 E. Main St., Cuba, N. Y.
- \*Ayres, Fred, Sussex Milk & Cream Co., Inc., Church St., Sussex, N. J.
- \*Bailey, M. A., The Diversey Corp., 14 W. 49th St., New York 20, N. Y.
- \*Baker, Walter T., H. P. Farmers' Co-Operative Assn., R. D. 1, Holland Patent, N. Y.
- \*Bartol, Anton, Manager of feeder station, c/o Blackhawk Sta., The Borden Co., Waukesha, Wis.
- \*Batchelor, R. L., Lathrop-Paulson Co., 152 W. 42nd St., New York 18, N. Y.
- \*Beals, O. K., Chief, Division of Foods and Dairies, State Department of Agriculture, Salem, Oregon.
- \*Bean, Orrest H., General Dairy Service Corp., 23 Leslie Ave., Utica, N. Y.
- \*Beecher, M. R., H. P. Hood & Sons, Norfolk, N. Y.
- \*Beekes, Melvin A., Queens Farms Dairy, Inc., High St., Copenhagen, N. Y.
- \*Bex, Charles T., City Department of Health, 219 Carlton Rd., Syracuse 4, N. Y.
- \*Blizzard, Arthur M., Dairymen's League Co-Op. Assn., Box 121, Flemington, N. J.
- \*Bryan, John S., Walker-Gordon Laboratory Co., Plainsboro, N. J.
- \*Buck, Charles A., Dairy Extension, University of Wisconsin, 723 18th Ave., Monroe, Wis.
- \*Butler, Donald W., Vermont Milk & Cream Co., Inc., West Pawlet, Vt.
- \*Camenga, Larry, Weckerle Dairy Co., 250 Grant St., Buffalo 13, N. Y.
- \*Chase, Rodney D., Dairymen's League, Morrisville, N. Y.
- \*Childs, Foster, Dairymen's League, New Paltz, N. Y.
- \*Chrisler, Earl S., Laboratory Supt., Borden's, 620 N. 8th St., Milwaukee 3, Wis.
- \*Clough, Ralph, Four County Creameries, Inc., Box 18, Harford Mills, N. Y.
- \*Combs, Dr. Perry T., Department of Health, Clinton St., Batavia, N. Y.
- \*Connolly, Joseph E., Department of Health, 93 Ivy St., Newark, N. J.
- \*Cooke, Herbert A., Spencer Dairy Service, Hamden, N. Y.
- \*Costello, F. J., Northern Milk Corporation, Adams, N. Y.
- \*Craig, Paul S., Cattaraugus County Dept. of Health, So. Main St., Machias, N. Y.
- \*Crawford, J. F., Dairymen's League, Adams, N. Y.
- \*Culver, Earl, Dairy Inspector, State Department of Agriculture, 408 Pine St., Green Bay, Wis.

- \*Cvetan, Robert, Department of Health, 1221 86th St., Niagara Falls, N. Y.
- \*Darrow, J. H., Department of Health, 37 Adriance Ave., Poughkeepsie, N. Y.
- \*DePew, H. F., Genl. Mgr., Luick Dairy Co., 1132 N. 6th St., Milwaukee 3, Wis.
- \*Despain, Carroll E., Provo City Sanitarian, Public Health Dept., P. O. Box 202, Provo, Utah.
- \*Deutsch, Mrs. Dorothy P., Laboratory Technician, Middletown Milk & Cream Co., Inc., Slate Hill, N. Y.
- \*Dewan, Cleon, Eastern Farms Products, Inc., 390 Ashland St., Brooklyn, N. Y.
- \*Dexter, Kenneth L., Reids Union Dairy, North Court St., Wampsville, N. Y.
- \*Dolan, James, Department of Health, 136 South 9th St., Newark, N. J.
- \*Dufenhorst, George, Quality Field Work Supervisor, Klenzade Products, Inc., R. 1, Box 434, Hales Corners, Wis.
- \*Edwards, Fred, Mgr., Producers Creamery Co., Cabool, Mo.
- \*Engendorff, Sgt. O. H., 36251083, Dairy Bacteriologist, Meat and Dairy Inspector, Veterinary Service, Section M, Casper Army Air Field, Casper, Wyo.
- \*Farrand, Earle H., Department of Health, R. D., Leroy, N. Y.
- \*Fischer, Leon J., Rochester Health Bureau, 287 Penhurst St., Rochester, N. Y.
- \*Frank, Guy, Breyer Ice Cream Co., 51 First Ave., Franklinville, N. Y.
- \*Frem, Harvey, A. Cardani Co., Inc., 37th Ave. & 11th St., Long Island City, N. Y.
- \*Gibson, Albert R., Bacteriologist, Golden State Co., Ltd., 5307 Telegraph Ave., Oakland, Cal.
- \*Gillespie, Joseph S., Associated Milk Dealers, Inc., 134 N. LaSalle St., Chicago 2, Ill.
- \*Glasser, Miss Jean, 760 Montgomery St., Brooklyn, N. Y.
- \*Grant, Allister, Plant Superintendent, Pacific Dairies, Ltd., Moncton, New Brunswick.
- \*Guilford, Dr. H. M., Director, Div. of Communicable Disease, State Board of Health, State Office Bldg., Madison 2, Wis.
- \*Halcy, Walter W., Department of Health, Health Centre, Lockport, N. Y.
- \*Haldorsson, Thorhallur, Student, Dairy Industry, Univ. of Wisconsin, 1210 W. Dayton St., Madison 5, Wis.
- \*Hayes, Arthur H., Dept. of Health, 12 Emerson Pl., Binghamton, N. Y.
- \*Heafner, S. B., Pennsylvania Salt Co., 27 Stevenson St., Cortland, N. Y.
- \*Herrington, E. M., Arkport Dairies, Inc., Arkport, N. Y.
- \*Horton, S. A., Mt. Joy Farmers Co-Op. Assoc., Mt. Joy, Pa.
- \*Houser, Leroy S., Sanitarian, U. S. P. H. Service, 852 U. S. Customhouse, 610 S. Canal St., Chicago, Ill.
- \*Hyde, Burt, N. Y. State Department of Health, 3 Slocum Ave., Granville, N. Y.
- \*Jacunski, Joseph J., City Milk Inspector, R. 1, Box 149, Wisconsin Rapids, Wis.
- \*Jasper, Harry, Klenzade Products Co., Box 102, Marshalltown, Iowa.
- \*Jermain, William S., Sparks Dairy, Inc., 88 Hoyt St., Buffalo, N. Y.
- \*Johnson, L. C., The De Laval Separator Co., Moravia, N. Y.
- \*Johnson, M. H., Roselake Dairies, Bear Lake, Pa.
- \*Josephson, Warren A., Sheffield Farms Co., Inc., 4 Berkley Rd., Mineola, N. Y.
- \*Ketcham, R. D., Dairymen's League, Mechanic St., Cato, N. Y.
- \*Kofron, John J., Hillside Dairy Co., 1418 Warrensville Center Rd., Cleveland Hgts. 21, Ohio.
- \*Lacere, Gerald M., N. Y. C. Health Dept., 929 Anst Ave., New York City.
- \*LaRue, John C., Jr., Dairymen's League, Arden, N. Y.
- \*Lawrence, William E., Lehmkuhl Laboratory, 73 Howell St., Rochester 7, N. Y.
- \*Leathers, F. J., Rochester Health Bureau, 64 Devon Rd., Rochester, N. Y.
- \*Lewis, John J., Borden Farms Products, Inc., Box 42, Pine Plains, N. Y.
- \*Little, Kenneth W., Dairymen's League, 29 Warren St., Homer, N. Y.
- \*Lord, F. J., Dairymen's League, Winslow Pl., Liberty, N. Y.
- \*Lynch, Paul Campos, P. O. Box 523, College Station, Texas.
- \*Maack, Dr. Arthur C., Technical Sanitation and Applied Bacteriology, Research Laboratories, Swift & Co., 6632 S. Greenwood Ave., Chicago 37, Ill.
- \*Marlatt, Howard B., Orange County Dairy Laboratory, 60 Lake Ave., Middletown, N. Y.
- \*Martinson, Dr. V. V., Veterinarian, Borden's, 472 N. Story Parkway, Milwaukee 13, Wis.
- \*Maxwell, C. F., Dairymen's League Co-Op. Assoc., 41 E. Court St., Warsaw, N. Y.
- \*McBride, Dr. Frank, Department of Health, 262 William St., Towanda, N. Y.
- \*McCarthy, Thos. P., Plant Manager and Fieldman, Pet Milk Co., Box 213, Shullsburg, Wis.
- \*McCuen, William G., Reeve & Mitchell Co., 1706 Lynnewood Drive, Upper Darby, Pa.
- \*McDowell, Roy E., Fieldman, The Borden Co., Waukesha, Wis.
- \*McHale, Edmund R., Jetter Dairy Co., 1620 Sunset Ave., Utica, N. Y.
- \*McMurray, Dr. T. Harold, Lancaster Milk Co., 958 Salisbury Court, Lancaster, Pa.
- \*Meverden, G. E., Plant Supt., Kraft Cheese Co., 45 E. Wisconsin St., Hartford, Wis.
- \*Morenus, Arland G., Spencer Dairy Service, 12 Lincoln Ave., Cortland, N. Y.

- \*Morgan, W. A., Jr., Dairymen's League, 33 Oak St., Geneseo, N. Y.
- \*Newell, Joseph, Dairymen's League, 70 John St., Kingston, Pa.
- \*Nielsen, Elmer G., Dairy Plant Operator, Donaldson Farms Dairy, R. F. D. 1, Bath, N. Y.
- \*Nielsen, S. J., Sanitarian in Charge, Division of Public Health Engineering, No. 1 Fordonia Bldg., Reno, Nev.
- \*O'Donnell, Earl J., Consulting Chemist and Operational Technician, Klenzade Prod., Inc., 1739 Summit Ave., Beloit, Wis.
- \*O'Hearn, John F., Dairymen's League, 469 Main St., Catskill, N. Y.
- \*Oliver, Ralph L., Johnson & Johnson, 17 Pine St., Brattleboro, Vt.
- \*Olson, Dr. A. T., Veterinarian, Borden's, 520 N. 8th St., Milwaukee 3, Wis.
- \*Ostrom, Ralph J., Secretary-Treasurer, Cream Crest Farms, Inc., 10,000 Skokie Blvd., Skokie, Ill.
- \*Palmer, Chester R., Sanitarian, Labette County Health Center, Parsons, Kans.
- \*Palmer, Wilbur, Public Welfare Dept., 212 N. St., Clair St., Wichita 12, Kans.
- \*Paylor, Glen H., Dairymen's League, 17 Williams St., Wolcott, N. Y.
- \*Payn, Fred, Milk Sanitarian, State Department of Agriculture, 1320 Farnam St., Davenport, Iowa.
- \*Pendleton, C. F., Crowley's Milk Co., Nichols, N. Y.
- \*Peters, Edward F., Dairy Inspector, LaCrosse, Health Dept., City Hall, LaCrosse, Wis.
- \*Plew, Austin D., Borden's, Box 132, New Milford, Pa.
- \*Plew, H. N., Borden's, Pine Island, N. Y.
- \*Potter, R. B., Oakite Products, Inc., 1925 Holland St., Erie, Pa.
- \*Pratt, William J., Universal Milking Machine Co., Cossayuna, N. Y.
- \*Priem, Wm. H., Dairy Inspector, State Dept. of Agriculture, 417 E. Pine St., River Falls, Wis.
- \*Quincy, Earl W., Dairymen's League, Blairstown, N. J.
- \*Rahe, Wm. L., Plant Mgr. and Dairy Farm Inspector, Madison Milk Producers Coop. Dairy, 1812 Park St., Middleton, Wis.
- \*Rasmussen, John R., New York City Health Department, 60 Lake St., Pulaski, N. Y.
- \*Rathbone, E. L., Mgr. Lexington Farms, Lexington, N. Y.
- \*Rathbun, Harry, Dairymen's League, Whitney Point, N. Y.
- \*Reeve, T/3 Robert K., 12103092, Dairy Inspector, Veterinary Service, Medical Dept., U. S. Army, Hg. Dist. No. 2, 6SC, 1698 SU, 706 Federal Bldg., Milwaukee, Wis.
- \*Reif, L. E., Fieldman, Borden's, 620 N. 8th St., Milwaukee 3, Wis.
- \*Reppen, A. J., Dairy Inspector, Wisconsin State Dept. of Agriculture, 814 18th Ave., Monroec, Wis.
- \*Rexford, P., R. W. Jones Co., 70 E. Ferry St., Buffalo, N. Y.
- \*Roberts, Geo. M., Cooperdale Dairy Co., 40 Academy St., Skaneateles, N. Y.
- \*Robinson, Leland G., N. Y. City Health Dept., 68½ Maple Ave., Cortland, N. Y.
- \*Rockafellow, Lyman D., Fieldman, Verifine Dairy Prod. Co., 536 Pine St., Sheboygan Falls, Wis.
- \*Schaefer, Wm. V., The Borden Co., 386 Broadway, Newburgh, N. Y.
- \*Shafer, H. D., Queensboro Farm Products, Inc., R. F. D. 4, Little Falls, N. Y.
- \*Shapiro, Max H., Bureau of Health, 165 Longview Terrace, Rochester, N. Y.
- \*Shean, Harry R., Dairymen's League, Arkport, N. Y.
- \*Shogren, C. B., Vice-Pres. and Sales Mgr., Klenzade Products, Inc., 2715 Riverside Drive, Beloit, Wis.
- \*Skelton, F. M., Scaltest, Inc., 65 Clinton St., Homer, N. Y.
- \*Skiver, W. D., Wyeth, Inc., Mason, Mich.
- \*Slingerland, Robert, Dairymen's League, 207 East Elm St., Penn Yan, N. Y.
- \*Smathers, Jas. B., Fieldman and Station Mgr., Pet Milk Co., Dodgeville, Wis.
- \*Smith, Leroy J., Queensboro Farm Products Co., Fort Plain, N. Y.
- \*Sperl, John G., Fieldman, Midwest Creamery Co., 822 Eastern Ave., Plymouth, Wis.
- \*Spiggle, J. D., Sanitarian, West Virginia State Health Dept., District 3, Point Pleasant, W. Va.
- \*Swift, Paul R., N. Y. City Health Department, 10 Bank St., Montrose, Pa.
- \*Thew, Harvey E., Manager, Madison Milk Producers Coop. Assoc., 29 Coyne Court, Madison 5, Wis.
- \*Titch, Floyd, Borden's, 23 High St., Bainbridge, N. Y.
- \*Uselman, Wm. E., Chemist and Bacteriologist, Galloway-West Co., Fond du Lac, Wis.
- \*Wade, G. C., Dairy Inspector, State Dept. of Agr., 309 E. Sunset Court, Madison 5, Wis.
- \*Wallis, W. C., Sanitation Supervisor, Calhoun County Health Department, Calhoun City, Miss.
- \*Walton, Joe, Sheffield Farms Co., Post St., Boonville, N. Y.
- \*Warner, Carlos H., Jr., Queensboro Farms Dairy Co., 531 Elizabeth St., Oneida, N. Y.
- \*Weber, Albert H., Borden's, P. O. Box 91, Millerton, N. Y.
- \*Weber, Christian C., Bellevue Dairy, Inc., 1060 So. Geddes St., Syracuse, N. Y.
- \*Weidig, Cpl. Willard J., Meat and Dairy Inspector, Army Air Forces, 465th AAF Base Unit, Detachment "M," Paine Field, Everett, Wash.

- \*Weinstein, Max, N. Y. City Health Department, 148 W. Washington Ave., Washington, N. J.
- \*Whipple, Howard A., Queensboro Farm Products, Inc., Van Hornesville, N. Y.
- \*Whistler, Frank O., Bureau of Health, 2400 Woodlawn Ave., Niagara Falls, N. Y.

- \*Willson, Dr. Robert F., Director of Dairy and Food Division, Health Dept., 3919 John R. Ave., Detroit 1, Mich.
- \*Wohnsiedler, Dr. Geo., Board of Health, 950 West St., Carthage, N. Y.
- \*Wolford, Irving J., Kohler Swiss Chocolate Co., Phocnix, N. Y.

#### CHANGES IN ADDRESSES

- Abraham, S., from New York City, to Middletown Milk & Cream Co., Slate Hill, N. Y.
- \*Ahl, Martin V., from Duluth, Minn., to 505 Florida Theater Bldg., St. Petersburg 1, Fla.
- \*Aulik, Bernard, from Madison, Wis., to Dean Milk Co., Chemung, Ill.
- Baldwin, E. St. J., from Borden's, 110 Hudson St., New York City, to Certified Laboratories, Inc., 19 Hudson St., New York City.
- \*Barron, J. L., from Roslyn Heights, N. Y., to 180 Hilton Ave., Hempstead, N. Y.
- \*Carkhuff, Floyd B., from 44 Lincoln Ave., Binghamton, N. Y., to 94 Martin Ave., Binghamton, N. Y.
- Clarkson, Capt. A. W., from Hannibal, Mo., to Capt. A. W. Clarkson, 0-523523, Squadron B. A.A.B., Chatham Field, Georgia.
- Cone, J. Frank, from Washington, D. C., to Dept. of Dairy Husbandry, State College of Washington, Pullman, Wash.
- \*Emerson, Robert D., from 164½ South St., Middletown, N. Y., to Piffour Dairy Farms, Inc., Nashanic, N. J.
- \*Evans, Nelson J., from 1002 Lafayette Ave., Buffalo, N. Y., to 68 Mildred St., Buffalo 2, N. Y.
- \*Fennimore, J. E., from Delhi, N. Y., to Deansboro, N. Y.
- Fish, Dr. James G., from 4644 Main St., Jacksonville, Fla., to 474 W. 71st St., Jacksonville 6, Fla.
- Frey, Dr. Charles N., from New York City (Fleischmann), to Director of Scientific Relations, Standard Brands, Inc., 810 Grand Concourse, New York 51, N. Y.
- \*Goelbert, Raymond, from Brooklyn 27, N. Y., to 669 Eighth Ave., New York 18, N. Y.
- \*Hanson, F. E., from Wauwatosa, Wis., to Soil Conservation Service, Webster, S. Dak.
- \*Kihlstrum, Elmer E., from 407 Stolp Ave., Syracuse, N. Y., to 201 Bishop St., Peoria, Ill.
- \*Legrid, Lester I., from 715 W. 6th St., Ashland, Wis., to 120 W. 12th St., Ashland, Wis.
- \*Millenky, Abraham, from 8409 Talbot St., Kew Gardens, N. Y., to 8343 118th St., Kew Gardens 15, L. I.
- \*Mitten, J. W., from Sheffield Farms Co., Camptown, Pa., to Walter Maguire Co., Inc., Camptown, Pa.

- Muenzer, A. B., from A. B. Munger, Toledo, Ohio, to . . . . .
- \*Newton, D. H., from 732 S. Cedar St., Sturgeon Bay, Wis., to 743 Kentucky St., Sturgeon Bay, Wis.
- \*Noth, Alvin, from . . . . . to Fieldman, Wisconsin Coop. Creameries Assoc., District No. 2, Norwalk, Wis.
- \*Petran, F. W., from 947 E. Pacific St., Appleton, Wis., to 414½ S. State St., Appleton, Wis.
- \*Powell, Marcus P., from Iowa City, Iowa (University of Iowa), to Assistant Sanitarian (R), U. S. Public Health Service, 15 Pine St., New York 5, N. Y.
- \*Radke, A. L., from . . . . . to Production Mgr., and Quality Control, Sanna Dairy Engineers, Hudson, Wis.
- \*Rasmussen, Bert L., from Liberty, N. Y., to 108 Broadway, Hornell, N. Y.
- \*Raudenbush, S. W., from St. Paul, Minn., to c/o Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia 7, Pa.
- \*Reiger, Herbert A., from Johnson City, N. Y., to 732 Tallman St., Syracuse 4, N. Y.
- \*Rogers, Harold L., from Norwich, N. Y., to 3 Potter Ave., Oneonta, N. Y.
- \*Salvato, J. A., Jr., from APO 702, Minneapolis, Minn., to Capt. J. A. Salvato, Jr., Sn.C, 0448045, 6858 76th St., Middle Village, Queens, N. Y.
- \*Schwartz, B. W., from . . . . . to B. W. Schwartz Co., Two Rivers, Wis.
- \*Springstead, Carl, from 2209 Monroe Ave., Rochester, N. Y., to Creer Road, Leroy, N. Y.
- \*Temple, Dr. Harry, from Pine Bush, N. Y., to Vermont Milk & Cream Co., R. F. D. 3, Fair Haven, Vt.
- \*Tinker, Paul F., from 947 James St., Syracuse, N. Y., to 345 W. Jefferson St., Syracuse, N. Y.
- \*Valleskey, Norbert W., from Manitowoc, Wis., to Darlington, Wis.
- \*Walts, Dr. Charles C., from 301 Myrtle Ave., Elmhurst, Ill., to Director of Research, Hershey Creamery Co., 301 So. Cameron St., Harrisburg, Pa.
- \*Webb, Tom, from Coldwater, Ohio, to Dean Milk Co., Pecatonica, Ill.
- \*White, Herbert L., from Hornell, N. Y., to N. Y. S. Health Dept., Box 62, Canton, Pa.
- Widder, Clarence O., from Trial Ave., Sheboygan, Wis., to 1208 S. 8th St., Sheboygan, Wis.

## THE EFFECTIVENESS OF SULFONAMIDE PREPARATIONS IN ELIMINATING MASTITIS \*

The Bureau of Dairy Industry, in October 1942, made a survey of the extent of mastitis infection in its dairy herd at Beltsville, Md., and at the same time began a study to determine the effectiveness of sulfonamide preparations in the eradication and control of the disease.

Bacteriological studies of milk samples showed that approximately 35 percent of the cows in the herd were infected. Streptococcal infections (mostly *S. agalactiae*) were found in 72.4 percent of the infected quarters, staphylococci in 9.0 percent, *Pseudomonas aeruginosa* in 14.2 percent, and coliform bacteria in 4.5 percent.

A sulfanilamide-in-oil preparation was made up by following in a general way the methods and formula described by Kakavas, Palmer, Hay, and Biddle at the Delaware Station. This was used in treating the infected quarters of some cows. Later sulfadiazine was used with the sulfanilamide in the proportion of 1 part sulfadiazine to 19 parts sulfanilamide (5 percent and 95 percent respectively). Both the sulfanilamide and the mixture of sulfanilamide and sulfadiazine were homogenized in light mineral oil, in the proportion of 1 pound to 1,350 cc. (45.65 fluid ounces) of oil, and sterilized in glass containers in a hot water bath at 65° to 70° C. (149° to 158° F.) for 2 hours.

One or both of the two sulfonamide preparations were used in treating 125 infected quarters. The infecting organisms were cleared from 80 percent of the quarters containing streptococci, 90 percent of the quarters containing staphylococci, 55 percent of the quarters containing *Pseudomonas aeruginosa*, and 83 percent of the quarters contain-

ing coliform bacteria. Of the 125 infected quarters 97, or 77.6 percent, were cleared by treatment with these preparations. Approximately 94 percent of the quarters that responded to the treatment, were cleared as a result of the first, second, or third treatments. The preparation containing sulfadiazine was especially effective in eliminating staphylococcal and coliform infections (89 and 83 percent respectively of the treated quarters were cleared).

Unfavorable reactions to sulfonamide injections were almost nonexistent and the treatments did not significantly depress milk secretion either during or after treatment.

The daily dosage of these sulfonamide preparations that was found to be most effective was 75 cc. to each infected quarter of the udder. In lactating cows the injections were made as soon as possible after milking, once daily for 4 consecutive days. The material was left in the udder until the next milking. The milk containing the residue of the injected material was discarded. Seven to 10 days after completion of the series of injections, samples of milk were again taken for bacteriological study to determine the effectiveness of the treatment. In treating dry cows the material was left in the udder. The results of the treatment in these cases were determined by studies of milk samples taken after the next calving.

Injections were made into the teat canal and the material was massaged upwards to insure distribution through the cistern and into the larger ducts. A separate, sterile cannula for each quarter was used. The teat was carefully cleansed with alcohol or other antiseptic material before the injection was made.

(Continued on next page)

\* By W. W. Swett, R. R. Graves, P. C. Underwood, C. A. Matthews, and J. Frank Cone, Bureau of Dairy Industry.

## “Dr. Jones” Says—\*

You know what the newspaper folks say: if a man bites a dog, that's news. The same principle: humans getting tuberculosis from cows—that's an old story. Of course, between tuberculin testing of cattle and pasteurization of milk, there hasn't been so much of it here late years. But, anyway, when a man gets tuberculosis from one herd of cows and then, several years later, turns around and gives it to three or four new herds, that ought to qualify for some sort of a news story. And apparently that happened, according to a report a county veterinarian gave at a meeting a while ago.

They had reason to suspect the herd on a certain farm so they did a tuberculin test on 'em. The whole herd (twenty-two of 'em) was infected. They were all put out of the way and the farmer got an entirely new herd. That was in 1929. From then up to 1942, they tested 'em every year and they were O.K.

In the meantime this farmer'd come down with tuberculosis himself. He went to a sanatorium for a couple of months then, apparently, went home and went to work. Evidently he was coughing up germs and I gather, from what I hear, that he wasn't any too careful.

\* *Health News*, New York State Department of Health, Albany, November 13, 1944.

Well, sir, after all those “clean” years, they tested the herd in 1942 and all of 'em were reactors. They got a new herd and a year later the same thing happened again—and still another time. They decided they'd better try and run it down: see how the cows were getting infected.

These tuberculosis germs—you see, there are various families or strains of 'em—maybe all descended from the same ancestors. There's one strain that specializes on humans, another on cattle. They can identify the different strains by laboratory tests. Years ago a lot of people, mostly children, got tuberculosis from these bovine germs. But cows being infected by humans, that's something we don't know so much about.

Anyway, they tested out the bacilli in the man's sputum and from the cows and they were all the bovine type. The conclusion was that the farmer'd got his infection from that first herd (I s'pose through the milk) and then, several years later, passed it on to the new herds.

It kind of looks as if the germs, as well as the Germans, still have a few tricks up their sleeve. And tuberculosis—well, it's some like George Peabody said about the snake: “I killed it,” George says, “but maybe I'd better go out and make sure it's dead.”

PAUL B. BROOKS, M.D.

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Since August 1943 a new sulfonamide preparation has been used. A large proportion of the quarters that failed to clear by treatment with the preparations described above have

since responded and only a few cows are left in the herd that are known to harbor mastitis organisms. These will be either cleared by treatment or disposed of in the near future.