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Editorials

Milk Laboratory Survey Form on Sale by APHA

EVERYONE interested in improving the reliability of his laboratory's plate counts of milk and milk products will be pleased to know that there is now available from the American Public Health Association a handy form for checking his procedures against those recommended in the latest (eighth) edition of *Standard Methods for the Examination of Dairy Products.* Printed on both sides of a single sheet, the form covers the essential details of apparatus, preparation, and technique, which occupy 26 pages in Standard Methods.

The form was originally developed by the United States Public Health Service for use in surveying milk laboratories throughout the country. It was considered so valuable by the Standard Methods Committee that it has been published by APHA for sale and for free distribution with copies of the third reprinting of the eighth edition of Standard Methods. The price is $1.00 for fifty copies, $1.50 for one hundred copies, or $10.00 for one thousand copies. Sample copies may be obtained without charge.

Many of us have assumed that the promulgation of Standard Methods procedures be so weighty an authority as the APHA would automatically solve the problem of securing uniformity. This assumption has been strengthened by the now almost universal reference to Standard Methods in municipal milk ordinances and state regulations. Possibly we did not stop to consider that milk examinations are often made by technicians inadequately trained, with human frailties, with ambitions to be different and original, without outside professional contacts or proper supervision, in laboratories poorly equipped because of niggardly appropriations. Had we done so, we might not have been so thoroughly shocked by Dr. Black's report of his survey of 408 milk laboratories (Reprint No. 2522 from the *Public Health Reports*). He found that no laboratory was actually meeting all requirements, and that the average laboratory violated 32 of the 168 sub-items on the survey form relating to the agar plate method. Obviously, many of these departures must have influenced the accuracy of the results.

As Dr. Black points out, a considerable share of the responsibility for these conditions falls upon public health administrators who commonly take laboratory results for granted. If some interested administrative official had visited local laboratories and had given them some aid and encouragement in facilities, equipment, procedures, and in-service or additional training, the commonly low caliber of bacteriological milk analysis would have been materially higher. This is borne out by the fact that the only two states really having some system of inspecting the laboratories and the personnel doing milk analysis ranked highest among the 48 states in compliance with Standard Methods pertaining to agar plate counts. The Public Health Service recognizes the need for official supervision of laboratories and has embarked on a program of arranging for state health department supervision of local laboratories that examine milk supplies used on interstate common carriers.

It is believed that the milk laboratory survey forms should be of value to administrators in improving the work of laboratories in their jurisdiction. Likewise, they should be useful as a guide to the worker in service and should be particularly helpful to those training new workers and students.

A. W. F.

Milk Sanitarians—Their Training and Employment Opportunities*

At the thirty-ninth annual meeting of the American Dairy Science Association in June of this year, their committee on "The Training and Employment of Milk Sanitarians," under the chairmanship of Mr. H. F. Judkins, made such a comprehensive report that all milk sanitarians should become acquainted with its findings. These are summarized as follows:

Definition of "Milk Sanitarian"

Three definitions are quoted from respective authorities, including the definition in Article II of the constitution of the International Association of Milk Sanitarians. Particular attention was called to a definition which stressed that the milk sanitarian must be "qualified by technical training and experience to supervise the production, processing, and distribution of an adequate supply of clean, safe, platable milk and milk products *in the interest of public health*" (Italics ours as emphasized by the committee's favorable comments).

Duties

The list of duties comprized twenty-three categories including farm and plant inspections, laboratory testing, technical advices to producers and operators, training of personnel, education of public, and promotion of sound regulatory measures.

General Qualifications

His personality must be pleasing and agreeable, and yet he must be able to gain the confidence of those with whom he works. A keen interest in the public health is important.

Education

The committee concluded that present four-year courses in dairying do not cover all the education and training necessary for a milk sanitarian. Special

* "The Training and Employment of Milk Sanitarians: A Committee Report." *Journal of Dairy Science*, *27*, 691 (1944).

courses to do this are not justified by the employment opportunities offered. A Student who wants to engage in milk sanitation work should take certain elective studies in his dairy undergraduate dairy courses. If he would advance materially, he must take graduate work in related subjects, as for example, some veterinary science, sanitary and mechanical engineering, public health, etc.

TRAINING

The training and experience gained in industrial and regulatory application of the principles of milk sanitation, together with executive ability, should be the basis for advancement to more responsible positions.

OPPORTUNITIES

There seems to be little or no opportunity for Army commissions in the field of milk sanitation, but there are some openings in the Public Health Service. Positions in city and state health departments are not very attractive because of the lack of a "future" and the salaries. More opportunities for the properly trained graduate exist in the industries because of the advancement possibilities.

* * *

The committee has brought the status of college education in dairy sanitation right out into the open. From other sources, the whole subject of education in food fields is under scrutiny. Several trends are indicated. One reveals the inadequacy of present college curricula to turn out good milk sanitarians. The Institute of Food Technologists has a committee studying the requirements for an adequate curriculum in the whole field of food technology. Health departments are instituting "short courses" for in-service employees. Special courses, industrial as well as collegiate, are being offered to meet a need that is more or less inarticulate and unorganized among the workers, and not yet fully recognized and supported by industrial management or officialdom.

J. H. S.

State Collaboration in Sanitary Milk Control

DURING the recent annual meeting of the American Public Health Association in New York (October 3–5, 1944), an informal conference was arranged to discuss reciprocal sanitary milk control among the states. Apparently the conference was held at the request of representatives of one or two areas with over-lapping milksheds. Copies of notices addressed to all state health officers also were sent to some municipal health officers believed to be interested. Dr. Haven Emerson presided. Although the meeting also was listed in the official program many others never knew about the meeting. Incidentally, the session was held in advance of the scheduled hour, depriving some "late-comers" of hearing all expressions of opinions.

The objective of the conference was to draw forth expressions of opinion as to whether or not state reciprocity regarding sanitary milk control was desirable, and if so, should the conference request the American Public Health Association to appoint a committee to study the question.

Those who spoke to the question were Mr. Beckett, Dr. Brooks, Mr. Fuchs, Dr. Getting, Dr. Godfrey, Dr. Grim, Mr. Palmer, Mr. Pincus, Dr. Shrader, Dr. Sebbins, Mr. Tiedeman, and Mr. Tompkins. These presentations emphasized the following main points, namely: (1) overlapping and sometimes conflicting sanitary regulations were confusing, obstructive, and unnecessarily expensive; (2) exchange of inspection data reciprocally among the states would remove these difficulties; (3) no reciprocal action is possible without a generally accepted basis of dairy farm requirements and a system of checking state certification procedure; (4) a report on a comprehensive study of milk sanitary-control ordinances is to be submitted to the INTERNATIONAL ASSOCIATION OF MILK SANITARIANS at their forthcoming annual meeting in Chicago, November 2–4, 1944; and (5) the data or recommendations of this latter group should be examined as predicatory for any other study that may be inaugurated in this already active field.

A resolution prepared and suggested by the chairman of the conference was presented, calling on the Governing Council to appoint a committee to study the advisability of state reciprocity in milk sanitation control. There appeared to be a difference of opinion as to the function of such a committee. Some thought that the committee was to decide only the general policy of the necessity for and desirability of reciprocity, whereas others thought the committee might undertake to prescribe uniform regulations which work was being done by the other groups better qualified to do it. The vote was nineteen in favor of the resolution, and twelve against.

J. H. S.

DAIRY SHORT COURSE

Massachusetts State College, Amherst, Massachusetts

The first dairy short course for the year 1945 to be offered by the Department of Dairy Industry at Massachusetts State College will open January 29 and will continue through February 3. The course, according to Professor J. H. Frandsen, Head of the Department, is especially adapted to meet the needs of inexperienced men and women who are interested in preparing themselves for milk plant work.

In this course, particular attention will be paid to milk and cream testing, pasteurizing, analyzing and inspecting dairy products, and problems pertaining thereto. Stress will also be laid on other important phases of dairy work such as sanitation and cleanliness. Persons completing the course satisfactorily will be entitled to the Babcock tester's license.

There are no entrance requirements except that applicants must be at least 16 years of age and must manifest an interest in general dairy testing or in dairy food processing. Applications should be in by January 24.

Immediately following the above-mentioned dairy course, the Massachusetts State College will also offer a five-day intensive short course in bacteriological methods for milk examination from February 5 through February 10, 1945. Applications for this course should be in by January 29. For full information, write to the Short Course Office, M.S.C., Amherst, Mass.

A Study of Methods for the Microscopic Examination of Raw Milk with Suggested Improvements

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For many years the agar plate count has been the accepted standard for the measurement of the sanitary quality of milk. The microscopic test has been an alternative method but has not been as widely used as has the plate technic. This paper is no brief for the advantages and disadvantages of the two methods of examination but is a presentation of a simplification of the microscopic test for production use in the examination of raw milk without reducing the accuracy of the procedure.

Irrespective of our particular likes or dislikes of the two procedures, the fact remains that our supply of bacteriological agar is limited and the number of available trained laboratorians is extremely small. Either the number of analysis must be reduced in many laboratories or shorter methods of examination must be substituted. The adoption of the microscopic technic in place of the plate procedure for producer milk samples not only makes it possible for the laboratory to maintain its present number of analysis but actually to make more without an increase in personnel.

The microscopic test has been well developed and is a dependable means of measuring milk quality. No attempt will be made in this paper to review its development or prove its value, since many publications have already reviewed these phases of the subject adequately.

Several years ago, one of the writers [Bryan (1)] simplified the microscopic test by the replacement of the pipette for measuring the test sample by a 4 mm. (outside diameter) loop. Inasmuch as a 4 mm. loop carries less than 0.01 ml. of milk, a smaller area (4 x 8 mm.) was smeared. In this manner, the milk on a given field area was apparently the same as that obtained by spreading 0.01 ml. of milk over a square centimeter area. The simplified test was used for checking producer milk samples and was not presented at the time as a substitute for the standard technic. The technic has been used routinely for checking producer milk samples for six years with complete success. Using this technic it has been possible to examine 12,000 samples yearly with a minimum of help.

Recently one of the writers (2) developed a new staining technic for detecting bacteria in egg meats. With this procedure it has been possible to stain the bacteria in the egg meat without staining the egg material. The organisms are stained a distinct blue without any stain or only slight tinges in the background. Later the stain was applied to milk smears with such surprising improvement that the following studies were instituted to determine the practicability of the stain and the loop technic as a standard procedure by comparisons with the present standard microscopic procedure.

EXPERIMENTAL PROCEDURE

Comparative study of loop and pipette in preparing smears.

The loop technic is not new. In 1916 Breed and Brew (3) made a comparative study of the accuracy of the loop and pipette technics. They found that, although a loop calibrated to deliver 0.01 ml. of milk speeded up the analysis, it introduced a variation of 35 percent, while the pipette technic gave a variation of not more than two percent. It is apparent from these results that a loop delivering 0.01 ml. is not practical.

Because the Bryan technic uses a smaller loop, the variability of content would appear to be not as great and, because a proportionately smaller film area is used, the amount of milk on a microscopic field would appear to be the same. Assuming these technics to be comparable, the procedure would be equal to the pipette technic as recommended by the Committee on Standard Methods for the Examination of Dairy Products. (4).

For the comparative tests seven milks were tested but only three were selected for presentation, inasmuch as the data on the other four were comparable. Milk No. 1 had an average count per field of 4 organisms or clumps, No. 2, 0.8 and No. 3, 0.4 organism or clump. Duplicate smears were examined from the same milks so that the only variable would be the method of smearing. If one smear or even several smears were examined from different milks, even though a large number were examined, such variables as percentage of fat, solids content, acidity, surface tension, and viscosity would have to be evaluated.

The loop procedures as recommended by Bryan was made by smearing a 4 mm. (outside diameter) loop of milk over an area 4 x 8 mm. Although the area of 4 x 8 mm. is easily judged by the fact that it is twice as long as the diameter of the loop, a guide (Figure 1) was placed beneath the slide so that the area could be smeared accurately. All smears made by the pipette technic were in accordance with *Standard Methods for the Examination of Dairy Products.*

All the slides were stained in exactly the same manner, using the same stain so that the only variable in the series was the method of smearing the films. In all instances. the number of organisms per field was recorded for each smear.

Examinations were made with a 1.32 mm. oil immersion objective and a 5x eyepiece. This combination yielded a conversion factor of 240,000 —one organism per field representing 240,000 organisms per ml. of milk. The results represent a "clump count" in which the clumps of bacteria as well as the individual organisms were counted as units.

With milk No. 1 (4 organisms per field), counts of bacteria were used of 25 fields taken from each of 20 smears, made by using the pipette technic and from each of 20 smears using the loop technic. With milk No. 2, (0.8 organism per field) in like manner, 50 fields from each of 30 smears, and with milk No. 3 (0.4 organism per field), 50 fields from each of 22 smears were examined. A statistical analysis of each set of smears was made in order to determine whether or not the loop technic was as efficient as the pipette technic for estimating the bacteria content of milk.

The averages and standard error pertaining to the loop and pipette technics are as follows:

	Loop Technic	Pipette Technic
Milk No. 1	4.37 ± 0.12	4.45 ± 0.10
Milk No. 2	0.79 ± 0.04	0.88 ± 0.04
Milk No. 3	0.42 ± 0.02	0.39 ± 0.02

Analysis of variance (Table 1) was carried out for testing whether or not the average number of bacteria obtained from the loop technic was significantly different from the average obtained from the pipette technic.

TABLE 1

ANALYSIS OF VARIANCE OF THE COUNTS OF BACTERIA MADE BY THE LOOP AND PIPETTE TECHNICS ON MILK NO. 1: LOOP AND PIPETTE COMBINED

Source of Variation	*Degrees of Freedom*	*Sum of*	*Mean Square*
Total	999	6587.7	...
Between technic means	1	1.5	1.5
Between smear means	38	150.1	3.9
Within smears	960	6436.1	6.7

Before the above analysis of variances were carried out, Bartlett's (5) homogeneity test was applied to determine whether or not the "within means" sums of squares could be pooled to form an error sum of squares. These tests did not indicate heterogeneity among the smears variabilities, hence the within smears sums of squares were pooled for obtaining the experimental error.

Since the counts of bacteria range from extremes of 0 to 13 bacteria, one would expect to find that the distribution of these counts followed the Poisson distribution. This was not true for the counts of milk No. 1; hence the reason for not transforming the counts to square roots.

The analysis (Table 1) indicates that the counts of bacteria made by using the loop technic are on an average as reliable as those made by using the pipette technic as based on a milk showing an average of approximately four organisms per microscopic field.

With milk No. 2, since there were so many fields with no bacteria in them, the counts of 5 fields were combined; these totals now represent the number of bacteria per unit of 5 fields. The sum of the counts of the first 5 fields made the first unit, the sum of the next 5 fields made the second unit, etc.

On examining the frequency distribution of counts from milk No. 2 taken from 50 fields in each of 30 smears, it was found that the counts were distributed as a Poisson distribution. The X^2 test applied to the two distributions (loop and pipette technics) indicates that a Poisson distribution fits the observed data very well. On examining the enumerations of bacteria per five fields from milk No. 2 it was discovered that they also were distributed as a Poisson curve. Since the totals for 5 fields are distributed as a Poisson curve, each count of 5 fields was transformed to $1/x + .5$ where x represents a count of 5 fields (6).

This analysis indicates that there is no significance between the averages obtained by using the loop and pipette.

Milk No. 3 was examined statistically in a manner similar to milk No. 2 and the analysis shows that the two technics give comparable results. The similarity of the counts is shown in the frequency distribution for Milk No. 3 in Table 2.

TABLE 2

FREQUENCY DISTRIBUTIONS OF COUNTS OF BACTERIA PER FIELD OF MILK WITH ABOUT 0.4 BACTERIA PER FIELD

No. of Bacteria per Field	*Pipette Method Frequency-percentages*	*Loop Method Frequency-percentages*
0	69.2	70.7
1	22.6	21.3
2	6.2	6.4
3	1.4	1.2
4	.5	.3
5	.1	.1

By using the following formula, the number of fields necessary to count from a number of specified smears is obtained in order that the standard deviation of the mean will have for values of 5, 10, 15, 20 and 25 percent.

$$n = \frac{m}{NK}$$

Where K, N, n, and m represent, respectively, the required variance of the mean, the number of smears, the number of units per smear, and the error mean square. For example, let the desired standard deviation of the mean be 5 percent of the mean, of the counts pertaining to the average of the loop and pipette technic, 4.41 bacteria and the number of smears be 10. The above formula gives the number of fields necessary to count from each of 10 smears so that the standard deviation of the mean will be $0.05 \times 4.41 = 0.221$ bacteria. This number is:

$$n=6.7 \frac{\text{(Error mean sq. in Table 1)}}{10\ (0.22)^2}=14 \text{ fields}$$

This means that it is necessary to count 14 fields for each of 10 smears in order to have the standard deviation of the mean equal 0.22. In Tables 2, 3, and 4 are presented the number of fields necessary to count from each of various number of smears to have a specified accuracy in the mean of the counts calculated from the counts obtained with milks Nos. 1, 2, and 3, respectively.

TABLE 3

NUMBER OF FIELDS NECESSARY TO COUNT FROM VARIOUS NUMBERS OF SMEARS IN ORDER THAT THE STANDARD DEVIATION OF THE MEAN WILL BE A CERTAIN PERCENT OF THE MEAN OF 4.41 BACTERIA PER FIELD.

No. of Smears	*Percent of the Mean* 5	10	15	20	25
1	137	34	15	9	6
2	69	17	8	5	3
3	46	11	5	3	2
4	34	9	4	2	2
5	28	7	3	2	1
6	23	6	3	2	1
7	20	5	2	..	..
8	18	4	2	..	..
9	16	4	2	..	..
10	14	3	2	..	..
15	10	2	1	..	..
20	7	1	..	..	..
30	5	..	..	..	..
40	3	..	..	..	..
50	3	..	..	..	..

TABLE 4

NUMBER OF FIELDS NECESSARY TO COUNT FROM VARIOUS NUMBERS OF SMEARS IN ORDER THAT THE STANDARD DEVIATION OF THE MEAN WILL BE A CERTAIN PERCENT OF THE MEAN OF 0.8 BACTERIA PER FIELD.

No. of Smears	*Percent of the Mean* 5	10	15	20	25
1	515	130	60	35	20
2	260	65	30	15	10
3	170	45	20	10	5
4	130	35	15	10	5
5	105	25	10	5	5
6	85	20	10	5	5
7	75	20	10	5	5
8	65	20	10	5	5
9	55	15	5	5	..
10	50	15	5	5	..
15	35	10	5	..	..
20	25	5	5	..	..
30	15	5	..	..	..
40	15	5	..	..	..
50	10	5	..	..	..

TABLE 5

NUMBER OF FIELDS NECESSARY TO COUNT FROM VARIOUS NUMBERS OF SMEARS IN ORDER THAT THE STANDARD DEVIATION OF THE MEAN WILL BE A CERTAIN PERCENT OF THE MEAN OF 0.4 BACTERIA PER FIELD.

No. of Smears	*Percent of the Mean* 5	10	15	20	25
1	1,250	319	138	78	50
2	625	159	69	37	25
3	417	106	46	26	17
4	313	80	34	20	13
5	250	64	28	16	10
6	208	53	23	13	8
7	179	46	20	11	7
8	156	40	17	10	6
9	139	35	15	9	6
10	125	32	14	8	5
15	83	21	9	5	3
20	63	16	7	4	3
30	42	11	5	3	2
40	31	8	3	2	1
50	25	6	3	2	..

The data presented in Tables 2, 3, and 4 for one smear (Graph 1) show the type of curve obtained with various numbers of organisms per a field. These curves were drawn free hand. An examination of these data, Tables 3, 4, and 5, indicates that the number of fields to count increases with a de-

TABLE 6
COMPARISON OF BACTERIA COUNTS OF PRODUCER MILK SAMPLES MADE BY TWO STAINING TECHNICS

Sample Number	Type of Staining: Standard Procedure	Acid Staining
1	5,000	5,000
2	5,000	9,000
3	144,000	115,000
4	15,000	38,000
5	53,000	100,000
6	53,000	200,000
7	14,000	65,000
8	9,000	5,000
9	38,000	57,000
10	115,000	300,000
11	5,000	14,000
12	34,000	48,000
13	9,000	9,000
14	14,000	19,000
15	96,000	144,000
16	72,000	75,000
17	9,000	15,000
18	192,000	245,000
19	53,000	67,000
20	19,000	25,000
21	29,000	24,000
22	5,000	5,000
23	245,000	576,000
24	10,000	15,000
25	67,000	50,000
26	14,000	15,000
27	5,000	9,000
28	100,000	173,000
29	9,000	15,000
30	5,000	15,000
31	9,000	5,000
32	806,000	1,140,000
33	173,000	240,000
34	912,000	2,160,000
35	48,000	320,000
36	177,000	2,000,000
37	2,340,000	3,040,000
38	2,520,000	2,080,000
39	50,000	68,000
40	3,840,000	4,512,000

crease in the number of organisms per field. For example, where the average number of organisms per a field is approximately 4, for an accuracy of 5 percent it would be necessary to count 137 fields whereas with an average count in a field is approximately 0.4, it would be necessary to count 1250 fields. If, however, an accuracy of 25 percent is desired, it would be necessary to count 6 fields with 4 organisms per a field and with 0.4 organisms it would require the counting of 50 fields.

It is suggested that producer samples be counted with an accuracy of 25 percent. It is further suggested that the results be reported with the accuracy appended as plus or minus percent of that used depending upon the number of fields counted.

COMPARATIVE STUDY OF STAINING TECHNICS

Two methods of staining were studied. One method is a modification of standard methods as it is used routinely in this laboratory. The slides are immersed in xylene to remove the fat, followed by a 95 percent alcohol solution. About one minute is sufficient in each and the slides are drained between solutions. The staining bath is prepared by adding 10 ml. of saturated alcoholic solution of methylene blue to 90 ml. of 30 percent alcohol (1). The slides are dipped in the stain just along enough for proper staining. They are then rinsed in water and decolorized in alcohol, if necessary, followed by thorough drying.

The second is a method which is recommended by Mallmann and Churchill (2) for use in staining egg-meats. The slides are stained according to the following procedure:

The staining bath is made of
- 1 gm. methylene blue (certified for bact. use).
- 500 ml. 95 percent ethyl alcohol.
- 0.5 to 5 ml. conc. hydrochloric acid (the greater the amount, the clearer the background).

The slide should remain in the staining bath from 3 to 5 minutes. It is then removed and dipped in a tap water bath only long enough to remove the excess stain. It is important to decolorize only partially in order to avoid decolorization of the background to such an extent that it is difficult to focus the microscope or to detect the edges of the smear. In addition, excessive washing will soften and loosen the film. The slide is air dried.

Because this stain contains 95 percent alcohol, it was found more satisfactory to omit the alcohol bath before staining, using only the xylene to remove the fat.

In this series, all the smears were made in duplicate by the loop technic, using producer milk samples to obtain variable counts and conditions of the milk.

Of the 40 samples (Table 6) examined, 31 gave a higher count with the acid stain. The standard stained slides were characterized frequently by heavy stained backgrounds and heavily stained debris which frequently retained the stain almost as well as the organisms themselves. Many bacteria were apparently obscured by stained material other than the bacteria. In contrast with the acid stain, debris was clear of stain and the background was practically colorless, offering no hiding place for bacteria. The organism retained the stain well and appeared distinct from the rest of the smears. This afforded more ease and speed in counting.

COMPARISON OF LIGHT SOURCES

In microscopy it is common practice to introduce a blue filter between the light source and the object to be examined when artificial illumination is used. This results in a neutral light source so that all colors of the object are transmitted to the eye. If the object is stained by methylene blue and a blue filter of moderate intensity is used, the blues of the object are softened. If the object has stained a very light blue, then the color may be entirely absorbed and the object becomes invisible. When polychrome dyes are used, white light is indicated. When a blue stain such as methylene blue is used and contrast is desired, then a red filter should be imposed; the blues are intensified and appear a purplish black. Thus in examining slides stained with methylene blue, a red filter would bring out clearly all bacteria taking the blue stain, even though the amount of stain absorbed by the bacterium was small. Unfortunately a red filter is very tiring to the eye so that prolonged observations are impossible. Less contrast would be obtained with an orange filter such as a Wratten "M" filter E-No. 22. This filter still gives very strong contrasts showing the bacteria with a purplish black color and it is not tiring to the eye. A number of methylene blue stained slides were examined using blue, red, and orange filters. The red and orange filters revealed poorly stained bacteria clearly whereas the blue filter absorved their color completely, rendering them invisible.

Counts were made on milk smears using both the standard and the acid stains. The counts were slightly higher with orange filter although no very poorly stained organisms were observed. In one instance where the plate count of a sample was extremely high, the blue filter revealed only one to three bacterial cells per a field whereas the red and orange filters revealed from 10 to 13 small rods, giving a microscopic count in keeping with the plate count.

SUMMARY

The Bryan loop technic for the microscopic determination of the bacteria content of milk was found statistically to be equally as accurate as the pipette technic recommended by the Committee for the Examination of Dairy Products, American Public Health Association. Smears stained by the acid stain of Mallman and Churchill were found to yield higher counts than the methylene blue stain recommended by the above Committee.

The use of a Wratten M filter No. E-22 (or its equivalent) between the light source and the object was found to give a sharper contrast of the organism to its background and revealed poorly stained organisms that were invisible with a blue filter or even natural light.

It was determined statistically that where one smear was examined as de-

termined by the examination of three different milks of different bacteria contents, the number of fields to be counted should be based on the percent accuracy of the results desired.

It is recommended that the Bryan loop technic be adopted as an alternative to the pipette technic in the standard methods for examination of milk.

It is recommended that the acid stain of Mallmann and Churchill be offered as an alternative procedure for the standard methods for the examination of milk.

It is recommended that the use of a Wratten M filter No. E-22 be placed between the light source and the object as a required procedure in the standard method for the examination of milk.

It is recommended that the percent accuracy of the count represented by the number of fields counted be reported with the microscopic bacteria count.

It is suggested that an accuracy of 25 percent be required for producer milk samples. When microscopic fields average at least one bacterial cell 10 fields should be counted and when fields show no organisms in 10 fields, at least 50 fields should be examined. If no organisms are found, the count would be under 5000. Further examination would have little significance.

All tests made in this study were made on raw milk. The procedures presented are not recommended for pasteurized milk.

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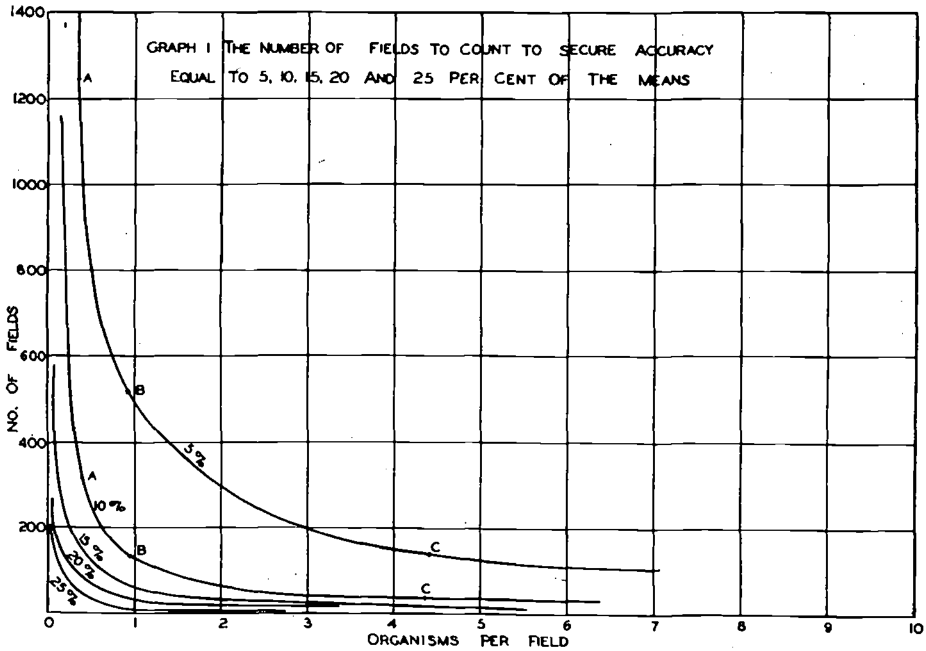

Extraneous Matter Tolerances in Cheese

Walter V. Price and Raymond Miersch *

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In controlling extraneous matter in cheese † the significance of the milk supply, construction and condition of the cheese factory, and methods of manufacture have not only been recognized in principle for many years but have also been specifically pointed out in recent months (7, 8). It would be ideal if all cheese were free of every visible trace of foreign material. How close this ideal can be approached in commercial practice is not known. Just as the presence of some extraneous matter is tolerated by the fluid milk industry, so probably some must also be tolerated by the cheese industry.

In considering the public welfare from the health, economic, and esthetic viewpoints, one questions to what extent contamination would be sufferable before a product should be condemned. Officials of health departments and food control agencies have always been confronted with this type of question in setting up standards for the protection of public health. When the contaminating substance or organism is pathogenic to man the answer is simply,—"No contamination." When the substance or organism is not directly pathogenic but perhaps indicative of undesirable conditions or practices, then the question is not so simply answered. This latter type of question confronts health officials in the establishment of bacteriological standards for water supplies and for grades of milk. Such standards may differ with localities, cities, and parts of the country; they are modified frequently to conform to changing economic and esthetic demands. A standard defining the tolerable amount and type of extraneous matter in cheese is essentially the second type of question.

The establishment of an extraneous matter tolerance should be based upon measurements from as large a number of factories in as wide a territory as possible and over a period of at least a year. But such measurements can only be a portion of the evidence; the balance must come from close and frequent contacts with the factories from which the samples for measurement are taken.

Factories which have been studied produced cheese which frequently showed defective vats despite the fact that some of these factories after inspection were judged "acceptable" food manufacturing establishments in terms of raw material, condition of building and equipment, and manufacturing methods. It seems fantastic to assume that all vats should have been perfect. Until data representing the output of all types of factories during all seasons of the year can be studied it would be unwise to say where the line of tolerance should be drawn. Attempts to do so might either set standards so high that rejections would cause wholesale closing of factories, or so low that the careless manufacturer would find it unnecessary to improve his methods.

A Plan for Control of Extraneous Matter

It seems possible to adapt to this cheese problem the "control chart" system of inspecting the quality of a manufactured product. The justification of this plan is based on the con-

* Industrial fellowship, National Cheese Institute, Chicago, Illinois.

† Methods of measuring extraneous matter have been described (1,2,5) and discussed (3).

viction that it is as unreasonable to expect perfection in cheese sediment tests as it is to expect a zero bacterial count or a perfect sediment test in a fluid milk supply. The principles of this system are discussed by Leslie E. Simon in *An Engineer's Manual of Statistical Methods*, John Wiley & Sons, 1941.

Any practical plan for control of extraneous matter will be willingly accepted and put into effect by industry only when the need for improvement, the means of improvement, and the results of non-cooperation are clearly understood. By all means, therefore, industry should participate in the discussion and development of a workable plan of extraneous matter control.

Certain groups of people and organizations in the cheese industry are vitally concerned in the welfare of the industry; they are the owners and operators of cheese factories, buyers of cheese, dairymen's and cheesemakers' associations, and trade associations. Consumers' interests in the industry are essentially represented by boards of health, departments of agriculture, and dairy and food inspection agencies. It would be ideal if all of these groups and organizations could cooperate in the selection of a "Control Committee" to take the first steps.

Examination of factories

The Control Committee might first select an area, perhaps a county, in which to begin. A meeting of factory operators, owners, and cheese dealers in the area could be called to explain to them in detail the need for control and the methods of accomplishing it. It would be desirable to obtain an expression from these individuals to indicate their interest and willingness to cooperate in the work. If the proper educational work has been done before this meeting by the interested organizations, such support will probably be given enthusiastically.

As soon as the group consents to cooperate in the work it should be asked to appoint a factory survey committee. Such a committee probably should include two or three makers and the local representative of the state board of health or dairy and food division. These men should be given the necessary information to guide them in their study and evaluation of factory conditions. Such a guide for example is that furnished in "Minimum Factory Requirements" of the Joint Committee on Research of the Cheese Industry of Wisconsin (4). Other guides or standards might be used if they proved to be more acceptable to state or federal regulatory authorities. The work of the factory survey committee could be summarized as a written report on every participating factory indicating as a final conclusion whether it is a satisfactory food-producing plant. This report might simply be the list of "Minimum Factory Requirements" checked to indicate faulty characteristics.

Examination of cheese

The cheese shipped by each factory is commonly tested for extraneous matter by the dealer who receives it. Where such tests have not been previously made the explanation of the program at the local meeting will have indicated the need and desirability of this analytical work.

It is necessary that all buyers should use the same size of sample and the same filter material and for this purpose the 50 gram sample and the poplin filter pad seem most suitable. Either phosphoric acid or sodium citrate solvent may be used. The routine to be followed by the laboratory in making and recording daily tests on every factory's output is a vital part of the program.

Steps for the analytical laboratory to follow in setting up and using the quality control chart

1. Make extraneous matter tests on one vat of cheese from a factory every day for 60 consecutive days. Count those tests defective which

show excessive sediment or critical material * after microscopic examination.

2. *Recording the data*

Count the defectives in the first five tests and record the total as shown in Table 1. Repeat this procedure with each successive group of five tests until twelve groups, a total of sixty consecutive tests, have been arranged as in Table 1.

3. *Plotting the data*

Plot the data from Table 1 on a 4" x 6" filing card (or cross section paper) as has been done in Figure 1. Note that factory name or number and dates when cheese was made appear on this control chart. This chart in Figure 1 happens to show a total of 26 defectives in 60 consecutive tests.

4. *Control limits*

Consult Table 2 and, using the data from the factory shown in Table 1, read in column 1 (continued):—"If total of defectives in 60 tests is *26,* the defectives in 5 consecutive tests will usually not exceed the "upper limit" *3,* and rarely exceed the "maximum" *4.* Draw lines to indicate these limits, *3* and *4,* on the control chart, as has been done in Figure 1.

5. *Meaning of the control chart*

Excepting group 8, none of the points exceed the "upper limit" line on the control chart, Figure 1. The point for group 8 on the "maximum" line is evidence that some-

* Material of insect or animal origin.

TABLE 1

TABULATION OF DATA AND CALCULATION OF TOTAL NUMBER OF DEFECTIVES IN 60 DAYS

Group	*Number of Tests*	*Number of Defectives*
1	5	2
2	5	3
3	5	2
4	5	3
5	5	1
6	5	2
7	5	3
8	5	4
9	5	0
10	5	2
11	5	3
12	5	1
Total	60	26

TABLE 2*

LIMITS OF NUMBERS OF DEFECTIVES EXPECTED IN 5 CONSECUTIVE TESTS WHEN THE TOTAL DEFECTIVES IN 60 CONSECUTIVE TESTS ARE KNOWN

If Total of Defectives in 60 Tests Is	*The Defectives in 5 Consecutive Tests* — *Usually Not Exceeding the "Upper Limit"*	*Rarely Exceeding the "Maximum"*	*If Total of Defectives in 60 Tests Is*	*The Defectives in 5 Consecutive Tests* — *Usually Not Exceeding the "Upper Limit"*	*Rarely Exceeding the "Maximum"*
1	**	**	16	2	3
2	**	**	17	2	3
3	**	**	18	2	3
4	1	2	19	2	3
5	1	2	20	3	4
6	1	2	21	3	4
7	1	2	22	3	4
8	1	2	23	3	4
9	1	2	24	3	4
10	1	2	25	3	4
11	2	3	26	3	4
12	2	3	27	3	4
13	2	3	28	3	4
14	2	3	29	3	4
15	2	3	30	3	4

* Prepared from Simon's (6) "Charts for sampling of attributes."

** When total defectives in 60 are 3 or less, use groups of 10 and look up "upper limit" and "maximum" in Table 3.

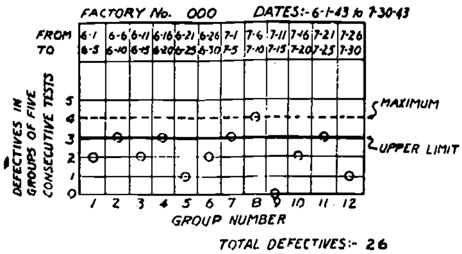

FIGURE 1—A control chart

thing went wrong in the factory in the period July 6th to July 10th. Actually the control chart indicates that the trouble probably began with group 6 so that the high of group 8 might have been prevented if prompt action had been taken.

The picture of this control chart is, however, not abnormal considering the total number of defectives and tests involved. Chance alone might cause a maverick (i.e., point falling above the "upper limit") like group 8. Table 4 is helpful at this point by showing when the number of mavericks cannot be attributed to chance alone. Reading Table 4 "If number of groups *of 5* equals *12*, mavericks can be *2*." Any points above the "maximum" indicate the necessity of corrective action by the factory operator.

6. *Continuing the control chart*

Set up another control chart for the next 60 test period. On the basis of the first 60 tests the "upper" and "maximum" limits can be drawn on the chart before any points are plotted because it is now possible to *predict* with a fair degree of accuracy what this factory *can* do.

7. *Routine use of control charts*

Post the control chart in the laboratory until the 60 test period is completed. Any change in trends of data should be reported at once to the cheesemaker and to the fieldman. After the limits have been determined for the next 60 test period and plotted on the new chart, then the old chart should be filed as a permanent record of extraneous matter. Copies should be given the cheese factory operator to demon-

TABLE 3*

LIMITS OF NUMBERS OF DEFECTIVES EXPECTED IN 10 CONSECUTIVE TESTS WHEN THE TOTAL DEFECTIVES † IN 60 CONSECUTIVE TESTS ARE KNOWN

	The Defectives in 10 Consecutive Tests			*The Defectives in 10 Consecutive Tests*	
If Total of Defectives in 60 Tests Is	*Usually Not Exceeding the "Upper Limit"*	*Rarely Exceeding the "Maximum"*	*If Total of Defectives in 60 Tests Is*	*Usually Not Exceeding the "Upper Limit"*	*Rarely Exceeding the "Maximum"*
1	1	2	16	4	6
2	1	2	17	4	6
3	1	3	18	4	6
4	1	3	19	5	7
5	2	3	20	5	7
6	2	4	21	5	7
7	2	4	22	5	7
8	2	4	23	5	7
9	3	5	24	5	7
10	3	5	25	6	8
11	3	5	26	6	8
12	3	5	27	6	8
13	3	5	28	6	8
14	4	6	29	6	8
15	4	6	30	6	8

* Prepared from Simon's (6) "Charts for sampling of attributes."
† When the number of defectives in 60 tests exceeds 18 it is better practice to use groups of 5 and Table 2 to fix the limits of the control chart.

strate the results of his quality control program.

8. *The purpose of Table 3*

Table 3 is like Table 2 except that it is to be used when the 60 consecutive tests are subdivided into 6 groups of 10 instead of 12 groups of 5. Like Table 2 it shows the upper and maximum limits of the number of defectives expected when the total defectives in 60 consecutive tests are known.

Groups of 10 should be used when the number of defectives in 60 tests are less than 4.

Tentative standards

When all factories in the participating area have been classified according to factory conditions and when extraneous matter tests for a period of 60 consecutive days are available, then the records for the area can be examined by the Control Committee. What this Committee might do with these records is suggested by the following illustration:

How the factory records can be used to set tentative standards

For the purpose of discussion let us assume that we have available the records of 17 factories located in a hypothetical area which has been surveyed by the committee of makers and the dairy official. The reports of the survey show that four factories are unsatisfactory and need to make repairs, changes in methods or improvements in milk quality; these factories can be ignored in the setting of tentative standards.

The records of all 17 factories are arranged graphically in Figure 2 in the order of the percentage of defective vats found in the 60 consecutive extraneous matter tests. The median or middle factory of the 13 which were satisfactory might well be chosen as the most typical of the group. Half of the remaining factories of the group have better records while the other half have worse records. It would seem reasonable, at least while more extensive records are being accumulated, to adopt as a tentative standard the record of the "middle" factory. The "upper limit", and "maximum" for this "middle" factory would then be dotted in red on the control chart of every factory in the group.

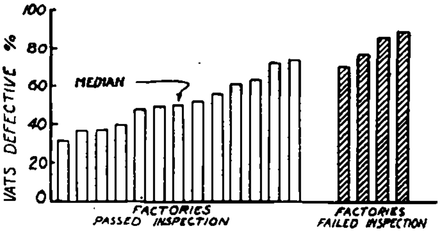

FIGURE 2—Daily sediment tests of cheese. Can be used to show relative ability of inspected factories to produce satisfactory cheese and would be of assistance in setting "reasonable" standards of excellence.

The "Control Committee" should inform the factories in the zone, preferably in writing, concerning the actions of the committee and the tentative standard adopted. From time to time the tentative standards may be revised to conform to improved practices, changing economic conditions, the general level of attainment in other zones, standards of trade associations and the regulations of food control officials.

DISCUSSION

The control chart system of inspecting the quality of a manufactured product has been thoroughly tried in indus-

TABLE 4*

NUMBER OF MAVERICKS ALLOWED FOR "ACCIDENTS"

If number of groups (of fives or tens) =	5	6	7	8	9	10	11	12
Mavericks (above "upper limit") can be:—	1	1	1	1	2	2	2	2

* Prepared from Simon's (6) "Charts for sampling of attributes."

try. The collection of the series of 60 consecutive tests provides data to estimate the quality of the factory output with a high degree of accuracy and serves to distinguish between factories doing satisfactory and unsatisfactory extraneous matter control work.

The subdividing of the 60 tests into consecutive groups of 5 (or 10 if the number of defectives is small) serves to indicate variations in factory production in time to make corrections, if necessary, before the manufacturer is faced with rejections. Wide fluctuations in numbers of defectives in these groups of 5 (or 10) indicate lack of uniformity in factory conditions or methods, and, even though the variations are within acceptable limits, show the necessity of corrective action by the maker.

The suggestions pertaining to levels of quality, classification of factories, and the like, which have been offered may be altered if necessary by members of the cheese industry. Parts of the program which cannot be arbitrarily altered are the specifications fixing:—the total numbers of tests at 60 in determining the defective output of a factory, and the grouping of the daily tests in sequences of 5, or 10, and the application of the "upper limits" and "maximum." These specifications are based upon certain statistical considerations which cannot be changed without altering the significance of the control chart. Such changes must only be made after consideration of the statistical background afforded by Simon's (6) discussions and charts.

The Joint Committee on Research of the Cheese Industry of Wisconsin approved the adoption of the eight ounce sample as the basis of inspection for extraneous matter. This was done to make more certain the detection of critical material. A study has since been made of the relative effectiveness of the eight ounce and fifty gram samples (3) with the result that for the factory improvement plan offered here, the fifty gram sample is recommended. It will encourage the regular testing of all cheese for extraneous matter by reducing damage to cheese in sampling, and by reducing costs in terms of a valuable war-time food. This can be accomplished with the fifty gram sample without sacrificing the reliability of the control chart system. The eight ounce sample can be used if it is considered desirable. It is essential for the control chart system to use the same size sample for testing the cheese from all factories covered by the same control "limits."

The problem of how to penalize the factory which fails to conform to the requests of the Standards Committee is not an easy one to solve. Food regulatory laws of course might be invoked immediately. Experience in quality improvement programs would seem to encourage a more gradual approach by educational and field work. The high levels of quality characteristic of our city milk supplies were attained gradually as better equipment, improved methods of sterilization, and better trained dairymen demonstrated the feasibility of such quality.

A manufacturer of any product can suffer only a certain number of rejections without "closing up shop." The operation of cheese factories continues on an ever-decreasing margin of profit as evidenced by the number closing each year. Greater investments in buildings, equipment, and manufacturing costs which might be required to satisfy new extraneous matter standards might be particularly difficult to finance without increased allotments for factory operations. Such allotments now are fixed by competition for milk between the various branches of the dairy industry and are additionally restricted at present by price regulations. Any standards of production imposed on the cheese industry at any time, and especially now, must be accompanied by greater returns if manufacturing costs are increased.

The justification of this plan for controlling extraneous matter is based on the conviction that it is unreasonable to expect perfection just as it is to expect a zero bacterial count or a perfect sediment test in a milk supply.

CONCLUSIONS

Our observations over a three year period indicate that:—the elimination of excessive amounts of extraneous matter from cheese is practical, and feasible; that the reduction of contamination of cheese with critical extraneous matter, like hairs, is possible; and that these two objectives can be accomplished without unduly increasing costs of manufacture. Regulations requiring absolute elimination of all critical extraneous matter must be enforced with tolerance until better production methods can be demonstrated as feasible and economical under commercial conditions or until convincing proof is offered that the public health is in danger.

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The Importance of Recognizing Organisms of the Genus Salmonella. Mildred M. Galton. *Florida Health Notes,* 35, 108–10 (June, 1943); *Pub. Health Engin. Absts.,* xxiv, Mi, 15 (1944).

The Salmonella infections (Salmonelloses) of man have been divided into: (1) Salmonella fevers (typhoid, paratyphoid) generalized infections of subacute course but which may show septic localization; (2) gastroenteritis or food poisoning—acute infections of the gastrointestinal tract, which may be extended to the whole body; (3) localized pyogenic infections.

The knowledge of whether a Salmonella is of human or animal origin is important not only in clinical diagnosis but for the epidemiological investigation in determining the source of the infection. The types of human origin, *S. paratyphi* (Para A), *S. schottmuelleri* (Para B), *S. hirschfeldii* (Part C), and *S. sendai,* usually produce a typhoidal fever (paratyphoid fever). The remaining known types of animal origin are usually associated with gastroenteritis, but the reverse in both types has been found to occur. Hormaeche and Peluffo found that infants and children are much more susceptible to Salmonellas of animal origin than the adult. Salmonella infections of animal origin in the adult may be due to accident, such as handling of pets and domestic animals, or ingestion of contaminated foods; in children, especially infants, the illness is endemic and although an increase of cases was noted in summer, they were found the year around. Fatal cases have been produced by a variety of types.

Carriers of Salmonella of human origin are comparable to typhoid carriers and may be chronic or convalescent. The carrier state in man is usually transitory for the animal types; chronic carriers are rarely encountered.

Salmonella organisms have not only been isolated from cases of enteric illness. Numerous reports of other infections due to these bacilli have appeared. They have been found in spinal fluid in meningitis, peritoneal exudate, ear infections, endocarditis, etc.

H. J. DARCEY.

Mastitis and the Plate Count of Milk

V. The Behavior of *Streptococcus uberis* in Milk Held at Different Temperatures

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IN the fourth paper (3) of this series it was shown that *Streptococcus uberis* mastitis usually does not materially increase the total plate count of herd milk at the time it is drawn. The temperature, however, to which milk is subsequently cooled and held on the farm may greatly affect the total bacterial count of milk. Therefore, the rate of multiplication of *Str. uberis* at several temperatures may be of interest to the dairy farmer and to public health workers.

The plate count of milk and to a smaller extent the acidity of milk are two important criteria in determining the acceptability of milk at the milk plant. The question to be answered is, whether *Str. uberis,* once present in milk, even in small quantities, will appreciably affect either of these qualities under different conditions of cooling. The purpose of this study was to measure the influence of several temperatures on the growth rate and lactose-fermenting activity of *Str. uberis.*

EXPERIMENTAL

Cultures. Fifteen strains of *Str. uberis,* representing 15 serological types, were used. Inoculums of each were made into tubes of litmus milk which were then incubated at 37° C. for 20 hours. Four similar transfers were made and upon the fifth transfer the incubation time was shortened to 16 hours. The final culture was used in preparing the dilutions used in inoculating sterile skimmilk.

Incubation. The following incubation temperatures were chosen to cover the range likely to be encountered under various conditions of cooling milk:

40° F.	Excellent cooling
50° F.	Good "
60° F.	Fair "
70° F.	Poor "
97° F.	Control

Temperatures of 40°, 50°, and 60° F. were obtained in oven-type incubators installed in a storage room where the prevailing temperature was 32° F. A temperature of 70° F. was obtained in a special electrical refrigerator, and a laboratory incubator provided a temperature of 97° F. Temperature adjustments in each incubator were made over the period of a month and constant temperatures were maintained for one week preceding the incubation of cultures. Readings were obtained (at each sampling interval) from standardized thermometers immersed in water and placed in the incubators.

Preparation of Skimmilk. Erlenmeyer flasks containing 100 ml. portions of good quality skimmilk were autoclaved at 15 pounds extra pressure for 12 minutes. At least six hours before inoculation, these flasks and sterile water blanks were distributed to the incubators to temper them to the respective incubator temperatures.

Inoculation of Skimmilk. The litmus milk culture resulting from the final transfer in the series described previously was diluted 1:10,000,000 in sterile water and one ml. of this dilution was used to inoculate each flask of sterile skimmilk. It was found by experimentation that an inoculum of this size generally produced a seeding of from 100 to 1000 organisms per ml. An endeavor was made to obtain initial seedings which were nearly equal.

Sampling. Just prior to inoculation, one ml. of skimmilk was removed from each flask and plated as a check on sterility. Following inoculation, each flask was whirled 25 times and a second one ml. portion was removed and inoculated into dilution blanks to be used in plating. A third one ml. portion was removed at this time for pH determination. The complete round of incubators was accomplished in about 10 minutes, each trip being started on the hour to insure constant time intervals throughout the experimental period. All of the samples were obtained aseptically.

Plating. Samples were plated according to methods outlined by the American Public Health Association (4). All dilutions were prepared in triplicate and were plated with Difco tryptone glucose extract agar to which 1 percent of skimmilk had been added.

Previous to the experimental work described here, a schedule of plating intervals and dilutions was prepared by trial-and-error experimentation. This schedule was designed to supply a maximum amount of information relative to the growth cycles of the cultures and at the same time to exclude any superfluous platings.

Plates were incubated at 37° C. for a period of 48 hours and counts were made on a Quebec colony counter.

pH Determination. Samples used for pH determination were tempered in a 25° C. water bath. The Beckman potentiometer was standardized at two hour intervals with a freshly prepared potassium acid phthalate solution of pH 3.92.

RESULTS

Plating. The readings from triplicate plates were averaged to obtain the plate counts of the cultures at each sampling interval. From these values multiplication curves were prepared for each strain. A curve to represent the average trend is given in Figure 1.

A general inspection of these curves revealed that all of the cultures multiplied rapidly at the control temperature of 97° F. In most cases a maximum population was attained in about 24 hours, with a small decrease as the 60 hour limit was approached. All cultures grew rapidly at 70° F., showed a rapid population increase up to 48 hours and a continued moderate increase to the 60 hour interval. All cultures multiplied at 60° F. but displayed a smaller population increase and a considerably longer lag phase than did the cultures held at 70° F. At this temperature a continued population increase occurred during the entire 60 hour period of observation.

At 50° F. the cultures showed variation in their rates of multiplication and some showed no perceptible increase. The curves did not reveal that any of the cultures grew at 40° F., and some cultures decreased slightly in numbers.

Analysis of Plating Technique. By way of approach to an analysis of the experimental data, it seemed desirable to first consider the fallibility of the plating technique by examining the chi-square values of all the sets of triplicate plates. The chi-square test was first applied to each of 614 sets of triplicate platings. It was found that 91.69 percent of these sets of values fell within the limit of 5.99 for the 5 percent point with 2 degrees of freedom. A certain number of values would be expected, theoretically, to fall outside of this limit and an examination of the distribution of these chi-square values would bring out any tendencies in the experimental work, which, in aggregate, would result in a curve with a

Multiplication of Str. Uberis at Different Temperatures

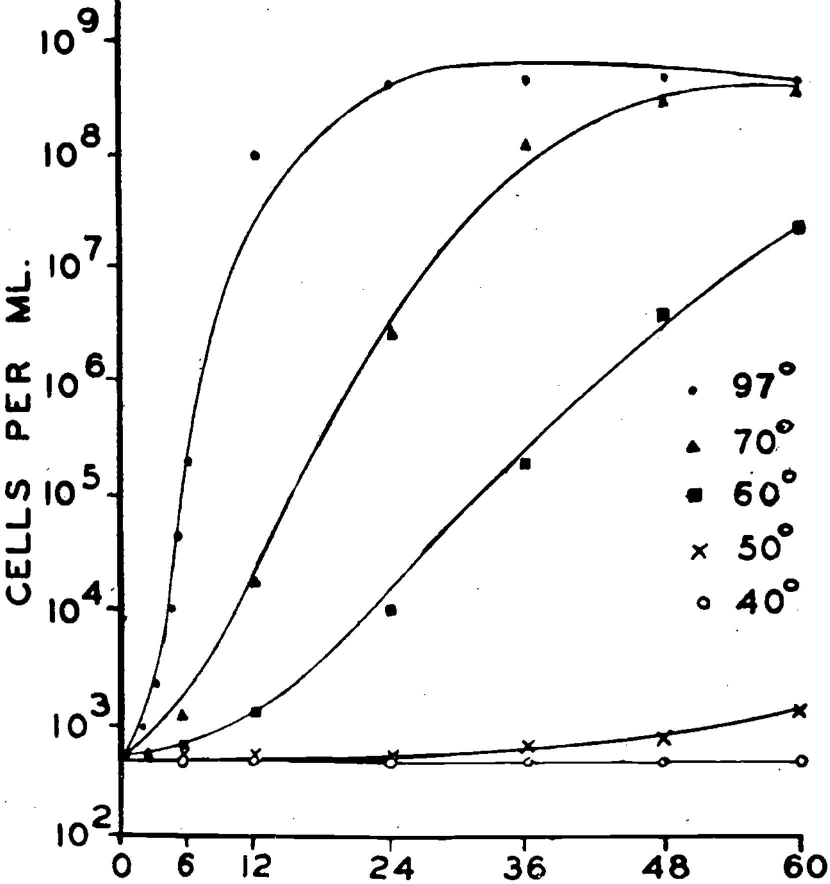

FIGURE 1

Hours After Inoculation

skewness differing from that of the usual chi-square distribution.

In Table 1, which was drawn up to determine the distribution of the observed values, P. represents probability expressed on a basis of 1.00 and χ^2 represents the corresponding limit of chi-square with 2 degrees of freedom for each probability value as taken from Table 3 in reference (1). A certain percentage of observed chi-square values, 100 — (P $\times$ 100), is expected to fall below the theoretical value at any level of probability chosen. Chi-square values obtained for each set of triplicate plates were entered in Table 1 on the vertical axis under the proper culture number and on the horizontal axis between the limitng sets of table chi-square values. The number of times the calculated χ^2 appeared is expressed by the numbers or frequencies in the body of the table. These frequencies were totaled across the horizontal axis under the heading "total observed." In this manner the distributon of calculated chi-square values over the range of probabilities was determined.

The theoretical distribution was next calculated. The total number of tests applied is 614. It would be expected

TABLE 1

DISTRIBUTION OF CHI-SQUARE VALUES OBTAINED IN ANALYSIS OF PLATING EXPERIMENT

P	χ^2	*Culture* 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	*Total Observed*
1.00	.000																
		0	1	0	1	1	1	0	1	0	0	0	1	0	0	0	6
.99	.0201																
		4	0	0	0	0	0	0	0	0	0	0	0	1	0	1	6
.98	.0404																
		2	2	0	2	0	4	2	2	1	0	0	0	0	0	0	15
.95	.103																
		2	2	1	3	2	0	2	2	1	1	0	8	2	2	0	28
.90	.211																
		5	5	1	5	1	4	3	5	7	4	6	2	1	4	0	53
.80	.446																
		4	2	2	4	2	2	5	4	4	9	3	4	2	4	6	57
.70	.713																
		6	10	13	7	7	11	9	9	9	11	8	8	11	10	7	136
.50	1.386																
		4	7	4	6	7	5	6	7	6	11	10	7	11	8	8	107
.30	2.408																
		1	1	5	2	6	2	5	4	4	0	3	2	3	2	7	47
.20	3.219																
		7	5	7	4	6	1	4	3	4	2	5	5	4	6	3	66
.10	4.605																
		5	1	2	2	3	3	3	1	2	1	2	4	2	3	3	37
.05	5.991																
		2	0	3	2	3	2	2	2	1	1	1	0	2	2	1	24
.02	7.824																
		1	2	0	0	0	0	1	2	1	0	0	0	2	1	0	10
.01	9.210																
		1	0	3	2	1	0	0	0	0	2	2	1	1	0	3	16
.001	13.815																
		1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	6
0	∞																
												Total					614

that 0.01 (the difference between the probabilities 0.99 and 1.00) of the chi-square values would fall between 0.00 and 0.0201. Similarly, 0.99 — 0.98 = 0.01, so another 1 percent of the total number of chi-square values may be expected to fall between 0.0201 and 0.0404. In this manner the expected values occurring at various levels of probability have been calculated for 614 samples as shown in the third column of Table 2. The observed values are compared with those expected by χ^2, combining the results for P = .01. The algebraic differences between columns 1 and 2 are recorded in column 4 of Table 2. Each difference is squared and divided by its corresponding expected value to obtain its contribution to the total chi-square.

Since 14 observed and expected values have been compared, there are 13 degrees of freedom between them. At the 5 percent level, with 13 degrees of freedom, $\chi^2 = 22.362$. The chi-square for the distribution in Table 2 is 55.90, a value beyond that even for the 0.1 percent level. The largest element in the chi-square, however, is contributed by the frequency below the 1 percent level, where 6.14 are expected and 22 are observed. Excluding this, the remaining χ^2 is 14.93, a value well within the limit at the 5 percent level for $n = 12$.

This analysis reveals that of the observed cases, 97.4 percent conform to the theoretical distribution and only 2.6 show excessive variability. This may be interpreted to mean that the

TABLE 2

COMPARISON OF EXPECTED WITH OBSERVED VALUES OF CHI-SQUARE

P		*Observed Frequency*	*Expected Frequency*	*Difference*	*Difference^2 Expected*
1.00					
		6	6.14	—.14	.003
.99					
		6	6.14	—.14	.003
.98					
		15	18.42	—3.42	.635
.95					
		28	30.70	—2.70	.243
.90					
		53	61.40	—8.40	1.15
.80					
		57	61.40	—4.40	.315
.70					
		136	122.80	+13.20	1.42
.50					
		107	122.80	—15.80	2.03
.30					
		47	61.40	—14.40	3.38
.20					
		66	61.40	+4.60	.345
.10					
		37	30.70	+6.30	1.29
.05					
		24	18.42	+5.58	1.69
.02					
		10	6.14	+3.86	2.43
.01					
		22	6.14	+15.86	40.97
0.00					
	Total	614	614.00	0.30	55.90 *

* Excluding 40.97, total equals 14.93.

technique involved in the plating of triplicate samples produced uniformly good results, justifying an analysis of the data.

ANALYSIS OF RESULTS

The critical temperature for the multiplication of all cultures was in the region of 50° F. where some of the cultures showed an apparent population increase and others showed no tendency in this direction. An analysis of variance was applied to the data from both the 40° F. and 50° F. incubators to uncover any significant trend which deviated from the average initial population. The plate counts of each culture at each sampling interval were converted to logarithmic values, the reason being that the multiplication of bacteria, which takes place in a geometric progression, may be more critically and accurately analyzed by transforming the counts to logarithms. These values are presented in Tables 3 and 4. Missing values were calculated and entered in each table.

In assigning the total number of degrees of freedom for the 40° F. and 50° F. analysis, one degree of freedom was subtracted for each missing value.

The total sum of squares was subdivided into the following components: 1. Difference between culture means (a significant dfference would be expected since the quantity of inoculum and the rates of multiplication obviously differed between cultures); 2. Linear trend with time or the average tendency to grow (or diminish) over a 60 hour period; 3. Quadratic

TABLE 3

TRANSFORMED VALUES OF PLATE COUNTS OBTAINED AT SAMPLING INTERVALS FROM THE 40° F. INCUBATOR

	Hours						
Culture	*0*	*6*	*12*	*24*	*36*	*48*	*60*
1	2.495	2.531	2.442	2.279	2.398	2.420	2.403
2	2.467	2.538	2.481	2.398	2.467	2.380	2.436
3	3.130	3.217	3.182	3.253	3.220	3.238	3.348
4	3.217	3.269	3.342	3.322	3.248	3.348	3.248
5	2.491	2.616	2.588	2.528	2.491	2.535	2.553
6	2.420	2.462	2.553	2.431	2.445 *	2.447	2.403
7	2.599	2.613	2.616	2.687	2.616	2.591	2.620
8	2.839	2.903	2.919	2.931	2.931	2.917	2.912
9	3.576	3.452	3.613	3.656	3.535	3.481	3.491
10	2.583	2.535	2.553	2.580	2.568	2.565	2.565
11	2.594	2.571	2.442	2.583	2.501	2.556	2.609
12	2.616	2.616	2.518	2.599	2.518	2.518	2.547
13	3.033	3.083	3.061	3.075	3.143	3.114	3.146
14	2.447	2.356	2.452	2.462	2.442	2.348	2.294
15	2.547	2.518	2.568	2.522	2.552	2.522	2.594

* Missing value supplied.

trend with time or the tendency to follow a simple curve instead of a straight line; 4. Other variation with time not accounted for by a simple time curve; 5. Cultures × linear, which tests whether the trend differed significantly between cultures; 6. Cultures × quadratic, the corresponding measure for consistency in curvature between cultures.

These factors are orthogonal or mutually independent of each other so that the effect of each can be measured from the same data. Curves were fitted by orthogonal polynomials (1). This procedure requires constant time intervals between observations and for this reason the six hour sample was omitted in the analysis, giving 12 hour intervals between the remaining values.

By this method, an equation of the form

$$y = b_1x + b_2x^2$$

is fitted by least squares to the observa-

TABLE 4

TRANSFORMED VALUES OF PLATE COUNTS OBTAINED AT SAMPLING INTERVALS FROM THE 50° F. INCUBATOR

	Hours						
Culture	*0*	*6*	*12*	*24*	*36*	*48*	*60*
1	2.393	2.336	2.328	2.336	2.307	2.403	2.495
2	2.342	2.420	2.410	2.427	2.410	2.420	2.398
3	3.110	3.199	3.170	3.238	3.328	3.452	3.921
4	3.285	3.238	3.279	3.279	3.248	3.403	3.565
5	2.565	2.580	2.560	2.616	2.896	3.594	4.324
6	2.531	2.522	2.501	2.616	2.410	2.442	2.380
7	2.693	2.681	2.613	2.763	2.934	3.204	3.426
8	2.696	2.899	2.953	2.970	3.017	3.072	3.336
9	3.605	3.398	3.447	3.540	3.568	3.540	3.602
10	2.588	2.568	2.591	2.553	2.560	2.522	2.447
11	2.568	2.626	2.547	2.556	2.531	2.599	2.599
12	2.501	2.640	2.628	2.769	2.919	3.037	3.104
13	3.037	3.114	3.173	3.176	3.386	3.672	4.143
14	2.531	2.442	2.514	2.415	2.431	2.672	2.678
15	2.531	2.580	2.599	2.713	2.815	2.863 *	3.034 *

* Missing value supplied.

tions, where y is the log of the plate count and x represents the successive 12-hour observation periods, both being measured from their respective means for the entire table. The analysis of variance then shows how much of the total variation in y is accounted for by b_1 and how much by b_2. Values for ξ_1 and ξ_2 used in the analysis were taken from Fisher and Yates (2). The results of the 40° F. analysis are given in Table 5 and those of the 50° F. analysis in Table 6.

TABLE 5

ANALYSIS OF VARIANCE BETWEEN MULTIPLICATION RATES OF THE DIFFERENT CULTURES AT 40° F.

Source of Variation	*Degrees of Freedom*	*Sum of Squares*	*Mean Square*	*Variance Ratio (F)*
Culture means	14	13.317559	0.951254	401.71 *
Trend with time, linear	1	0.000475	0.000475	0.20
Trend with time, quadratic	1	0.000410	0.000410	0.17
Other variation with time	4	0.006767	0.001692	0.71
Cultures x linear	14	0.073161	0.005226	2.21 **
Cultures x quadratic	14	0.038971	0.002784	1.18
Remainder	55	0.130233	0.002368	1.00
Total	103	13.567576		

* Highly significant, probability of chance occurrence <.001.
** Significant, probability of chance occurrence <.025.

At 40° F. the culture means differed widely as was expected. Since the linear trend with time was less than the error, the population of the cultures remained stationary throughout the experimental period.

The F value for "cultures × linear," however, exceeds the error significantly, which may be attributed to a tendency on the part of some of the cultures to die, measured as negative growth in the analysis, to as great an extent as others grow. Hence, although the average trend of all the cultures showed no deviation from the horizontal axis the trends of individual cultures differed enough to show a significant varance.

In the 50° F. analysis "culture means" again differed very significantly. The F value for "trend with time, linear," however, reveals a significant change in the average populaton of all the cultures during the period of incubation, as would be anticipated from the population increase in Figure 1. The significant F value for "cultures × linear" showed that at 50° F., as at 40° F., the separate cultures differed significantly in their rates of multiplication. To determine the number of cul-

TABLE 6

ANALYSIS OF VARIANCE BETWEEN MULTIPLICATION RATES OF THE DIFFERENT CULTURES AT 50° F.

Source of Variation	*Degrees of Freedom*	*Sum of Squares*	*Mean Square*	*Variance Ratio (F)*
Culture means	14	15.809298	1.129236	22.57 *
Trend with time, linear	1	1.245282	1.245282	24.89 *
Trend with time, quadratic	1	0.128351	0.128351	2.57
Other variation with time	4	0.169849	0.042462	0.85
Cultures x linear	14	3.159309	0.225665	4.51 *
Cultures x quadratic	14	0.662111	0.047294	0.95
Remainder	54	2.702119	0.050039	1.00
Total	102	23.876319		

* Highly significant, probability of chance occurrence <.001.

tures with significant growth at 50° F. the analysis was carried further. The expected variance for the slope of a single culture is the mean square of the error term in the analysis of variance and is equal to .05004. The variance for the slope of a single culture $[L^2]$ may be computed from the values used in obtaining the linear term equation,

$$[L^2] = \frac{L^2}{70}$$

For 1 and 54 degrees of freedom the F value at the 5 percent point is 4.03. To be significant, $[L^2]$ must be equal to or greater than the product of 4.03 × .05004. Therefore the linear trend which would be signficant may be derived as

$$\begin{aligned}[L^2] &= 4.03 \times .05004 \\ L^2 &= 14.116 \\ L &= 3.757\end{aligned}$$

The linear term for each culture at 50° F. appears in Table 7. An examination of the values reveals that cultures 3, 5, 7, 12, and 13 have linear terms exceedng 3.757. It may be concluded that these five cultures increased in population during the incubation period, whereas the population of the remaining ten cultures did not reveal a signficant change, as measured by this test.

It was considered unnecessary to apply an analysis to the data obtained from the 60° F., 70° F. and 97° F. incubators since it is obvious that all cultures multipled rapidly at each of these temperatures.

TABLE 7

COMPARISON OF LINEAR TERMS FOR DIFFERENT CULTURES WITH THE LINEAR TERM AT THE 5 PERCENT LEVEL

Culture Number	*Linear Term*
1	+0.706
2	+0.293
3	+4.991 *
4	+1.741
5	+12.177 *
6	−1.138
7	+5.609 *
8	+3.604
9	+0.292
10	−0.905
11	+0.286
12	+4.392 *
13	+7.237 *
14	+1.225
15	+3.409

* Surpasses 3.757, linear term at P=.05

Changes in pH of the Milk. pH determinations were made at each sampling interval during the 60 hour incubation period. The more essential features of these data are given in Table 8, where the values given represent averages of the 15 strains. About 67 percent of the values are included between the numbers obtained when

TABLE 8

AVERAGE CHANGES IN pH OF MILK DURING INCUBATION PERIOD

	Incubation Temperatures				
	40° F.	*50° F.*	*60° F.*	*70° F.*	*97° F.*
Av. initial population	544/ml.	540/ml.	520/ml.	532/ml.	552/ml.
Av. initial pH	6.34±.09	6.33±.09	6.32±.09	6.32±.09	6.29±.10
Range of initial pH's	6.15—6.48	6.11—6.47	6.10—6.47	6.09—6.45	6.06—6.43
pH at 12 hours					6.19±.85
Range at 12 hours					6.04—6.38
pH at 36 hours				6.19±.16	
Range at 36 hours				5.90—6.33	
pH at 48 hours			6.29±.12		
Range at 48 hours			6.01—6.49		
pH at 60 hours	6.37±.09	6.36±.09	6.26±.16	6.05±.15	5.54±.26
Range at 60 hours	6.14—6.47	6.12—6.47	5.88—6.47	5.78—6.27	4.97—6.20

the standard deviation is added to and subtracted from the average.

No drop from the original pH of the milk occurred either at 40° F. or 50° F. during the entire incubation period. At 60° F. no appreciable drop in pH occurred until after 48 hours. The pH at the end of 60 hours showed a decrease of 0.06 from the initial value. At 70° F. no appreciable change was noticeable until after 36 hours when the pH had decreased 0.13 from the initial value and after 60 hours the total drop was 0.27. After 12 hours incubation at 97° F., the average pH of cultures dropped 0.10; the final value showed an average decrease of 0.75 from the initial value.

It is important to note that the initial population of the sets of cultures averaged about 540 organisms per ml. Any appreciable increase in the initial population would be accompanied by a relatively faster change in pH.

COMMENT

Cooling temperatures of 50° F. and below effectively prevent a population increase and pH change in milk due to *Str. uberis.* In farm practice where milk is held from 12 to 24 hours before being delivered, a holding temperature of 60° F. would provide good conditions for a fairly rapid increase of the *Str. uberis* population. Milk held at 60° F. for longer periods, or milk held at higher temperatures would undoubtedly promote a rapid increase in the numbers of *Str. uberis.*

SUMMARY

Milk cultures of 15 strains of *Str. uberis* were incubated at 40° F., 50° F., 60° F., 70° F. and 97° F., respectively, for a 60 hour period. Samples removed at intervals, were plated in standard agar and tested for pH. A statistical analysis of the rates of multiplication of *Str. uberis* revealed that no significant population increase occurred at 40° F. Individual cultures, however, showed a significant difference in their rates of multiplication at 40° F. This was attributed to the tendency of some of the cultures to die during the incubation period. At 50° F., one-third of the cultures showed a significant population increase. All cultures multiplied rapidly at 60° F., 70° F. and 97° F.

The pH of the milk cultures did not change at 40° F. or 50° F. during the entire incubation period. Perceptible changes in pH values were noted at 60° F., after 48 hours, at 70° F. after 36 hours and at 97° F. after 12 hours.

Under the conditions of this experiment, the critical temperature for the multiplication of *Str. uberis* in milk cultures was about 50° F. Little or no increase in numbers took place below this temperature and increasingly rapid multiplcation occurred as the temperature was raised.

The results obtained indicate that the presence of *Str. uberis* mastitis in a herd may contribute materially to the total plate count of the herd milk, if the milk is stored at temperatures above 50° F.

ACKNOWLEDGMENT

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The Incidence and Types of Coliform Organisms in Pasteurized Cream

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MANY articles have been published concerning the numbers and types of coliform organisms found in milk and dairy products in general. The incidence of this group of organisms in raw milk and cream is so great as to invalidate its use as an indication of the sanitary quality of these products. In pasteurized milk, however, the presence of the coliform group has been used to indicate either an excessively heavy initial pollution of the milk or contamination after pasteurization. It has been observed that the incidence of coliform organisms is much higher in pasteurized cream than in pasteurized milk. The Connecticut State Bureau of Laboratories * gives the following summary of all milk and cream samples tested by it in 1940 and 1941:

	1940	*1941*
Milk samples, "coliform satisfactory"	84.7%	65.3%
Cream samples, "coliform satisfactory"	56.0%	33.1%

Further study on the types of lactose fermenting organisms found in raw and pasteurized cream samples seemed to be indicated.

One hundred and seventy-eight samples of cream as received for routine testing through the winter of 1942 by the Connecticut State Bureau of Laboratories were studied. These included 18 samples of raw cream, 148 of pasteurized, and 12 samples marked pasteurized but found to be underprocessed according to the phosphatase test. Samples had been kept on ice from 2 to 7 days after being tested by the Connecticut Laboratory before being submitted to the present study. However many samples, particularly those of creams imported from various parts of the country, had left the producer 2 to 3 weeks previously. For this reason no quantitative studies were made on any of the samples. But since there is little restriction on the age of cream which may be sold, a qualitative coliform survey was considered to be representative of that of many retail creams.

One milliliter portions were pipetted into brilliant green lactose peptone bile broth (Difco dehydrated) and incubated at 37° C. for 4 days before being discarded. Eosin methylene blue agar plates were streaked from all broth tubes whether or not fermentation had occurred. After 24 hours incubation, these plates were studied with the aid of a watchmaker's lens (magnification 5X) and representatives of every type of colony on each plate were transferred to nutrient broth. Gram stained slides were made of these cultures and any failing to be Gram-negative, non-spore-forming rods were discarded. The rest were purified by re-streaking on EMB plates and again subculturing well isolated colonies on agar slants. If more than one colony type appeared, each was again streaked on EMB and the process repeated until one was reasonably sure of having pure cultures.

The purified cultures were inoculated into lactose broth and incubated for 3

* I am deeply indebted to Dr. F. L. Mickle, Director of the Connecticut State Bureau of Laboratories for his courtesy and cooperation in sending me this information and also in providing me with cream samples for this study.

weeks at 37° C. Suitable media for the IMViC tests were also inoculated. These tests were performed according to the following methods:

Tryptone broth (Difco dehydrated) cultures were tested for the production of indole after 2 days' incubation at 37° C. using Kovac's reagent.

The methyl red reaction was determined on 4 day buffered peptone dextrose broth cultures incubated at 30° C., while the production of acetyl methyl carbinol was detected with O'Meara's reagent on cultures in the same medium grown 2 days at 30° C. Preliminary tests made on cultures incubated at 37° C. gave many double positive methyl red and Voges-Proskauer reactions or indefinite methyl red readings. When these strains were retested after incubation at 30° C., most of the double positives were eliminated. Vaughn, Mitchell, and Levine (1939) found that the 30° C. incubation for both tests gave more consistent results for typical Escherichias, Aerobacters, or the intermediate coliforms.

The utilization of sodium citrate was determined by the use of Simmond's citrate agar slants incubated for 5 days at 37° C.

Those cultures yielding a — + — — IMViC reaction were tested in cellobiose broth. According to Griffin and Stuart (1940) the utilization of cellobiose by this group related them definitely to organisms from non fecal sources while the lack of fermentation of the carbohydrate related them to members of the genus Escherichia.

RESULTS

Coliform organisms were isolated from 111 or 67.3 per cent of the 178 cream samples tested when 1 ml. of the sample was used. Sixty-seven samples or 37.6 percent were "coliform satisfactory"—a figure which corresponds well with the results of the Connecticut Laboratories for previous years. Only 7 samples failed to give a presumptive test but still yielded coliform organisms when the brilliant green-bile broth was streaked on EMB. Late lactose fermenting organisms were the only coliforms isolated from most of these. Thirteen samples, 7.3 percent, gave false positive presumptive tests. There was evidence in several cases that such a reaction was due to a synergism between a streptococcus and a dextrose-fermenting Gram-negative rod.

Too few raw cream samples were tested to make the results very significant, but, as can be seen in Table 1 and as might be expected, there was a higher incidence of coliform organisms in samples of raw cream (72.1 percent) than in pasteurized (61.5 percent).

Four hundred and seventy-two cultures of Gram-negative bacteria were isolated from the 111 coliform positive samples of which 362 produced acid and gas from lactose. Although these represented isolations from different types of colonies on EMB, many strains from one sample turned out to be identical in their IMViC and lactose reactions. Many of these strains also showed colony variations on repeated plating on EMB most of which were due to differences in speed of attacking lactose. It is difficult for this reason to place a proper value on the percentage distribution of the types isolated.

Seven IMViC types were represented among the organisms isolated

TABLE 1

COMPARISON OF NUMBERS OF POSITIVE PRESUMPTIVE AND CONFIRMED COLIFORM TESTS IN RAW, UNDERPROCESSED, AND PASTEURIZED CREAM SAMPLES

Cream	*Total Samples Tested*	*Pre+ Conf+*		*Pre— Conf+*		*Pre+ Conf—*		*Pre— Conf—*	
		No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Raw	18	12	66.6	1	5.5	1	5.5	4	22.0
Underproc.	12	7	58.3	0	0.0	2	16.5	3	25.0
Past.	148	85	57.4	6	4.1	10	6.7	47	32.0
Total	178	104	58.4	7	3.9	13	7.3	54	30.3

but the typical Aerobacter (— — + +) occurred by far the most frequently (Table 2). The intermediate coliform types — + — + and — + — — were the next most common types. It is interesting that of the 57 strains of the latter type isolated, all but 2 fermented cellobiose which, as already mentioned, places these in the nonfecal coliform group.

These results show the same trend as those of Stuart, Wheeler and Griffin (1938) for certified milk (Escherichia 10.3 percent, intermediate 32.4 percent and Aerobacter 57.3 percent) and also as those of the summarized results of various workers by Griffin and Stuart (1940) in which the distribution of types among the 2224 cultures isolated, presumably from all types of milk, was Escherichia 28.8 percent, intermediate 20.3 percent, and Aerobacter 49.5 percent.

TABLE 2

DISTRIBUTION OF IMViC TYPES ISOLATED FROM RAW, UNDERPROCESSED, AND PASTEURIZED CREAM SAMPLES

		Raw		*Underproc.*		*Past.*		*Total*	
Group	*IMViC Type*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Escherichia	++−−	11		3		29		43	
	++−+	2	28.2	2	18.5	13	14.5	17	16.5
Intermediate	−+−+	4		1		67		72	
	−+−−	7	23.9	7	29.6	43	38.1	57	35.6
Aerobacter	−−++	19		13		122		154	
	−−+−	0	47.8	0	51.8	11	47.3	11	47.8
	+−++	3		1		4		8	

Only one IMViC type was found in over half of the coliform positive cream samples. Two types were isolated from about 30 percent while up to 5 different types were found in a few cases. The same predominance of the Aerobacter group is evident when one studies the frequency of occurrence of the types in cream samples. Of the 111 coliform positive samples, 24.3 percent were found to contain Escherichia, 63 percent intermediate forms and 71 percent Aerobacter.

While the occurrence of coliform organisms in samples of pasteurized cream is much greater than in pasteurized milk, the incidence of the various IMViC types in cream and milk seems to be similar. There is no evidence here to show when the contamination occurs but, whether it is before or after pasteurization, the presence of even a small number of coliform organisms can quickly develop into the predominating flora according to Robinton (1942). She found tremendous increases in numbers of coliform organisms, particularly the Aerobacters, when they were inoculated into sterile cream and held at 8° C. for even as short a time as 6 to 12 hours. This increase was much greater than that observed in milk treated the same way experimentally. This fact plus the fact that most regulations concerning the sale of cream do not put an age limit on its salability are good reasons why the incidence of coliform organisms in cream as purchased by the consumer is so high.

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A Microscopic Field Spacer

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Recently, Olson and Warren (1) described a modified mechanical stage designed to facilitate the counting of bacteria in milk by the direct microscopic or Breed method (2). Their device permits the counting of equally spaced fields across the diameter of a circular area previously scratched onto a glass slide. A somewhat similar apparatus has been in use in the laboratory of the Baltimore City Health Department for the past 2 years and offers certain advantages over the Olson and Warren device.

Apparatus

The design of the microscopic field spacer is shown in the accompanying illustration. A brass disc was fitted over the knob of the adjusting wheel of the mechanical stage. Two sets of 10 notches each were cut into the edge of the disc so that movement could be interrupted by means of a stop spring. Each set of notches was followed by a smooth space.

Operation

In making total bacterial counts by the Breed method in this laboratory, a series of 5 conventional areas of milk is prepared on a single glass slide. The operator sets the microscope objective over the first area and adjusts the disc of the field spacer to the first notch and then turns the disc through the 10 successive notches at the end of which a smooth space is encountered. This indicates that 10 equally spaced fields have been traversed. The smooth space is then skipped over and observations continued with the second series of 10 notches on the same sample area or on the succeeding area depending upon the number of fields to be counted.

The method described is advantageous in a number of ways. First, the field area of the smear is not limited to a fixed geometric design. Hence, the apparatus can be used for types of microscopy other than direct microscopic counting of milk. We have used it in diagnostic bacteriology, particularly in the counting of *Mycobacterium tuberculosis*. Second, bacterial counts are automatically attained in increments of 10 equally spaced fields. Accordingly, the problem of determining the number of fields counted is greatly simplified. In general, it is felt that the use of the microscopic field spacer here described should be of considerable value as a time-saver.

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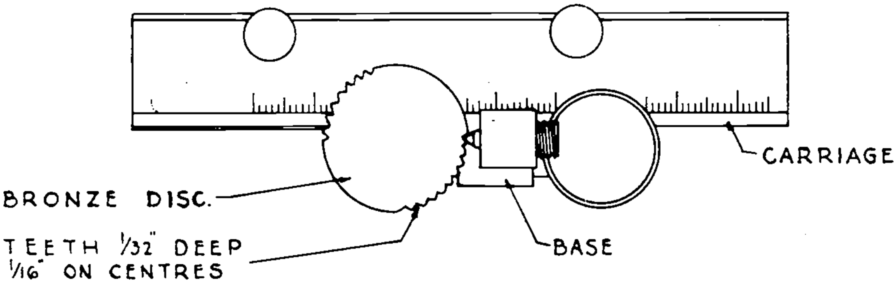

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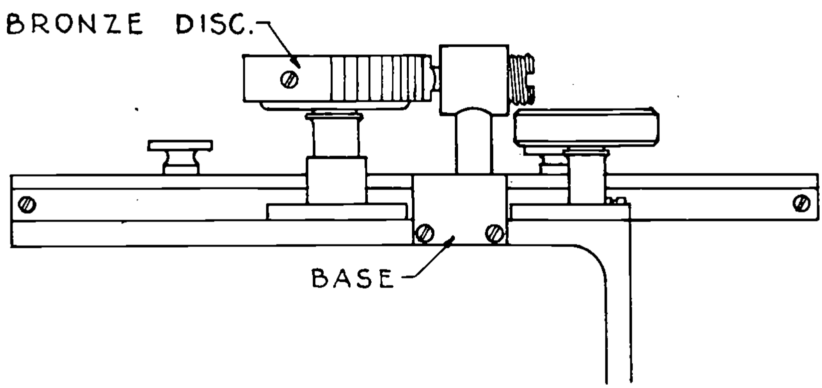

FULL SIZE ELEVATION

Softening Water for Use in Dairy Plants*

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FROM an industrial cleaning viewpoint, the ideal water supply would be freshly collected rain water that had fallen through an atmosphere of clean air. Such water would be relatively pure and free from constituents which interfere with processing. Since this ideal water is never available in quantity, we must choose the best water that we can find and then treat it to suit the requirements of our processes. While this paper will deal primarily with water for dairy cleaning operations, a few remarks will be included on other uses for water.

SOURCES OF WATER

Within the incorporated limits of cities and towns, the best water supply is generally that furnished by the water works. For sanitation and health reasons, this water will meet the requirements for a potable water, although it may be quite unsuited for cleaning or boiler use. If the city supply is from a very large lake, the mineral content will be relatively low and constant and, if filtered, the water will probably require less treatment than any well water that might be available. If the city supply is from a small lake or pond, or from a river, the mineral content may vary widely throughout the year. If the city supply is from wells, we can generally expect a relatively high but constant mineral content. In some instances a better well water might be located at a different level in the ground. If the dairy is located beyond the town limits, a private well supply is probably used, and in such cases several waters may be available at different depths. With due consideration to the cost of drilling and pumping and to the quantity of water available, it would be prudent to select the best water rather than the first level reached.

SOURCES OF IMPURITIES

Since all matter is at least slightly soluble in water, the rain or snow that forms in the sky starts an immediate collection of foreign material. Saturated by the gases of the atmosphere in which it forms and through which it falls, the rain washes the air free of dust. Some of this dust may be slightly soluble and hence contributes the first dissolved mineral matter. Water soluble matter from the top soil of the ground is collected when the rainfall forms as surface run-off. Water percolating through the ground is further saturated with carbon dioxide from rotting vegetation, and, while suspended matter may be filtered from the water, there is in turn a dissolving of all rock formation. In the limestone regions, the carbon dioxide saturated water reacts with the calcium carbonate to form the more soluble calcium bicarbonate. This latter reaction is of primary importance in this section of the country, since the bulk of all water hardness is of this character. Underground streams later reach the surface as springs which greatly increase the mineral content of ponds and streams that consist largely of surface waters. Surface waters collect mud and silt as well as pollution from the sewers of towns and industries.

* Presented at Wisconsin Dairy Manufacturers' Conference, University of Wisconsin, March 30, 1944.

Treatment restores such waters to a potable condition.

OBJECTIONABLE IMPURITIES

The foreign matter present in water may be grouped on the basis of the troubles that arise in processing as well as the means of removal.

Suspended Matter

Clay and silt in surface waters or fine sand in a poor well supply are obviously objectionable. Municipal supplies from such sources are usually, but not always, settled in basins and filtered through open gravity sand filters. If the water supply to the dairy is not clear, it can be clarified by passing the water through a pressure sand filter with little loss of head and at a very nominal cost.

Taste, Odor and Color

While these factors may not enter directly into the matter of cleaning, they would be quite objectionable in process water. Taste and odor are closely related. A small quantity of hydrogen sulfide gas gives water an odor of rotten eggs. Some industrial wastes entering a surface supply give a variety of objectionable tastes, but the prevention of stream pollution is gradually eliminating this source of trouble. Waters originating from marsh regions may be colored from rotting vegetation and may also have odors that are rather stale. Algae growths in ponds are also responsible for objectionable odors and some color. Gaseous impurities can often be removed by the use of a small spray pond, but fixed odors are best removed by activated carbon filters. Sometimes an overtreatment with chlorine to destroy odor is followed by such filters to remove the excess chlorine.

Hardness

The salts of calcium and magnesium that are collected by the water in its path through the earth constitute what has commonly been called hardness. These salts are not objectionable in drinking water, and until comparatively recent years no effort was made to remove them from city supplies. Many people still think that softened water is unhealthy to drink, but there is no marked evidence to indicate that towns with very hard water are unusually healthy. Hardness in water is the primary cause of all objectionable deposits on surfaces being cleaned. Since this is the major problem of water correction, more details will be given later.

Iron

Well supplies often contain sufficient iron in soluble form to be troublesome from the viewpoint of staining. In a freshly drawn sample of water the iron is not apparent, but upon standing a short time the water becomes cloudy due to the loss of carbon dioxide. Further standing allows sufficient absorption of oxygen to produce ferric iron which has the familiar red rust color. As little as 0.3 parts per million of iron will produce visible stains on white fixtures and on cotton cloth. Iron can be removed by aeration, settling and filtering, by lime-soda softening, and by some forms of base-exchange softening. The rusting of hot water pipes is a separate problem that is due to the presence of oxygen in the water.

Bacteria

Almost without exception the city water supplies are treated when necessary to keep the bacterial counts below the accepted maximums. Private deep well supplies are ordinarily satisfactory, although the failure of casings could allow surface water contamination. Shallow wells are always subject to surface seepage. Various regulatory bodies ordinarily check the water supply for bacteria count and the presence of B. coli as a part of the sanitary control measures, so we merely mention this in passing.

TROUBLES WITH HARDNESS

Efforts have been made to classify waters on the basis of hardness. The U. S. Geological Survey Water Supply Paper No. 658 classifies as follows:

	Parts per Million	*Grains per Gallon*
Soft	0– 60	0– 3.5
Moderately hard	60–120	3.5– 7.0
Hard	120–180	7.0–10.5
Very hard	over 180	over 10.5

In the middle western limestone region, almost all waters fall in the last group, but even the softer waters will give trouble to a lesser degree.

Notable hard water troubles in the dairy may be listed as follows:

Boiler Operation

Scaling of boiler tubes with consequent loss of efficiency and tube failure is the primary trouble. The liming and stoppage of feed water pipes may also occur, even though some kind of internal treatment is used to prevent scaling. Heavy corrosion of condensate lines may result from the high carbon dioxide content of the condensate due to the evolution of carbon dioxide with the steam.

Hot Water Supplies

If coil heaters are used, heavy scaling can occur on the coils and in the entire hot water piping system. In severe cases, water lines reduce to a mere trickle or stop entirely.

Can Washing

In machine washing, the hard water leaves a lime coating on all surfaces of the machine, leaves a lighter film on the cans, clogs up spray jets, and accelerates the wear on moving parts.

Bottle Washing

The highly alkaline soaker compartments merely collect sludge, but the conveyor unit, bottle holders, and all parts of the spray rinse compartment receive a heavy coating of lime. While clouding of bottles results from several causes, one of the main factors is the lime film deposited during rinsing with hard water.

Water Cooling Coils

If hard water is used as a cooling liquid in or around coils, the coating of lime will eventually decrease the heat exchange value of the coils.

Equipment Cleaning

Films of lime accumulate on all surfaces unless mechanical scouring means are used to remove the films before they become too thick. These films contribute to the so-called milkstone deposits.

Washroom Maintenance

Quite apart from the actual dairy equipment are the wash bowls and shower stalls. The use of hard water with soap results in heavy scum formations of lime soap and included dirt.

CAUSE OF DEPOSITION

The mechanism that leads to most of the above deposits is the reversal of the conditions that allowed the water to collect the hardness originally. Bicarbonate hardness originated from the reaction of a cold carbon dioxide bearing water on limestone. If such a hard water is heated, the carbon dioxide is again liberated, and the insoluble calcium carbonate again forms on the heating surfaces as well as on any surface to which the unstable water makes contact. Non-carbonate hardness (sulfates and chlorides) does not deposit as readily, but in a boiler the evaporation concentrates the water remaining so that the solubility of the non-carbonates is also reached with a resulting deposit of very hard scale in the case of sulfates.

Most alkaline cleaning agents act as water softeners, but since they are merely added to the system, the removal of hardness occurs in the wash water, and hence the sludge or scale collects on the surface of the materials being cleaned. Although most of these agents act to form a sludge rather than a scale in the alkaline wash waters, during rinsing there is insufficient present to form sludges but enough present to form scales.

PRE-TREATMENT OF WATER

In a sense all internal treatment of boilers and the use of cleaning materials in hard water might be classed as forms of water treatment, but the failure to achieve results is due to the selection of the place for the treatment. Treating must be done *before* the processes for which the water is intended so as to collect the sludge or hardness in an orderly fashion instead of allowing it to collect in places where it is not wanted. Quite often the materials for pre-treatment cost less than those that have been used internally or otherwise wasted in cleaning processes. The equipment for treating is extra, but since it saves the liming and consequent failure of other equipment, the final result may be a surprisingly large saving, with thoroughly clean boiler tubes and equipment included as a free premium. Several processes or types of water softeners are available and are briefly explained below:

Hot Process Lime-Soda

Since the process of softening water is accelerated by heat and since hot water is required for the boiler feed, this style of equipment has long been used for boiler water pre-treatment. Chemicals in the form of hydrated lime and soda ash are fed in exact proportion to the requirements of the water. After mixing and settling, the clear softened water is drawn from the system. With careful control, the hardness can be reduced to about one grain per gallon.

Cold Process Lime-Soda

This is similar to the previous process except that in the past the time of processing was longer, the equipment was therefore larger, and the water was reduced to about 2 to 3 grains with the best control. Improvements in recent years have revolutionized this process so that it is very fast and requires relatively small equipment. Hardnesses below one grain are reported.

Siliceous Zeolites

Water for cleaning purposes can be most easily and completely softened with what is commonly known as the base-exchange or zeolite water softener. Zeolite minerals as a class are insoluble complex alumino-silicates that are available commercially in hard granular particles about the size of coarse torpedo sand. The mineral is placed in a filter-like pressure vessel and when hard water flows through the bed, the hardness, calcium and magnesium, is exchanged by a surface reaction with the sodium contained in the zeolite. Since sodium salts are completely soluble and compatible with all cleaning materials, the resulting softened water is quite ideal for cleaning. When the "exchange capacity" of the softener is reached, the effluent water slowly increases in hardness. Before this occurs, the unit should be cut out of service for regeneration. This regeneration or reviving of the mineral is accomplished with a solution of ordinary salt which reverses the previous reaction of softening. In this unique reaction the accumulated calcium and magnesium that has collected in the zeolite bed, so to speak, is removed and washed to the sewer. After a short period of rinsing to remove the excess salt, the unit is again ready for service. Approximately one hour is required for the regeneration. The base-exchange softener has several distinct advantages over previously mentioned methods. A variable water can be softened without adjustments of feed, although the capacity in gallons will vary with hardness. A completely softened water can be obtained except when the initial hardness is very high. Disadvantages include the fact that the total salts content is not decreased, and hence the effluent water is not as well adapted to boiler purposes as is a water that is properly treated by the lime-soda method.

Carbon Type Exchangers

A newcomer in the field of base-exchange materials is a non-siliceous substance of carbon origin that functions similarly to the siliceous zeolites. Among advantages offered is a resistance to slightly acid waters and a high exchange capacity. A truly novel feature for boiler water purposes is the operation on a so-called hydrogen cycle when an exchange of all salts is made and acid is used for regeneration. The effluent water contains the acids of the original salts. Carbonic acid or carbon dioxide is removed by degasifying the water. The balance of the acids can be neutralized by a caustic feed, by remixing the water in proper proportions with alkaline water from a sodium cycle exchanger, or by the ultimate in water treating perfection, an anion exchanger. The latter is a separate unit filled with mineral that is capable of exchanging the acids for hydroxyl ions and thereby producing the equivalent of distilled water. These various methods of treating water are mentioned to indicate the more recent developments in this field rather than to suggest their application to dairy use. Applications have been largely limited to the field of very high pressure boiler operations and to other uses where distillation of water had been practiced to secure sufficient purity.

CORRECTION OF WATER

No matter how economical and ideal might be the use of completely pretreated water in the future, we are forced to return our thoughts to present conditions where such water is seldom available. Corrective measures resolve themselves into a selection of cleaning materials and methods that give the least trouble in operating.

Alkaline Materials

Phosphate compounds have long been regarded as "water softeners," and beyond question they offer the best solution to a difficult problem. For many years the principal product was trisodium phosphate, a rather strongly alkaline salt that precipitates hardness as a light flocculent material and therefore tends to form less permanent coatings on surfaces. In more recent years the patented sodium hexametaphosphate has taken a place in this field. This material is rather unique in that it tends to form a soluble complex with the calcium and magnesium salts instead of precipitating them. Small amounts have been suggested for stabilizing water for condensers so that the liming of surfaces is prevented. Since the material is about neutral, it is mixed with alkaline salts in the field of cleaning. In the alkaline solutions a relatively larger quantity is required to prevent precipitation. Tetrasodium pyrophosphate exhibits properties that might be described as midway between the two aforementioned phosphates. Pyro is mildly alkaline, forms stable soluble complexes with magnesium, and is more stable in solution than metaphosphate. Sodium tripolyphosphate and sodium tetrapolyphosphate have been offered in the field of cleaning materials, and from data at hand they appear to function in a manner that is similar to a mixture of pyro and metaphosphate. To prevent precipitation in alkaline wash waters, enough of the phosphates must be added to form the soluble complexes. Therefore the amount needed is in rough proportion to the hardness of the water. Similar prevention is also needed in the rinse water, but practical means of application are seldom available.

Acid Materials

Organic acid cleaners for can washers have probably been misnamed since acid solutions are not good detergents for the removal of ordinary milk residues. If a hard water is made slightly acid with an acid that forms soluble calcium salts, the hardness will not form lime coatings on surfaces even when the water is heated. Therefore, the acid cleaners are really a means of correcting water for hardness. Wetting and foaming agents that are resistant to both acids and hardness are added to the acid to provide better emulsification. The acid cleaners so constituted will prevent lime coatings and may do a better job than alkaline cleaners in hard water. For special removal of residues of the type known as "milkstone," various acids have a definitely useful place since acids are capable of dissolving or softening residues that are not affected by alkaline cleaners. Such use of acids for special cleaning, however, is not a part of the present discussion.

If and when completely softened water is available, the problem of cleaning is greatly simplified and can be more easily standardized along logical lines. Calcium is still a problem because of its presence in the milk but properly controlled uses of phosphate-containing cleaners will prevent undesirable depositions on equipment.

In concluding this subject, it might be well to briefly review the history of water and its treatment. In the early days the choice of location of an industry was often dependent upon finding a plentiful supply of soft water. As means of water treatment became available, industry was more free to locate on the basis of raw material supplies and of finished product markets. Demands for greatly increased power brought the need for larger steam boilers and constantly increasing boiler pressures. Even the best natural water supplies are now externally treated for use in very high pressure boilers. Thus the ability to treat water has lifted restrictions that might otherwise have changed the entire pattern of our national development. A critical study of the waste created by not treating water will, in many cases, reveal the economy of proper treatment.

A Course of Instruction for Food Handlers*

A. A. Robertson

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From the standpoint of public health, food presents two problems:

First—Quality insofar as safety is concerned.

Second—Quality insofar as nutritive value is concerned.

While the second phase of this problem, that having to do with nutrition, is, of course, of great public health significance, this group is primarily concerned with the quality of food from the standpoint of its safety.

Everyone present knows that food may serve as the transmitting agent for the causative organisms of certain of the communicable diseases and that the diseases most frequently transmitted in this manner are those belonging to the intestinal group. Food may also be the transmitting agent for diseases of the respiratory group. Poisoning may also result from the ingestion of food containing chemical poisons. Some organisms, harmless in themselves if ingested, may get into certain foods and produce toxins which may in turn result in illness if ingested. The toxins produced by some of the staphylococci, perhaps, are the most important ones insofar as food is concerned. Utensils in which food is placed may also be contaminated by these organisms, chemicals or toxins.

Two steps are essential in the prevention of food-borne outbreaks of disease.

First—Inspection of food products and rejection, because of detectable deterioration, of those unsuited for human consumption.

Second—The employment of proper facilities in the handling, preparing, storing and serving of food which will prevent its contact with infected materials or its contamination with germs or chemicals.

The purpose of this meeting is not to discuss the inspection of food products but rather to consider facilities and methods of handling, preparing, and serving food so as to prevent its contamination. with particular emphasis being given to such facilities and methods in restaurants, taverns, soda fountains, and other eating and drinking establishments.

How to prevent the contamination of food in these establishments has been a problem of health officials for many years. Generally speaking, public health authorities are agreed that routine physical examination of food handlers is not the answer to the problem. Routine physical examinations, unless such examinations include X-rays and laboratory examinations of blood, sputum, feces, and possibly other specimens are practically useless. Such examinations are impractical. The cost is too great for the results obtained. Then again, a doctor's certificate of freedom from disease today is no indication of what the clinical findings will be next month, next week, or even tomorrow morning. In other words, negative findings may be misleading and engender a false sense of security. There is no guarantee that such findings will continue to be negative.

Educational Program

During the past few years, a number of health departments both state and local, have developed programs for the instruction of food handlers. The officials in these departments believe

* Presented at a meeting of the Massachusetts Food Sanitarians Association, April 27, 1944.

that by giving instruction to food handlers, better and more lasting results will be attained in assuring the safety of food. Recently, the Newton Health Department has developed such a course of instruction. After discussing the matter with educational experts, the decision was reached that the use of lantern slides would probably be the best or at least the most practical method to use. The assistance of several science teachers was obtained with the understanding that when the slides were prepared that they would be made available to them for classroom instruction.

The Christmas Seal Sale Committee was approached and asked to appropriate the sum of $100.00. Monies raised by the sale of Christmas Seals is intended for the prevention of tuberculosis. Our approach to the committee was on the basis that tuberculosis was one of the diseases which could be transmitted by improperly sanitized utensils and also that a tuberculous person handling food could transmit the disease through food and there was always the possibility that other persons might become infected. The committee voted to approve our request and appropriated $100.00 for the project. Incidentally, the use of funds, derived from the sale of Christmas seals for educational purposes such as this, meets with the approval of National and State Tuberculosis Associations. This amount was found to be considerably more than was actually required to prepare about 125 slides and also to purchase a projector.

It was learned that the hobby of one of the science teachers, in a local junior high school, was color photography. After consulting him, he volunteered his services and the use of his camera. The only expense in connection with the actual taking of the pictures was the cost of the films and the purchase of three or four flood light bulbs. At first, some black and white shots were taken as the cost was somewhat less than for kodachrome slides. After viewing the color slides and comparing them with the black and whites, it was decided that the color slides were so far superior that no more black and white pictures were taken. Even when pictures of diagrams were taken, an attempt was made to get some color into them by drawing the diagrams on colored paper.

The pictures were taken on 2 x 2 Kodachrome films manufactured by the Eastman Company. Rolls of film for 8 or 16 pictures are available. The 8 size was used in preference to the 16 even though the cost per picture was slightly more. Regardless of how good a photographer is, some films are not satisfactory after developing and must be re-shot. The technique of taking colored pictures is somewhat different from that of taking black and whites. If you should decide to prepare a set of slides, it would be advisable to go slowly at first. Take only one film and wait until the negatives have been developed and the positives returned from the Eastman Company. Whoever is taking the pictures can then check up on his technique. To save time, it was found advisable to plan the work so that most of the pictures to be taken on any given day could be taken in one or two locations.

After being developed, the finished pictures are returned by the Eastman Company mounted in a cardboard folder. If the slides are to be used frequently or if there is a possibility that they wil be exposed to heat from the projector lamp for several minutes at a time, it is advisable to mount the positives between glass, first placing the slide in a bantam mask and then binding the edges with Scotch tissue or photographers' binding tape. The average cost per slide is about 25 cents which includes a small amount for retaking a few shots.

CONTENT

Four lectures have been prepared to describe the slides. It was found convenient to have the script for each slide typed on a separate sheet of paper. This assists the lecturer and also the projector operator who can watch the sheets being turned over and change the slides. Each lecture lasts approximately one hour, not including the question and discussion period. With some of the smaller groups, the question periods have lasted for another hour. The number permitted to attend any one lecture has been limited to 25. It was found that better results were obtained with small groups. The subjects of the four lectures are:

I Disease Transmision from the Standpoint of Food Handling
II Sanitization of Eating and Drinking Utensils
III Care of the Establishment and Inspection and Care of Food
IV Personal Hygiene and Service

First Lecture

What microbes are, what they look like, how they may be identified, how they grow, how they spread from one person to another by direct and indirect contact, and how they may be destroyed are some of the matters discussed in the first lecture. Slides have been prepared showing the classification of diseases and the classification of microbes. Several slides illustrate methods of identifying bacteria. One slide shows a physician taking a throat culture, another the swab being smeared on a slide in the laboratory, another the slide being stained. A picture of the technician examining the slide under the microscope is followed by others showing bacilli, streptococci, staphylococci, and spirilla. Some other simple methods of identifying bacteria such as lactose and brilliant green fermentation tubes and hemolytic streptococci plates, are illustrated and discussed.

Following these pictures, a series of diagrams is shown giving the classification of communicable diseases and various ways diseases may spread from one person to another by direct or indirect contact. Following the lecture, the group is taken on a visit to the health department laboratory. Here, in addition to looking over the autoclave, the incubator and other pieces of equipment, they are given an opportunity to see bacteria under the microscope. The purpose of this first lecture was rather aptly stated by one of the food handlers who said, "Perhaps you haven't intended to make us live in deadly fear of bacteria, but you certainly have instilled in our minds a wholesome respect for them".

Second Lecture

The second lecture deals entirely with the sanitization of utensils and an explanation of the bacteriological examination of smears from utensils. The pictures show proper and improper methods of sanitizing the utensils such as scraping and rinsing the plates, rinsing glasses and cups, washing in a good detergent, the use of stiff brushes, the bactericidal treatment in hot water, chlorine, or other approved chemical, and air drying. Several slides illustrate proper and improper methods in the use of dish-washing machines. The importance of proper storage and handling after sanitizing is stressed, and five or six pictures illustrate methods recommended to prevent recontamination.

All of the food handlers are decidedly interested in knowing what becomes of the smears our inspectors take from utensils in the various establishments throughout the City. A series of slides have been made showing the preparation and sterilization of the buffer solution and the tubes, the smears being taken, the specimen being pipetted, the pouring of the plate, plates in the incubator, plates showing colonies, and counting the colonies.

Several slides have also been made to illustrate proper methods of cleaning bake pans, coffee urns, and other pieces of equipment.

Third Lecture

The third lecture is divided into two sections. The first section deals with the care of the establishment. Among the subjects illustrated by slides are: cleaning of floors, work benches, and tables; improper and proper methods of waste disposal; rodent, insect, and fly control; cleanliness of toilet rooms and other details which have to do with good housekeeping.

The second section of this lecture is devoted to a discussion of inspection of food when it is received at the kitchen and also its care after being received. The slides illustrate and the script explains how evidence of spoilage in meat, fish, clams, lobster, and canned food products, may be detected. The care necessary in safeguarding milk is stressed. One slide shows a refrigerator with food stored in such a manner that prevents the circulation of air and another shows the proper methods of storing food in the refrigerator.

Considerable time is devoted to a discussion of the preparation and care of salads, hashes, and custard or cream-filled bakery products with emphasis being given to the danger involved if these food products become contaminated with pathogenic organisms particularly toxin-producing staphylococci. Finally, several pictures show food exposed to contamination on counters while others show the food properly protected.

Fourth Lecture

The fourth lecture deals with personal hygiene and service. The importance of keeping hands and finger nails clean, and the danger of contaminating food if one has a slight cold or a mild incapacitating attack of diarrhea, is emphasized. Other items such as wearing clean, washable outer clothing, cooks wearing hats and waitresses wearing caps and hair nets are mentioned. While some of these items do not have much bearing on public health, they do contribute to habit formation and a spirit of cleanliness and thus tend to promote a reaction which will lead to more attention to cleanliness in food handling.

Tests

To make certain that the language used is understood, a True-False test for each of the first three lectures has been developed. The members of each group are asked not to consider these tests in the nature of examinations. The purpose is merely to find out if the information is being "put across" in a manner which they can understand. There is no compulsion about taking the tests but with rare exceptions, those taking the course have done so and apparently with much interest. The tests are passed out at the end of the lecture and are returned at the next session. They are marked as soon as possible, usually the next day. When an incorrect answer is given or in cases where no answer is given, the correct answer together with any explanation deemed necessary is given on the back of the sheet.

Certificates

All persons, who attend the first lecture and any two of the other three, are given certificates signed by the health officer and the chief sanitary officer. Perhaps the time is coming when such certificates will be required before any person will be permitted to engage in the occupation of food handling. At the present time, however, the course offered in Newton is on a voluntary basis. One disadvantage of a voluntary program is that oftentimes those who need the instruction the most are the ones who will not participate. On the other hand, making the course compulsory, takes away, to some extent at least, some of the educational features.

In-service Lectures

Due to the manpower shortage, it has been impossible for some establishments to permit their employees to take off the necessary time to attend the lectures. An attempt has been made to overcome this difficulty by offering to give the lectures at any establishment instead of in the health department quarters, provided at least ten food handlers will attend. The course has been given for two such groups and very frankly, it is believed that these smaller groups were more successful than the somewhat larger groups. With smaller groups, almost everyone present will participate in the discussion following the formal lecture. With larger groups, the discussion is usually limited to one or two persons. Working with smaller groups is not any more time-consuming than lecturing to larger groups. It has been found that the essential material in the four lectures can be condensed somewhat and that it can be given in two lectures with good results.

RESULTS

The number of food handlers reached to date has been small but as previously mentioned, the number attending has been purposely limited. Of the approximately 800 food handlers employed in Newton, only about 100 have completed the course although some 50 others have attended less than the three lectures required before a certificate is issued. These 100 persons are employed in 32 of the 110 eating and drinking establishments located in the City. The program thus far has been in the nature of an experiment and it would have been preferable to wait a year or so before expressing a definite opinion as to its success or failure. It is felt, however, that the results obtained thus far, justify a continuation of the program. The lectures have been discontinued for the summer but it is planned to offer them again in the fall.

Much time, study, and effort must be devoted to the preparation of any course of instruction for food handlers, if the course is to be of any lasting value. Getting ready for each lecture takes time. Two hours or more must be given over to the lecture, the question period, and any demonstration following the lecture. From experience thus far, there is a growing conviction that it is all very much worth while. Improvement has been noted in many establishments. There is more interest and cooperation on the part of both owner and employees. Better methods are being followed and the inspectors are being asked more questions by the food handlers. Perhaps this interest may be because these food handlers who have taken the course have a better understanding of the public health reasons for the various regulations and what constitutes a reasonable compliance. Improvement has been particularly noticeable in better methods in the sanitization of dishes and this improvement has been reflected in more satisfactory results as indicated by lower bacterial counts. In all lectures, the fact that compliance with health department regulations is good business, has been stressed and the response to date seems to indicate that the methods employed in Newton have met with a reasonably good measure of success.

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1st Vice-President, H. S. Adams......Flint, Mich.
2nd Vice-President, Charles Gotta..Lansing, Mich.
Secretary-Treasurer, Harold J. Barnum, Health Department, Ann Arbor, Mich.

NEW YORK ASSOCIATION OF MILK SANITARIANS

President, Samuel Abraham......Slate Hill, N. Y.
Vice-President, E. S. St. J. Baldwin, New York, N. Y.
Secretary-Treasurer, W. D. Tiedeman, New York State Department of Health, Albany, N. Y.

WISCONSIN MILK SANITARIANS ASSOCIATION

President: Dr. K. G. Weckel, Department of Dairy Industry, University of Wisconsin, Madison, Wisconsin.
Vice-President: W. P. Uselman, Galloway-West Company, Fond du Lac, Wisconsin.
Secretary-Treasurer: Dr. L. W. Brown, State Department of Agriculture, Madison.
Auditors: M. H. Ford, State Department of Agriculture, Whitehall; A. T. Bruhn, State Department of Agriculture, Madison.
Directors at Large: V. P. Melhuish, The Carnation Company, Oconomowoc; C. K. Luchterhand, State Health Department, Madison.

Associations Which Have Designated the
JOURNAL OF MILK TECHNOLOGY
As Their Official Organ

CALIFORNIA ASSOCIATION OF DAIRY AND MILK INSPECTORS

Acting President and Vice-President, F. H. Lucas, 202 Monita Street, Bakersfield, Cal.
Secretary-Treasurer, A. E. Reynolds, State Office Bldg. No. 1, Sacramento, Cal.

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Vice-President, J. E. Rochwell.......Chicago, Ill.
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Secretary, B. E. Horrall, Dairy Department, Purdue University, Lafayette, Indiana.
Assistant Secretary, W. K. Moseley, Moseley Laboratory, 315 North DeQuincy St., Indianapolis, Indiana.

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Vice-President, Dr. L. W. Rowles....Topeka, Kan.
Secretary-Treasurer, Tom Larsen, Kansas State Board of Health, Topeka, Kan.
Directors, (1) J. R. Mingle, Deputy State Dairy Commissioner, Oakley, Kan.; (2) Howard Weindel, Milk Sanitarian, Lawrence, Kan.

MASSACHUSETTS MILK INSPECTORS' ASSOCIATION

President, J. Fred Sheehan..............Everett
Vice-President, Thomas J. Travers......Worcester
Secretary-Treasurer, Robert E. Bemis...Cambridge

Metropolitan Dairy Technology Society

President, F. L. Seymour-Jones..New York, N. Y.
Vice-President, Harry Scharer...New York, N. Y.
Secretary-Treasurer, H. E. Roberts, New Brunswick, N. J.
Sergeant-at-Arms, S. H. Harrison, New York, N. Y.

Missouri Association of Milk Sanitarians

President, C. W. Drumgold, St. Louis City Health Dept., St. Louis, Mo.
Vice-President, J. K. Smith, Jackson County Health Dept., Independence, Mo.
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, Philadelphia Dairy Council, Philadelphia.

Texas Association of Milk Sanitarians

President, Taylor Hicks.......San Antonio, Texas
1st Vice-President, F. C. Armstrong, Fort Worth, Texas.
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.

Association News

New York State Association of Milk Sanitarians

The Annual Meeting of the New York State Association of Milk Sanitarians was held in Syracuse on September 20–22.

The attendance was as great as for any previous meeting.

The discussions included such timely topics as the Prevention of Cheese-borne out-breaks, the Possibilities of centralizing dairy farm inspections under State authorities with reciprocal acceptance between neighboring States and a Report by Dr. C. J. Blanford, Market Milk Administrator on Current Milk Supplies. The committee on the Uniform Design of Milkhouses submitted an interesting progress report. The last half day was devoted to an informative discussion of Coliform Organisms in Pasteurized Milk.

Mr. Samuel Abraham of the Middletown Milk and Cream Company, Slate Hill, N. Y., was elected President for the coming year and Mr. E. S. St. J. Baldwin of the Borden Company, New York City, Vice-President. W. D. Tiedeman was re-elected Secretary-Treasurer. Mr. Sol Pincus, Deputy Commissioner and Sanitary Engineer of the New York City Department of Health was elected a member of the Executive Committee.

Dr. Bryan Heads Department

Beginning July 1st, Dr. C. S. Bryan, Division of Veterinary Medicine, Michigan State College, was appointed Professor of Surgery and Medicine and head of that department in the school of Veterinary Medicine at Michigan State College. He retains his laboratories in the Department of Bacteriology and Public Health and will continue his work in the fields of Bovine Mastitis and Dairy Bacteriology.

New Members

ACTIVE

Cavanaugh, Verne, Public Health Sanitarian, Indiana Board of Health, 1098 W. Michigan St., Indianapolis 7, Ind.

Eagan, H. E., Associate Milk Specialist, U. S. P. H. Service, State Board of Health, Division of Sanitary Engineering, Jackson, Miss.

Ellinger, Cyril, Dairy Supervisor, Board of Health, Edmonton, Alberta, Canada.

McDonald, Miss Cornelia, Bacteriologist, U. S. P. H. Service, State Board of Health, Jackson 113, Miss.

Slocum, George C. T/5, Med. Det., 1878th Unit, Camp Claiborne, La. (Mailing address) 6 Biltmore Rd., Worcester, Mass.

Zook, John, Sanitarian, Geary County Health Dept., Box 71, Junction City, Kans.

ASSOCIATE

Casto, Benjamin H., City Dairy Inspector, Board of Health, 1536 East 85th St., Chicago, Ill.

Cobb, Herbert H., Supt., Coble Dairy Products, Inc., Wilkesboro, N. C.

Dixon, W. J., Commissioner, Kansas City, Mo.

Engimann, Arthur J., Asst. Milk Sanitarian, Will County Health Dept., 21 East Van Buren St., Joliet, Ill.

Fruit, Bert L., Fieldman, Momence Milk Coop. Assn., 349 So. Evergreen Ave., Kankakee, Ill.

Fulford, Albert D., Sanitarian, Carteret County Health Dept., Beaufort, N. C.

Gullett, Ernest, Senior Sanitarian, Henry County Health Dept., 614 N. Poplar St., Paris, Tenn.

Kegg, Vaughn C., Milking Machine Sales, Farm Bureau Coop. Assn., 246 N. High St., Columbus 16, Ohio.

Lee, Lloyd T., Owner, Holmen Dairy, Holmen, Wis.

Litchfield, Jesse R., Plant Foreman and Fieldman, Teegarden Creamery Co., Teegarden, Ind.

Malter, Ernest, General Manager, Marshall Dairy Products Co., 159 W. Jackson St., Marshall, Mo.

Marshall, Iris P., Mgr., Kristoferson's Creamery, Sequim, Wash.

Martin, Herbert D., Monongalia County Health Dept., Morgantown, W. Va.

McCue, J. C., Fieldman, Momence Milk Coop. Assn., Gilman, Ill.

Miller, Dr. S. M., Commissioner of Health, Peoria 2, Ill.

Quinn, M. Gerald, Chemist and Bacteriologist, Dairymen's League, 59 Beiter Walk, Buffalo 15, N. Y.

Reynolds, John B., Plant Supt., Momence Milk Coop. Assn., 611 N. Maple St., Momence, Ill.

Rossich, Basil N., Hamtramck Health Dept., Hamtramck, Mich.

Servis, L. R., Monroe City Health Dept., Monroe, Mich.

Siplock, Alex. L. T/4, 2058 W. 11th St., Cleveland 13, Ohio.

Smith, B. L., Managing Director, B. L. Smith Publishing Co., 122 Richmond St., West, Toronto, Canada.

Sterner, Alvin R., Michigan Producers Dairy Co., Adrian, Mich.

Tracy, Paul L., Plant Manager, Union Milk Co., Union, Ill.

Van Horn, D. H., Sales and Service Representative, Thatcher Mfg. Co., 4252 Wolf Rd., Western Springs, Ill.

Wirzikoski, Rose, Acting Chief Bacteriologist, Board of Health, 9 Ontario St., Toledo, Ohio.

Zulkowski, Edward, City Dairy Inspector, Board of Health, 1036 West 32nd St., Chicago, Ill.

CHANGES IN ADDRESSES

Barnum, Harold J., from Health Dept., Ann Arbor, Mich., to Representative, Calgen, Inc., 718 Soule Blvd., Ann Arbor, Mich.

Bastian, Harold, from Momence, Ill., to c/o Sturtevant Ice Cream Co., 5th Ave. and 16th St., Rock Island, Ill.

Bezdenejnykh, V. A., from Washington, D. C., to U. S. S. R., Moscow 8, Dmitrovskoye Shosse 3, Kvartira 23, Russia.

Brooks, Pfc. Paul L., from Camp Grant, Ill., to *Corporal* Paul L. Brooks, 117 So. Monroe St., Green Bay, Wis.

Bulmer, L. C., from Birmingham, Ala., to Sealtest, Inc., 230 Park Ave., New York 17, N. Y.

MacMorrah, W. F., from 125 Harrison St., Lewisburg, Pa., to 320 High St., Troy, Pa.

Marshall, R. B., from Peoria, Ill., to 121 N. Main St., Juneau, Wis.

Obituary

"Bill" Dotterer

William David Dotterer died September 25, 1944, of coronary thrombosis after an illness of less than two weeks.

He was born August 26, 1885, in Newton Mills (a town no longer in existence), Forest County, Pennsylvania, the son of Ida Jane Mohney and Herval A. Dotterer. He grew up on a farm, though his father was employed by the United Natural Gas Company.

He studied four years at Allegheny College, Meadville, Pennsylvania, graduating there in 1913 with the degree of Bachelor of Science. He majored in bacteriology, under Dr. Robert S. Breed.

Upon graduation he was employed as manager of a water company in Centerville, Iowa, for a period of about two years. Then, desiring further training in bacteriology research, he associated himself with Dr. Breed, at the Geneva Experiment Station, as an unpaid assistant. He lived in the Breed home, and there was formed an association which has contributed much to the knowledge of the bacteriology of milk and milk products. One of the early studies was directed at the control of the spread of bovine tuberculosis in swine fed on cheese plant whey.

In the Spring of 1916 Mr. Dotterer became Health Commissioner and Registrar of Vital Statistics for the village of Princeton, New Jersey, and the University. On September 16, 1916, he married Dorothy Sansom, of Clarion, Pa. A daughter, Dorothy Dane, was born in Princeton. During his service as health commissioner, Princeton suffered its extremely severe outbreak of poliomyelitis.

Mr. Dotterer remained at Princeton until November, 1917, when he moved to Chicago to become Director of Laboratories for the Bowman Dairy Company, of that city. One son, William D. Dotterer, Jr., was born a year later.

"Bill" was always willing to contribute his share of the thought and work in a worthy activity, as is attested by the following list of committee memberships and elective positions he has held:

- Milk and Dairy Products Committee—A.P.H.A.
- Milk Definitions and Standards Committee—I.A.M.D.
- Committee on Sanitary Procedure—I.A.M.S.
- Committee on Standard Methods for the Examination of Dairy Products—A.P.H.A.
- Sanitation Advisory Board—U.S. P.H.S.
- Editorial Committee—A.D.S.A.
- Chairman, Laboratory Section—I.A. M.D.
- President, Chicago Dairy Technology Society
- Executive Board, Ass'n Illinois Milk Sanitarians
- Advisor to the Agricultural College, University of Illinois

In addition to the organizations named above, Mr. Dotterer was also a member of:

- Society of American Bacteriologists
- Society of Illinois Bacteriologists
- Institute of Food Technologists
- Illinois Public Health Association

He also participated actively in the civic affairs of his community, Barrington, Illinois. He was a Boy Scout leader, a member of the official board of the Methodist Church, and a member of the Board of Education from 1926 to 1940. He was a Mason and a Phi Gamma Delta.

His ashes will be interred in hills of his native State.

ADDRESS OF THE PRESIDENT

1944 Annual Meeting
International Association of Milk Sanitarians
Chicago, Illinois, November 2, 1944

MEMBERS OF THE INTERNATIONAL ASSOCIATION OF MILK SANITARIANS, GUESTS AND FRIENDS:

Until comparatively recently, it has been customary for the presiding officer of the Association to deliver a presidential address at some time during the course of the meeting. Several of my immediate predecessors in the office of President have spared the assembled members this ordeal, possibly because they deemed the lack of such an address no serious deprivation. I have decided to revive the custom, however, because of the opportunity it affords to present to the membership a summarized accounting of the activities of the administration since the last meeting, and to offer for your consideration certain suggestions for future policy and action.

The two years which have elapsed since the St. Louis Meeting have been unusually difficult for practically all of us. This is not a bid for sympathy, for every one of us appreciates the degree and extent of the uprooting and the greater sacrifices which have been made by those of our associates who are now in the Armed Forces of our Country. It is not necessary to elaborate on the increased difficulties of milk control which have resulted from decrease in the dairy farm population, increase in the size of herds and production, shortages of dairy and agricultural equipment and supplies, restricted supplies of gasoline and tires, mandatory rearrangements of truck routes, and depletion of the staffs of control and quality improvement organizations. We are not yet through the woods, but the going appears to be slightly better. It is possible that we are growing accustomed and habituated to the adverse aspects of the situation; or, on the other hand, it may be that we are learning how to meet the problems with which we are confronted.

It appears to me that the very tangible difficulties inherent in milk quality control during the past several years are resulting in the evolution of better methods and procedures. If that impression is correct, the bitter experiences and troubles of recent years will have been a blessing in disguise. If it is demonstrated that, with depleted inspection staffs—or, what constitutes the same thing, limited automobile travel—the desired milk quality can be maintained by greater emphasis upon platform inspections and tests, or by more frequent laboratory examination of the finished product, associated with an organized program of instruction of producers and handlers, all along the line, we may expect the development of a trend toward these latter means of attaining and maintaining milk quality and safety. I think a trend—at least in thought—in that direction is becoming evident. If it is discovered that one or more of the tools we have been using for the determination of milk quality is inadequate or inaccurate, we have the choice of discarding it, or of endeavoring to improve it; we should not continue to use it in its current inadequate form. One of the discussions scheduled for this meeting pertains to such a matter.

From the standpoint, then, of development in the practical approach to the attainment of desired milk quality and safety, the difficulties of the past several years have not been a total debit. Instead, these difficulties have, I suspect, shaken many of us out of a complacency which is said to be the first indication of an approaching complete crystallization of point of view and opinion.

While the war years have, in a way, been marked by beneficial developments in milk control principles and practices, it can hardly be said—truthfully—that they have been characterized by an inspiring upsurge in the activities of Association committees. Standing committees were appointed—as is customary. I sympathize deeply with those who accepted or retained chairmanships, and have nothing less than respect for those who were so conscientious as to decline membership on a committee because the press of routine vocational activities upon their time would handicap or prevent participation in committee activities. The situation was so grave and discouraging that it was deemed preferable to disband one committee—"Applied Laboratory Methods," in the work of which practical studies and observations are essential—rather than to continue the committee on a purely nominal status. The latter alternative had too much of the appearance of condoned inactivity, and might have set a troublesome precedent.

I would like to propose, for the benefit of my successors, that any member of this Association, or an affiliate, who would like to participate in a committee project, be fully privileged to write the President to that effect, and to name his committee preference. In that manner committee chairmen will be assured of enthusiasm on the part of some members, at least, of their committees; and the task of the President will be simplified and facilitated. Approval of such a custom or example of Association etiquette would advance the ultimate welfare of the Association by providing a means for new and relatively unknown members to take an active part in committee activities, and to bring their lights out from under a bushel.

On the credit side of the ledger, as the report of the Secretary will announce, will be found a healthy increase in membership, resulting mainly from the affilliation of five state associations with the International Association. These are: Associated Illinois Milk Sanitarians, Iowa Association of Milk Sanitarians, Michigan Association of Dairy and Milk Inspectors, New York Association of Milk Sanitarians, and Wisconsin Milk Sanitarians Association.

This very worthy policy of the Association—the provision for affiliation of local organizations of like-minded individuals with this Association—may develop into a problem which should be seriously studied in advance. Restaurant and food sanitarians are also becoming organization-minded, with a national association and a journal as their ultimate objective. Many of these restaurant sanitarians are also milk sanitarians, because of their employment in health departments of counties or small municipalities. One such local organization of restaurant sanitarians has inquired about affiliation with this Association. From the standpoint of increased membership and revenue, affiliations by such organizations would have certain advantages. The complications must also be considered, however. Such organizations will certainly desire the publication in the JOURNAL OF MILK TECHNOLOGY of papers devoted to restaurant and food sanitation. An occasional such paper will not lead to the implication that the title of our Journal is a misnomer. But, if, as the affiliated associate membership of the Association becomes progressively larger, the Journal is to carry a progressively increasing proportion of papers on food sanitation, both the name of this Association and the title of the Journal, and the characters of both, will inevitably become subject to appropriate change.

Whether such a change—ultimately, if not soon—is desirable is a question open to debate. I urge that you give it mature consideration, from both the International Association and state organization aspects, for it is a question to which an answer must be available when called for. The Executive Board should know your aggregate opinion.

At the St. Louis Meeting it was proposed from the floor of the business session, that the Association create, for a deserving candidate, a scholarship in milk sanitation in a recognized school. I have given this matter much thought since the St. Louis Meeting, and have come to the conclusion that the proposal is not practical. I question the ability of all of us to agree upon the choice of the school we would honor by creating such a scholarship; the selection of a candidate for the scholarship presents several problems; and, at best, we will have benefitted only one individual, in whom few, if any, of us will have other than an extremely impersonal interest.

It seems to me to be preferable that available funds of the Association be expended in the conduct of Association business. Some of the standing committees should meet once or more during the interim between Annual Meetings; the Advisory Committee to the War Production Board has been called to two meetings in Washington during its life-time; members should not be expected and required to defray their expenses to such meetings, nor should the Association expect to command their services at the expense of the organizations by which they are employed. I, therefore, recommend that, when the Executive Board approves the holding of a committee meeting, the Secretary-Treasurer may be authorized to pay the expenses or part thereof of committee members in attendance at such meetings; with the proviso that such an understanding shall not apply to committee meetings held in connection or conjunction with an Annual Meeting of the Association. (The approval of this recommendation may encourage some of you to apply for committee appointments.)

A number of manufacturers of dairy supplies publish one or more pamphlets each year, which are intended to be of an educational and instructional, as well as advertizing, nature. Health departments prepare and distribute instructional literature, and produce motion picture or strip films. Some are good and effective; some are not so effective; and there are some . . . So what- you might ask.

For two whole years I have been trying to think of means for building the prestige of this Association—to make it a concrete entity, with influence that cannot be denied nor ignored. We have a considerable number of past-presidents who, in the main, became lookers-on in Association affairs at the expiration of their terms. Let us put those who are not already serving in some capacity to work on a committee to receive, review, and judge pamphlets, motion pictures, strip films, and other vehicles of instruction, on the basis of subject matter, approach, style, and whatever other criteria it may be desirable to establish, to the end that the Association may issue Awards of Merit to those which are worthy. In the course of time, if such a committee functions effectively, an Award of Merit from this Association will be much sought after, and its attainment a mark of distinction. Such an award might include the privilege of imprinting a statement or seal on the undistributed copies, or reprints, of the recipient publication.

I recommend that the Executive Board and incoming President be authorized to make provision for, and to appoint, such a Committee on Awards.

There are two features of this meeting which are not included in the printed programs. The first is a demonstration of milk straining on the farm, and a display of strainer discs and strainers, in the Century Room, on the 19th floor of this hotel, on Friday evening. I am able to assure you that this display and demonstration will more than repay you for the long elevator trip—for which no priorities nor reservations are required—or for foregoing some other form of big-city entertainment. Notices of the time and place of this feature of the meeting will be posted conspicuously. The second unlisted feature is a demonstration of properly and improperly constructed and assembled plumbing, in which the nature of cross-connections, the causes and remedies of siphonage, and other conditions of interest to sanitarians are shown. All those who deal with water supplies and sewage disposal in milk plants will find this demonstration of much interest. The demonstration is unique; there is only one other, smaller installation in the whole country. Glass piping and colored solutions make the demonstration almost completely visual. The demonstration will be held Saturday afternoon, and transportation will be furnished.

Some of those in attendance may wish to see installations of specific types of milk plant equipment while in the city. If you will make your desires known, by contacting me or leaving a note at the Registration Desk, the necessary arrangements will be made.

The speakers have been requested to limit the time of their papers, so that time is available for ample discussion. Many of you have come far to attend this meeting. If you hear something you do not understand, ask the speaker to explain it. If he makes a statement with which you do not agree, feel free to rise and express your views. In the interests of the greatest benefit to all present, I shall request that speakers from the floor come forward, identify themselves, and use the microphone. Nothing detracts so forcibly from the success of a meeting as the inability of those in one part of the audience to hear what a speaker is saying.

C. A. ABELE

REPORT OF SECRETARY

INTERNATIONAL ASSOCIATION OF MILK SANITARIANS
OCTOBER 14, 1944

The annual meeting of this Association for the year 1943, although scheduled, was canceled, upon the urgent request of the Director of the Office of Defense Transportation. The Executive Board realized that there were many problems, both local and national, which were confronting milk sanitarians, and that a meeting of the Association might remedy some existing problems and unsatisfactory situations. However, the federal request appeared to be so urgent that the Board believed that the best interests of the nation would be served by canceling the meeting.

Those problems which were confronting us in 1943 are still before us. Some have become more acute. Others, unpredictable, have arisen. Many of these relate directly to the safety and quality of milk supplies which are being used by members of our armed forces, by workers in vital industries, and by civilian populations.

It is generally recognized and accepted that the best and most practical way to attack a problem is not by long and cumbersome correspondence, but by personal conferences and discussions between those individuals and interests who are concerned, especially between those who are entrusted with the responsibility of working out satisfactory solutions.

The Office of Defense Transportation, again this year, asked that no conventions be held unless they were vital to the successful prosecution of our military efforts. The Executive

Board considered this request. It was the unanimous opinion of the Board that the problems now confronting the members of our Association were of such a nature that it would be a disservice to the industry and to all organizations having contact with the industry, if the Association did not use every implement available and make every effort possible to solve these problems. It is the sincere belief of the Executive Board that in holding this convention we are conforming to the wishes and policy of the O.D.T. The participation by all members in the deliberations of this meeting has resulted in fully carrying out the purpose of this convention.

The membership of the Association, as of October 14, 1944, was 1,665, of which 337 were active members. Since our 1942 meeting we have accepted 708 new members. It is interesting to note that three charter members are still active in the Association, namely, J. A. Gamble, Philadelphia, Pa.; H. N. Parker, Jacksonville, Florida; and W. H. Price, Detroit, Michigan.

The JOURNAL OF MILK TECHNOLOGY has continued to hold its enviable position as an outstanding dairy publication. The Editor and Managing Editor have carried on successfully under adverse conditions.

Various committees have continued to function even under severe handicaps.

It is a pleasure to report to the Association that as a result of the action taken at the 1942 meeting, relative to affiliation of local or state associations of milk sanitarians with the International, the following associations have become affiliated with this Association:

The Associated Illinois Milk Sanitarians
The Iowa Association of Milk Sanitarians
The Michigan Association of Dairy and Milk Inspectors
The New York State Association of Milk Sanitarians
The Wisconsin Milk Sanitarians Association

To your Secretary, it appears that both the International and local or state associations will make their biggest contribution to the industry, and will be able to complete their best work through close co-operation. The problems of one are the problems of the other. An international or national problem is only a local problem which encompasses a greater area. This large area does complicate a problem, yet, when it is fully resolved, it is found that the individual is the one affected. Continued and extended efforts for co-operation between local and state associations and the International should result in a clearer and more comprehensive understanding of our problems than would be possible if each individual or organization worked separately.

Everyone has been called upon to give more and more of his time and services to activities outside his usual field of work. Without a doubt there is no one here but who would do more if he could. Under these conditions, those members who have been called upon to accept added responsibilities in the interests of the Association have responded to an extent that is surprising.

Your President has taken a most active interest and participation in matters pertaining to the Association, especially as they related to affiliations and membership. He, with his local committee, has planned this convention.

The Editor and the Managing Editor of the JOURNAL OF MILK TECHNOLOGY deserve the sincere appreciation of the Association for the excellent work they have carried out.

Various committees have given time and study to various problems. Their reports have added considerable to our knowledge of particular subjects.

There are many members who, as individuals, have contributed to the

Association's program and work. To all these, your Secretary, speaking for the Association, is sincerely grateful.

Based upon correspondence and personal conferences between members and the Secretary during the past two years, it is your Secretary's opinion that among the many interests which will receive the attention of the Association, three should be carefully studied and considered. They are:

1. The study and, if warranted, the approval of proposed equipment;
2. The consideration of expanding the scope of the Association to include persons whose duties are those of sanitarians, and who are not milk specialists;
3. The study of a program which would result in a closer bond between affiliate associations and the International.

It is most gratifying to know that during this convention those three problems have received consideration and are being studied.

There seems to be every reason why the Association should continue to advance. Co-operation such as has existed between the Association and other groups and individuals having the same interests, aims, and ideals, can only result in satisfactory solutions of problems which are confronting all of us.

C. S. LEETE
Secretary-Treasurer

SUMMARIZED FINANCIAL STATEMENT

TO OCTOBER 14, 1944

Receipts

Cash on hand October 7, 1943	$1,866.92	
Annual dues	3,001.39 *	
Total		$4,868.31

* $1.11 Exchange

Disbursements

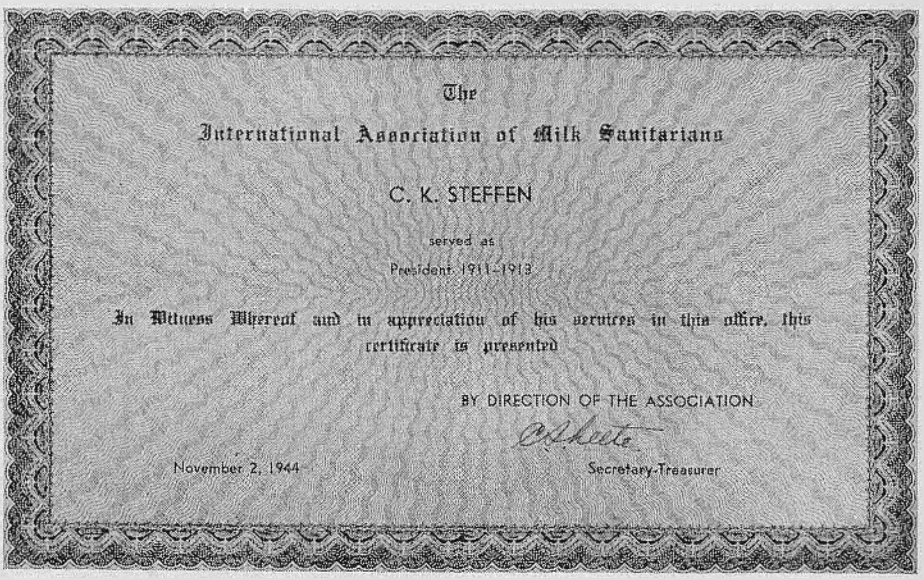
including payments to the Journal of Milk Technology and affiliated associations	$2,451.70
Balance	$2,416.61

PRESENTATION OF CERTIFICATES OF SERVICE

This organization, first as the International Association of Dairy and Milk Inspectors and more recently as the International Association of Milk Sanitarians, has, since is organization in 1911, had thirty Presidents, including the incumbent.

This roster of past-Presidents includes the names of the pioneers and leaders in Milk Hygiene and Sanitation, in this Nation and Canada, during the past quarter century. This Association may well take pride in its acumen in having selected them as officers. Their works have reflected glory on the Association, as well as upon themselves.

The speaker is in position to realize and appreciate the personal time and effort these past-Presidents have devoted to the interests of the Association, and the extent to which the Association is indebted to them, individually and collectively. I am quite certain that the letters written by the twenty-nine Presidents who preceded me, if laid end-to-end, would reach from HERE to far beyond THERE. The time taken from normal pursuits, such as golf games,


The

International Association of Milk Sanitarians

C. K. STEFFEN

served as

President 1911-1913

In Witness Whereof and in appreciation of his services in this office, this certificate is presented

BY DIRECTION OF THE ASSOCIATION

November 2, 1944

Secretary-Treasurer

fishing trips, or purely domestic evenings by the fireside, in order to conduct the affairs of the Association, is incalculable. Nevertheless, if you attempted to question them as to how much time they had devoted to their administrative duties, they would merely shrug their shoulders and smile at you.

What recognition has the Association given of these indispensable services? I do not speak of recompense, but of recognition and evidence of appreciation. When the new officers have been installed and the last Business Session has been adjourned, the retiring president becomes just another past-President. He may be requested to serve as a member or as the chairman of a standing committee. Otherwise, he drops out of the active affairs of the Association, and returns to annual meetings—if he attends—only as one of the members of the Old Guard, who sit around in the overstuffed lobby chairs and "beat their gums" about the "good old days."

This is not to imply that "chewing the fat" in the most comfortable lobby chairs is sinful. The point is that the Association gives them opportunity to do little else. I do not indicate that they should be continued in office, or even in the control of committees, to the exclusion of newer members. But it does appear that the Association is rather profligate of the talents of its retired officers; that it should—in some manner—avail itself of these talents, to its benefit and their honor. That is an end which will be achieved by some one of my successors, I trust.

Keeping these retired officers as active members of the Association—and I mean active—is only incidental to the purpose of this ceremony. The Association owes these men a debt which can not be paid in full. The very least that the Association can do is to indicate to past-presidents its appreciation of their services, in the form of a Certificate. This is a tangible evidence of the confidence the Association has placed in each of them by advancing him to its highest office, and of appreciation of the sacrifices he has made in order to serve it. The intrinsic value of such a certificate is negligible—it could not be hocked nor swapped; but its sentimental value to the recipient is beyond price.

The Executive Board of the Association has authorized the preparation of such certificates for the past-Presidents.

Of the twenty-nine presidents who served from 1911 through 1942, nine are deceased. Mr. C. J. Steffen, of Milwaukee, the first President (1911 and 1912), and Mr. Alexander R. Tolland, of Boston (1937), have passed away during the current calendar year. Of the others, Professor C. L. Roadhouse, Davis, California (1920), and Mr. Howard R. Estes, Birmingham, Michigan (1928), have discontinued their membership in the Association. Of the remaining eighteen, ten are present, and I am privileged to present these Certificates to them.

I wish the time were available for me to include in my introduction of each of these past-presidents a resume of their accomplishments and honors; but we have a full program for the evening, and I must forego that pleasure. I shall, therefore, limit the introduction of each to his name, the year of his presidency, and his present connection.

Ernest Kelly—1918–19 and 1919–20. Assistant Chief, Bureau of Dairy Industry, U. S. Department of Agriculture, Washington, D. C.

Herbert E. Bowman—1921–22.

George E. Bolling—1922–23. Director of the Laboratory and Inspector of Milk, Brockton, Massachusetts.

W. A. Shoults—1926–27.

Col. Ira V. Hiscock—1927–28.

Ralph E. Irwin—1929–30. Chief Engineer, Division of Milk Supply, State Department of Health, Harrisburg, Pennsylvania.

A. R. B. Richmond—1930–31. Chief, Division of Food Control, Department of Public Health, Toronto, Ontario.

William B. Palmer—1931–32. Executive Officer, Milk Association of the Oranges, Orange, New Jersey. Managing Editor, Journal of Milk Technology.

Horatio N. Parker—1932–33. Director of Laboratories and Sanitation, City Health Department, Jacksonville, Florida.

Paul F. Krueger—1933–34.

C. K. Johns—1934–35. Senior Assistant Agricultural Scientist, Central Experiment Farm, Ottawa, Canada.

George W. Grim—1935–36. Chief Milk Control Officer, Milk Control District No. 1, Ardmore, Pennsylvania.

John G. Hardenbergh—1936–37. Secretary, American Veterinary Medical Association, Chicago, Illinois.

V. M. Ehlers—1938–39. Director, Bureau of Sanitary Engineering, State Department of Health, Austin, Texas.

Paul B. Brooks—1939–40. Deputy Commissioner, State Department of Health, Albany, New York.

Frederick W. Fabian—1941–42. Research Professor of Bacteriology, Michigan State College, East Lansing, Michigan.

In the name of the International Association of Milk Sanitarians I present each of you with this Certificate, as a token of the recognition and appreciation of your services as President.

(President Abele then presented the Certificates to each of the ten former presidents who were in attendance.—*Editor.*)

Correspondence

Summaries of previous installments of this series:

Morgan R. Beckwith, in 1996, sends the editor of the JOURNAL OF MILK TECHNOLOGY a packet of letters written back in 1937 from an "Uncle Bob" to his nephew, a milk producer, as to how to outwit milk inspectors.

First letter, published in the May-June issue, page 184: The nephew is advised to organize an information system among his neighbors so as to inform one another when the inspector is in the neighborhood, and endeavor to anticipate the requirements that he may be stressing at the time. Inspections may follow a familiar pattern or may be varied in emphasis from time to time, reflecting ill-advised directions from arm-chair superiors.

Second letter, published in the July-August issue, page 246: Be sure to learn the requirements of the ordinances of your local milk market. Have the inspector write down just what he wants done so that he will not be likely to require different arrangements at some later time. Endeavor to secure the inspector's good will by giving him presents and other favors, thereby putting him under obligation to you.

EDITOR

THIRD LETTER

Sunny Acres, Oregon, August 5, 1937.

Dear Nephew:

I did not expect such a prompt reply to my last letter. And I must confess that I am quite flattered by the announcement that you have organized a small group of your neighbors to report to one another on the whereabouts of the dairy inspector, when he is in your general vicinity. Your proposal to have, first one and later another, get word to the inspector that his presence at a certain dairy on a certain day, or at his convenience provided he will give notice of his coming, is a novel one. In that way, that producer can be fully prepared for the inspector's visit, and your whole group, if not too large, may reasonably anticipate that he will then also visit your places on the same trip. That is very clever, and I take pride in this exhibition of our family ingenuity.

In my last letter I promised to tell you next how to deal with an inspector who will neither accept little gifts nor respond to invitations to hunt or fish on your property. There are, of course, numbers of approaches, the most satisfactory being wholly dependent upon the individual weaknesses or keenness of the inspector with whom you have to deal.

If I recall correctly (I am making no copies of these letters), the next lesson is Number 4. It has been my observation that most dairy inspectors will take advantage of any opportunity to display their knowledge of some subject in which they are interested. Let us be charitable, and take it for granted that some phase of dairy farm milk sanitation is most frequently the most appropriate subject for discussion; but, there are also other pertinent subjects, such as cattle breeding lines, or production records, or feeding programs, or general agricultural economics, or—more likely—baseball or other sport of local or seasonal interest, horse-racing, politics, or local gossip. Sometimes the favorite topic of discussion or conversation of an inspector—or the range of subjects he can authoritatively and interestingly cover—will surprise you. This range may include music, the theater, stamp-collecting, the best-sellers, *et cetera*.

The actual nature of the topic of discussion is really beside the point, however. The subject is immaterial, provided the discussion is spirited. The whole point is that you, or whoever is on hand when the inspector arrives, must engage him in conversation, even if only about the weather. Pick out a comfortable place, where he can find a seat. If he will not sit, follow him around, AND KEEP TALKING. When properly conducted, such a conversation can usually be made to flatter the inspector, which will increase his goodwill toward you and your dairy farm.

I must warn you, however, to proceed warily in discussions of political subjects and personalities. Even though he may have civil service status, an inspector may be reluctant to participate in discussions of the shortcomings or possibility of overthrow of the party or individuals in office. And, if he does not enjoy civil service status, the discussion must, perforce, be rather one-sided. Furthermore, I must also emphasize that argument, of which there is always a fine prospect in discussions of politics, is not likely to be to your advantage: you cannot possibly win both the argument and the inspector's goodwill, but must lose one or the other.

You are probably wondering why I suggest that you, or your employees, should squander so much valuable time in idle conversation, on the chance of flattering the inspector. If you can flatter the inspector, so much the better; but that is not actually imperative. The main object of this conversational smokescreen is to occupy the inspector's time, so that

(Continued on next page)

Dr. Jones Says—*

Communicable disease outbreaks from cheese: that's something that's come to the front here fairly recently. They've reported 'em occasionally around different parts of the country but there seemed to be so few of 'em it didn't appear to be a very serious problem. Cheese that wasn't pasteurized or made from pasteurized milk: it ordinarily was stored several months before it was used. If any disease germs had gotten into it, it gave 'em time to die out.

But between lend-lease and feeding the armed forces and all: the demand has been so heavy it's cut down on the storage time. Some claim, too, that more people've taken a liking to new cheese: "green cheese," they call it sometimes. Anyway, the past year or so there's been several serious outbreaks of typhoid and so on in this country and Canada.

It's quite possible, too, that there've been other cheese outbreaks that they haven't found out what they came from. It ain't like an outbreak from milk or water, for example. There it's localized: limited to one milk or water supply. But cheese—it goes all over and cases scattered here, there and the other place: it might never be recognized as one outbreak from a single source.

The fact is we had an outbreak here in this State two or three years ago: twenty-odd cases of typhoid in one of the northern counties. The cases'd been occurring over a considerable period and they hadn't been able to connect 'em up. Then they struck a clue that led to a local cheese factory. It developed that these folks (some of 'em delivered milk to this factory) they'd been eating fresh curd. This cheese was pasteurized finally before it was sold. But the curd they got out of the vat, that hadn't been.

Out in California, where they had one of these outbreaks, they passed a state law requiring 'em either to pasteurize the milk or the cheese or to "cure" it for a prescribed time before releasing it. I understand they're giving some thought to something along that line here in this State.

They used to tell me, when I was a kid, the moon was made of "green cheese." Maybe that's why they put it out of reach: it hadn't been pasteurized.

PAUL B. BROOKS, M.D.

* *Health News*, New York State Department of Health, Albany, September 18, 1944.

(Continued from preceding page)

he will be inclined to rush through his inspection superficially when he feels he must move on to the next farm; or to distract him while he is making his inspection. so that he will fail to notice defects and delinquencies. If the inspector is not particularly talkative, you must carry the ball and do the talking.

Another variety of this artifice is to lead the inspector to a section of the farm, other than the barn or milk-house, to show or demonstrate some thing or phenomenon foreign to milk sanitation, and thus occupy his time or distract his attention from the sanitary conditions of your place. This is an effective method for gaining time—while you have the inspector elsewhere—for an employee to clean up or remove some condition which, if discovered, would affect the score or grade of your dairy farm.

There are, of course, other variations of this theme, which your specific situation will make possible and appropriate, and which will occur to you from time to time as the exigencies of your circumstances demand. You must study your inspector, and govern yourself accordingly. If he is immune to this method, and to the others which I have discussed in preceding lessons, there are still other approaches which I shall discuss in future letters.

It was pleasing to learn that you are enjoying a fine growing season, and that your prospects for adequate feedstuffs are so good. Unless a hailstorm strikes the orchards during August, we anticipate a normal crop of fruit. I wish, however, that the prospects for good prices were somewhat better.

With love from your Aunt Matilda and me.

UNCLE BOB.

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Authors

Subjects

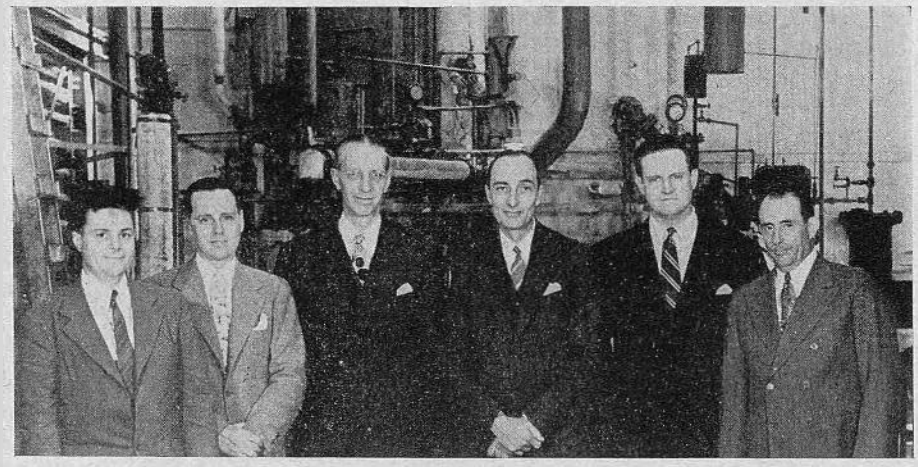
J. J. SCHAEFER JOINS WYANDOTTE CHEMICALS CORPORATION AS DIRECTOR OF DEVELOPMENT

Wyandotte Chemicals Corporation has recently announced the formation of their new Development Department which will be headed by J. J. Schaefer.

About five years ago Wyandotte Chemicals Corporation embarked on an organic research program and the development of both organic and inorganic products will now be handled by this new department.

Mr. Schaefer is a graduate of the University of Dayton and the Massachusetts Institute of Technology. He was a member of the technical staff of Niacet Chemicals Corporation of Niagara Falls from 1928 to 1934. In 1934 he became Director of Research for Sharples Chemicals Incorporated and was a Vice President of that Company from 1936 until his recent resignation.

Mr. Schaefer is a member of the American Chemical Society, the American Institute of Chemical Engineers, and of the Chemists Club of New York.



WYANDOTTE RESEARCH, DEVELOPMENT AND SALES EXECUTIVES INSPECT ORGANIC PILOT PLANT

Wyandotte Chemicals Corporation Research, Development and Sales executives recently inspected the Wyandotte Chemicals Corporation organic pilot plant. Shown from left to right are Dr. W. F. Waldeck and Dr. Thomas Vaughn of the Research Department, J. J. Schaefer, Director of Development, and Lawrence D. Linke, his assistant, Howard F. Roderick, Director of Research, and Carter B. Robinson, Vice President in Charge of Sales, J. B. Ford Division of Wyandotte Chemicals Corporation.