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Journal of

MILK and FOOD TECHNOLOGY

Official Publication

International Association of Milk and Food Sanitarians, Inc.

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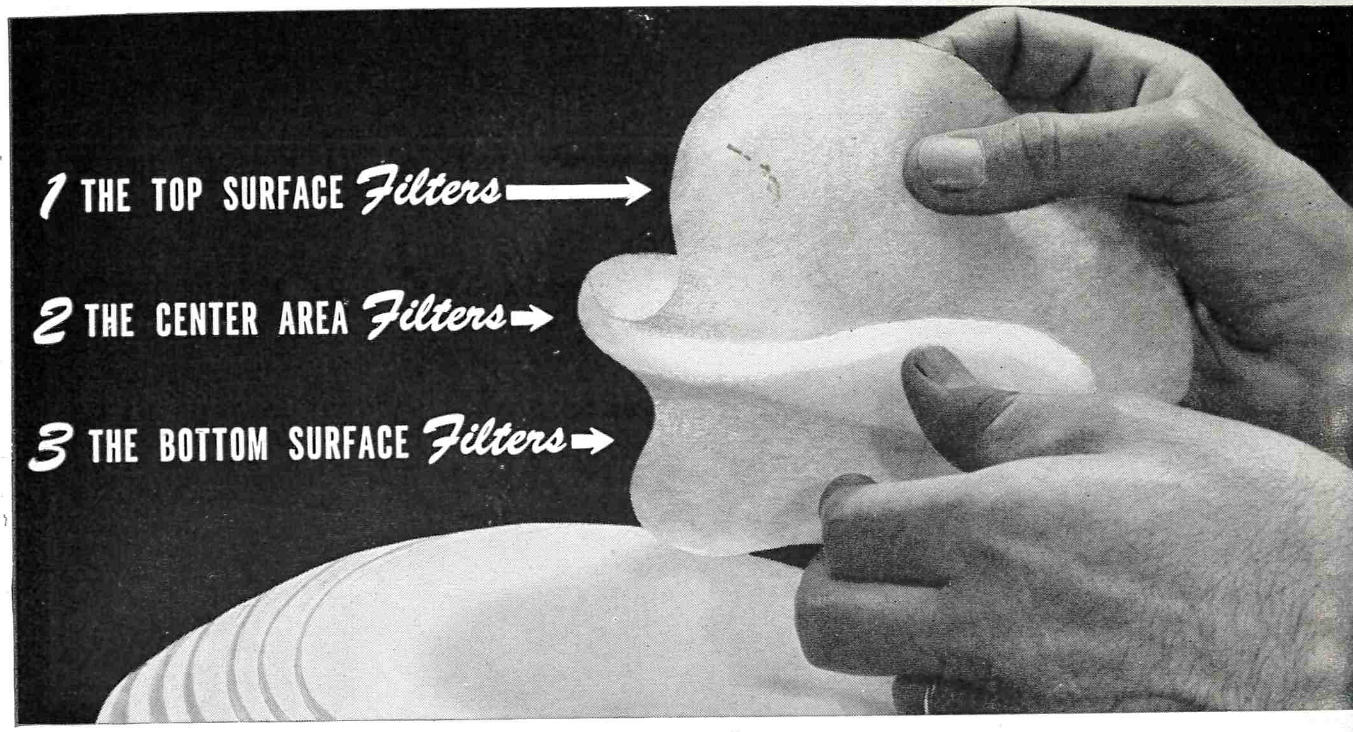

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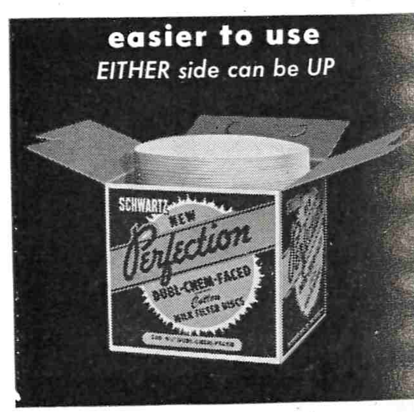

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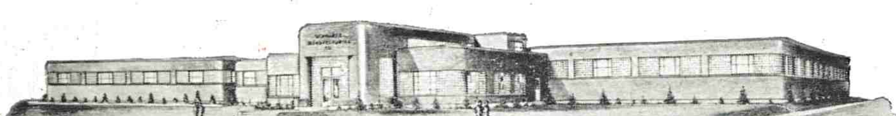

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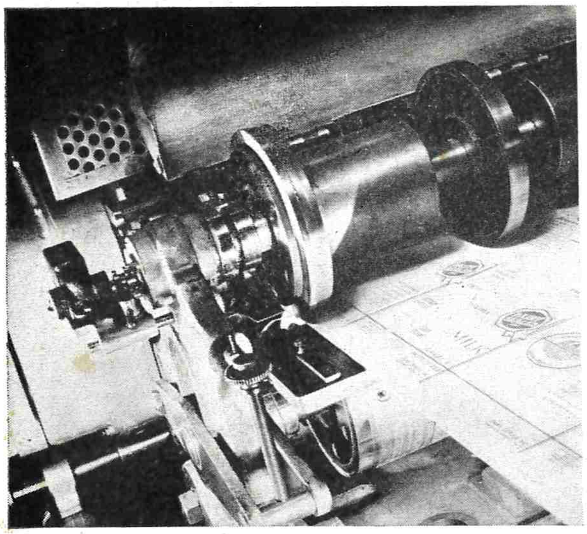

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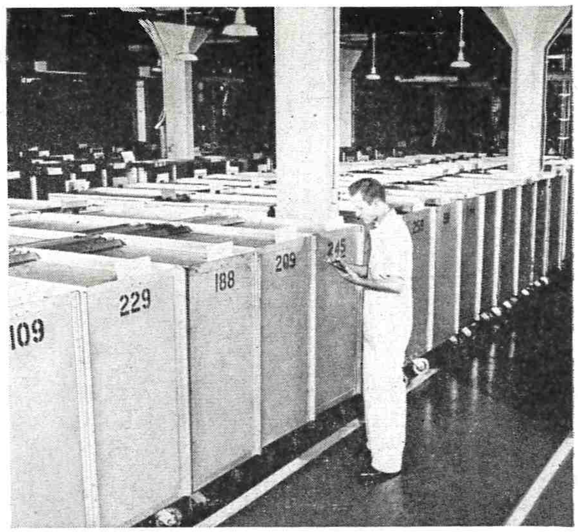

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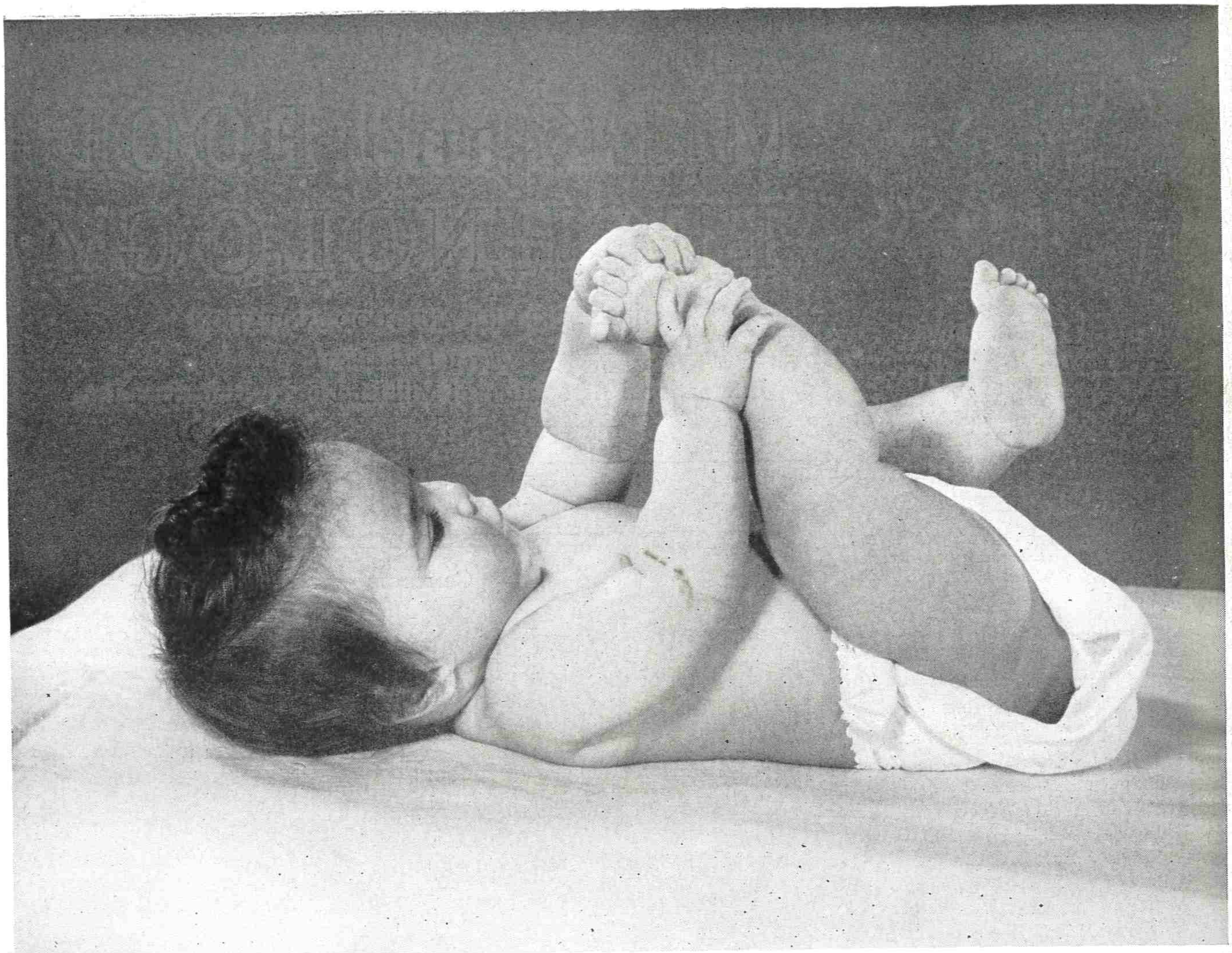

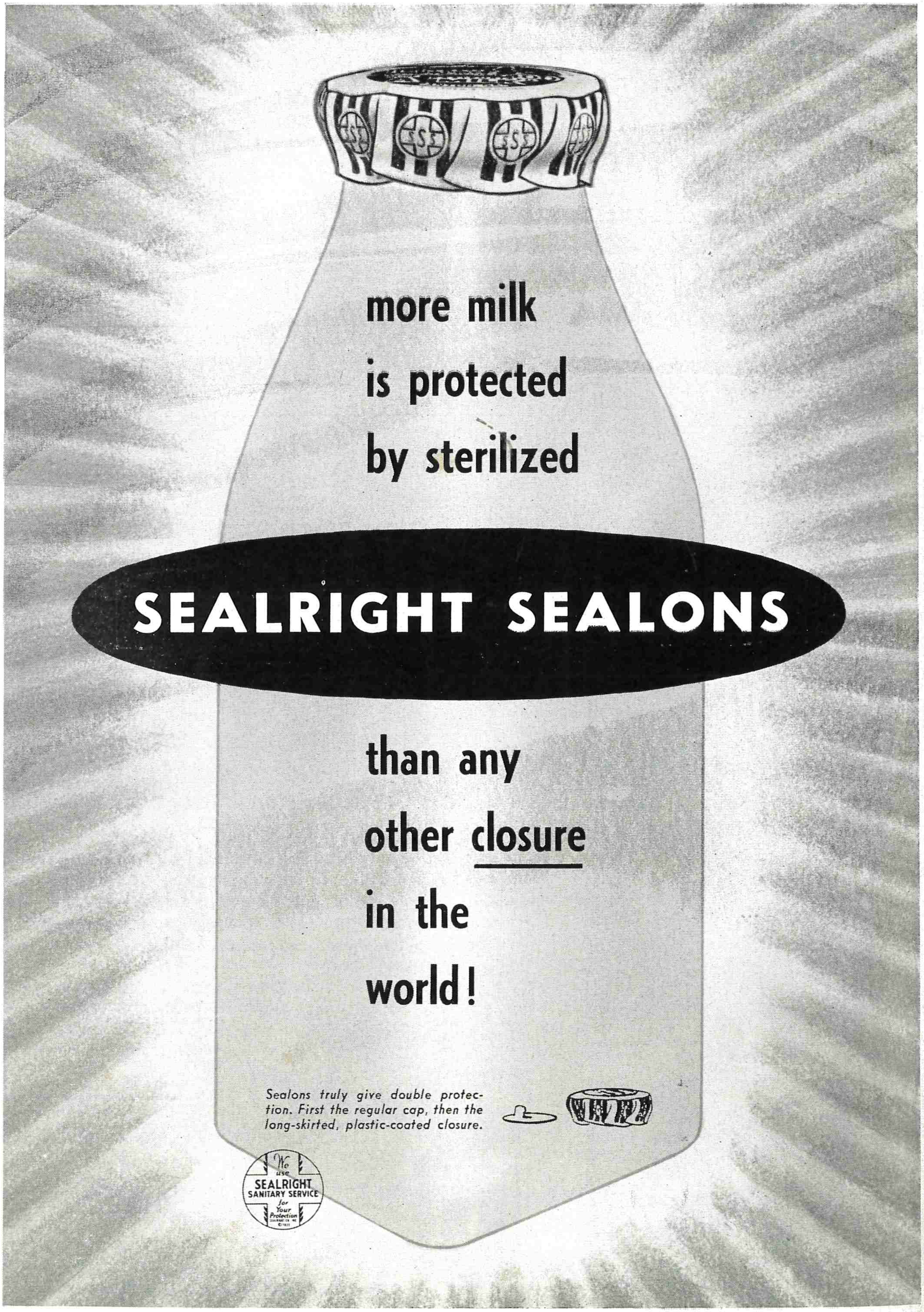
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THE PROGRAM OF THE DAIRY PRODUCTS IMPROVEMENT INSTITUTE, INC.[1]

A. C. Dahlberg[2]
and
Donald H. Race[3]
Dairy Products Improvement Institute, Ithaca, New York

Three years ago "The Purpose, Plans, and Progress of the National Conference on Interstate Milk Shipments" was the subject of an address by your former chairman, J. L. Rowland, at the annual meeting of the Dairy Products Improvement Institute. Our members were impressed by the program of the conference. Now it is our privilege to tell you about the program of the Institute on sweet cream for manufacturing purposes which, we believe, should be brought to your attention.

A program on any phase of milk sanitation must recognize that in market milk areas sanitation from farm to consumer is one of the best of any food industry. The great advances in milk sanitation have been made by the cooperation of producers and processors with the various regulatory and educational agencies, and progress will be made in the future only through such mutual efforts. The Institute's program for the sanitary production of sweet cream for manufacturing purposes is based on the general application of the knowledge, practices and essential regulations for the production of quality milk. Experience shows that there is little difference of opinion among industry and regulatory officials as to facts and objectives but there is variance of thought concerning methods of accomplishing the results.

History

The Dairy Products Improvement Institute was incorporated as a non-profit organization under the Membership Corporation Law of the State of New York on July 30, 1947. The persons involved in the act of incorporation resided in the states of Massachusetts, New York, and Pennsylvania. Details of the organization are given in its Certificate of Incorporation and By-Laws which are available as a pamphlet to those who are interested in them. At the first meeting of the Directors held on the day of incorporation Mr. W. A. Wentworth was elected President, an office which he still occupies, and the late Dr. Carl W. Larson was elected Managing Director each year until his retirement in June 1953.

Two conditions prompted the inception of the Institute. The first was that the northeastern states constituted a so-called cream deficit area. The shortage of sweet cream for manufacture into ice cream, sour cream, cream cheese, etc. was acute. Those persons in the dairy industry and in colleges who seemed qualified to evaluate this cream deficit problem were almost unanimous in the opinion that this shortage would become worse and would be permanent. The usual tables and graphs substantiated this prediction but subsequent developments have varied from it.

The second situation prompting the formation of the Institute was the existence of the Dairy Products Improvement Committee with headquarters in Chicago, Illinois, organized in 1944 for the purpose of aiding producers in the production of quality cream to supply this market. The late Dr. Hugo H. Sommer of the University of Wisconsin was selected to prepare and administer a comprehensive and practical program for the production of sweet cream of high quality. The Committee published the bulletin entitled "Production Requirements for Sweet Cream" which gave farm production details and a method of evaluating the quality of cream. Dr. Sommer's work was chiefly on farm production problems. There was an obvious need for a northeastern organization to serve the interests of the companies and the state and city regulatory agencies located in the areas that expect to receive and accept cream to be produced under the program of Dr. Sommer.

The Dairy Products Improvement Institute had these problems in mind at the time of its inception. However, its objectives are broad and include more general work on milk and cream quality from production to acceptance in the market of utilization. The "Production Requirements for Sweet Cream" prepared by Dr. Hugo H. Sommer made no distinction between cream for bottling and for manufacture; however, the Institute has always considered milk and cream for manufacture into dairy products to be its principal field of activity.

Objectives and Methods

The objectives of the Institute as adopted by the Board of Directors are as follows:

"1. To promote the welfare of the dairy industry through raising the general level of quality.

2. To promote the acceptance and use of uniform and simplified sanitary standards with which to attain and measure that quality.

3. To expedite the movement of dairy products between political subdivisions by assisting health authorities to determine and to make effective only essential sanitary requirements to the end that duplicating and/or conflicting inspections, quality standards and quality measurements will be unnecessary and the best possible economic distribution of the products will be effected.

4. To formulate suggested sanitary standards for proposed adoption by health authorities covering new processing developments within the industry, and to disseminate these standards to interested parties".

The work of the Institute is based upon a long-term program to promote its objectives in several manufacturing fields involving milk and cream quality, sanitary regulations, and the movement of dairy products of acceptable quality standards into areas where it can be utilized most expeditiously.

A general statement is now being prepared for a booklet entitled "Requirements for the Sanitary Produc-

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[1]Presented before the National Conference on Interstate Milk Shipments held in Memphis, Tennessee on March 29 and 30, 1955.

[2], [3]Advisor to the Board of Directors and Field Director, respectively, Dairy Products Improvement Institute, Inc., 302 East State Street, Ithaca, New York.

tion of Sweet Cream". It gives the essentials for the sanitary production of milk on the farm and its processing into sweet cream for use in dairy products. Standards of sanitary quality of the milk, raw and pasteurized cream are proposed based upon the sanitary requirements of public health and a high quality product of the dairy industry. This statement sets the minimum acceptable goals of excellence in methods of production and product quality. There is also an operating manual concerned with the details of milk production, separation, and cream processing which is of primary interest to the company producing the cream. It outlines the program giving the details of production and processing of cream to meet sanitary requirements and product quality. The Institute is not in a position to supervise and maintain the desired standards but often it can furnish information to both the producing and receiving plants and regulatory agencies concerning the approximate sanitary aspects of the production and processing of the cream in selected areas.

This program of the Institute shall be promoted by cooperation with all existing agencies active in work affecting the sanitary quality of sweet cream. There are regulatory agencies on both state and city levels in the areas of production and utilization which are mutually and vitally concerned and legally responsible for the healthfulness of milk and cream used for manufacture. Then there are the dairymen who produce the milk, the processors that produce the cream, and the operators of the plants where the products are utilized who are interested not only in the sanitary quality but also in other characteristics affecting the economic value of the product. The Institute offers to aid all parties whenever and wherever possible in the formulation and execution of proper specifications and standards.

The cream quality program of the Institute is based upon inspection of farms and plants by a regulatory agency to assure the presence of adequate facilities and good sanitary conditions, regular inspection and testing of the milk at the plant by qualified company men to detect undesirable milk, work by the field sanitarians with those producers whose product does not meet standards, and proper processing and handling in the receiving plant and during storage and shipment to the place of utilization. Wherever milk supplies are ample it is recognized that the local dairymen ought to be able to supply local markets with quality cream for manufacturing.

SOME SPECIFIC PROBLEMS

The Institute takes the position that it is neither economically feasible in the dairy industry nor justifiable in the interests of public health to apply all of the present bottled milk sanitary requirements of production on the farm, to all dairy products. As a matter of fact in those few areas under one set of sanitary regulations for milk it is generally understood or specified that the requirements do not include such products as butter, cheese, and evaporated milk. It is recognized that application of fluid milk regulations to all dairy products would create an impossible situation in respect to enforcement and the free movement of food products through the ordinary channels of trade. More liberal sanitary standards for these products cannot be excused or allowed on the grounds of the substitution of high heat treatment of any product for sanitation in its production.

The Institute recognizes the necessity for high sanitation and quality standards, but some of the sanitary requirements that are in effect for market milk are not necessary. Should the sanitary requirements for the production of market milk be limited to the essentials of sanitary milk production, then most of the reasons for two standards would be eliminated. The value of a single sanitary standard is recognized but the possibility of agreeing on required farm facilities acceptable to health and agricultural departments and economically feasable to the dairy industry is very remote at the present time. The Institute is endeavoring to assist in the formulation of such dairy farm inspection forms limited to the essentials of producing milk for bottling that the inspection may give a clear picture of the necessary facilities and conditions on the farm. The report of the sanitarian then could be applied as usual for bottled milk but not as severely for milk for manufacture bearing in mind that the essential factors of sanitation should not be violated.

This question of dual sanitary standards for farm facilities and the limitation of the bottled milk standards to essentials is more than of academic interest. A specific example of this fact is the situation in New York. In 1953, it was the second highest state in total milk production. It ranked first in total milk consumption, first in the manufacture of cream cheese and sour cream, and second in cottage cheese, ice cream and total cheese production. Figures on total sweet cream production are not available but it is certain that most of it is produced on farms inspected for bottled milk and processed in plants similarly inspected. It has been stated that about 85% of all milk used to manufacture the approximately 95,000,000 pounds of cheese made in New York State is inspected under sanitary regulations for bottled milk by New York State and local health departments. About one-half of the entire milk supply of New York State is used for manufacture yet most of it is under fluid milk regulations. It ought to be clear, therefore, that sanitary regulations for milk for bottling in New York must be considered in any program of sanitation of milk for manufacture and that the bottled milk sanitation regulations do affect the cost of producing such milk. Fortunately, the regulations for the sanitary production of fluid milk on the farm in New York State have been held closely to essentials, otherwise dairymen of the state would be at a disadvantage in competing with sweet cream for manufacture from other states. It is gratifying to note that, except for the annual physical examination of herds, the Institute's program for the sanitary production of sweet cream is in good agreement with the bottled milk regulations in New York State.

Even though very good information establishes the essentials of sanitary milk production and there is general agreement on these facts, nevertheless, unanimity of opinion does not exist regarding sanitary requirements to be put into laws, ordinances and farm score forms. Major differences of opinion may be selected which have been deeply entrenched by argument and practice. These differences in opinion and regulations have to do with items that are chiefly non-essential or on which there can be no definite answer that is exactly right at all times. For example, it is very desirable to specify a bacterial standard for the major grade of bottled milk and this standard could be uniform throughout the country. However, bacterial standards for such milk prior to pasteurization as received from the producer vary from 75,000 to 400,000 per ml. to no standard at all. With such discrepancies in requirements for the predominating grade of milk for bottling it is not surprising that acceptable bacterial regulations are difficult to establish to include milk for manufacture.

At the present time and until milk production requirements are more uniform in respect to non-essentials, there is no public health necessity for a single standard for the sanitary production of milk on the farm, in fact, there is good reason for two standards. Let us illustrate this point. Milk for bottling may be subjected to adverse conditions not encountered with milk for manufacture. Market milk may be cooled at the receiving plant and pasteurization delayed a day either through shipment to the plant of pasteurization or by hold over at the city plant. The milk is pasteurized at the relatively low temperature of 162° F. for 15 seconds followed by cooling to 50° F., or below, and it generally is not held much below 50° F. Delivery to the store or to the consumer usually occurs within 24 hours after pasteurization but the milk may be held as long as a week in the home refrigerator at an unknown temperature prior to consumption. On the other hand the situation is more favorable to the protection of the public health if the milk is made into cream for ice cream manufacture. The milk is separated into cream and immediately pasteurized at 155 - 160° F. for 30 minutes at the receiving plant. The cream is cooled to 40° F. or below at which temperature it is held until received and used at the city plant. The mix is pasteurized at 155 - 160° F. for 30 minutes, promptly frozen and held in the frozen state until consumed. Protection of the public health and fine product quality to the consumer can be assured with less rigid sanitary standards for milk production on the farm when the milk is used in ice cream than as bottled milk.

The Institute favors the enforcement of the essentials of sanitary milk production on the farm but they should be only those requirements necessary to assure milk of high quality. Actually, the detailed specifications of farm sanitation of the Institute are comparable to those of many states and cities for the predominating grade of bottled milk and, properly enforced and promoted, they are ample to produce milk of excellent quality. Much of the work of securing the cooperation of producers ought to be done by the milk companies and producers' cooperatives rather than depending upon regulatory agencies.

Any program of milk production and processing must be based upon quality standards for the product which is the ultimate evaluation of the success or failure of the production program. Consequently, the Institute has adopted standards of quality for the milk as received from producers, for the raw cream at the processing plant, and for the cream immediately after pasteurization, and as received at the plant of utilization. These quality standards include flavor and odor as well as the usual sanitary standards for sediment and bacteria.

The bacterial standards of the Institute for raw milk for manufacturing purposes are more liberal than the most prevalent standard for bottled milk but they are within the range of these standards. Lest there be unjustified criticism of this phase of the Institute program it is well to point out that the maximum bacterial count of raw cream prior to pasteurization permissible under the Institute's program is the same as the standard of the U.S.P.H.S. and the bacterial count immediately after pasteurization is only half that permitted by the U.S.P.H.S. for Grade A cream.

It has been considered desirable to have the bacterial limits on raw milk for manufacture slightly more tolerant than those generally required for milk for bottling. There is no established public health reason for any selected bacterial standard for milk for both bottling and manufacture, as previously mentioned. The history of the origin of the 200,000 bacterial count for raw milk does not indicate special reasons for this exact figure to assure consumers of a wholesome bottled milk supply. Establishment of one bacterial standard for milk used for all purposes would give impetus to the idea that the same facilities should be available on all dairy farms and such enforcement would increase expenses of dairy farmers producing milk for manufacture and would tend to increase the price of cream unnecessarily without public health advantage.

SUMMARY

The necessity for industry to carefully and systematically test the quality of the milk as received and of the processed cream as offered to the market is stressed in the program of the Institute. Such testing serves as the basis of the sanitation work of field sanitarians with milk producers. Records of such tests must be kept for examination by regulatory officials. If regulatory officials do some spot testing and checking of methods and farm inspections a very good idea of the sanitation may be readily obtained with a minimum of effort. When such data are available there is reason for a realistic evaluation and acceptance of the information.

This program by industry, based upon sound sanitary requirements and product standards, to produce the sanitary quality of cream desired by health and agricultural agencies and the market, and its coordination with law and ordinance enforcement should inspire more reliance on the part of a regulatory agency in the work of other agencies and of industry. It reduces the need for multiple and duplicating inspections and it stimulates acceptance by one regulatory agency of milk and cream approved by another. One of the very gratifying results of this work has been the splendid cooperation and assistance of the various health and agricultural officials who are cognizant of the problems and are willing to aid by their efforts.

In conclusion, it may be well to state that the Institute program is

Continued on Page 156

BACTERICIDAL EFFECTIVENESS OF IODOPHOR DETERGENT-SANITIZERS[1]

W. S. Mueller
University of Massachusetts, Amherst, Mass.

(Received for publication December 20, 1954)

The bactericidal properties of an iodine liquid and an iodine powder detergent sanitizer were found to be practically equal. At 25 ppm. of available iodine both products compared favorably with 100 ppm. of available chlorine in killing E. coli, S. typhosa, M. pyogenes **var.** aureus **and** Ps. aeruginosa, **in the presence of hard water, whole milk, and dishwash soil. The iodine detergent-sanitizers can be recommended for sanitizing food utensils, if field tests substantiate results of the laboratory performance tests.**

The milk and food industry is showing considerable interest in the new iodine sanitizing agents. The germicidal property of elemental iodine has been known for a long time, but the combination of iodine and a surface active agent to form an iodophor is a rather recent development. Terry and Shelanski(4), Lazarus(2), and Johns (1) have reported favorably on the germicidal properties of the iodophors.

Since surface active agents differ in the degree of their re-activity with iodine, it is logical to expect varying degrees of efficiency from the iodophors or similar products now being marketed. This study deals with the bactericidal effectiveness of two new iodine detergent-sanitizers.[2] These products are designated throughout this report as iodine liquid and iodine powder. The iodine liquid contains elemental iodine in a loose complex with certain nonionic surfactants, particularly the ethylene oxide condensates, which also act as a solubilizing medium. The iodine liquid also contains an acid, generally phosphoric, which stabilizes the iodine and enhances its germicidal properties.

The iodide powder does not contain elemental iodine; it contains iodine-iodate salts in combination with certain acids that react when dissolved to release free iodine and also similar nonionic surfactants to act as a solubilizing medium or as a carrier for the iodine.

Experimental Methods

This study was planned to test the bactericidal properties of iodine liquid and iodine powder and to determine the effectiveness of calcium hypochlorite as a control material against the following organisms: *Pseudomonas aeruginosa* (A.T.C.C. No 10197), *Micrococcus pyogenes* var. *aureus* (A.T.C.C. No. 6538; F.D.A. No. 209), *Escherichia coli* (resistance equal to U.S.P.H.S. No. 198 strain), *Salmonella typhosa* (Hopkins strain F.D.A. 26; A.T.C.C. No. 6539) and *Bacillus cereus*. The iodine detergent sanitizers were tested at 12.5 ppm. and 25 ppm. available iodine concentration, whereas calcium hypochlorite was tested at 100 ppm. of available chlorine. The effect of hard water, whole milk, and dishwash soil on bactericidal efficiency also was investigated.

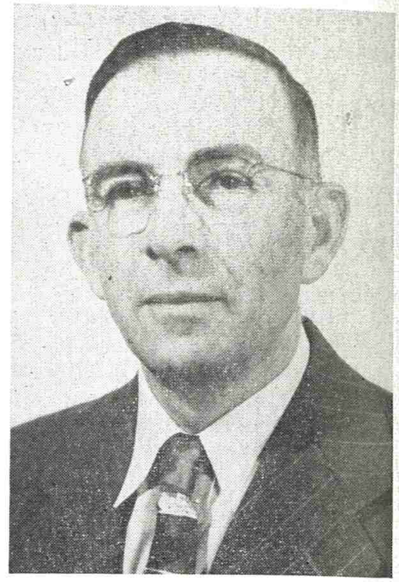
Bactericidal test procedure. A modification of the Weber and Black(6) method was used. The chief modifications introduced into the Weber and Black method were (a) substitution of vials (16 mm. mouth dia.) for test tubes to hold the germicidal mixture, and (b) agitation of the germicidal mixture with a glass-covered metal rod (15 mm. x 1.5 mm.), rotated by a magnetic stirrer submerged in the constant temperature bath, in place of swirling the test tubes. Percentage kill was not determined beyond 99.9999 per cent.

Determining iodine in test solution. In this study, iodine solutions of 25 and 50 ppm. (representing double-strength solutions required before mixing with the bacterial suspension) were checked by a colorimetric method before and immediately after the actual bacteriological test. Iodine in solution at very low concentration may be completely extracted with chloroform to yield a pink solution. The intensity of the color varies directly with the iodine concentration, determined with a Beckman Model B spectrophotometer. Iodate—iodide solution of known value served as standards for comparison. Iodine concentrations as low as 5 ppm. could be determined by the colorimetric method with a high degree of accuracy.

Determining hydrogen-ion concentration. The pH value of the various bactericidal solutions was determined with the Beckman, laboratory model G, pH meter, using a glass electrode, at 25° C.

Preparation of hard water. A stock solution of hard water (2000 ppm. $CaCO_3$) was prepared according to United States Navy specification 51D10.

Preparation of dishwash soil. The composition of the dishwash soil was as follows: butter 3 per cent,



Dr. W. S. Mueller is Associate professor of Dairy Industry at the University of Massachusetts, where he has been on the Experiment Station staff since 1931. A graduate of the University of Illinois, he received the M.S. degree from Rutgers University and the Ph.D. degree from the University of Massachusetts. Prior to his present position, he held the Edible Gelatin Manufacturers' Research Society of America fellowship at the University of Massachusetts. His numerous publications deal with gelatin, dairy products, antioxidants, nutritive value of cocoa and chocolate, quaternary ammonium germicides, and detergent-sanitizers.

[1]Contribution No. 988, Massachusetts Agricultural Experiment Station, University of Massachusetts, Amherst.

[2]"Idonyx" products supplied by the Onyx Oil and Chemical Co., Jersey City, N. J.

TABLE 1—AVERAGE CONCENTRATION OF IODINE AND CHLORINE IN GERMICIDAL TESTS

Product tested	Iodine powder (ppm. I)		Iodine liquid (ppm. I)		Ca hypochlorite (ppm. Cl)
Nominal concentration desired	12.5	25	12.5	25	100
Concentration as determined at beginning of test	12.6	25.1	12.5	25.1	100.1
Standard deviation	(±0.3)	(±0.7)	(±0.1)	(±0.2)	(±1.1)
Concentration as determined at end of test	12.5	24.9	12.3	24.9	99.7
Standard deviation	(±0.4)	(±0.6)	(±0.3)	(±0.4)	(±0.8)
Average	12.5	25.0	12.4	25.0	99.9

Note: Average time between beginning and end of germicidal test was 2 hrs. 20 min., with a maximum of 4 hrs, and a minimum of 1 hr. and 15 min.

lard 3 per cent, peanut butter 3 per cent, flour 3 per cent, dried egg yolk 3 per cent, evaporated milk 5 per cent, distilled water 80 per cent. The materials were blended in a Waring Blendor, homogenized (hand homogenizer), and then sterilized in an autoclave. The amount added to the test solutions was measured in percentage by volume.

Preparation of whole milk. One part of sterile evaporated whole milk was diluted with one part of sterile distilled water. The amount added to the test solutions was measured in percentage by volume.

PRESENTATION OF RESULTS

Although it was desirable to prepare the various bactericidal solutions at the exact strength selected, *e.g.* 12.5, 25.0, and 100 ppm., it was impractical to do so. Therefore, the values represent nominal concentrations. Table 1 gives the average concentration of iodine and chlorine at the beginning and end of the germicidal tests and also the standard deviation from the mean. The germicidal solutions were stored in glass-stoppered volumetric flasks while the bactericidal tests were made. It should be noted that the

TABLE 2—BACTERICIDAL EFFECTIVENESS OF IODINE DETERGENT SANITIZERS

Kind and concentration of product tested	Minimum time in seconds for 99.9999% kill: Dist. water	Hard water (500 ppm.)	1% Whole milk	1% Dishwash soil	1% Whole milk + hard water (500 ppm.)	1% Dishwash soil + hard water (500 ppm.)
Ps. aeruginosa 103,000,000 per ml.						
12.5 ppm. Iodine powder	15	15	60	15	----	----
12.5 ppm. Iodine liquid	15	15	60	30	----	----
25 ppm. Iodine powder	15	15	15	15	15	15
25 ppm. Iodine liquid	15	15	15	15	15	15
100 ppm. Ca hypochlorite	15	15	15	15	----	----
M. pyogenes var. *aureus* 104,000,000 per ml.						
12.5 ppm. Iodine powder	15	15	300	30	----	----
12.5 ppm. Iodine liquid	15	15	300	30	----	----
25 ppm. Iodine powder	15	15	30	15	30	15
25 ppm. Iodine liquid	15	15	30	15	30	15
100 ppm. Ca hypochlorite	15	15	30	15	----	----
E. coli 118,000,000 per ml.						
12.5 ppm. Iodine powder	15	15	15	15	----	----
12.5 ppm. Iodine liquid	15	15	15	15	----	----
25 ppm. Iodine powder	15	15	15	15	15	15
25 ppm. Iodine liquid	15	15	15	15	15	15
100 ppm. Ca hypochlorite	15	15	15	15	----	----
S. typhosa 99,000,000 per ml.						
12.5 ppm. Iodine powder	15	15	15	15	----	----
12.5 ppm. Iodine liquid	15	15	15	15	----	----
25 ppm. Iodine powder	15	15	15	15	15	15
25 ppm. Iodine liquid	15	15	15	15	15	15
100 ppm. Ca hypochlorite	15	15	15	15	----	----
B. cereus 88,000,000 per ml.						
12.5 ppm. Iodine powder	>15 min.	>15 min.	>15 min.	>15 min.	....	....
12.5 ppm. Iodine liquid	>15 min.	>15 min.	>15 min.	>15 min.	....	....
25 ppm. Iodine powder	>15 min.	>15 min.	>15 min.	>15 min.	>15 min.	>15 min.
25 ppm. Iodine liquid	>15 min.	>15 min.	>15 min.	>15 min.	>15 min.	>15 min.
100 ppm. Ca hypochlorite	>15 min.	>15 min.	>15 min.	>15 min.	....	....

TABLE 3—HYDROGEN-ION CONCENTRATION OF IODINE DETERGENT SANITIZER SOLUTIONS.[a]
(pH at 25° C.)

Kind and concentration of product tested[b]	Distilled water	Hard water (500 ppm.)	Whole milk 1%	Dishwash soil 1%	1% Whole milk + hard water (500 ppm.)	1% Dishwash soil + hard water (500 ppm.)
12.5 ppm. Iodine powder	3.42	3.43	5.13	3.78	......	......
12.5 ppm. Iodine liquid	3.27	3.28	4.33	3.41	......	......
25 ppm. Iodine powder	3.23	3.22	3.75	3.33	3.70	3.52
25 ppm. Iodine liquid	3.00	3.00	3.51	3.02	3.32	3.05
100 ppm. Ca hypochlorite	8.95	8.79	8.18	7.52	......	......

[a]Average for the five organisms in the germicidal tests.
[b]Concentration means parts per million of available iodine and chlorine.

solutions were relatively stable under the conditions of the test.

Bactericidal effectiveness against non-sporeformers. Calcium hypochlorite solution (100 ppm. available chlorine) was used as a standard for comparison because 50 ppm. available chlorine as hypochlorite is the minimum concentration permitted under the *Ordinance and Code Regulating Eating and Drinking Establishments* as recommended by the United States Public Health Service(7). In actual practice, hypochlorite solutions are usually prepared at a strength of 100 ppm. available chlorine and replenished when reduced to 50 ppm. available chlorine. In the comparison of the iodine detergent-sanitizers with hypochlorite, 99.9999 per cent kill of the test organisms was taken as the end point(5).

The data obtained were too extensive to be presented in their entirety. Each product was tested once by the modified method of Mueller(3) in a preliminary survey and twice by the Weber and Black method(6). The results are summarized in Table 2, and their interpretation is based on the U. S. Public Health Service recommendation(6) that effective germicides, regardless of type, proposed for food utensil sanitizing, when tested in recommended "use" concentration should produce approximately 100 per cent kill in not more than about 30 seconds when diluted in the water actually employed in sanitizing food utensils. It will be noted from Table 2 that the iodine powder and liquid were practically equal in bactericidal effectiveness. Calcium hypochlorite (100 ppm. available chlorine) produced 99.9999 per cent kill in not more than 30 seconds for all four nonsporeforming organisms, under all conditions of the test. Both iodine detergent-sanitizers at a concentration of 25 ppm. available iodine equalled calcium hypochlorite in effectiveness as a germicide against all four non-sporeforming organisms. This was true even in the presence of hard water, whole milk, and dishwash soil. Both iodine detergent-sanitizers at a concentration of 12.5 ppm. available iodine equalled calcium hypochlorite in effectiveness against *E. coli* and *S. typhosa* under all conditions of the test. However, against *Ps. aeruginosa* and *M. pyogenes* var. *aureus,* the effectiveness of 12.5 ppm. of available iodine equalled that of calcium hypochlorite only in distilled water, and was not equal to that of chlorine in the presence of whole milk and dishwash soil. Of the four non-sporeforming organisms tested against iodine, *M. pyogenes* var. *aureus* had the greatest resistance, followed by *Ps. aeruginosa.*

Bactericidal effectiveness against a sporeformer. Table 2 indicates that calcium hypochlorite and the iodine detergent-sanitizers were not very effective against *B. cereus* two-year spores for the concentrations of bactericide and contact times employed.

Hydrogen-ion concentration. The pH values obtained on suspension of each of the five test organisms (double concentration of approximately 200 million organisms per milliliter) were as follows:

Ps. aeruginosa	7.61
M. pyogenes var. *aureus*	7.60
E. coli	7.54
S. typhosa	7.40
B. cereus	7.70

Since the pH values of the suspensions of the various test organisms did not differ greatly, the pH values of the various test solutions prepared can be reported as average values in terms of hydrogen-ion concentration for the five organisms tested (table 3).

CONCLUSIONS

Iodine liquid and iodine powder detergent-sanitizer products had equally effective bactericidal properties.

The iodine detergent-sanitizers at 25 ppm. of available iodine compared favorably with 100 ppm. of available chlorine in killing *E. coli, S. typhosa, M. pyogenes* var. *aureus, Ps. aeruginosa* in the presence of hard water (500 ppm. $CaCO_3$), one per cent whole milk, and one per cent dishwash soil.

At 12.5 ppm. of available iodine, the iodine detergent-sanitizers compared favorably with 100 ppm. of available chlorine in killing *E. coli* and *S. typhosa,* in the presence of hard water (500 ppm. $CaCO_3$), one per cent whole milk, and one per cent dishwash soil.

Available iodine at 12.5 ppm. compared favorably with 100 ppm. of available chlorine in killing *Ps. aeruginosa* and *M. pyogenes* var. *aureus* when tested in distilled water and in hard water. However, 12.5 ppm. of available iodine was not equal to 100 ppm. of available chlorine in killing *Ps. aeruginosa* and *M. pyogenes* var. *aureus* when tested in the presence of whole milk and dishwash soil.

According to these findings, the iodine detergent-sanitizers can be recommended for sanitizing food utensils, if field tests substantiate results of the laboratory performance tests.

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DISHWASHING MACHINE STANDARDS FROM A MANUFACTURER'S VIEWPOINT[1]

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Mr. G. B. Fox has been closely related with the dishwashing machine business for the past twenty-five years. As manager of the Special Engineering Division, Hobart Manufacturing Co., he has been engaged in engineering, production and related sales work, and from 1932-1935 represented his company in London, England. Mr. Fox is a member of the board of Stouder Memorial Hospital and is active in the Kiwanis Club of Troy, Ohio.

Prior to 1944, there seemed to be no common meeting ground for representatives of the dishwashing machine industry and public health officials. When industry was considering a new model or models, or the redesign of old units, the major problem immediately became how wide a national acceptance can be obtained. When our problems were discussed with various public health officials, we seemed to always turn up with about as many answers as the number of health officials contacted.

In 1944, The National Sanitation Foundation (NSF), a non-profit group, with headquarters at the School of Public Health at the University of Michigan, was organized. The Foundation charter provides for a broad consideration of the problems of public health and environmental sanitation and charges the trustees with the obligation of approaching solutions through research and development.

Here at last, it was felt, was the answer to one of our major problems.

Very soon after NSF was founded, definite research programs were started; and one of the very first was the testing of commercial dishwashing machines. These research findings were published in bulletin form and were widely distributed. Research Bulletin No. 1 was published October 1, 1947, and contained a complete research study on the sliding-door, single-tank, stationary-rack, spray-type, dishwashing machines. Research Bulletin No. 2 was published August 1, 1949, and contained a study of a single-tank, spray-type, automatic rack-conveyor-type dishwashing machines, with final curtain rinse.

Research work is slow, concise, and factual. Therefore, even though a considerable amount of ground was covered in Bulletins No. 1 and No. 2, all phases of dishwasher testing has not been completed. However, in June of 1948, a dishwashing panel was formed. Health officials and industry were assembled at the same table for the purpose of thoroughly discussing and recommending certain procedures. These recommendations are contained in the Clinic Report publication published in July of 1948. This was the first time in the history of the dishwashing machine industry where people of national repute representing health officials and industry sat down at a conference table and discussed their mutual problems on a national basis. Not only were these problems discussed, but definite recommendations were formulated. These recommendations are contained in the NSF published Clinic Report IV, pages 53 to 70 inclusive.

This clinic and the research work previously done by the Foundation by no means completed the work. It was necessary that the multiple-tank, spray type, automatic rack type, machines with final curtain rinse be tested. When this work was finished, NSF published a single bulletin, containing in condensed form a summary of the findings and the further research being carried on at that time. This bulletin is the standard No. 3 as prepared by NSF and was published in May of 1953. All of the findings were of course based on actual research work. It is recognized that industry's part in NSF is not all there is to the problem of clean dishes, but it is pertinent to point out that industry is vitally interested in this tie-in with public health.

Description of Spray Type Machines

The "Spray-type Machine" is the type of unit which, at present, is produced in volume by the major manufacturers of dishwashing machines, and is the only type of machine on which research has been conducted by NSF. Since dishwashing machines are produced for the very small operation, as well as medium and very large operations, it would be well, at this point to break down these various types of spray-type machines into four well-defined groups, with a short description of each type:

Group 1.

This group consists of Small, Stationary-Rack, Door or Rolling-Hood-Type Machines. There are three sub-groups of this type of machine as follows:

Sub-Group (a)—This is a front door opening, under-counter or free standing unit. It is a small unit usually installed in front or back bars of taverns for glass washing, front or back bars of soda fountains for glass and mixed dishwashing, hospital diet kitchens, decentralized washing in small hospitals, or in small restaurants for mixed glass and dish washing, where the restaurant has a customer count of up to approximately 50 persons per meal. To permit ease of operation a unit of this type often is installed

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[1]Presented at the 41st Annual Meeting of the International Association of Milk and Food Sanitarians, Inc., Atlantic City, New Jersey, October 21-23, 1954.

at each station in a front or back bar of taverns or soda fountains.

Sub-Group (b)—These are revolving-hood, telescopic-hood, or sliding or rolling-door models. They are small machines which usually employ 16″ x 16″ or 18″ x 18″ racks. These units normally are installed in the same type of establishment as the unit described under *Sub-Group (a)*, except that larger models increase the capacities to the point where they will handle quantities of dishes for customer counts up to 125 persons per meal.

Sub-Group (c)—These are the most commonly used of all dishwashing machines and they probably include one-third of the units produced today. This type is the vertical, sliding-door unit, constructed for either straight-through or corner installation. It normally utilized a 20″ x 20″ rack. Since this is the most popular dishwashing machine used, it naturally was selected by NSF as the first type of unit on which basic research was to be conducted. This work was completed, and Research Bulletin No. 1 was published by NSF in October of 1947. This machine normally is installed for centralized mixed dish or glass washing in dish pantries, where the establishment has a customer count of up to 250 persons per meal.

GROUP NO. 2

The second group of machines are termed the Single-Tank, Automatic -Rack - Conveyor, Curtain-Rinse-type. This is produced in both small and medium-sized units, with recirculated pumped wash solution and final curtain rinse. Since this type of machine is second in popular demand, it was only natural that it was selected by NSF for the second research project on dishwashing machine testing. This research work was completed by NSF and Bulletin No. 2 was published in August of 1949.

These units normally are installed in dish pantries for centralized, mixed dish washing in medium-sized establishments. The smaller unit has a mixed dish capacity of approximately 300 to 400 persons per meal, and the medium-sized unit of from 400 to 600 persons per meal. Many times these units are used in very large establishments for the washing of glasses and silverware only, where a larger unit is utilized for the washing of the mixed dishes.

GROUP NO. 3

This third group of spray-type dishwashing machines is classed as the Multiple - Tank, Automatic - Rack-Conveyor Type, With Final Curtain Rinse. These machines are constructed with two or more units built in the same housing and are, therefore, high-capacity machines. They are constructed with a recirculated, pumped wash, a recirculated, pumped rinse, and a final hot water curtain rinse.

These multiple-tank units normally are installed in dish pantries for centralized washing in large restaurants, hotels, institutions, and industrial feeding operations. They usually are produced in three sizes, the smallest having a mixed dish capacity of 500 to 700 persons per meal, the next size suitable for approximately 700 to 900 persons per meal, and the largest size for approximately 1,000 to 2,000 persons per meal, dependent upon the installation and type of service. For this type of installation, glasses usually are washed in a separate machine.

GROUP NO. 4

This group is defined as the Multiple-Tank, Flat or Inclined-Dish, Conveyor-Type unit. These, of course, are large units and consist of two sub-groups:

Sub-Group (a)—This commonly is known as the flat bakelite or nylon belt machine, where the china lays flat on the conveyor. These machines usually consist of one or more recirculated, pumped wash sections, a recirculated, pumped rinse section, and a final curtain rinse.

These flat-type belt units normally are installed in the same type of establishment as those in Group No. 3. The mixed dish capacity at normal speeds is only approximately 600 to 900 persons per meal. As with the machines in Group No. 3, glasses and silverware are washed in a separate unit.

Sub-Group (b)—This sub-group is a relatively new addition to the dishwashing machine field. This is the inclined-dish, spray-type, conveyor unit, which might commonly be termed "Continuous Racking." It is a multiple-tank unit, through which passes a conveyor constructed with inclined wire loops or nylon pegs. The china is inclined at an angle on the conveyor at approximately the same angle as normally racked dishes. These units usually consists of a recirculated, pumped-water-scrapping section, a recirculated, pumped wash section, a recirculated, pumped-rinse section, and a final hot water curtain rinse.

These large, continuous-racking type machines are of high capacity and are normally installed in large restaurants, hotels, institutions, and industrial feeding operations. They normally are built in sizes suitable for handling the mixed dishes for service of from 700 to 3,000 persons per meal. As is true in these large-type machines, glasses normally are washed as a separate operation.

In this grouping of spray-type units, there is an absence of any mention of the "Push-Through, Single-Tank, Curtain-Type Unit." Research work was carried out by NSF on this type of unit quite sometime ago. Since acceptable results could not be obtained, it was decided at the NSF Clinic held in Ann Arbor in June of 1948 that this unit should no longer be produced. All major manufacturers, therefore, dropped this machine from their manufacturing schedules.

REQUIREMENTS FOR GOOD DISHWASHING OPERATION

The dishwashing layout must be well planned to handle the anticipated volume in an orderly manner. Many times the physical layout is directly affected by the space allocated. Every installation should be planned to properly care for the following basic operations:

1. *Soiled Dish Tables*—A sufficient soiled dish loading space should be allowed. A quick drain, full soiled dish table width, with removable strainer, should be fabricated immediately adjacent the dishwashing machine. This drain prevents the entrance of liquid soil into the dishwashing unit.

2. *Scrapping*—For the removal of unconsumed food, several methods of scrapping are employed:

a. Rubber scrapping block, with

waste can below for disposal of unconsumed food waste.

b. Water Scrapping. This type of scrapping breaks down into various methods:

(1) Flush off by means of warm water streams, utilizing a special shower head and insulated, self-closing squeeze valve. For this method, the china is placed in the dish rack and the rack located over a large strainer-equipped sink.

(2) Flush off by means of warm water streams, utilizing a special shower head and insulated, self-closing squeeze valve in combination with a food waste disposer. For this method, the china is placed in dish racks and the rack located over a large recess in the soiled dish table, under which is located an electrically-driven, food-waste disposer.

(3) "Salvajor" Method. This is a trade-name of a device which combines water scrapping and soil collection. The dishes are held under a stream of water of sufficient force to flush off gross soil, with a minimum of splashing. The water is recirculated, with fresh water added constantly for dilution purposes. The large particles of food soil are trapped by screens, through which the return water passes. The "Salvajor" is an independent unit, which is placed in the soiled dish table ahead of the dishwashing machine.

(4) Mechanical Scrapping. This method is by means of a spray-type washing unit with a power-driven, recirculating pump. The water is recirculated in the same manner as the wash compartment of a spray-type dishwashing machine. This unit usually utilizes for its replenishing detergent water supply, the spill-over water from the wash tank of the accompanying dishwashing machine. The pre-wash device is usually a separate unit and is used in conjunction with the standard, *automatic dishwashing machine*. The racks are usually automatically conveyed through the water scrapping unit, thence through the dishwashing machine. This method is generally accepted today as the most modern and efficient method in better installations.

3. *The Dishwashing Machine* — It is imperative that the establishment be carefully studied and the dishwashing machine adequately sized for the operation. Since the various types of dishwashing machines have been previously discussed, no further comment is necessary at this point; however, the necessity of ample hot water facilities should be considered.

The machine itself is provided with adequate heating means for the wash tank, or, in the case of multiple-tank machines, for all tanks employed. The fresh, hot water supply for the final rinse for the various types of dishwashing machines is always a problem and, too many times, is not given enough serious consideration. Since this hot water supply must come fom the regular building supply, and since this supply is normally maintained at a temperature lower than lethal temperatures, a booster heater or booster recovery system is usually required. Booster heaters or booster recovery systems now are available for gas, steam, or electric heat. It is important in any installation planning that the heating and plumbing engineers carefully size these booster heaters or booster recovery systems for the particular size of machine being installed. All major dishwashing machine manufacturers provide data concerning rinse water consumption by their respective models.

4. *Clean Dish Tables* — Clean dish tables of sufficient size should be provided, allowing ample space for air drying of the china prior to unloading. When dishes are washed and rinsed at lethal temperatures, air drying in well-ventilated dish pantries can be accomplished in 30 to 45 seconds. With this time as a known factor, the clean dish table can be sized accordingly to suit the particular machine.

5. *Miscellaneous Factors* — There are several other general factors which make for a good installation.

To prevent breakage and abuse, and to permit more rapid handling, rack returns of the sliding or roller type should be employed wherever practicable. Proper storage for the racks should also be provided during the down-time of the dishwashing operation. All dish pantries should be well ventilated, ceilings sound-proofed, if possible, and well lighted. To reduce the noise level of the dish tables, there is available an inexpensive paint-on type sound deadener available.

It is recommended by all dish machine manufacturers that a well designed detergent dispenser be installed on the recirculated, pumped-wash unit. There are several dispensers available from the detergent manufacturers which will closely control the detergent feed.

Since all dishwashing machines are marketed through kitchen equipment houses, the fabrication of soil and clean dish tables and other appurtenances, as well as installation, is, therefore, a part of the kitchen equipment house's function. All well-established, kitchen equipment houses employ capable kitchen engineers who specialize in planning good dish pantry layouts and operations. Specialty men work extremely close with these kitchen engineers.

As in all other food service units, it is realized that improvements must constantly be made in food machine products. No industry can stand still—one either goes forward or soon falls by the wayside. In recent years, too much stress has been placed on streamlining in some types of products. It certainly is not necessary to make a food machine appear as though it is going 60 miles per hour in a given direction. Rather than stress streamlining in our food machine design, the motto "MAKE IT EASY TO CLEAN AND EASY TO KEEP CLEAN" should be uppermost in the minds of our design engineers.

DETERGENT SANITIZERS

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CLEANING STAINLESS STEEL SANITARY LINES IN-PLACE[1]

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Cleaning-in-place (C.I.P.) procedures have been compared with dismantling and brushing techniques. Various times, temperatures, velocities and cleanser compositions were studied to determine the combination which was between that which would yield a satisfactory and that which would yield an unsatisfactory condition. Bacteriological and physical examination of C.I.P. lines cleaned at 150°F. or above for 20 min. indicate that C.I.P. procedures are as effective as, or better than dismantling and brush cleaning.

Until recently the method of cleaning stainless steel and other lines used in dairy plants was to dismantle and brush-clean them. Health departments and other regulatory bodies in the United States believed that brush cleaning was the only satisfactory method. However, World War II brought about a shortage of stainless steel lines, and glass lines were substituted. Since the glass line did not lend itself to dismantling without the probability of considerable breakage, a procedure was instituted whereby cleaning solution was recirculated through the line. Adoption of recirculation cleaning did not occur commercially until trials which indicated its adequacy were completed and then it was permitted only on a tentative basis by some regulatory agencies. As a result, the possibility of a new and better method for cleaning sanitary lines became apparent, and many studies were initiated in experiment stations and industrial plants. One such study was undertaken at Iowa State College. The purpose of the study reported herein was to determine the effects of velocity, time, temperature and types of cleaners on in-place cleaning. Data on hand cleaning also were obtained for the same lines, since it was reasoned that results obtained by recirculation cleaning should be evaluated in the light of those by hand cleaning.

Several workers have published papers concerning velocities, time, temperatures and types of cleaners that should be used for cleaning by recirculation. Holland *et al.* (5) suggest a minimum velocity of 5 ft./sec. through the largest pipe diameter yet state that velocities from 2 to 8.5 ft./sec. give satisfactory cleaning. Parker *et al.* (10) found velocities of 3.4 and 4.3 ft./sec. to give satisfactory results. The time of the recirculation period varies depending upon the type of lines being cleaned. Some workers recommend from 10-15 min. (1, 2, 3, 5, 8, 10). Temperatures used for recirculation cleaning also depend upon the type of line being cleaned. Low temperatures (120-150° F.) (5, 10) are used on most cold milk lines while higher temperatures (150-170° F.) (5, 10) are used for hot milk lines and HTST (High-Temperature, Short-Time) pasteurizers. Cleaners employed for cleaning by recirculation vary widely in their composition but most of them used contain an alkali source, a polyphosphate and a wetting agent. Recently the use of chelated caustics has come into the picture; these seem to do a satisfactory job of cleaning.

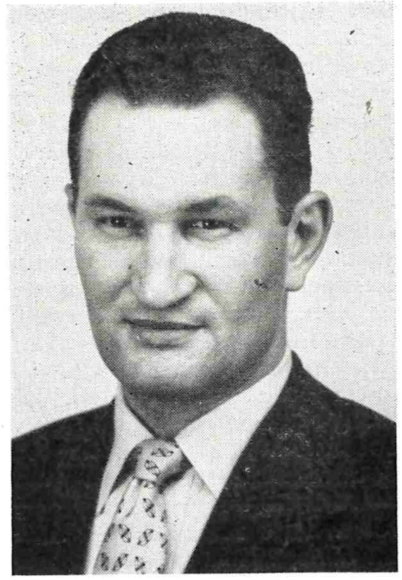
Experimental

Hand cleaned lines

Facilities in the Iowa State College market milk laboratory were used to make this study. Hand cleaning procedures consisted of dismantling, brush washing in a pipeline wash tank, sanitization and reassembling with new fiber gaskets. The reassembled lines were then examined for bacteriological and physical cleanliness. Bacteriological examination consisted of opening the union aseptically, removing the gasket with sterile forceps and swabbing the bevels and internal surfaces of the union.

After the gasket was removed it was placed in 20 ml. of a sterile 0.02 per cent (w/v) "azolectin" solution in a 4-oz. screw cap jar and shaken vigorously 50 times. Azolectin solution was used to neutralize the quaternary ammonium compound used in sanitization (7). Samples that were not plated within 0.5 hr. were placed in ice water and were so held until plated. One ml. aliquots were plated in duplicate on T.G.E. (tryptone, glucose, beef extract) agar for standard plate counts; 1-ml. portions were plated on V.R.B. (violet red bile) agar for coliform counts. All plates were incubated at 35.5° C. The former plates were counted after 48 hrs. while the latter were counted after 18 hrs.

To determine whether or not some organisms had penetrated the surface of the paper and fiber gaskets, a number of gaskets were plated subsequent to the washing technique. They were cut into small sections with sterile scissors and transferred aseptically, with the remaining 17 ml. of the azolectin suspension, to a sterile blendor cup. Ninety-nine ml. of sterile buffered distilled water were added and the gasket was blended (Waring blendor) for three minutes. A 12-ml. portion of the gasket suspension was divided among 3 petri dishes for standard plate counts



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and a like amount for the coliform counts. These plates were incubated, counted and the results recorded as the number of colonies per gasket.

The bevels of the lines were examined by the swab technique. The swab employed was a wooden applicator stick (2.75 in. long) with non-absorbent cotton twisted on it to a length of 0.75 in. Before use, the swabs were sterilized in 4 oz. screw cap jars at 250° F. in an autoclave for 20 min. During use, the swab was removed from the jar and wetted by placing in a sterile 13 x 80 mm. screw cap vial containing 5 ml. of sterile azolectin suspension. Excess azolectin suspension was removed by pressing the swab against the side of the vial. Both the male and female bevels were swabbed by running the swab over the surface 10 times, reversing the direction after 5 revolutions. After swabbing, the swab was returned to the vial of azolectin suspension by breaking the applicator stick at a point below that touched by the fingers. The vial was shaken vigorously 50 times and aliquot portions were plated. If samples were not plated within 0.5 hr. they were immersed in ice water until plated. One-ml. aliquots were plated in duplicate on T.G.E. agar and 1-ml. portions plated on V.R.B. agar for total and coliform counts, respectively. Plates were incubated, counted and counts recorded as the number of colonies per 8 sq. in.

The internal surfaces of the pipes were sampled by the swab technique after the gaskets were removed and the bevels swabbed. Approximately 8 sq. in. of surface was swabbed by running the swab over the inner surface 10 times, reversing the direction after 5 revolutions. The same plating, incubation and counting techniques were used as for the bevels. Results were recorded as the number of colonies per 8 sq. in.

Cleaned in-place lines

The circuit employed for cleaning by recirculation consisted of 85 ft. of 1.5 in. diameter and 20 ft. of 2 in. diameter, 18-8, beveled stainless steel line. All horizontal lines were sloped at 0.5 in. per 10 ft. Included in this system were raw, hot pasteurized, 136° F. and cold pasteurized milk lines. These lines were arranged so that with short connections they formed a complete system among themselves when the HTST pasteurizer was included. Short sections of 320-grit, 500-grit and electropolish lines were installed in the raw milk section while a 10-ft. section of 1.5 in. diameter pyrex glass line was installed in the cold pasteurized milk line.

To control the temperature of the recirculating fluid, an automatic solenoid steam valve[3] was employed. When the HTST pasteurizer was in the system a velocity of 2 ft./sec. was attained but when it was excluded a velocity of 7 ft./sec. was attained.

The cleaning problem in this plant was similar to that in most dairy plants of medium size, the only exception to this being the processing of fresh concentrated (3:1) milk.

The method of recirculation used was:

1. All lines not in the continuous system were disconnected and the continuous system and circulating unit connected.

2. The lines were flushed with water at 110-120° F. until the effluent was clear.

3. All valves were dismantled and brush-cleaned with detergent, rinsed, and replaced.

4. Acid solution was recirculated at 150° F. for 20 min.

5. The acid solution was rinsed from the system with water (90-120° F.).

6. Alkali solution was recirculated at 150° F. for 20 min.

7. Alkali was rinsed from the system with water (90-120° F.).

8. The lines were opened at drainage points, allowed to drain and dry. At 3, 7 and 10-day intervals, unions were opened, the lines were examined for physical cleanliness and swab tests were made.

9. Hot water sanitization (180° F. for 10 min.) was employed immediately after the alkali was rinsed from the lines until results obtained by swab tests, before and after sanitization, indicated that this treatment was not necessary.

10. Before use the next day a hypochlorite solution of 200 ppm. (inlet concentration) was passed through the system to sanitize the lines.

The time-temperature combination (150° F. for 20 min.) selected for the majority of the work was based upon preliminary data. The combination desired was one which was just about between that which would yield a satisfactory and that which would yield an unsatisfactory set of lines. During this preliminary phase of the work *Dilac* (H_3PO_4 plus corrosion inhibitor), was employed at the rate of 0.015 per cent (w/v) and cleaner A was used at the rate of 0.04 per cent active alkalinity (as Na_2O). The series of runs for the preliminary work consisted of two week recirculation periods at 130° F. for 10 and for 20 min., 140° F. for 10 min., 150° F. for 20 min. and 170° F. for 20 min.; all at 2 ft./sec.

After establishing the time-temperature combination (150° F. for 20 min.) each of three cleaners (A, B, and D) were used for a two week period at 2 ft./sec. in a system including the HTST pasteurizer and all the milk lines. Comparative runs were made at 7 ft./sec. with only the raw milk and cold pasteurized milk lines. Upon completion of the above series, one run of 4 days was made with cleaner A, during which swab tests were made 12 hours after cleaning rather than immediately after cleaning. In all other runs swab tests were made at 3, 7 and 10 day intervals immediately after cleaning.

Additional 4-day runs were made at 120° and 140° F. for 20 min. with cleaner A at 2 ft./sec. to determine whether or not these temperatures gave results equivalent to those obtained at 150° F. for 20 min. at 2 ft./sec.

Cleaner concentrations used after completion of the preliminary runs were 0.015 per cent (w/v) *Dilac* and 0.08 per cent active alkalinity for all alkali cleaners.

The cleaners used in this study had the following compositions:

Cleaner A

Trisodium phosphate ($Na_3PO_4 \cdot 12\ H_2O$)	60%
Sodium tripolyphosphate ($Na_5P_3O_{10}$)	38%
Santomerse No. 1	1%
Sterox	1%

[3]General Control Magnetic valve. K-15-C. 3/8 in. pipe size, 7/16 in. port size. 115 v, 60 cycle. No. 225 solenoid for 150 psi, steam with class H coil.

Cleaner B

Soda Ash (Na_2CO_3) 11.9%
Sodium metasilicate (Na_2SiO_3)........11.4%
Sodium tripolyphosphate ($Na_5P_3O_{10}$) 66.4%
Nonionic wetting agent 1.3%
Nacconol 1.0%

Cleaner C

Soda Ash (Na_2CO_3) 56%
Sodium metasilicate (Na_2SiO_3)........34%
Sodium tetraphosphate ($Na_6P_4O_{13}$)....9%
Nacconol 1.0%

Cleaner D

Chelated caustic....Composition not known

The examination procedures, plating methods, etc. were the same as those used for hand cleaning except that sterile buffered distilled water was used in place of the azolectin solution because no quaternary compounds were employed. In later work rubber gaskets were substituted for paper or fiber gaskets in the cleaned-in-place (C.I.P.) system; these were plated by the washing technique only.

Since the quality of the final product is the criterion for good cleaning procedures, the first bottle of each product from the filler was plated for total plate and coliform counts. This was done for both the hand cleaned and C.I.P. lines. However, when trouble was experienced with high coliform counts in the first bottle of product, sterile sampling cocks were installed in the cold pasteurized line. These cocks were placed approximately 20 ft. apart so that samples of the first product through the line could be taken, and plated for total plate and coliform counts.

RESULTS

Product quality

The following table is a resume of the results obtained by plating the first bottle of the products through hand cleaned (H.C.) lines.

At first glance these data would indicate that the product quality of the milk through H.C. lines was better than milk that passed through C.I.P. lines. This is not the case, however, for line samples taken through the sterile sampling cocks show that the high coliform counts of milk passed through C.I.P. lines came from sources beyond the recirculation system.

With this in mind, the data indicate that the product quality of milk put through C.I.P. lines is equal to that of milk put through hand cleaned lines.

C.I.P.-vs-H.C.

In Table 2 the results obtained by recirculation and hand cleaning are summarized. These results generally indicate that if the recirculation solution was above 150° F. for 20 min. the internal surfaces, bevels and gaskets of all lines were cleaned better by recirculation with cleaner A than they were by hand-cleaning procedures. At 140° F. for 10 min. the raw and cold pasteurized milk lines were cleaned satisfactorily by recirculation. However, when the recirculation solution was below 140° F. for 10 min. hand cleaning was more nearly satisfactory than recirculation cleaning. These are exceptions to the above statements. At higher temperatures (150°-170° F.) of recirculation, unsatisfactory conditions were encountered much less frequently with recirculation than with hand cleaning. At lower temperatures of recirculation (130-140° F.) there was no consistent advantage of recirculation as measured by bacteriological and physical examination. At these temperatures results secured by recirculation were erratic. A comparison of H.C. and C.I.P. on internal surfaces, bevels and gaskets indicates that there was a smaller difference between the condition of internal surfaces than there was between bevels and gaskets. The data obtained by swabbing the bevels of hand cleaned lines indicate that they were frequently missed when brush cleaned. The gaskets taken from hand cleaned lines frequently showed contamination that most probably came from highly contaminated bevels. H.C. lines at times showed evidence of high coliform contamination, whereas no coliform contamination was found with C.I.P. lines. The bevels and gaskets from C.I.P. lines were consistently satisfactory bacteriologically, although at times they were physically unsatisfactory.

The above comparisons were made from data obtained in runs with cleaner A. Data obtained from runs IV, V, VII and VIII, with either cleaner B or D, comparing H.C. and C.I.P. lead to the same conclusions.

Gaskets in H.C. lines were subjected to possible contamination from the handlers and uncleaned bevels while gaskets from C.I.P. lines were subjected to temperatures which for the most part were in excess of pasteurization exposure, which may account for their better condition.

Effect of recirculation time on cleaning efficiency

The time of recirculation at 130° F. (Table 2—XII, XIII) with cleaner A did not significantly affect the bacteriological results obtained on the internal surfaces and bevels of the raw or cold pasteurized milk lines. The 136° F and hot pasteurized milk lines were not cleaned

TABLE 1—DISTRIBUTION OF STANDARD PLATE AND COLIFORM COUNTS OF THE FIRST BOTTLE OF EACH PRODUCT RUN THROUGH H.C. AND C.I.P. LINES

Type of count	Cleaning method	Distribution ranges (counts/ml.)	Per cent of total no. of samples: Homogenized milk	cream line milk	Skim milk
Standard plate	C.I.P.[a]	<10,000	100.0	100.0	100.0
		<1,000	92.6	50.0	71.4
		<300	35.2	11.1	15.4
	Total samples		54	34	26
	H.C.[b]	<10,000	98.9	93.5	100.0
		<1,000	98.0	43.5	73.8
		<300	78.5	6.53	57.9
	Total samples		98	46	14
Coliform	C.I.P.[a]	>10	14.8	14.7	7.7
		1-10	27.8	30.6	34.6
		<1	59.3	56.0	57.7
	Total samples		54	34	26
	H.C.[b]	>10	1.02	6.52	5.27
		1-10	10.2	30.4	52.7
		<1	89.8	69.6	47.3
	Total samples		98	46	19

[a]Cleaned-in-place lines.
[b]Hand cleaned lines.

TABLE 2—PERCENTAGE OF COUNTS WHICH LIE IN THE DISTRIBUTION RANGE 1 TO 100 COLONIES, CALCULATED AS OF 8 SQ. IN. OF SURFACE

Run No.	I	II	III	IV	V	VI	VII	VIII
Temperature and Time	170-20	150-20	150-20	150-20	150-20	150-20	150-20	150-20
Velocity, ft./sec.	2	2	2	2	2	7	7	7
Cleaner	A	A	A	B	D	A	B	D
% Act. Alk. as Na_2O	0.04	0.04	0.08	0.08	0.08	0.08	0.08	0.08
Raw milk lines								
Per cent and total no. of counts: Surfaces	100 (9)	55.7 (9)	88.9 (9)	88.9 (9)	88.9 (9)	88.9 (9)	77.8 (9)	100 (9)
Bevels	89 (9)	44.5 (9)	75.0 (8)	88.9 (9)	66.7 (9)	100 (9)	88.9 (9)	88.9 (9)
Gaskets	37.5 (8)	22.2 (9)	50.0 (8)	33.3 (9)	11.1 (9)	33.3 (9)	37.5 (8)	44.5 (9)
136° F. milk lines								
Per cent and total no. of counts: Surfaces	100 (8)	66.7 (9)	85.8 (7)	a	100 (8)	a	a	a
Bevels	87.5 (8)	100 (9)	85.8 (7)	a	100 (8)	a	a	a
Gaskets	0.0 (8)	33.3 (9)	28.6 (8)	a	12.5 (8)	a	a	a
Hot pasteurized milk lines								
Per cent and total no. of counts: Surfaces	100 (9)	100 (9)	55.6 (9)	a	66.7 (9)	a	a	a
Bevels	89 (9)	55.6 (9)	66.7 (9)	a	88.9 (9)	a	a	a
Gaskets	33.3 (9)	66.7 (9)	33.3 (9)	a	0.0 (9)	a	a	a
Cold pasteurized milk lines								
Per cent and total no. of counts: Surfaces	87.5 (8)	100 (7)	100 (9)	100 (9)	100 (9)	62.5 (8)	87.5 (8)	77.8 (9)
Bevels	87.5 (8)	85.8 (7)	87.5 (9)	77.8 (9)	100 (9)	75.0 (8)	62.5 (8)	88.9 (9)
Gaskets	57.2 (7)	57.2 (7)	28.5 (7)	62.5 (8)	44.5 (9)	12.5 (8)	25.0 (8)	11.1 (9)

Run No.	IX	X	XI	XII	XIII	XIV	XV	XVI
Temperature and Time	150-20[b]	140-10	140-20[c]	130-20	130-10	130-10	120-20	Hand cleaned lines
Velocity, ft./sec.	2	2	2	2	2	7	2	
Cleaner	A	A	A	A	A	A	A	
% Act. Alk. as Na_2O	0.08	0.04	0.08	0.04	0.04	0.04	0.08	
Raw milk lines								
Per cent and total no. of counts: Surfaces	88.9 (9)	100 (9)	100 (9)	77.8 (9)	66.7 (9)	89.0 (9)	100 (9)	93.1 (44)
Bevels	77.8 (9)	88.9 (9)	100 (9)	44.5 (9)	55.6 (9)	66.7 (9)	66.7 (9)	36.4 (33)
Gaskets	75 (8)	12.5 (8)	22.2 (9)	33.3 (9)	42.8 (7)	33.4 (9)	0.0 (8)	0.0 (11)
136° F. milk lines								
Per cent and total no. of counts: Surfaces	77.8 (9)	a	a	66.7 (9)	a	a	a	80.5 (41)
Bevels	77.8 (9)	a	a	66.7 (9)	a	a	a	83.0 (41)
Gaskets	12.5 (8)	a	a	25.0 (8)	a	a	a	
Hot pasteurized milk lines								
Per cent and total no. of counts: Surfaces	33.3 (9)	a	a	22.5 (9)	a	a	a	82.5 (40)
Bevels	77.8 (9)	a	a	44.5 (9)	a	a	a	67.5 (40)
Gaskets	0.0 (8)	a	a	12.5 (8)	a	a	a	70 (10)
Cold pasteurized milk lines								
Per cent and total no. of counts: Surfaces	100 (9)	88.9 (9)	66.7 (9)	67.5 (8)	88.9 (9)	100 (8)	88.9 (9)	93.0 (43)
Bevels	100 (9)	88.9 (9)	100 (9)	67.5 (8)	100 (9)	100 (8)	100 (9)	76.7 (43)
Gaskets	100 (8)	44.5 (9)	55.6 (9)	14.3 (7)	37.5 (8)	71.5 (7)	0.0 (9)	25 (8)

[a]Samples not taken because lines not physically clean.
[b]Data taken 12 hrs. after cleaning.
[c]Four day runs.
( ) Total samples.

physically with either a 10 or 20-min. recirculation. The same physical results were obtained at 140° F. for 10 min. (Table 2–X) on the 136° F. and hot pasteurized milk lines as were obtained at 130° F. for 20 min. (Table 2–III) the hot milk lines as were obtained at 130° F. for 10 to 20 min. On the other hand, at 150° F. for 20 min. (Table 2–III) the hot milk lines and the pasteurizer were cleaned. These data indicate that temperature is an important or more important than time for proper cleaning.

Effect of recirculation temperature on cleaning efficiency

Data in Table 2–I, XII, XIII and XVI indicate that more nearly satisfactory results were obtained at the higher temperatures (170° F. for 20 min.) than at the lower temperatures (130° F. at 10 or 20 min.). Two possible reasons for this are, effect of high temperatures on microorganisms and effect of high temperatures on chemical activity during the cleaning process. The difference in the results obtained on the internal surfaces at the different temperatures were not as definite as the difference in results obtained on the bevels and gaskets. This suggests that one advantage of the higher temperature is the heat penetration.

Effect of velocities on raw and cold pasteurized milk lines

The data in Table 2–III through VIII obtained on the internal surfaces of the raw milk lines indicate that there was slight but not consistent difference in cleaning efficiency when solutions were recirculated at 2 or 7 ft./sec., respectively, with either cleaner A, B or D at 150° F. for 20 min. The data on the internal surfaces indicate no significant difference in cleaning efficiency.

There was no difference in bacteriological conditions of either bevels or gaskets for raw milk lines cleaned at 2 or 7 ft./sec. Bacteriological conditions were slightly more satisfactory at 2 ft./sec. than at 7 ft./sec. with the bevels and gaskets of the cold pasteurized milk lines. Velocity of recirculation should not affect the bacteriological condition of the bevels and gaskets, since they are not in the flow stream. This may explain the similarity of results on bevels and gaskets cleaned at 2 and 7 ft./sec.

These data also indicate that internal surfaces are more easily cleaned than bevels, and bevels are more easily cleaned than gaskets.

A velocity of 7 ft./sec. gave better results than 2 ft./sec. on the internal surfaces of raw and cold pasteurized milk lines at 130° F. for 10 min. (Table 2–XIII, XIV). At either velocity the bevels on the cold pasteurized milk lines were cleaned more effectively than those on the raw milk lines. A comparison between the results obtained when the above velocities were employed and those obtained by hand cleaning indicates that the internal surfaces are cleaned equally well, but that the bevels and gaskets are cleaned better by recirculation than hand cleaning.

Effect of cleaners on lines and H.T.S.T. pasteurizer

The bacteriological condition of the internal surfaces of the raw, 136° F., hot pasteurized and cold pasteurized milk lines were similar for cleaners A and D (Table 2–III, IV, V). Data obtained with cleaner B for the raw and cold pasteurized milk lines were similar to those obtained with cleaners A and D. The hot milk lines and the H.T.S.T. pasteurizer were not cleaned physically by cleaner B at the same concentration (0.08 per cent active alkalinity as Na_2O) as was effective with cleaners A and D; during additional studies with cleaner B these lines and the pasteurizer were excluded from the system.

Results obtained with the bevels and gaskets indicate no significant difference in cleaning efficiency among the cleaners used.

The H.T.S.T. pasteurizer was satisfactorily cleaned most of the time with cleaners A and D at 0.08 per cent active alkalinity (as Na_2O). When the pasteurizer was not cleaned satisfactorily a loose deposit of milk residue remained on the upper corner of the first raw milk plate in the regenerator section opposite the hot milk outlet from the holding tube. This deposit occurred most frequently on days when the amount of milk processed was greatest. Cleaner B in no instance cleaned the pasteurizer or the hot milk lines. Since this cleaner did not give satisfactory results with the pasteurizer and hot milk lines, these were excluded from the system when further work was done with this cleaner.

Effect of cleaner composition

Cleaner C was used only to study the effect of alkali cleaning without prior acid recirculation. Cleaners A, B and D were studied only with accompanying acid recirculation.

As stated previously, cleaners A and D gave a satisfactory physical condition in all the lines and H.T.S.T. pasteurizer but cleaner B cleaned only the cold milk lines. Cleaners A, B and D were used at the rate of 6, 3 and 0.6 lbs./60 gal. of water, respectively or 4,930, 2,460 and 494 ppm. respectively. Since the active alkalinity (0.08 per cent as Na_2O) was the same for all cleaners the amount and type of constituents may have caused the difference in cleaning efficiency. A solution of cleaner A had a higher polyphosphate concentration (1,870 ppm.) than a solution of cleaner B (775 ppm.) which may account for the better cleaning by A. Assuming the soil to be composed of calcium caseinate and calcium phosphate according to Brandsaeter *et. al.* (1), the polyphosphate would sequester and remove the calcium and allow the casein to be peptized and "dissolved" by the alkali. Cleaner B had a lower concentration of polyphosphate (775 ppm.), perhaps too low to accomplish this same effect. Another explanation may be the different types of alkalies used in each cleaner; cleaner A contained Na_3PO_4, cleaner B, Na_2CO_3 and Na_2SiO_3 and D, NaOH. The calcium concentration required to precipitate $Ca_3(PO_4)_2$, $CaCO_3$ and $CaSiO_3$ and the amount of alkali present may affect the efficiency of cleaning. The effect of the concentration of calcium is shown in Table 3. The amount of calcium required to precipitate $CaSiO_3$ is much less than for $CaCO_3$ or $Ca_3(PO_4)_2$. This may explain why the milk residues were not removed with cleaner B which contained Na_2CO_3 and Na_2SiO_3; whereas, cleaners A and D which contained only NaOH and Na_3PO_4 did remove them. Thus, the polyphosphate concentration of cleaner A (1,870 ppm.) may have been high enough to sequester the calcium in the water and in the milk residue while the polyphosphate concentration of cleaner B (775 ppm.) may not have been high enough to sequester all the calcium.

Cleaner D, a chelated caustic, may act in the same manner as A but the bonding of the calcium would be different.

Other studies made

Data obtained from the lines of different degree of polish indicated no difference in cleaning efficiency with difference in finish.

Comparison of the data from glass and stainless steel lines indicated that there was no significant difference in the bacteriological condition when cleaned in the same system.

A study also was made to determine the cleaning efficieny of the various cleaners without the use of acid. Cleaners A, B and C were used in 6 runs, 3 of which were made at 130° F. for 20 min. and the other 3 at 155° F. for 20 min. The same recirculating procedure was used as mentioned previously except that no acid was circulated prior to the alkali recirculation. The bacteriological data indicate that cleaners A and B used at 155° F. for 20 min. gave more nearly satisfactory results than when used at 130° F. for 20 min. Cleaner C was not studied bacteriologically because a water stone build-up occurred in 2 days. Cleaners A and B permitted water stone formation in 10 and 5 days, respectively. This water stone formation may be explained on the basis of the calcium concentration as mentioned previously. The main source of calcium in this instance came from the 17 g.p.g. water used for recirculation fluid.

The data obtained from lines held twelve hours after cleaning before swab tests were made indicate that the cold milk lines were satisfactory while the hot milk lines were unsatisfactory (Table 2–II, IX) when compared to data obtained by sampling immediately after cleaning. Hot water sanitization was not used subsequent to acid and alkali circulation for only the efficiency of cleaning was to be measured.

Data obtained from lines cleaned by recirculation at low temperatures, 140 and 120° F. for 20 min., (Table 2–XI,XII) indicate that the internal surfaces of the cold milk lines were satisfactory while the gaskets and bevels were unsatisfactory when compared to data from lines cleaned at 150° F. for 20 min. (Table 2–III).

DISCUSSION

Much of the information obtained from this study agrees substantially with that of other workers in the field. However, there are certain exceptions. The results from this study should be compared with results involving other stainless steel lines because data obtained with glass is limited.

The temperatures of recirculation (120-170° F.) used in these studies were essentially the same as those (130-170° F.) which had been used by other workers (5, 9, 10). Results obtained on hot milk lines at lower temperatures (120-140° F.) indicate that the bacteriological condition was poor, while at higher temperatures (150-170° F.) these same lines indicate a more nearly satisfactory bacteriological condition. Cold milk lines generally were satisfactory at high and low temperatures of recirculation.

Results obtained by other workers (5, 10) show that velocities did not affect the cleaning efficiency of pipe surfaces. They did not report data relative to bevels and gaskets.

Results on studies of velocities indicate that speeds of 2 and 7 ft./sec. gave equivalent cleaning on internal surfaces of cold milk lines when cleaned at 150° F. or above. However, a velocity of 7 ft./sec. gave better cleaning than 2 ft./sec. when a temperature of 130° F. for 10 min. was used. The data show that velocity is not related to the effectiveness of cleaning of the bevels and gaskets. They indicate that temperature is more important than velocity in the bacteriological cleanliness of bevels and gaskets.

Results obtained in these studies indicate that no build-up of microorganisms occurred during the two week recirculation period. This agrees with the finding of other workers, (6, 8, 9, 10).

There has been some question as to build-up of toxigenic micrococci occuring in C.I.P. lines, especially as regards gaskets. Observations made in these studies, based upon colony characteristics (color, size, shape, microscopic examination, etc.), indicate no such build-up. This is admittedly incomplete evidence of the absence of micrococci, but with few exceptions there were few colonies of any type. In cases in which a considerable number of colonies appeared they were characteristic of sporeformers rather than micrococci.

Cleaners used in these studies were similar to those used by other workers in the sense that most of them contained alkali, sequestering agent and wetting agents. Holland *et al.* (5) stated that cleaners with less than 10 per cent wetting agent did not give proper cleaning while Parker *et al.* (10) stated that those cleaners with less than 10 per cent wetting agent give good cleaning. Results obtained in this study agree with those of Parker *et al.* (10). The above workers also stated that higher concentrations of cleaners are required to clean hot milk lines than cold milk lines. Findings in this study indicate that at higher temperatures the chemical activity is greater and cleaning more efficient, for hot milk lines were cleaned with 0.08 per cent active alkalinity at 150-170° F. while at 130-140° F. they were not cleaned.

In the 1953 Milk Ordinance and Code (11) it is proposed that C.I.P. lines should have a standard plate count not greater than 100 colonies/8 sq. in. of milk contact surface in three out of four samples. If this proposed standard is to be applied to milk contact surfaces it should include the surfaces of bevels and gaskets as well as the surfaces of the pipe, for regardless of how they were assembled, some unions would tend to leak and allow milk to contact the surfaces of the bevels and gaskets. This then would be considered a portion of the milk contact surfaces.

A comparison of the results from hand cleaning made with the proposed standard indicates that the internal surfaces of the lines were satisfactory but that the majority of the bevels and gaskets were unsatisfactory. The hand cleaned lines were satisfactory judged from the usual sanitation standards in that they were physically clean and the milk passed through them met Grade A standards.

A direct comparison of results between C.I.P. (150° F. or higher

TABLE 3—RELATIONSHIP AMONG THE CONCENTRATION OF CALCIUM, THE TYPE OF WASHING COMPOUND AND THE FORMATION OF WATER STONE.

Alkali	Compound formed	Calcium concentration[a] (mols./liter)	Solubility products[a] (mols./liter)
Na_2SiO_3	$CaSiO_3$	9.05×10^{-6}	7.33×10^{-9}
Na_2CO_3	$CaCO_3$	1.20×10^{-4}	1.44×10^{-8}
Na_3PO_4	$Ca_3(PO_4)_2$	3.78×10^{-4}	3.43×10^{-18}

[a]Taken from chemical handbooks.

for 20 min.) and hand cleaned lines indicates that most of the internal surfaces and all of the bevels of the C.I.P. lines were more nearly satisfactory than the internal surfaces and bevels of hand cleaned lines. Gaskets from C.I.P. cold milk lines were more nearly satisfactory than H.C. lines. Regardless of the cleaning temperature the gaskets from hot milk lines, cleaned-in-place, were unsatisfactory when compared to gaskets from H.C. lines.

A comparison of the results from C.I.P. lines (150° F. or higher for 20 min.) with the proposed standard indicates that the majority (75 per cent or more) of the internal surfaces and bevels were satisfactory despite the fact that all the gaskets were unsatisfactory. At lower temperatures of recirculation (130-140° F.) the majority of the bevels and gaskets were unsatisfactory. Also at these lower temperatures the hot milk lines were not cleaned physically.

If hand and recirculating cleaning as used in these studies are to be judged in the light of the proposed standard of 100 colonies/8 sq. in., neither of the two cleaning methods appears to be fully satisfactory; indicating that the proposed standard may be too rigid. The reason for neither method being satisfactory was that the bevel and gasket surfaces generally exhibited a poorer bacteriological condition than the internal surfaces. Since the bevels and gaskets appear to be the limiting factor in both methods of cleaning it poses a question as to whether a bacteriological standard should be established for bevels and gaskets without considerably more study as to a logical number of organisms per 8 sq. in. Sufficient data have not been presented in this paper to warrant the proposal of a new standard.

SUMMARY AND CONCLUSIONS

The bacterial quality of the milk products passed through cleaned-in-place lines is equal to the quality of products passed through hand cleaned lines.

Higher temperatures in C.I.P. cleaning generally give better physical cleaning than lower temperatures in so far as hot milk surfaces are concerned.

Higher C.I.P. temperatures generally did not give better bacteriological cleaning than lower temperatures for surfaces of cold milk lines.

The internal surfaces of sanitary lines were cleaned more easily than either bevels or gaskets. This was true for both H.C. and C.I.P. lines.

Of the cleaners tested, which contained polyphosphates, cleaner A, which contained the highest concentration of polyphosphate in solution, gave the best physical cleanliness. Cleaner D, a chelated caustic, gave results similar to A.

Bacteriological results from C.I.P. lines (150° F. or higher for 20 min.) were consistently lower than those of H.C. lines and showed no coliform contamination; H.C. lines showed erratic results and spotty coliform contamination.

Microorganisms did not penetrate into the interior of the paper or fiber gaskets when used for a period up to 3 weeks in C.I.P. lines.

Velocities had no effect upon the cleanliness of bevels and gaskets at the temperatures employed. A velocity of 7 ft./sec. at 130° F. for 10 min. did show better results on internal surfaces of cold milk lines than a velocity of 2 ft./sec. at the same temperature.

The recirculation procedure used to collect the data in this paper is given in the experimental section.

Temperature in C.I.P. procedures has more effect upon cleaning efficiency than either time or velocity, when the recirculating time is 20 min. or longer.

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DAIRY PRODUCTS IMPROVEMENT

Continued from Page 143

designed for the production of high quality cream for manufacture yet it will give excellent milk for bottling. Even though the principal emphasis is on cream for manufacture the program in some areas must be co-ordinated with the sanitary control program for fluid milk.

THE NATIONAL STATUS OF BRUCELLOSIS[1]

ENOS J. PERRY
Extension Service, Rutgers University, New Brunswick, New Jersey

Enos J. Perry was graduated from Penn State in 1916 and from Columbia University in 1928. He served as county agricultural agent in his native Pennsylvania for several years before taking the position of dairy specialist at West Virginia University in 1920. Since July 1, 1923, he has been in charge of the dairy extension program at Rutgers University where special attention has been given to herd improvement by means of cooperative artificial breeding associations and dairy herd improvement associations. Another major project has been the educational program in behalf of herd health.

The stepped up brucellosis eradication program now under way through cooperation between the states and the federal government is expected to eliminate about 400,000 reactors in dairy herds by next July 1, 1955. This will nearly double the number of reactors eliminated in recent years. This is history in the making. The extra $30,000,000 which Congress provided in 1954 and 1955 is almost double that which was available previously. It will enable the farmers to get $25.00 indemnity for a grade animal instead of $9.00, and $50.00 for a purebred instead of $18.00. The major milk markets are tightening up their sanitation requirements – probably the chief reason why twice as many reactors were sent to slaughter in 1953 than was expected. The slogan today is "Wipe Out Brucellosis" because it has been demonstrated that elimination is possible. As early as July 1, 1942, North Carolina was declared a certified brucellosis free area, and New Hampshire and Maine have since qualified, and it is reported that all dairy cows in Oregon have been tested.

REVIEW OF PROGRESS

A brief review of some major facts relative to the brucellosis scourge may not be amiss. Brucellosis was formerly known as contagious abortion and it is well to remember this because it was the abortions that brought about the campaign to control the disease. The cattle owners asked for help. Testing was requested and supplied by New Jersey as early as February, 1927. Nationally speaking, very little in an organizational way was done before July, 1934, when Congress provided funds for a cattle reduction program tied up with that year's severe drouth and big feed shortage. Since there were too many cattle the question was asked "Why not eliminate a lot of the diseased ones?" This gave the blood testing program great impetus. At that time about 10 percent of the country's cattle were infected. This figure has now been cut to about 3.5 per cent. Eradication methods have been greatly improved over the years and we now have good sound procedures that can be used with assurance. The standard blood test is the basic factor in brucellosis eradication. It is the only means available for telling whether or not an animal is affected with the disease. With reference to the great boons, calfhood vaccination and the ring test, I quote Dr. J. R. Porteus, Federal Inspector from New Jersey:

"The strong aid that we now have in eradicating brucellosis is calfhood vaccination. It is not a substitute for the blood test and it is not a guarantee that the animal vaccinated cannot become infected. In fact if there were no brucellosis there would be no need to vaccinate. It produces a lot of resistance to infection. The ring test is for testing on the herd basis. When herds are found negative in 2 or 3 successive milk ring tests they could be considered brucellosis free in the majority of cases, thus making it unnecessary to run more expensive blood tests in many instances. While used differently in various states, it is a screening process which saves time and expense. It is a partial but not a complete substitute for the blood test which must continue to be used on all herds where infection is present or where each animal is to be tested."

In conjunction with the ring test the Federal Department of Agriculture recommends minimum standards for a certified herd. Such a herd should pass three milk ring tests with not less than 90 days between each and this should be followed by a clean blood test. For a certified area, all the cattle must pass two milk tests at least 6 months apart, together with a blood test of any herds not included in the milk test. The number of reactors must not be more than 1 per cent of the cattle and the number of herds infected must not exceed 5 per cent.

Thus the measure of our progress is partially the number of blood tests made each year, partially the number of the milk ring tests that are run, and partially the number of calf vaccinations made. The actual measure is the number of brucellosis free herds and areas that we have, and this standard is attained by testing all of the herds in a given area and getting rid of all infected stock.

FIGURES REFLECTING PROGRESS

In the United States during the fiscal year ending June 30, 1954, there were 9,002,109 blood tests run and the indicated rate of infection was 2.6 per cent as compared with 7,750,000 tests and an infection rate of 3.4 per cent for the preceding year – an increase of 16 per cent in blood tests and a drop of

[1]Presented at the 41st Annual Meeting of the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC., Atlantic City, New Jersey, October 21-23, 1954.

23 per cent in rate of infection. Calf vaccinations rose from 3,688,-149 to 3,999,101 in a year. The cattle represented in the milk ring tests increased from 12,000,000 in the year ending June 30, 1953, to 16,633,034 for the last fiscal year — a rise of 38 per cent.

FACTORS AFFECTING PROGRESS

Thankful as we are for this progress to date, we are still challenged and obstacles remain to be surmounted — more in some areas than in others. The blood tests conducted in the last fiscal year revealed that the per cent of infected herds ranged all the way from a low of 1.9 for a New England state to 31.5 per cent for one of the north central states. The per cent of reactors ranged from a low of 0.3 per cent for that same northeastern state to a high of 10.3 per cent for a southern state. Progress in brucellosis eradication is greatly affected by the market demands for high quality, healthy cattle and cattle products, and the amount of funds and number of personnel available to carry out control programs.

The New Jersey Department of Health has set the date of April 1, 1958, when all milk sold in the state must come from herds clean of brucellosis. Some milk dealers in the state have antedated this requirement. Certain of their producers by procrastinating cannot now avail themselves of the flexible plan B which permits marking and retention of reactors and the disposal of them at a convenient season after they are milked out, or fail to conceive, etc.

In certain areas the rise in the per cent of cases of undulant fever believed traceable to milk supplies has given boards of health cause for concern. A few years ago, 75 cases were reported toward the end of summer in Sussex County, New Jersey, a county noted both for its dairy herds and vacation areas for tourists from the cities where the only milk sold for years was pasteurized.

A CONTINUING EDUCATIONAL PROGRAM

The degree to which officials of the U. S. Department of Agriculture, State Departments of Agriculture, State Colleges of Agriculture, farmers organizations, public health authorities, veterinary associations, and other interested parties have joined hands in the crusade against brucellosis has been amazing and most heartening. The goal ahead can be most quickly attained by an accelerated educational program. In the forefront of the campaign, there have been and will continue to be the County Agents and Extension Specialists of each state along with the control officials of the State and the Federal Bureaus of Animal Industry. An example of cooperation in New Jersey between the Agricultural Extension Service and the Bureau of Animal Industry of New Jersey largely typifies what has been going on throughout the country for many years. On March 12th, 1952, Agricultural Agent Richard Lippincott of Trenton, New Jersey sent the following letter to all of the cattle owning farmers of Hamilton Township in Mercer County:

"Dear Sir:

"We are cooperating with the U. S. and New Jersey Departments of Agriculture in their plan to test the cattle of Hamilton Township for Brucellosis — a disease appearing in cattle which can cause severe economic losses. In addition, this disease can be transmitted from cattle to humans where it appears as what is commonly called undulant fever. It should be much to your advantage to know if you have any infected animals in your herd."

"Within a very short time, Dr. Edward Carbrey of Trenton will call at your farm for the purpose of collecting blood samples from your cattle for a brucellosis test. The service will cost you nothing and there are no restrictions attached. The results of the test are for your own information and use. Dr. Carbrey will be happy to answer any questions you might have about this program.

"In the past several years, neighboring counties have instituted this same program with most satisfactory results. We are now able to offer this service to you and trust that you will take full advantage of it."

Agricultural Agent Babbitt of Hunterdon County, New Jersey has used a slightly different method to promote area cleanups by townships. He calls a meeting of the area's dairy leaders who are already in the testing program. Armed with a list of untested herds, a discussion is held and the list of names is finally divided up among those present. Each leader contacts his group explaining the sound reasons for cooperating in order to have clean herds on every farm. New Jersey's one day Dairy Institute held in each of the dairy counties in February has repeatedly afforded some time to explain by discussion, moving pictures and exhibits the facts about the scourge of brucellosis and how it can be controlled.

There is need to get behind a bigger than ever program to finish the cleanup job. There is an abundance of effective ammunition on hand. Several examples may be cited. Losses to the livestock farmers due to brucellosis are estimated to exceed $65 million dollars a year; the milk yield of infected cows is reduced about 22 per cent and the calf crop about 40 per cent; one out of every 5 aborting cows will become sterile; in areas of large dairy cow population where much blood testing has been done the incidence of undulant fever is declining; and in the last 5 or 6 years the number of cases in up-state New York dropped from 250 to 45 cases in a year. The following quotation of Dr. A. K. Kuttler of the Animal Disease Eradication Branch, U. S. Department of Agriculture is particularly appropriate, "When we consider that almost 60 per cent of agricultural income is from livestock and that brucellosis could be eliminated from that stock at a cost of the losses sustained by the livestock industry in any one year, we need no further justification for the expenditures being made for this important project."

C. G. Bradt of the Animal Husbandry Department, Cornell University, recently completed a study of public livestock health programs in the country and issued an encouraging report. He found that all state Extension Services were conducting livestock health programs and that, . . . "brucellosis was the featured project upon which greatest emphasis was being placed. Relationships between extension agents and state and federal livestock sanitary officials were cordial. However, progress was not equal in all areas. Lack of funds, shortage of veterinarians, particularly in the range states, and insufficient extension personnel to do all the jobs waiting to be done were the chief retarding factors noted. The dairy states and dairy areas of the range states were observed as making the greatest advances in eradicating brucellosis. Due to a shortage of veterinarians, some states use trained laymen, working under veterinarians, to draw blood, vaccinate calves and run the milk ring test."

The Bradt report clearly indicates that great progress is being made under the country-wide eradication program. Supporting facts are the much lowered infection rates in most states, the wide acceptance of calfhood vaccination, the marked impetus given to testing as a result of adoption of special milk ordinances, the demands by certain milk companies, and last but not least, the attestations of dairy farmers that their cleaned up herds are producing heavier, calving more regularly and without any "abortion blowups" that formerly plagued many an untested herd.

Dr. Raymond Kerlin, in charge of brucellosis eradication in New Jersey reported that less than 4 per cent of the state's cattle are reacting on initial test. Regarding calf vaccination he stated, "The closer we stick to 6 months of age for vaccination the better it will be to get a maximum resistance. At Ideal Farms, Augusta, New Jersey, with its 1400 herd, the largest herd of registered Guernseys in America, many calves are vaccinated every month at or very near 6 months of age and there has not been a reactor for several years."

Extraordinary Leaflet

As a part of its educational program, the U. S. Department of Agriculture has just issued Leaflet No. 369, entitled "Wipe Out Brucellosis". It should be in the hands of every cattle owner who has not yet seen the light concerning this disease. It very briefly, yet effectively, explains what brucellosis is, what it does, and why a farmer can not afford to tolerate it in his dairy or beef herd. It does not mince words. One of the concluding paragraphs states, "The most vital contribution you can make toward complete eradication is to arouse interest in the problem among your neighbors. No matter how careful you are with your own herd, you are not safe as long as your neighbors continue to bring brucellosis into the community. No laws, regulations, or program plans can ever be effective unless owners themselves are interested in wiping out the disease. Campaigns on a community or regional basis can and will do the job. Your County Agent or State veterinarian will be glad to help. North Carolina, New Hampshire and Maine are now certified brucellosis free. That proves we can wipe out the disease."

In market milk areas time is running out for dairymen whose herds are not yet being blood tested. In the words of Dr. A. K. Kuttler "apparently there is more need to be reminded than to be converted". In no uncertain terms we must remind herd owners who say blood testing is alright but they won't test until they have to, that such an attitude is decidedly short sighted. For the sake of the health of their herds, the health of their families, the health of the town and city consumers, and as an aid in expanding the sale of their milk and beef for consumption and their cattle as foundation breeding stock, brucellosis must be wiped out.

NOTICE TO MEMBERS OF IAMFS

Please, notice letter by H. L. Templeton, Chairman, Membership Committee, on page XI, please, fill out questionaire (page XII) promptly and mail as directed.

FORTY-SECOND ANNUAL MEETING

HOTEL BON AIR — AUGUSTA, GEORGIA, OCTOBER 4 - 6, 1955

BACTERIAL COUNTS OF MILK AS AFFECTED BY INCONSPICUOUS DETERIORATION IN MILKING MACHINE TEAT-CUP LINERS[1]

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(Received for publication February 9, 1955)

Used teat-cup liners, appearing in reasonably good physical condition but having microscopic breakdown of the inside surfaces, were compared with new liners with respect to effect on the bacterial counts of milk. Under similar practical conditions, milk from units equipped with the used liners sometimes had considerably higher counts than milk from the new liner units. When the contamination level was low there was little consistent difference in milk counts.

One of the important factors influencing milking machine sanitation is the presence of inconspicuous cracking and erosion of the inside surfaces of rubber teat-cup liners (2,6). To what extent this condition influences the bacterial count of the milk has not been demonstrated. The factor of dilution during milking may modify the effect of seemingly high contamination of the liners. On the other hand, Jensen (5) has shown that the bacterial content of teat-cup liners may become great enough, as a result of inadequate sanitizing treatments, to considerably increase the bacterial count of the milk. To determine whether microscopic cracking of the liners is of particular influence on the bacterial count of milk, studies were made under practical milking conditions at the College dairy barn.

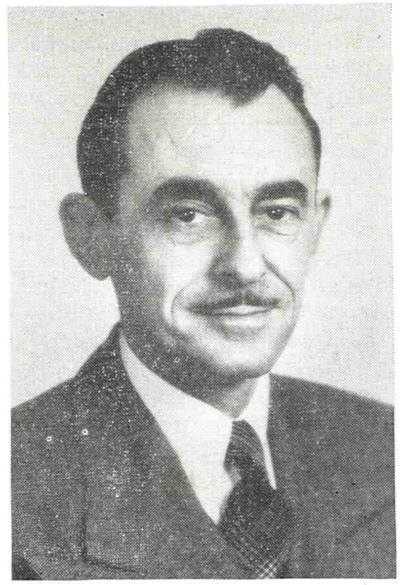
Methods

Four comparative trials were conducted at different periods of the year and for different lengths of time. In each trial, one milking machine unit was equipped with used teat-cup liners and another unit was fitted with new liners of the same type. The used liners employed were of two common brands and had been currently in service on grade A dairy farms. They appeared to be in reasonably good physical condition but examination with a wide-field microscope at 85X showed cracking and erosion of the inner surfaces. Both milking units were operated at the same time under the same conditions. They received similar treatment and were used in milking approximately the same number of cows daily.

Prior to each comparative trial, the used liners were thoroughly cleaned by soaking in organic acid solution[2], washing, boiling in 2 per cent lye solution and again washing. New liners were washed only. A thorough cleaning was also given to all other parts of the teat-cup assemblies, and to the pail head, pulsator, and stanchion air hose. The milk tubes on each unit were new. Before the initial milking in each trial all parts of the assemblies were steam sterilized. After the original sanitizing treatment, subsequent cleaning during the trials involved routine methods employed at the dairy barn. The usual practices of wiping udders and teats with warm chlorine solution before milking and of dipping teat-cups in chlorine solution between cows were followed.

Under the method of handling milk at the College dairy barn, it was not practical to accumulate the milk from each unit in two separate lots for final sampling. Accordingly, in each trial it was necessary to obtain milk samples directly from the buckets of the units during the 2 to 3-hour milking period. Furthermore, it seemed that such progressive sampling might yield information relative to the trend of contamination during the milking operation. Hand strippings were not included because of the possible effect on bacterial counts of extraneous material sometimes inadvertently introduced at this stage.

Milk samples were obtained from the milker buckets with sterilized pipettes and placed in sterilized containers. In three of the trials, each sample consisted of aliquots from three cows successively milked by the same unit. Five to seven such composite samples for each unit were obtained progressively during the milking period. In the fourth trial, samples were from individual cows. In these cases a preliminary sample was obtained aseptically from the udder to serve as an index of the general level of the bacterial content of the milk before it contacted the milking machine unit. This index sample consisted of several streams of milk from each quarter after about eight previous streams had been drawn into a strip cup and before the unit was applied. All samples were taken during the evening milking, iced immediately and, after the milking period, held in the laboratory refrigerator until morning. Part of each sample was then laboratory pasteurized and immediately cooled. Bacterial counts on both raw and pasteurized milk samples were made by the agar plate method



Dr. Claydon received the B.S. degree from the University of Saskatchewan and the M.S. and Ph.D. degrees from Iowa State College. He has served on the staff of the University of Arkansas, and subsequently spent two years with the Dairy Products Division, Arkansas State Board of Health. Dr. Claydon's present position is Associate Professor, Dairy Husbandry, Kansas State College.

[1]Contribution No. *231*, Department of Dairy Husbandry, Kansas Agricultural Experiment Station, Manhattan.

[2]Commercial preparation used as directed for removal of milkstone.

TABLE 1—SUMMARY OF BACTERIAL COUNTS ON MILK FROM MILKING MACHINES EQUIPPED WITH NEW VERSUS USED TEAT-CUP LINERS

		Log. av. plate count per ml[a]			
		Raw milk		Past. milk	
Trial	Period in operation	New liner unit	Used liner unit	New liner unit	Used liner unit
	Assembled flush-washing of liners. Lye solution storage.				
1	1st milking	1,410	3,540	....	....
	3 d.	1,260	3,220	....	....
	6 d.	3,420	2,800	250	350
	Disassembled brush-washing of liners. Dry storage.				
2	1st milking	8,430	18,010	2,260	5,870
	3 d.	7,270	6,400	1,910	2,320
	7 d.	12,650	41,660	5,990	5,930
	Disassembled brush-washing of liners. Dry storage.				
3	1st milking	1,290	990	120	85
	2 d.	770	800	....	....
	7 d.	1,880	2,030	130	500
	10 d.	1,610	1,500	130	65
	14 d.	980	950	75	120
	17 d.	1,550	1,560	140	100
	Assembled flush-washing of liners. Dry storage.				
4	1st milking	2,080	6,470	330	100
	2 d.	1,730	2,920	75	210
	4 d.	1,350	6,730	70	70
	8 d.	950	2,310	55	75
	11 d.	270	3,420	40	50
	15 d.	2,690	7,200	65	300
	19 d.	1,620	34,360	55	3,120

[a]Each value is the log av. of counts on 5 to 7 samples taken progressively during the milking period. In the first 3 trials, each sample was a composite from 3 cows. In the 4th trial, each sample was from a single cow.

using tryptone glucose extract agar.

Bacteriological examinations frequently were made of the liners before and after milking in an effort to correlate contamination at this source with counts of the milk. Teat-cups were removed from the claw for examination. The pulsation-vacuum method previously described (1) was used in most of the examinations. As work progressed, however, it appeared that this procedure applied to liners before milking might remove a sufficient number of bacteria to affect the counts on the milk subsequently obtained. Accordingly, in trial 4, bacteriological examination of liners before each milking was limited to an ordinary rinse count on one liner picked at random from each unit. It was considered that the method would remove a smaller proportion of the contamination than the more thorough pulsation-vacuum procedure and yet would serve as an index of the relative contamination in new and used liners.

Trials 1 and 4, in June and February, respectively, involved long tube machines. Routine cleaning consisted of flush-washing without dismantling the assemblies. In trial 1, lye solution rack storage of assemblies was employed between milkings. In trial 4 dry storage was used. Trials 2 and 3, in July and October, respectively, utilized short tube machines. In both these trials (2 and 3) dismantling and brush-washing of liners was employed after each milking. Liners then were stored dry.

RESULTS AND DISCUSSION

During the study, a total of 242 milk samples were obtained from the milking machine units, with one-half being from units equipped with used liners and the other half, obtained at the same time, from units having new liners. Bacterial counts on raw and pasteurized samples are summarized in Table 1.

Although differences between the bacterial counts of the raw milk from used liner units and new liner units often were negligible, they sometimes were of considerable magnitude, with counts on milk from units with used liners being the higher. In several instances the latter counts were higher than would seem desirable for milk sampled directly from the milker bucket. In trials 1 and 3 log. average counts were relatively low with no practical differences between units in either raw or pasteurized samples. In trial 2 the level of contamination was higher and differences between counts on raw milk from the new liner unit and the used liner unit were more

TABLE 2—BACTERIAL COUNTS ON MILK FROM MILKING MACHINES EQUIPPED WITH NEW VERSUS USED TEAT-CUP LINERS DURING MILKING OF THE FIRST 7 CONSECUTIVE COWS WITH EACH UNIT.
(Final period of trial 4)

Unit with new liners				Unit with used liners			
	Plate counts per ml.				Plate counts per ml.		
Cow No.	Milk directly from udder[a]	Milk from unit Raw	Milk from unit Past.	Cow No.	Milk directly from udder[a]	Milk from unit Raw	Milk from unit Past.
A1	1,300	3,200	180	B1	50	44,000	1,900
A2	150	1,500	60	B2	140	22,000	1,500
A3	2,100	1,200	40	B3	50	19,000	1,800
A4	900	240	30	B4	8,500	32,000	6,400
A5	620	2,400	40	B5	250	120,000[b]	9,000
A6	....	1,200	....	B6	350	32,000	....
A7	9,200	8,800	....	B7	2,400	25,000	....
Log Av.	1,300	1,620	55		350	34,360	3,120

[a]As an index for comparison several streams of milk were obtained asceptically from the 4 quarters of each cow after about the first 8 streams had been discarded.
[b]Visible extraneous material in milk.

marked and of practical importance in two of the three examination periods. However, there was little consistent difference in the counts on the pasteurized milk with samples from both units being relatively high. In trial 4 raw milk from the unit with used liners was consistently higher in count than milk from the other unit with differences tending to become greater toward the end of the trial. The last period of this trial showed the greatest differences found in the study. In this case the log. average count of the raw milk from the used liner unit was more than 20 times as high as that from the new liner unit. In the pasteurized samples there were no practical differences except in the last period where milk from the used liner unit was much higher in count than the milk from the new liner unit.

Data from the last period in trial 4 are given in more detail in Table 2. Since it was possible that high count milk from individual cows might be influencing the results, counts of aseptically drawn "index" samples obtained at the same time are shown for comparison. It is recognized that such counts may differ from counts on complete milkings. However, they serve as a measure of any unusual variation. Although there was considerable difference in the count of the milk directly from the udder of the various cows, the consistently higher counts on both the raw and pasteurized milk from the used liner unit could not be attributed to cows giving high count milk. It is significant that although these data were obtained at the end of the trial period and marked contamination had accumulated in the used liners, milk from the new liner unit which received the same treatment had a low bacterial count.

The relative contamination in used and new liners both before and after milking during trial 4 is shown in Table 3. Comparisons should not be made between the data obtained before and after milking since different examination procedures were used as described under "Methods". Pre-milking contamination probably is much greater than indicated by the method used. However, the striking differences between the amount of contamination in the new and used liners is evident. It is possible that the low counts obtained before milking on the eleventh day arose from a temporary change in clean-up personnel which may have resulted in more effective sanitizing of the liners at this period. The tendency for counts to increase as the trial progressed, was more marked in the used than in the new liners. The high counts obtained on the used liners after milking emphasize the sanitation problem involved.

TABLE 3—RELATIVE CONTAMINATION OF NEW AND USED LINERS BEFORE AND AFTER MILKING (TRIAL 4)

Period in operation	Bacterial count per liner			
	Before milking[a]		After milking[b]	
	New	Used	New	Used
1st milking	0[c]	0[c]	22,000	280,000
2 d.	170	49,000	2,450	400,000
4 d.	1,200	160,000	....	....
8 d.	980	490,000	....	....
11 d.	100	420	31,500	6,700,000
15 d.	1,000	180,000	4,200	1,300,000
19 d.	2,800	320,000	84,000	18,000,000

[a]An index value of relative contamination determined from a rinse count on one liner picked at random from each set and using 35 ml. of sterile water per liner. These counts should not be compared with those obtained after milking, when a different procedure was employed.

[b]Log. av. of counts on 4 separate liners. Pulsation-vacuum method using 35 ml. of sterile water per liner.

[c]Liners were thoroughly washed and steam sterilized in the laboratory before initial milking. For practical purposes counts were recorded as zero.

It was obvious during the study that a relatively high level of contamination in liners was necessary to give practical differences in the counts of the milk. When the pulsation-vacuum procedure was used for bacteriological examination it appeared that a count of less than 500,000 per liner before milking did not have a consistent practical effect on the count of the milk. This generally is in accord with the standard for milking machines suggested by Dahlberg (4) and is further supported by theoretical consideration of the dilution factor. Bacteriological examination of liners before milking removes a considerable proportion of the contamination and subsequent counts on the milk are probably lower than otherwise. When bacteriological examination was made on liners by the pulsation-vacuum procedure both before and after a milking period, the used liners usually increased markedly in bacterial count during milking. If the counts were unusually high at the start, however, they tended to remain about the same. Although several explanations might be offered to account for the frequent increases in counts in the used liners, they do not explain all cases and are mainly speculation. With the new liners, there was much less tendency for counts to increase during milking and often there was a definite decrease.

During none of the trials was there any noticable accumulation of "milkstone" film or obvious evidence of unclean conditions in the liners. At the end of the last trial where the cleaning treatment had involved flush-washing and dry storage, even microscopic examination revealed little accumulated material in either new or used liners.

Although there is a general relation between counts on the liners and counts on the milk, and it is closer under high levels of contamination, there are various complicating factors. Under conditions where used liners accumulate sufficient contamination to have definite influence on the count of the milk, new liners under the same conditions are likely to be much less affected. Where a higher level of liner contamination prevails than occurred in this study it may be that the effect of liner deterioration would be more marked. It would appear that a weekly treatment of liners, such as boiling in 2 per cent lye solution, would be a desirable precautionary measure to limit accumulation of bacteria in liners that might have inconspicuous deterioration of the surfaces.

SUMMARY

Studies were made of the effect of inconspicuous breakdown of the inside surfaces of milking machine teat-cup liners on the bacterial counts of milk. Under similar practical conditions of machine care and operation, milk from units equipped with used liners appearing in reasonably good physical condition but having microscopic breakdown, sometimes had considerably higher counts than milk from units with new liners having no microscopic deterioration. Frequently, the same conditions that resulted in considerable contamination in milk from the used liner units still produced good results with the new liner units. Relatively high contamination in the liners was necessary to cause a practical increase in the count of milk. Under conditions where the contamination level was relatively low, there was little consistent difference in milk counts. During each trial period, bacterial accumulation increased more rapidly and to a much higher level in used liners than in new liners.

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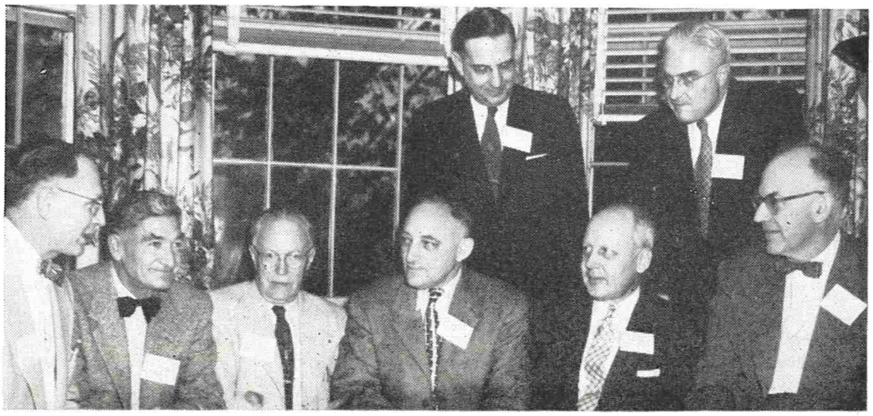
NEWS AND EVENTS

JOINT MEETING OF 3-A SANITARY STANDARDS COMMITTEES CONFERS ON DAIRY EQUIPMENT STANDARDS IN BETHESDA, MD., APRIL 26-28

A semi-annual Joint Meeting of the 3-A Sanitary Standards Committees those groups which formulate 3-A Sanitary Standards for Dairy Equipment — was held April 26 - 28 at the Kenwood Country Club in Bethesda, Md.

Approved by the over-all group were amendments to the existing 3-A Sanitary Standards for Fittings Used on Milk and Milk Plant Equipment and Used on Sanitary Lines Conducting Milk and Milk Products. The amended standards will be published in The Journal of Milk and Food Technology — official publication of International Association of Milk and Food Sanitarians — in the very near future, after which reprints may be obtained from IAMFS and the offices of any national dairy trade association.

Additionally, the conferees made substantial progress in the drafting of amendments to the existing 3-A Sanitary Standards for Farm Holding and/or Cooling Tanks; and in the development of 3-A Sanitary Standards for fillers and sealers of fibre milk containers, and for manually operated bulk milk dispensers. The agreement secured to these three standards was such that it is expected that the few remaining differences can be agreed upon by the principals of the 3-A Sanitary Standards Committees. Such agreements, which it is hoped may be secured before the next semi-annual joint meeting of the committees, will permit the publication of these three standards (for farm holding and/or cooling tanks; for fillers and sealers for fibre milk containers; and for bulk milk dispensers) in the Journal of Milk and Food Technology at an early date.



These are the eight men who comprise the 3-A Symbol Council — the new body which will supervise the use of the "3-A" symbol on dairy equipment which conforms to the 3-A voluntary sanitary standards. The eight came together for their first formal meeting April 25 at Kenwood Country Club in Bethesda, Md. Four members of the council are representatives of International Association of Milk and Food Sanitarians, two are representatives of users of equipment (appointed by Dairy Industry Committee), and two are representatives of fabricators of equipment (appointed by Dairy Industries Supply Association). Seated, left to right, are K. G. Weckel, M. D. Howlett, Jr., C. A. Abele, and Paul Corash, representatives of IAMFS; William A. Dean, Jr. and A. E. Nessler, representatives of users appointed by DIC; and standing are Paul K. Girton and George W. Putnam, representatives of fabricators appointed by DISA.

Interim reports were heard from task groups and special committees working on a tentative 3-A Suggested Method for C-I-P Lines for Farms, tentative 3-A Sanitary Standards for Non-coil Type Stainless Steel Batch Type Pasteurizers, tentative 3-A Sanitary Standards for Portable and Stationary Bucket or

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Pail Type Milking Machines, and tentative 3-A Sanitary Standards for Construction and Installation of HTST Pasteurizers. Discussion on these will be resumed at the next meeting.

All sections of the United States were represented at the sessions which were attended by nearly 100 persons, including city and state sanitarians, representatives of U.S. Public Health Service, Dairy Industry Committee's Sanitary Standards Subcommittee members (representing chiefly users of dairy equipment) and Dairy Industries Supply Association Technical Committee and Technical Task Committee members and Technical Task Committee invited observers (representing manufacturers of the equipment). Representatives of the Department of Navy, U. S. Department of Agriculture and the Veterans Administration also attended.

Social high-point of the meeting was a dinner April 27, at which the featured speaker was the Honorable Bradshaw Mintener, Assistant Secretary of the U. S. Department of Health, Education and Welfare. Other honored guests at the banquet included Senator Alexander Wiley of Wisconsin; Senator Edward Thye and Congressman August Andresen of Minnesota; and a number of high ranking armed forces, health, food procurement, and food service officers.

Dr. E. H. Parfitt, Chairman of the Joint Meeting of 3-A Sanitary Standards Committees, here shows to four other persons prominent in the sanitary standards program a gold wrist watch awarded him for ten years of service to the group. Left to right are H. L. Thomasson, Executive Secretary of International Association of Milk and Food Sanitarians; C. A. Abele, Chairman of IAMF's Committee on Sanitary Procedure; Dr. Parfitt, who is also Executive Secretary of the Evaporated Milk Association; M. H. Brightman, Executive Secretary of Dairy Industry Committee, which represents users and fabricators of dairy equipment; and John Faulkner, Chief of the Milk and Food Program, Division of Sanitary Engineering Services, U. S. Public Health Service. The presentation occurred at a late April meeting of the Committees in Bethesda, Md., as almost a hundred conferees from all parts of the country gathered to consider new and revised 3-A Sanitary Standards for particular items of dairy equipment. T. A. Burress, a Director and a member of the Technical Committee of Dairy Industries Supply Association was spokesman for the groups in the making of the presentation.

PARFITT AWARDED GOLD WATCH FOR 10 YEARS' ACTIVITY IN DAIRY EQUIPMENT STANDARDS

In recognition of his ten years service as Chairman of the Sanitary Standards Subcommittee of Dairy Industry Committee, in which period he has also presided at the Joint Meetings of the 3-A Sanitary Standards Committees, in which U. S. Public Health Service and International Association of Milk and Food Sanitarians equally participate with Dairy Industry Committee, Dr. E. H. Parfitt was presented with a gold wrist watch at a Joint Meeting held April 26-28 at Kenwood Country Club, Bethesda, Md.

The presentation came as a complete surprise to Dr. Parfitt, whose primary dairy industrial work is as Executive Secretary of Evaporated Milk Association.

In making the award for the joint group, T. A. Burress, The Heil Co., a director of Dairy Industries Supply Association, observed that Dr. Parfitt had exerted a steadying and constructive influence on the deliberations of the standards conferees. Frequently, Mr. Burress remarked, it had been from among original wide divergences of opinion involving equipment makers, equipment users and sanitarians that there had emerged under Dr. Parfitt's guidance solid basic 3-A Sanitary Standards concurred in by all interested segments of the industry and meriting the country-wide approval of regulatory men.

TALKS ON SANITATION GIVEN BY DR. MAXCY

Dr. R. Burt Maxcy, Associate Director of Public Health Research for The Diversey Corporation, Chicago, Illinois, has recently concluded a series of talks on sanitation methods in the dairy and food industries.

At a meeting of the Associated Illinois Milk Sanitarians in Chicago on May 10 he spoke on "Water Conditioning of Cleaning Compounds." In Providence, R. I., on April 28 Dr. Maxcy discussed "Quaternaries vs. Hypochlorites" before the Rhode Island Association of Dairy and Food Sanitarians. He talked on "Sterilizing Efficiency of Bottle Washers and Caustic Solutions" on March 7 to the Texas Bottled Water Association at Texas A. & M. College, College Station, Texas.

Prior to joining The Diversey Corporation in 1954, Dr. Maxcy was Technical Consultant for the George Meyer Company of Milwaukee, Wisconsin, manufacturers of bottling machinery. He received his B.S. degree from Mississippi State College and completed his post-graduate work at the University of Wisconsin. Dr. Maxcy held an assistant professorship in the Dairy Department of Kansas State College from 1950 to 1952. He is the author of several research papers on problems in the dairy and food industries.

In his position as Associate Director of Public Health Research, Dr. Maxcy will continue work on development and education in the field of public health sanitation.

HIGH U.S. OFFICIAL LAUDS GROUPS ON 3-A DAIRY EQUIPMENT STANDARDS

"Each of you can take justifiable pride, I believe, in the progress you have made together toward assuring that milk – perhaps the one food most necessary for proper health and growth – and the products derived from milk, are both as wholesome as modern technology can make them and as accessible to all as possible."

Thus spoke Bradshaw Mintener, Assistant U. S. Secretary of Health, Education and Welfare, before the semi-annual Joint Meeting of 3-A Sanitary Standards Committees, April 27, at Kenwood Country Club, Bethesda, Md.

These committees include representatives from International Association of Milk and Food Sanitarians, U. S. Public Health Service and Dairy Industries Committee.

For them, Mr. Mintener reviewed the work of the Department of Health, Education and Welfare in fields related to milk and milk products, its participation in such programs as the Interstate Milk Shippers Certification Program, and its cooperation with American Butter Institute in a general cream improvement program and related activities of the Food and Drug Administration. He paid tribute to Dairy Industries Supply Association and Milk Industry Foundation for assisting the U. S. Public Health Service with equipment and technical counsel in studies relating to Q-fever. He touched on recent research in the application of atomic radiation to food processes involving milk and dairy products.

Members of the Chocolate Milk Research Foundation study plans for national promotion at meeting in Chicago. Elaborate program of consumer education and information has been launched to encourage drinking of chocolate milk both as refreshing, tasteful beverage, as a nutritious healthful food. Seated, left to right, A. D. Pashkow, Chocolate Products Co.; William Hottinger, Bowey's Inc.; Harvey Hahm, Robert A. Johnston Co.; and Lowell Johnson, Bowey's Inc. Standing, left to right, are Fred Drucker, Krim-Ko Corp.; John W. Erickson, Chocolate Products Co.; Fred W. Drenk, Robert A. Johnston Co.; Donald Bowey, Bowey's Inc.; and Hunt Hamill, Krim-Ko Corporation. Erickson, Drenk, Bowey and Hamill are directors of the new industry Foundation.

CHOCOLATE MILK RESEARCH FOUNDATION

Huge pitchers of chocolate milk graced the conference table as top executives of four major chocolate ingredient manufacturers met in Chicago and launched plans for a national program to encourage more drinking of chocolate milk and chocolate dairy drink.

Directors of the newly formed Chocolate Milk Research Foundation – John W. Erickson, vice president, Chocolate Products Co., Chicago; Fred W. Drenk, manager of advertising and sales promotion, Robert A. Johnston Company, Milwaukee; Hunt Hamill, vice president, Krim-Ko Corp., Chicago; and Donald F. Bowey, president, Bowey's Inc., Chicago – disclosed plans for a widespread consumer program of education and information.

Formation of the industry foundation is the culmination of joint thinking by the executives of the four founding companies. Although all four are on a competitive basis, they felt all would benefit by joining together to inform the public of the nutritional and healthful values of chocolate milk, as well as its refreshing and tasteful appeal.

Research data and findings, the result of scientific studies at several universities, will be incorporated into information distributed by the foundation to milk dealers as well as to the consuming public. These research projects involve nutritional studies, health benefits, consumer attitudes and market surveys.

Special promotions, in which the Chocolate Milk Group will participate include the annual "June is Dairy Month", a special "September, Back to School" program, and a national "Chocolate Month" promotion in November.

During the summer months emphasis will be placed on the serving of chocolate milk or dairy chocolate at picnics and backyard barbecues. Special receipes using chocolate milk in desserts and baking are also being developed by the foundation's home economist.

GORDON W. MOLYNEUX PASSES ON

Gordon W. Molyneux, Senior Milk Sanitarian (Restaurants) in the Milk and Restaurant Sanitation Section of the Bureau of Environmental Sanitation, New York State Health Department died suddenly on May 5, 1955. Mr. Molyneux had recently undergone major arterial surgery and was apparently recovering satisfactorily when an internal hemorrhage developed. Mr. Molyneux was appointed to his position with the State Department of Health effective March 16, 1951. He had, just previous to this appointment, been Supervising Milk and Food Sanitarian with the City of Yonkers, New York, Department of Public Health. For 18 years he was Supervising Milk Inspector with the Westchester County, New York, Department of Health where he became well known as a leader in the field of milk sanitation. A veteran of World War I, he had since remained in milk and food work either as a public employee or in private industry.

He was a member of many professional organizations including the American Public Health Association, New York State Association of Milk Sanitarians, of which he was a Past President, the United States Association of Food and Drug Officials, the International Association of Milk and Food Sanitarians, Inc. and the Environmental Sanitation Section.

An outstanding worker in his field, he will be greatly missed by his many friends and associates.

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INDEX TO ADVERTISERS

QUESTIONNAIRE FOR INFORMATION ON VOCATIONAL DATA OF MEMBERSHIP

Dear IAMFS Member:

Your association and the Journal of Milk and Food Technology has steadily grown in stature over the years. Beginning with January 1954, the Journal was issued monthly. In order to continue this and to increase the size and scope, it is necessary to increase our advertising volume. Prospective advertisers have informed us that they need additional information relative to the professional activities, employment and other general data of our membership. We would therefore appreciate it if you would fill out the following questionnaire to the best of your ability and send it to H. L. Templeton, Chairman, Membership Committee, 6125 Florence Blvd., Omaha 11, Nebraska. The material you submit will be held completely confidential. In addition, we would appreciate having any comments you wish to make.

Very truly yours,
H. L. Templeton, Chairman
Membership Committee

1. *Which of the following occupational groups would you say you would fit? (You may answer more than one category.)*
   - Attorney ☐
   - Bacteriologist ☐
   - Chemist ☐
   - Consultant ☐
   - Educator ☐
   - Engineer (general) ☐
   - Farmer ☐
   - Food Processor ☐
   - Laboratory Technician ☐
   - Librarian ☐
   - Manufacturer of Food Equipment ☐
   - Manufacturer of Milk Equipment ☐
   - Milk Processor ☐
   - Physician ☐
   - Publisher ☐
   - Sanitarian ☐
   - Sanitary Engineer ☐
   - Student ☐
   - Veterinarian ☐
   - Other ☐
2. *How many of the following do you visit each year?*
   - Barber Shops ______
   - Butcher Shops ______
   - Dairy Farms ______
   - Food Plants (excl. milk) ______
   - Groceries ______
   - Hotels ______
   - Lodging Houses ______
   - Milk Plants ______
   - Nurseries ______
   - Restaurants ______
     - Drug Stores ______
     - Soda Fountains ______
   - Schools ______
   - Sewage Disposal Plants ______
   - Tourist Homes ______
   - Trailer Camps ______
   - Water Works ______
   - Other ______
3. *Milk Sanitation*
   - a. Approximately how many cows are there on the farms under your supervision? ______
   - b. Approximately how many milking machines are there on these farms? ______
   - c. How many farms are now under the bulk milk pickup system? ______
   - d. What is the total production of the farms? ______ plants? ______ under your supervision?
   - e. Are the plants filling bulk milk dispensers? ______ How many? ______
4. *By which of the following agencies are you employed?*
   - a. Government Agencies –
     - Federal ☐ State ☐
     - Civilian ☐ City ☐
     - Military ☐ County ☐
   - b. Educational Institutions –
     - University or College ☐
     - High School ☐
     - Federal, State, or City ☐
     - Industrial ☐
   - c. Laboratories –
     - Official agency ☐
     - Commercial or industrial ☐
     - Institutional ☐
   - d. Industry –
     - Milk and milk processing plants:
       - Receiving stations ☐
       - Evaporating plants ☐
       - Dry milk plants ☐
       - Ice cream plants ☐
       - Fluid milk plants ☐
       - Cheese plants ☐
       - Butter plants ☐
       - Butter ☐
   - e. Other ☐
5. *Automatic Vending Machines – How many of the following are under your jurisdiction?*
   - Carbonated and non-carbonated beverage ______
   - Coffee ______ Sandwich ______
   - Milk ______ Other Foods ______
   - Soup ______ Other ______
6. *For statistical information, please indicate size of the city or place in which you have your residence. (If a suburb, check size of city of which it is a suburb.)*
   - Over 1,000,000 (in the United States, *only* New York, Chicago, Philadelphia, Los Angeles, Detroit) ______
   - 100,000 to 1,000,000 ______
   - 25,000 to 100,000 ______
   - 2,500 to 25,000 ______
   - Under 2,500 (non-farm) ______
   - Farm ______
7. *Please write in the state in which you have your permanent residence* ______
8. *Please furnish the following information relative to the car you drive.*
   - Make ______ Year ______
   - Miles driven per year ______
9. *Do the advertisements in the Journal of Milk and Food Technology help you in your work?* Yes ☐ No ☐
10. Comments:

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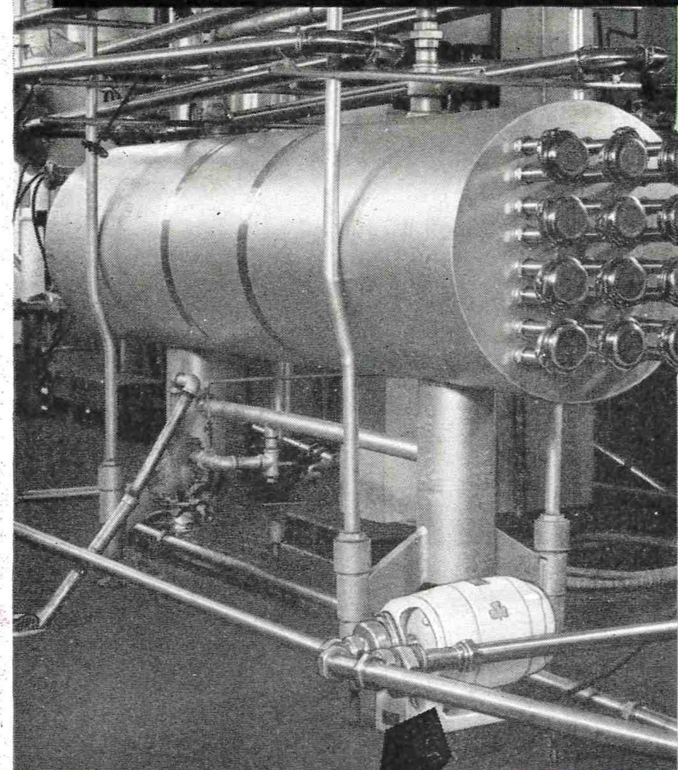
TRI-CLAMP *"Return Cups"* provide simple, fast disassembly for cleaning CHESTER-JENSEN HEATER

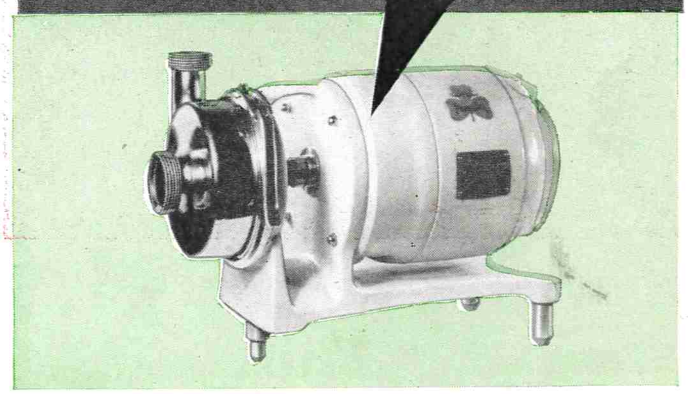


. . . can be used for "take-down" or cleaned-in-place service

• This Chester-Jensen Heater is unique in that it does not employ conventional methods of return flow. Instead, a stainless steel return cup takes the place of complex return covers or fitting assemblies. The return cup is held in place with a simple TRI-CLAMP toggle union.

The advantages of these Tri-Clover snap-action clamps are obvious—faster, simpler original assembly at lower cost—and speedy disassembly for cleaning, inspection, or replacement.

While this is a specialized application of the exclusive Tri-Clover TRI-CLAMP principle, the same basic advantages apply to the full line of TRI-CLAMP stainless steel ells, crosses, tees, laterals, etc., for use in either "take-down" or cleaned-in-place lines. When installed in "take-down" lines, the "easy on and off" feature means a tremendous savings in labor at wash-up time. When used in C-I-P lines, Tri-Clamp fittings offer important savings in both original cost and in maintenance expense.



Included on the Chester-Jensen heater system is the Tri-Clover *"Pump King,"* one of a complete line of Tri-Clover sanitary pumps — that years of service have proven will out-perform and out-last any other centrifugal pumps available to the dairy industry. These pumps feature: *Wide choice of seals — Design that actually exceeds 3A sanitary standards — Streamline heads for faster assembly and disassembly — Patented impeller for higher efficiency — Pump heads that can be turned 360 degrees to simplify installation* — and many other features which make it the most "copied" pump in the industry. *For full details, send for Pump Catalog 253.*

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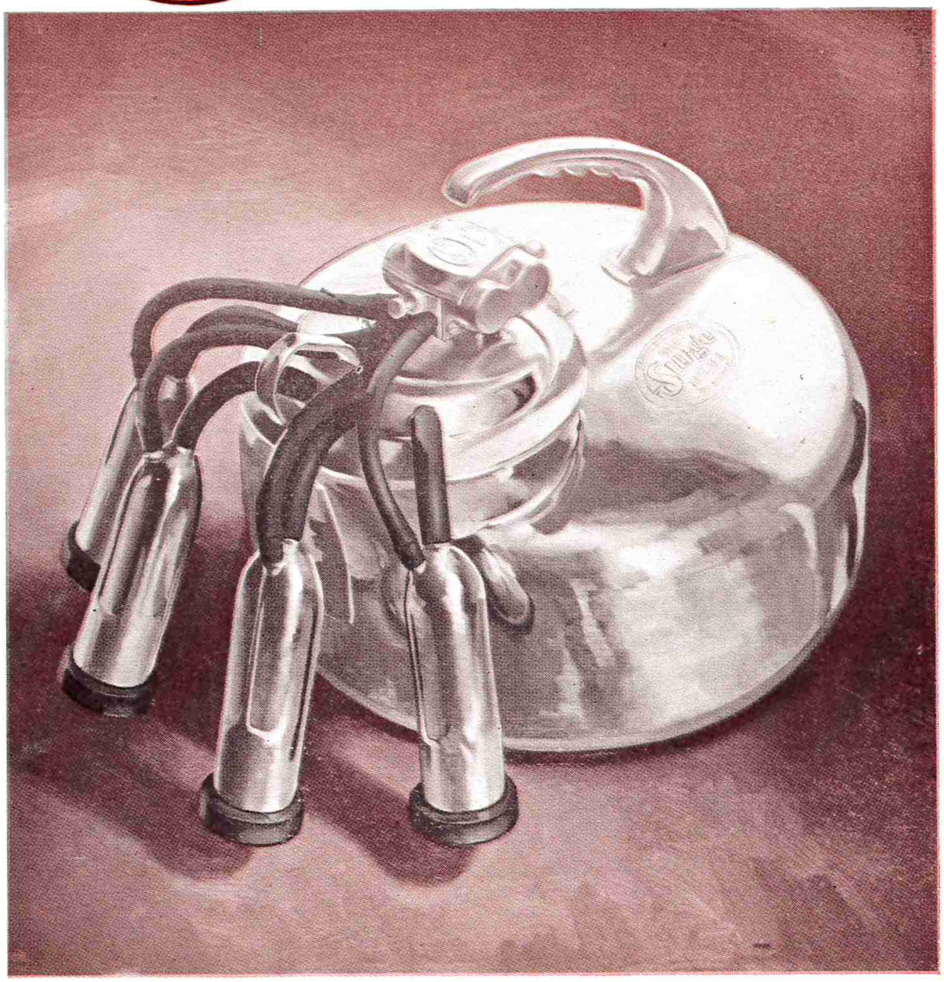

We are quite sure that leaving the machine on the cow after she is milked might cause mastitis.

Anything you can say or do to help get the machine off the cow at the right time will be appreciated.

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