DECEMBER, 1954
VOLUME 17 NO. 12

Journal of

MILK and FOOD TECHNOLOGY

Official Publication

International Association of Milk and Food Sanitarians, Inc.

HYAMINE makes odorless, non-irritating, chemically stable sanitizers

In meat packing plants the preferred way to clean meat cutting tables is to remove greasy residues first with an alkaline cleaner containing TRITON X-100, a Rohm & Haas non-ionic detergent. Then apply a HYAMINE sanitizer which reaches germ breeding places; maintains activity against organism growth.

The use of HYAMINE in commercial, hospital and public automatic laundries has grown steadily. HYAMINE is not irritating to the skin. It is absorbed and held by textile fibers, and provides residual antiseptic activity, helping to prevent ammonia dermatitis (diaper rash). The HYAMINE held by the fibers acts as a barrier against contamination—a safety factor *not* provided by chlorine or live steam alone.

HYAMINE and HYAMINE-TRITON cleaning compounds are preferred *for janitorial work* in hospitals, schools, and buildings of all types. Cleaning personnel like the quick-acting, dirt-removing action of TRITON detergent. They appreciate the odorless, non-irritating qualities of HYAMINE solutions. Institution and building managers profit from the versatility and fast, germ-killing cleaning activity of HYAMINE-TRITON sanitizers.

Good sanitation procedures and healthy cows are *both* necessary to produce good milk. Cleaning is easy and fast when detergent-sanitizers containing HYAMINE and TRITON are used. These compositions have consistently helped farmers produce low bacteria-count milk. Reports on field trials and on the wide-spread use of HYAMINE-TRITON detergent-sanitizers on dairy farms will be sent at your request.

Soda fountains, restaurants, bars and cafes find HYAMINE-formulated compounds effective and low-cost sanitation aids. Glassware, dishes and silver are protected against bacteria when sanitizers containing HYAMINE are added to the rinse water. Workers like sanitizing solutions based on HYAMINE because they are odorless and do not irritate the skin. HYAMINE germicides are effective bacteria killers over a wide range of water temperatures. They withstand long exposure to high temperatures without decomposing or volatilizing.

CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

HYAMINE *and* TRITON *are trademarks, Reg. U.S. Pat. Off. and in principal foreign countries.*

yes, there is a difference in

FILTER DISKS

Of course there's a difference in filter disks. Chances are it's not the difference you may *see* . . . like the thickness or the surface of the disk or even the color of the box.

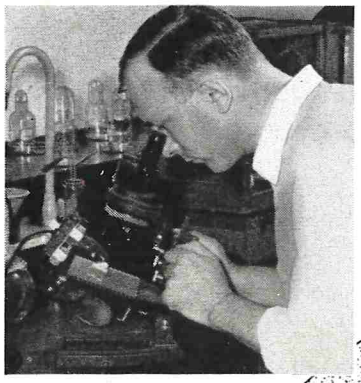
It's what you don't see that makes the *real* difference . . . the assurance of safe filtration that is the result of years of painstaking research and development by the Johnson & Johnson researchers.

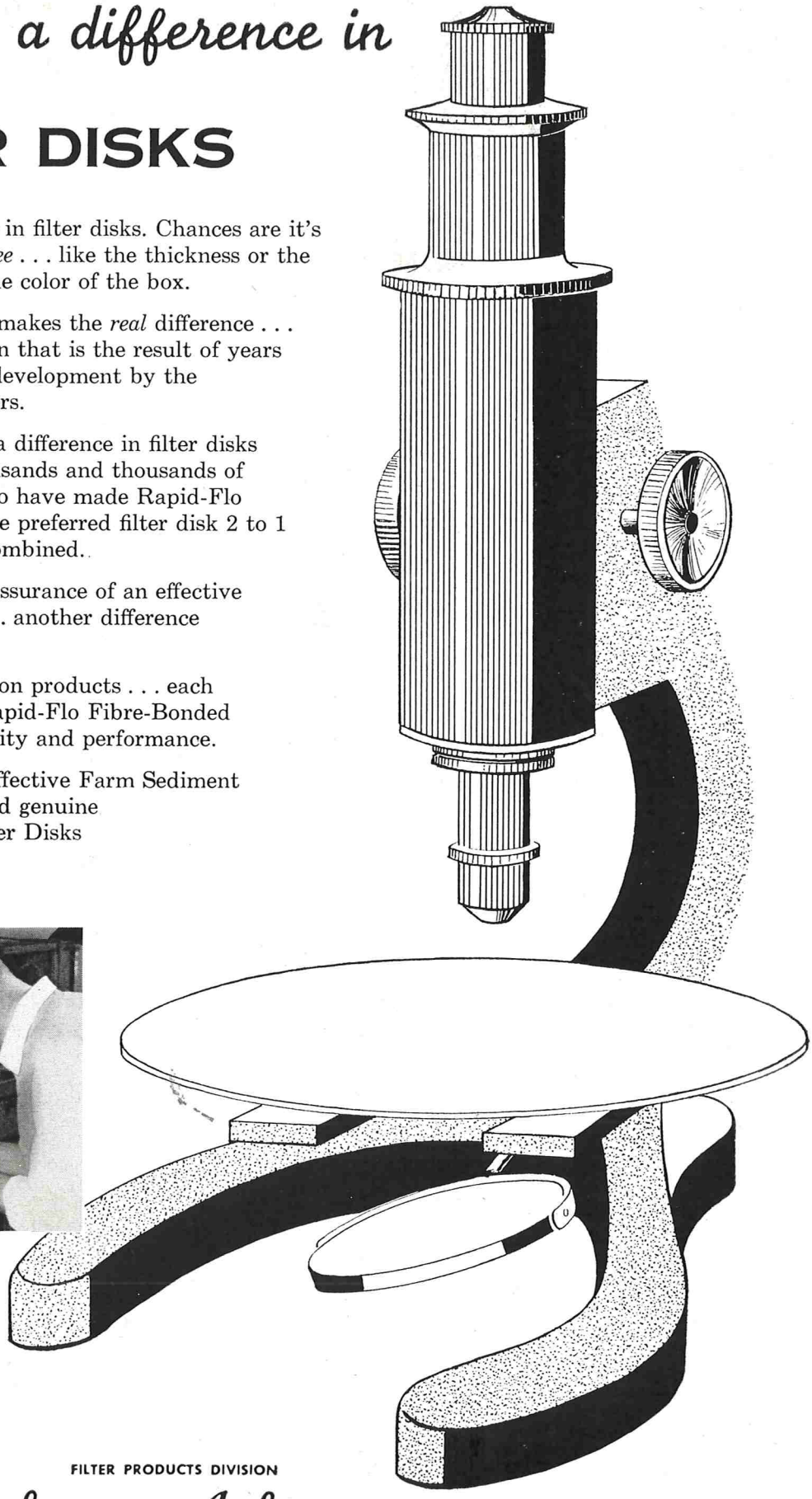
The final proof that there is a difference in filter disks is found on the farms of thousands and thousands of quality-minded dairymen who have made Rapid-Flo Fibre-Bonded Filter Disks the preferred filter disk 2 to 1 over the next three brands combined.

And Rapid-Flo safety gives assurance of an effective Farm Sediment Check-Up . . . another difference that you don't see.

Yes, like all Johnson & Johnson products . . . each outstanding in its field . . . Rapid-Flo Fibre-Bonded Filter Disks give proved quality and performance.

For safe milk filtration and effective Farm Sediment Check-Ups always recommend genuine Fibre-Bonded Rapid-Flo Filter Disks





FILTER PRODUCTS DIVISION

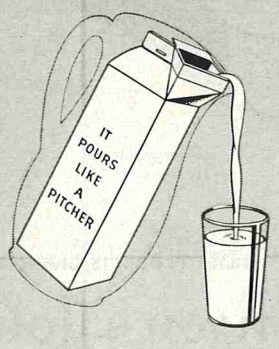
Johnson & Johnson

4949 WEST 65th STREET CHICAGO 38, ILLINOIS

Leading paper milk carton for 7 consecutive years!

... and —

WAT PURE



© Pure-Pak
® EX-CELL-O CORP. DETROIT, MICH.

YOUR PERSONAL MILK CONTAINER

CH-PAK in '55!

Sanitation in milking . . .

AND THE U. S. PUBLIC HEALTH SERVICE STANDARDS

STANDARDS set by the U.S. Public Health Service in 1939 were calculated to improve the quality of milk produced on America's dairy farms. If generally adopted, it was believed that dairymen and dairy equipment manufacturers who adhered to these standards would eliminate most of the common hazards to good sanitation.

In section 7 of this Milk Ordinance and Code, the standards for sanitary *construction* of milking equipment were defined. Here were *basic* standards. Without such standards, later efforts to improve sanitation would be for the most part ineffective.

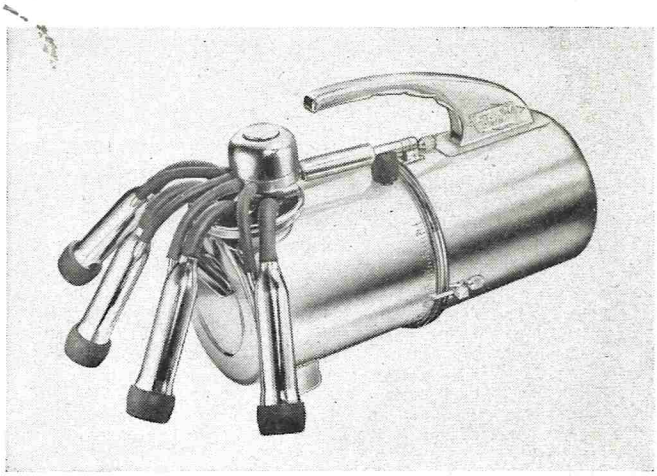
In creating a new suspended-type milker, our Rite-Way designers discussed the sanitation features of their new design with U.S. Public Health Service sanitation consultants. Our goal was to make sanitation *practical*. We reasoned that a genuinely sanitary milker would be well worth any possible extra costs incurred in its manufacture. Rite-Way carefully met every condition of section 7 of the Code.

Two design features were considered to be of primary importance.

(1) the vacuum line and pulsator should be separated as far as possible from the milk line. It was recognized that the cleanest vacuum lines would be those most difficult for milk to enter under average farm operating conditions.

(2) the milker itself must be *easy to clean*. Since prompt cleaning after each milking is absolutely necessary, the entire milker and pail must be designed for quick and thorough cleaning under normal procedures.

The result was a completely new idea—a pail that unfastened in the middle and came completely apart, exposing every square inch of its interior for quick, thorough cleaning. To keep the milk line clean, the pulsator was attached to the vacuum line in a way that made it impossible for the milk to enter either the pulsator or the vacuum line. These features were rigidly tested in the laboratory and on the farm. The result: the most practical and sanitary milker yet devised.



"Swing" is the only suspended or floor-type milker whose construction complies with the U.S.P.H.S.

Rite-Way called their new milker the "Swing". Today, it is widely advertised and a large part of our sales message stresses such important features as its proper teat cup positioning, lighter weight, narrower shape, and its ease of adjustment to any cow.

But the outstanding feature of "Swing" is its contribution to good sanitation. *Today, it is the only suspended or floor-type milker whose construction complies with U. S. Public Health Service standards.*

The standards established by this agency are available—indeed manufacturers who are interested are encouraged by the U.S. Public Health Service to design their equipment so as to comply with the provisions of the Milk Ordinance and Code. We feel we have measured up to our responsibility by adhering strictly to these standards.

We invite further inquiry and will be glad to send complete information on the Swing Milker or any other item in the Rite-Way line.

RITE-WAY DAIRY DIVISION
PACKAGE MACHINERY COMPANY
East Longmeadow, Massachusetts
Chicago, Illinois • *Oklahoma City, Oklahoma*

The Journal of Milk and Food Technology (including Milk and Food Sanitation) is issued monthly beginning with January number. Each volume comprises 12 numbers. Published by the International Association of Milk and Food Sanitarians, Inc., with executive offices of the Association at Ritz Building, 12½ East Broadway, P. O. Box 437, Shelbyville, Ind.

Entered as second class matter at the Post Office at Shelbyville, Ind., March 1952, under the Act of March 3, 1879.

EDITORIAL OFFICES: J. C. Olson, Jr., Associate Editor, University of Minn., St. Paul Farms, St. Paul, Minn.; H. L. Thomasson, Managing Editor, P. O. Box 437, Shelbyville, Ind.

Manuscripts: Correspondence regarding manuscripts and other reading material should be addressed to J. C. Olson, Jr., Associate Editor, University of Minn. St. Paul Farms, St. Paul, Minn.

"Instructions to Contributors" can be obtained from the Edtor for the use of contributors of papers.

Journal of

MILK and FOOD TECHNOLOGY

INCLUDING MILK AND FOOD SANITATION

Official Publication

International Association of Milk and Food Sanitarians, Inc.

REG. U.S. PAT. OFF.

Vol. 17 — DECEMBER — No. 12

CONTENTS

Business Matters: Correspondence regarding business matters, advertising, subscriptions, orders for single copies, etc., should be addressed to H. L. Thomasson (address above).

Subscription Rates: One volume per year Individual non-members, Governmental and Commercial Organization subscription, 1 yr. $5.50
Public, Educational and Institutional Libraries, 1 yr. $3.00
Single Copies 1.00

Orders for Reprints: All orders for reprints should be sent to the executive office of the Association, P. O. Box 437, Shelbyville, Ind.

Membership Dues: Membership in the **International Association of Milk and Food Sanitarians, Inc.,** is $5.00 per year, which includes annual subscription to the **Journal of Milk and Food Technology,** (including **Milk and Food Sanitation**). All correspondence regarding membership, remittances for dues, failure to receive copies of the **Journal,** changes of address, and other such matters should be addressed to the **Executive Secretary** of the Association, H. L. Thomasson, Box 437, Shelbyville, Indiana.

Dear IAMFS Member:

5 Minutes, Please?

1 Minute to think of the names of a few people who should be members of IAMFS.

3 Minutes to jot down their names and addresses.

1 Minute to mail.

FREE: COPY—

Journal of Milk and Food Technology will be sent

MAIL TO:

Box 437, Shelbyville, Ind.

YES, please send a free copy to the names given below . . .

☐ with my compliments ☐ omitting my name

Signed .....

Address .....

City and State .....

Name .....

Firm .....

Address .....

City and State .....

Name .....

Firm .....

Address .....

City and State .....

Name .....

Firm .....

Address .....

City and State .....

Name .....

Firm .....

Address .....

City and State .....

A TRIBUTE TO DR. J. H. SHRADER,

Retiring Editor, *Journal of Milk and Food Technology*, Official Publication,
INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC.

F. W. Fabian, Professor Emeritus
Department of Bacteriology and Public Health, Michigan State College, East Lansing, Michigan

We are gathered here this evening to honor a man, who aside from editing our Journal, has entered our hearts as a friend.

Dr. Shrader as you relinquish your responsibilities after many years of devotion to our Association, you carry with you our warm admiration. We look forward to your continued friendship and council and wish you the blessings of health and abundant happiness in the years ahead, and the fullest enjoyment of your well-earned retirement. However, to us who have been so close to you all these many years, your withdrawal from our picture is going to leave a gap which will be very difficult for us to get used to. Without any question, we are going to miss you.

In thinking about what I would say this evening, it occurred to me that it would be a good time to run over some of the highlights of your career.

It has been my good fortune to have known and worked with you for over a quarter of a century. During this time you have been intimately associated with the dairy and food industry in one capacity or another. Your contributions as a research worker, teacher, and author have been many and valuable. In these various capacities your life has reached many and has spread wisdom with a warmth and kindness which is one of your very fine qualities.

I do not know what you would consider your greatest achievement in life; neither do I know how others would evaluate you. Many of your students would doubtless consider your influence as one that profoundly affected their lives by showing them new vistas and new frontiers. Others might consider your authorship of Food Control, Its Public Health Aspects and your other writings as your greatest accomplishment. As for me, I consider your outstanding achievement the service which you have rendered this Association through your editorial work, first in editing the "*Annual Proceedings*" of the Association and later the *Journal*. The tremendous amount of work necessary to get the first bimonthly *Journal* started was an Herculean task against great odds and for an Association which on the whole said that it could not be done.

I well remember when you and "Brumley" (The late W. B. Palmer, Managing Editor until his death) first suggested the idea of a bimonthly journal at the Louisville, Kentucky meeting in 1937. What a storm of protest and doubt arose at the business meeting when you first suggested it. Over the years they had become so accustomed to the "*Annual Proceedings*" only that scarcely anyone thought that the Association could support a bimonthly journal. Finally, after much discussion, most of which was unfavorable toward establishing such a journal, you and Brumley agreed that if the Association would permit you to publish a bimonthly journal for one year, that you would not only do the work gratis but would personally defray and deficit incurred by the Association incident to publishing it. This, friends, took real courage. Starting as a bimonthly journal, you have since changed it to a monthly journal and have in addition changed the format from a small 6″ x 9″ to the present 8½″ x 11″. Truly a remarkable achievement. I am relating these details incident to the founding of the *Journal* for the benefit of those who take over the editorial duties in the future. The *Journal* was the brain-child of two men who labored long and hard throughout the years to bring it to be a sucessful fruition. Whoever assumes the editorship in the future should have a better understanding of their pioneer work so that he shall not assume his duties lightly.

In all the years that I have worked with you as an Associate Editor, I have had profound respect for your editorial ability, your scholastic attainments, and your good judgment. Your editorials have been timely, informative and masterpieces of English composition. You have always been kind and considerate and, above all, a gentleman. During all these years I have never heard you say nor have seen you write an unkind word about an author or a paper. No matter how severe and critical the reviewers were of an article submitted for publication, nor how meager and unscientific the data were, nor how ungrammatical the paper, you always rephrased the reviewers criticisms, and possibly added some of your own, in a kindly and dignified way, so that the author was not humiliated and retained his self respect. Your letters of rejection were written in such a way to encourage the author in the future to plan his research work more carefully and to write his findings in a clearer and more concise manner. To me that is the mark of a great editor and a great man. These qualities I have found in you who has served as our first and only Editor over these years.

Now as a token of our esteem and love for you, I am presenting on behalf of the Associate Editors and many other of your very dear friends a typewriter—the true symbol of the editor. Since the contributions were so generous, also, a check so that you may buy plenty of paper to write to your heart's content. May you spend the rest of your days in peace a "picking" and a "pecking" away on it.

SOME REMARKS OF RETIRING EDITOR

Memories! It was seventeen years ago this month that Bill Palmer, carrying a large bundle of books, dashed to the train, just as it was ready to pull out of Newark, en route to our Louisville meeting in 1937. These books were the first issue of the new Journal of Milk Technology. Since then we have published about five thousand pages of reading material in the thirteen volumes of the original 6 by 9 inches, and then a thousand pages in the almost four volumes of the larger size of 8½ by 11 inches. These contain 3,900,000. words.

This project is the consummation of the work of William B. Palmer ("Bill Palmer") that was persistently pursued over the years. His idea was definitely presented at the Montreal Meeting in 1931, but consistent pressure extending over several years was necessary before the Association, at its Atlantic City meeting in 1936, authorized the Executive Board to go ahead with the publication of a journal. President J. G. Hardenberg was their staunch supporter, and it was his counsel and vision that gave us the courage to keep going when obstacles loomed and the going was hard. Only Bill Palmer, Sid Leete, and I stuck with the project after it got launched.

The Journal has been uniquely effective in three areas:

(1) it provided a stimulus that caused the Association to increase greatly in membership and prestige;

(2) it provided a means for widely distributing around the world the new information on food sanitation; and

(3) it made the food sanitarians to become profession-conscious.

I remember when the Journal of Dairy Science was published bi-monthly and changed to a monthly. I wondered as to what far off date our Journal would so step out. This is now an old story. As we look ahead to further developments in our field, I think that we might review our setting or maybe we might say our orientation. Are we working at jobs, or filling positions, or creating a higher level of society? In other words, are we earth-bound or socially creative?

This leads to the question: development for what end? Of course, we reply that it is for food sanitation. But why this particular subject and not some other? We reply, for a safer, better, more satisfying life. But why this?

From time immemorial man has sought the answer to the question: what are we here for? We do not intend to answer this right now because we have a more immediate problem. It is this. We are human beings living on a more or less crowded earth, contacting each other in increasing ways. We are a great community, each member of which is seeking self-expression, and trying to develop a more meaningful and satisfying life. In other words, the impulse to live, the onward thrust of the life force, seeks to perpetuate itself in an environment where beauty, goodness, and truth are expressed at a maximum. Such an impulse distinguishes man from the beasts of the field. Only man knows what he is. Only man seeks to change his environment, to control (to a degree) the forces of nature. By so doing, he increases his own powers for a fuller development of his capacities. These latter are inherent in him. Like all qualities and properties of life, they must be developed in order to be maintained. That is one reason why life is a quest for an ever increasing spiritual or mental self-expression or realization of those values of truth, beauty, and goodness.

Here is where the food sanitarian comes to grips with the environment. The deteriorative forces of nature seek to destroy their delicate living organism: man. The great mass of humanity is helpless before these attacks, particularly on the young and the aged. The food sanitarian intervenes. He has the satisfaction of being a partner in the great creative task of making life more secure, more pleasant, more satisfying, and increasing the potentiality hence for a more abundant self-expression.

This self-expression: is it the goal of living? No. How do we know? Because self-expression when self-centered becomes psychically corrosive. Here is the area where psychopathology reigns. The most healthy organism is the cooperative one. The great permanent satisfactions come from the helpfulness that we render our fellows. This means a built-up society of good will. Here, creativity is at its maximum. Here is where we realize that we are co-workers with the great cosmic spring of creative energy, helping to obtain its fuller expression.

All of the above points up to this directive principle: that which contributes to a higher standard of living. So greater self-expression in the pursuit of the fundamental values of truth, goodness, and beauty, and to a greater abundance of and respect for life—these are legitimate areas within which we see our proper field of action, and our chart for regulatory action.

So, when we run into some new situation that requires our making a decision as to what course to take, we can safely invoke this principle. We can ask ourselves: does the action that I contemplate lead to a larger or better opportunity for man's self-expression or reverence for life, or will my proposed action lead to an advance in man's ideals of truth, beauty, and goodness? If we can answer in the affirmative, then go ahead.

I have found in my fellow members of this Association a spirit of devotion to duty, of service to mankind, that differs from that of any of the several professional organizations to which I belong. I observed this when I joined the Association way back in Ivan Weld's days—in 1925 or so. It still lives. And within this membership is the hand-picked group of you gentlemen here. I have found you to be devoted to ideals of character, of professional quality that commands my respect and affection. In the years of our associations, I have not seen a trace of any spirit that is not cooperative and constructive. Such an editorial team! Fellows, I'm proud of you. I appreciate your helpfulness, your industry, and your loyalty. May God bless you every one.

J. H. SHRADER

CONTAMINATION OF RUBBER MILK TUBES OF MILKING MACHINES AS AFFECTED BY DETERIORATION OF THE INSIDE SURFACES

T. J. CLAYDON

Kansas Agricultural Experiment Station, Manhattan[a]

(Received for publication, May 19, 1954)

Studies were made on the susceptibility to bacterial contamination of rubber milk tubes as affected by deterioration of the inside surfaces. Even with used tubes having only microscopic breakdown, contamination was much greater than with new tubes. The average contamination in the used tubes averaged 15 times as great as in new tubes under laboratory conditions and 12 times as great under practical operating conditions with dry storage. When lye storage was used bacterial counts were lower and differences were smaller. Even inconspicuous deterioration of the interior surfaces of rubber milk tubes is a potential hazard in milking machine sanitation.

In milking machine sanitation, increased attention is being given to the rubber parts as factors in contamination[1, 2, 3, 4, 5, 6]. Although obvious breakdown of rubber is recognized as a sanitary hazard, little consideration has been given to the influence of less evident conditions. It has been shown that inconspicuous deterioration of the interior surfaces of teat-cup liners is an important factor affecting the susceptibility of the liners to contamination[2]. It might be expected that the same would prevail for the rubber milk tubes. On the other hand, since the tubes are not subjected to flexing and squeezing action and there is less likelihood of fat and other milk materials being worked into the rubber, the condition might be less significant. Accordingly, studies were made to determine what effect breakdown of the inner surfaces of milk tubes had on their susceptibility to bacterial contamination.

METHODS

During the study, 10 used milk tubes, currently in service, were obtained from three grade-A dairy farms. The tubes were from bucket type machines, and were of one brand, since others were not readily available in the area. They had undergone various sanitizing treatments and had been in service for periods ranging from 5 to 18 months.

In the laboratory the tubes were thoroughly cleaned by soaking in organic acid solution[b], washing, boiling in 2% lye solution for 15 minutes, and again washing. They then were inspected for general physical condition. Since the tubes were to be used in experimental work, they could not be cut open at this time for close inspection of the interior surfaces. Examination was made as fully as possible by viewing from the open ends against a light source. Following experimental work, the tubes were cut and the interior surfaces examined under a stereoscopic microscope at 85X magnification.

Bacteriological studies — To determine the importance of surface condition of the rubber milk tubes in sanitation problems, bacteriological studies were made on the used tubes in comparison with new tubes of the same type and under the same conditions. In some laboratory trials, new plastic tubes were included for comparison. At the start of each comparison, the cleaned new and used tubes were steam sterilized. They then were contaminated either by experimental laboratory procedures or by usage under practical operating conditions.

In experimental contamination, a 35 ml. quantity of incubated raw milk was added to each milk tube stoppered at one end. After stoppering the other end, a vigorous and uniform shaking procedure was used to distribute the milk over the interior surface. After draining off the milk, the tube was rinsed briefly under a water faucet to flush out free milk droplets, again drained and then examined bacteriologically.

When contamination was achieved under practical operating conditions, a used tube was placed on one milker unit and compared with a new tube on a second unit of the same type under the same routine conditions at the College dairy barn. In the initial comparisons, tubes were brought into the laboratory immediately after evening milkings, flushed with lukewarm water under a faucet and held dry overnight. Bacteriological examinations were made the following morning. In the remaining investigations, washing was done as usual at the dairy barn.[c] In one phase the teat-cup assemblies and tubes were stored in a lye rack after washing and in another they were hung to drain and stored dry. Milk tubes were removed before the afternoon milking and taken to the laboratory for bacteriological examination. Where lye storage had been used, the tubes were first rinsed briefly under a water faucet to remove excess lye solution.

Bacteriological examinations were made by adding 35 ml. of sterile water to each tube, suitably stoppered with sterile stoppers. After a uniform shaking procedure, the rinse water was plated immediately, using Standard Plate methods and tryptone glucose extract agar. Although it is recognized that a considerable proportion of the bacteria would remain on the surfaces of the rubber, this rinse procedure was considered satisfactory for comparative studies.

RESULTS

General physical conditions of milk tubes—The condition of the interior surfaces of the cleaned, used tubes, as viewed from the open ends against a light source, varied from dull and slightly scratched to definitely rough and broken surfaces. Some tubes appeared little different from new tubes. Upon cutting open the used tubes, deterioration of the inner surface sometimes was evident to the unaided eye as a roughened, finely cracked surface. In other tubes the surfaces appeared clean and smooth with no obvious breaks. None of the tubes showed softness or tackiness of the interior surfaces as is sometimes evident in teat-cup liners as a result of fat absorption.

The interior surfaces of new tubes viewed from the ends did not appear so smooth as expected. Some surface irregularities and apparent

[a]Contribution No. 224 Department of Dairy Husbandry, Kansas Agricultural Experiment Station.

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

[c]The teat-cup assemblies and tubes were promptly flushed with tepid water. A detergent solution at about 140° F., followed by clear water at the same temperature, was then drawn through the assemblies.

TABLE 1—EXAMPLES OF BACTERIAL COUNTS ON USED AND NEW TUBES AFTER EXPERIMENTAL CONTAMINATION FROM THE SAME LOTS OF MILK.[a]

Trial[b]	Counts per ml. water rinse[c]		
	Rubber tubes		Plastic tubes
	Used	New	New
1	44,000	9,000	1,100
2	2,400	110	95
3	14,000	1,200	450
4	75,000	700	600
5	10,000	1,800	220
6	6,600	260	140
Log av.	13,940	855	310

[a]Each trial involved a different lot of milk of different quality.
[b]Each trial included a different used tube, but the same new tubes were usually, although not always, used.
[c]35 ml. water rinse used per tube.

TABLE 2—BACTERIAL COUNTS ON USED AND NEW RUBBER TUBES AFTER OPERATION UNDER THE SAME PRACTICAL CONDITIONS.[a]

Trial[b]	Days in operation	Counts per ml. water rinse[c]	
		Used tube	new tube
1	1	78	4
	2	2,000	150
	3	1,760	16
2	1	10	5
	3	710	10
	4	2,500	150
Log av.		410	20

[a]Before making bacteriological examinations, the tubes were flush washed and held as described under "Methods".
[b]Each trial involved a different set of milk tubes.
[c]35 ml. water rinse used per tube.

TABLE 3—BACTERIAL COUNTS ON USED AND NEW RUBBER TUBES AFTER OPERATION AND SANITIZING UNDER THE SAME PRACTICAL CONDITIONS (DRY STORAGE)

Trial[a]	Days in operation	Counts per ml. water rinse[b]	
		Used tube	new tube
1	1	24,000	350
	2	700	300
	4	1,200,000[c]	120,000[c]
	5	1,000,000[c]	100,000[c]
	6	1,500,000[c]	100,000[c]
2	1	1,300	240
	2	4,000	600
	3	10,500	410
	5	300,000[c]	25,000
	7	14,000	400
Log av.		38,380	3,070

[a]Each trial involved a different set of milk tubes.
[b]35 ml. water rinse used per tube.
[c]Estimates, plates crowded.

scratches or creases were evident. On cutting open, the surfaces showed no breaks or roughness, but did not have the smooth, even surface usually seen in new teat-cup liners.

On microscopic examination the interior surfaces of the used milk tubes were found to have the same general types of breakdown as previously found in used teat-cup liners and illustrated in an earlier report[2]. Surfaces that appeared dull and rough to the unaided eye were intensely cracked and disintegrated. Even those surfaces that appeared unbroken macroscopically were eroded and pitted, giving a spongelike effect. Combinations of these two general types of breakdown were common.

With new tubes the microscopic appearance of the interior surfaces supported the impression gained macroscopically. Although no cracking was evident and the surfaces were much better than those of the used tubes, the new tube surfaces were irregular and uneven and gave the impression of being "unfinished".

Effect of deterioration of the inner surface of the tube on susceptibility to contamination — When new and used rubber tubes were experimentally contaminated in the laboratory under the same conditions, the bacterial counts on the used tubes were much higher in every case than those on the new tubes. In 17 trials involving 25 comparisons of 10 used tubes with new tubes the counts on the used tubes ranged from four to more than 100 times as great as the corresponding counts on the new tubes. The log average count on the used tubes was 13,200 and on the new tubes 880. The log average count on new plastic tubes used for comparison in 14 of the trials was 420. Results of six representative trials are presented as examples in Table 1. Different lots of milk used in the different trials accounted for the range of contamination among trials.

When contamination of the tubes occurred under practical operating conditions, with the tubes being stored dry following the sanitizing procedure, counts on the used tubes again were higher than those on the new tubes. After laboratory flushing and dry storage, counts were low to moderately low

with both used and new tubes (Table 2). However, in the six comparisons with two different sets of tubes, the log average count on the used tubes was 20 times as great as the log average count on the new tubes. Although the trials were of short duration, there was a tendency for the counts to become higher in both new and used tubes as the trials progressed.

When tubes were sanitized at the dairy barn under routine conditions and held dry, the bacterial counts were frequently high. (Table 3) As in previous trials the used tubes were more heavily contaminated in every case than the new tubes, ranging from slightly more than twice as great to almost 70 times as great. In the 10 comparisons, involving two different sets of tubes, the log average count on the used tubes was about 12 times as great as the corresponding count on the new tubes. The wide range of contamination among the different comparisons presumably reflected the variation in efficiency of the sanitizing operations.

When the teat-cup assemblies and milk tubes were stored in a lye rack following routine washing operations, the counts on both new and used tubes were usually low (Table 4). With two exceptions the counts on the used and new tubes were approximately the same. In the 11 comparisons with two sets of tubes, the log average count on the used tubes was slightly more than four times as great as the log average count of the new tubes. There was no particular tendency for the counts to become higher as the trials progressed.

TABLE 4—BACTERIAL COUNTS ON USED AND NEW RUBBER TUBES AFTER OPERATION AND SANITIZING UNDER THE SAME PRACTICAL CONDITIONS (LYE RACK STORAGE)

Trial[a]	Days in operation	Counts per ml. water rinse[b]	
		Used tube	new tube
1	1	47	43
	2	1,200	18
	4	29	20
	6	25	1
	12	100	110
	25	5,800	130
2	1	65	8
	2	410	28
	4	20	9
	5	18	35
	7	36	38
Log av.		98	22

[a]Each trial involved a different set of milk tubes.
[b]35 ml. rinse water used per tube.

DISCUSSION

The experimental contamination procedure was a useful means of measuring the effect of deterioration of rubber milk tubes on susceptibility to bacterial contamination. The results obtained generally were supported by later trials where contamination occurred under practical operating conditions and where dry storage was used.

It is evident that surface breakdown that occurs in tubes while they are in service magnifies the contamination problem. Observations indicated that tubes appearing in reasonably good condition and in which cracking was largely of microscopic nature were often as susceptible to contamination as were those tubes having more obvious breakdown. In other words the length of life of the tubes from a sanitation standpoint was less than when determined by clearly evident physical deterioration or by operating efficiency. This relationship was generally similar to that demonstrated with rubber teat-cup liners[2].

Although the study was not designed to compare the effects of sanitizing treatments on the contamination of used and new tubes, it appears that lye storage is a means of reducing the differences in bacterial counts. However, such a conclusion should be made with reservations since the trials were made at different times than the dry storage trials and other conditions may have varied. The further fact that, in two of the comparisons, counts on the used tubes were considerably higher than counts on the new tubes indicates that lye storage is not an infallible means of counteracting the effect of surface breakdown. Nevertheless, the results suggest that such treatment helps to reduce the contamination hazard of milk tubes having surface deterioration.

The tendency on farms is to use milk tubes until they will no longer remain attached to the pail head or claw, or until the ends have been trimmed back so that the tubes are too short for further use. Observations made during the study indicate that this stage is far past the point where deterioration of the inner surfaces constitutes an increased contamination hazard. With the increase in pipeline milking installations where the milk tubing is usually longer, it is likely that surface breakdown in the tubes will be a proportionately greater problem.

The low counts obtained on new plastic tubes and the smooth nature of the inner surfaces suggest some advantages for this material and further studies are being made over longer periods of practical operation with this type of tube.

SUMMARY AND CONCLUSIONS

Studies conducted on used rubber milk tubes in comparison with new rubber tubes revealed that deterioration of the inside surfaces increased the susceptibility of the tubes to bacterial contamination. This relationship existed even with tubes having only microscopic breakdown and otherwise appearing in satisfactory physical condition. With experimental contamination, the log average count on used tubes was 15 times as great as the corresponding count on new tubes. When contamination occurred under conditions of practical operation and sanitizing, followed by

dry storage, the log average count on the used tubes was 12 times as great as the log average count on the new tubes. Where lye storage was used in place of dry storage, counts were usually lower and the differences between used and new tubes were considerably reduced in most cases.

It is evident that deterioration of the interior surfaces of rubber milk tubes is a potential hazard in milking machine sanitation. The condition may develop while the tubes still appear to be in reasonably satisfactory operating condition. Modifications in rubber composition or utilization of suitable plastic milk tubes might minimize the problem.

REFERENCES

1. Berridge, N. J. The Deterioration of Milking Rubbers. I. The Effect of Microorganisms. *J. Dairy Research*, 18: *246.* (1951)

2. Claydon, T. J. Contamination of Milking Machine Teat-Cup Liners As Affected by Inconspicuous Deterioration of the Interior Surfaces. *J. Dairy Sci* 36: *707.* (1953)

3. Cone, J. F. Bacteria Thrive in Rubber Parts of Milking Machines. *65th Ann. Rept. Penn. Agr. Expt. Sta.* p.10 (1952)

4. Cooper, J. H. and Gardner, E. R. The Deterioration of Milking Rubbers. III. The Effect of Farm Treatment. *J. Dairy Research* 20:*340.* (1953)

5. Gardner, E. R. and Berridge, N. J. The Deterioration of Milking Rubbers. II. The Effect of Fat. *J. Dairy Research.* 19:*31.* (1952)

6. Jensen, J. M. and Bortree, A. L. Storage and Treatment of Milking Inflations. *J. Dairy Sci.*, 29:*849.* (1946)

THE COLIFORM BACTERIA OF STRAWBERRIES*

J. ORVIN MUNDT, G. A. SHUEY, AND IVAN C. MCGARTY

Departments of Bacteriology and General Chemistry, University of Tennessee, Knoxville, Tennessee

(Received for publication September 23)

The positive presumptive tests obtained on the examination of strawberries undergoing processing for freezing are generally caused by Gram negative bacteria indigenous to plants and to the soil. The bacteria produce gas at the expense of the sugars naturally present in the berries. Washing the berries in chlorinated water or in water containing detergents does not eliminate the microorganisms. The incidence of coliform bacteria appears to be associated with dirty fruit, and soft and unsound fruit. A greater number of positive presumptive tests are obtained with lauryl tryptose broth than with brilliant green bile 2 percent broth. The former medium is more efficient in detecting the organisms of human and of animal origin.

Tanner[1] has reviewed the literature concerned with the presence of coliform bacteria on strawberries. Early workers were generally agreed that these organisms are ubiquitous, and that their removal by chlorination of the wash water is uncertain. Recently Barber[2], discussing the bacteriology of raw fruits, stated that neither quaternary ammonium sanitizers at 200 ppm nor chlorine solutions at 1,000 ppm during an exposure of 15 minutes effected destruction of coliform bacteria. The raw fruit under discussion could well be strawberries, although not mentioned by name.

During experimental and routine bacteriological examinations of strawberries in the processing season, it was noticed that a large proportion of both unprocessed and processed berries yielded positive presumptive tests for coliform organisms. Generally, the true coliform bacteria could not be confirmed on the customary media, although the bacteria in the positive presumptive tubes were Gram-negative, and grew prolifically, although atypically, on eosin-methylene blue (EMB) agar.

The typical positive presumptive test also may be considered confirmatory for the presence of coliform organisms, according to *Standard Methods for the Examination of Dairy Products*[3]. Therefore studies were initiated to determine (a) the nature of the organisms responsible for the positive presumptive reactions, (b) the actual presence of organisms of human origin, and (c) the effect of washing berries in continuously chlorinated water (inplant chlorination) upon the incidence of these bacteria.

EXPERIMENTAL PROCEDURES

Both lauryl tryptose (LS) broth and brilliant green-bile 2 percent (BGB) broth were employed, the latter because it is a standard medium for this purpose, and the former, because Mallmann and Darby[4] recommended its use for the presumptive isolation of coliform bacteria.

The strawberries were of the *Blakemore* and *Tennessee Beauty* varieties ,each of which has between 8 percent and 10 percent sugar, of which 75 percent is reducing sugar. All samples were obtained from the processing lines at the Food Technology Building of the University of Tennessee, or from two commercial plants, one in East Tennessee and one in West Tennessee. Samples were taken at various stages of processing, from the raw product in the crate through packaging. Berries were washed for approximately 75 seconds in soaker-sprayer washers with water which was chlorinated on request to provide inplant chlorination at the levels desired.

Approximately 1-pound samples were gathered in sterile jars and liquidized. Presumptive inoculations were made in decimal dilutions beginning with 1 ml of the fluid in 5 tubes of the presumptive media at each dilution. Positive tubes were streaked on EMB agar, and colonies were picked for further study. Plating media were Bacto violet red-bile agar and BBL desoxycholate agar.

*Published with the approval of the Director of the Experiment Station.

Born in 1912, Dr. J. Orvin Mundt received degrees from the Universities of Wisconsin and Maine, and from Michigan State College. He is the author of a number of papers relating to the processing, preservation, and sanitation in the food industries. He is currently an officer of the Dixie Section of the Institute of Food Technology, and is a member of the Society of American Bacteriologists and of Sigma Xi.

Associate Professor of Bacteriology, and recently named Associate Bacteriologist at the new Food Technology Institute, Dr. Mundt has been at the University of Tennessee since 1947.

RESULTS

Presumptive tests: The data summarized in Table 1 show that 60 percent, or 47 of 78 samples, passed through both media, were presumptively positive in LS broth, and 8 percent, or 6 of the 78 samples, were positive in BGB broth. Of those positive in LS broth, 16 of 23 samples, 70 percent, of those taken from the crate or washed in plain water were presumptively positive, while 31 of the remaining 55 samples, or 56 percent, of those washed in water chlorinated to deliver 5 to 9 ppm available chlorine were presumptively positive. In contrast, one sample of the 23 not washed in chlorinated water was positive in BGB broth, and 5 samples of the remaining 55, or 9 percent, of those washed in chlorinated water were positive in this medium. The MPN ranged from 0 to over 1,600 coliform bacteria per gram of berry.

Plate counts: The use of solid media to determine the numbers of coliform organisms was unsatisfactory, and was discontinued. Although violet red-bile agar proved somewhat superior to desoxycholate lactose agar, both media gave rise to large numbers of colonies with all gradations from the typical coliform to pinpoint in size, and lines of demarcation between typical and atypical or non-coliform colonies could not be discerned satisfactorily. Plate counts seldom correlated with determinations of the most probable numbers on the one hand, or with the numbers of completed tests on the other.

Confirmation of presumptive positive tubes: All presumptive positive tubes were streaked on EMB agar, and representative colonies were passed through lactose broth. Results are shown in Table 2.

Of the 67 samples presumptively positive in LS broth, 33 or 50 percent were confirmed as coliform organisms, while of the 8 samples positive in BGB broth, 3 were confirmed.

Comparison of the presumptive media in detection of coliform bacteria: Where samples were passed through both media, 19 confirmations were made of the presumptively positive samples in LS broth, only 3 in BGB broth, and 3 were detected in both media. This comparison is shown in Table 3.

Quality of the strawberries as affecting the presumptive test: It was observed that fewer positive presumptive tests were obtained when berries were sound and clean. Various lots of field-run berries were graded and sampled as they underwent processing. Typical results of presumptive tests are shown in Table 4.

Of 8 samples washed in tap water, all were positive in both media except one, which was negative in BGB broth, when berries were high in percentage of rot, and were dirty or soft. Some reduction in the number of positive presumptive tests was obtained by chlorination of the water at 6 ppm available chlorine, with 2 and 5 samples negative in the respective media. In contrast, two-thirds of

TABLE 1. COMPARISON OF NUMBERS OF PRESUMPTIVELY POSITIVE TESTS OBTAINED WITH LAURYL TRYPTOSE AND BRILLIANT GREEN BILE BROTHS, ON STRAWBERRIES WASHED IN TAP AND IN CHLORINATED WATERS

ppm chlorine	Number of samples	Presumptively positive in		Presumptively negative in		Positive in both media
		LS	BGB	LS	BGB	
0	23	16	1	7	22	0
5	14	9	0	5	14	0
6	8	5	1	3	7	0
7	22	12	2	10	20	2
9	11	5	2	6	9	1
Totals	78	47	6	31	72	3

TABLE 2. COMPARISON OF NUMBERS OF PRESUMPTIVELY POSITIVE TESTS IN LS AND BGB BROTHS CONFIRMED

	LS broth	BGB broth
Number of samples	134	120
Number presumptively positive	67	8
Number presumptively negative	67	112
Number confirmed	33	3
Number unconfirmed	34	5

TABLE 3. COMPARISON OF THE ABILITY OF LS AND BGB MEDIA TO DETECT COLIFORM BACTERIA

Detection of coliforms in LS broth only	19
Detection of coliforms in BGB broth only	3
Number detected in both media	3

TABLE 4. THE EFFECT OF THE QUALITY OF THE BERRY UPON THE NUMBERS OF PRESUMPTIVELY POSITIVE SAMPLES IN LS AND BGB BROTHS

Quality of berry	Number of samples	Washing treatment	Positive in		Negative in	
			LS	BGB	LS	BGB
Dirty, soft, high in percent of rejects	8	Tap water	8	7	0	1
	10	6 ppm chlorine	8	3	2	5
Clean, firm, low in percent of rejects	9	Tap water	3	1	6	8
	16	6 ppm chlorine	5	1	11	15

the berries which were low in rot, and were firm and clean, were free of gas-producing organisms as determined in LS broth, and all except one each of those washed in tap and in chlorinated waters were free of these organisms as determined in BGB broth.

To provide further evidence that the presence of gas-producing bacteria was associated with softness of the berry, lots were sorted at the receiving line, and soft (rejected) berries were washed as indicated in Table 5. Of three lots not washed, 7 lots washed with 7 ppm, and 1 with 9 ppm available chlorine, all were positive in LS broth, with 5 of the 11 samples confirmed, and 7 were positive in BGB broth, with 5 samples confirmed. In view of the generally poor record of detection of coliform bacteria via BGB broth, these results are significant in indicating that the presence of these organisms is associated with the condition of the berry. It is probable that, since they withstand the action of chlorine, they find their way beneath the surface of the berry into the inner, affected tissue, and hence are protected.

Effect of detergents upon positive presumptive tests: Through the courtesy of Mr. Richard D. Haynes*, 36 samples of berries were obtained from experimental work with detergency. These were passed through LS broth, with results as shown in Table 6. Detergents were no more effective than water alone in removal of the bacteria, for 8 of 16 samples were presumptively positive, while of those washed in water alone 4 of 10 were positive. In comporison with the unwashed berries, some reduction occurred, since 80 percent of the latter contained gas-producing bacteria. It should be borne in mind, however, that the experimental work involving the detergents was not directed toward the removal of the coliform organisms.

Identity of isolates: Representative colonies on EMB plates streaked with material from presumptively positive tubes were transferred to agar slants, and subsequently were passed through lactose broth. Cultures were divided into the fermenters of lactose, and those which failed to produce gas within 48 hours.

Table 5. The Effect of Washing Rejected Berries in Tap and in Chlorinated Waters Upon the Presumptive Tests in LS and BGB Broths and Upon Confirmation.

Treatment	Number of samples	Positive in LS	Positive in BGB	Negative in LS	Negative in BGB
Not washed	3	3	1	0	2
Water with 7 ppm chlorine	7	7	6	0	1
Water with 9 ppm chlorine	1	1	0	0	1

Table 6. The Effect of Detergents in the Wash Water Upon the Presumptive and Confirmed Tests in LS Broth

Treatment of berry	Number of samples	Number presumptively positive	Number confirmed
Not washed	10	8	2
Washed in tap water	10	4	1
Washed in detergent water	16	8	1

Of the 22 cultures which produced gas, 2 were identified as the true *Escherichia coli;* 3 as *Aerobacter aerogenes*; all but one of the remainder utilized citrate as the sole source of carbon. Of these, 5 possessed a sheen reminiscent of *E. coli,* while the remaining 12 cultures were similar to *Aerobacter aerogenes.*

Seventy cultures were obtained which produced gas after the designated 48-hour incubation period. All cultures fermented dextrose and sucrose promptly, and all failed to produce either hydrogen sulfide or urease. Of these, 45 were similar to or identical with *Paracolobactrum intermedium,* described in *Bergey's Manual*[5] as being indigenous to soil. The remaining 25 cultures differed chiefly in the ability to digest gelatin.

To arrive at an explanation for prompt production of gas in the presumptive media, tubes of nutrient broth containing 0.008 percent dextrose were inoculated with the 70 cultures. This quantity of sugar corresponds to the amount introduced with 0.1 ml of liquidized, unsugared strawberry. In most instances one-third of the insert vial contained gas within 24 hours; with few exceptions, the color of the indicator, brom-cresol-purple, was a dilute or faded red color, thus indicating the formation of a very small amount of acid.

Recovery of Escherichia coli: This organism was recovered from six of all the samples taken during processing. Only once was the organism recovered in BGB broth only as the detecting medium, and with one sample, both media contained it after incubation. The remaining four isolations were obtained through LS broth only.

Discussion

Obviously, organisms described as coliform bacteria in the broad sense of the term are generally present on strawberries. They persist in or on the berries despite washing, even when the wash waters contain as much as 9 ppm available chlorine.

The majority of the "coliform" bacteria isolated from strawberries are considered indigenous either to plants or to the soil. This fact should be given due attention in considering the sanitary implications. A similar condition has been indicated recently by Appleman[6] with reference to frozen orange juice, and Mundt[7] reported identifying *Aerobacter aerogenes,* but not *Escherichia coli,* from a group of isolates from strawberries.

E. coli was isolated but six times from all line samples, and from several of the relatively few samples of hand sorted, unsound berries. Thus, although more work is in-

*Food Technologist, Central Research Laboratories, Phosphate Division, Monsanto Chemical Co., Dayton 7, Ohio.

volved, confirmatory and differentiating procedures following the presumptive tests are indicated, in order to assess the significance of organisms producing gas in the primary media.

The true coliform bacteria appear to be present with greater frequency in or on dirty and soft berries, and in lots in which there is high percentage of rejects during processing. To some extent, good practices in managing strawberry production, as well as more rigid criteria for grading berries, could reduce the incidence; however, climatic conditions during harvest play an important part in determining the condition of the berry. It should be pointed out, too, that the presence of *E. coli* is not restricted to soft berries, for occasional isolates were obtained from clean an apparently sound fruit.

Despite the higher percentage of false presumptively positive tests obtained, the lauryl tryptose broth is superior to brilliant green-bile 2 percent broth in the detection of the true coliform bacteria, as shown by the greater number of isolations via this medium. In the examination of strawberries, lauryl tryptose broth should be employed together with brilliant green-bile broth, or become the medium of choice.

CONCLUSIONS

Coliform bacteria are generally present on or in strawberries, and are more prevalent in dirty and unsound fruit. The majority of the organisms responsible for the presumptively positive tubes of lauryl tryptose and of brilliant green-bile 2 percent broths are slow lactose fermenters which produce gas by fermentation of the sugar contained in the inoculum.

The majority of the organisms producing gas in the presumptive media are identical with, or similar to, *Paracolobactrum intermedium*, which is considered indigenous to soil. *Aerobacter aerogenes* and related organisms are also found on strawberries.

It is concluded that lauryl tryptose broth should be employed in the sanitary control of strawberries to be frozen, and that the presumptive test, when positive, should be followed by confirmatory and differentiating procedures leading to species identification.

REFERENCES

1. Tanner, F. W. *The Microbiology of Foods.* Second Edition (1944), Garrard Press, Champaign, Ill.

2. Barber, F. W. New Developments in the Dairy Field. *Tech. Bull.* No. 23, Intern. Assoc. of Ice Cream Mfgrs., Jan., 1954.

3. *Standard Methods for the Examination of Dairy Products.* Tenth Edition (1953), Amer. Public Health Assoc., Inc., New York 19, N. Y.

4. Mallmann, W. L., and Darby, C. W. Use of a Lauryl Sulfate Tryptose Broth for the Detection of Coliform Organisms. *Amer. J. Pub. Health,* 31, 127 - 134, (1941).

5. Breed, R. S., Murray, E. G. D., and Hitchens, A. P. *Bergey's Manual of Determinative Bacteriology.* Sixth Edition (1948), Williams and Wilkins Co., Baltimore.

6. Kaplan, M. T., and Appleman, M. D. Microbiology of Frozen Orange Concentrate. III. Studies of Enterococci in Frozen Concentrated Orange Juice. *Food Technol.* 6, 167 - 169, (1952).

7. Mundt, J. O. Microbiology of Strawberries During Harvest. *Quick Froz. Foods,* 12 (9), 53 - 56, (1950).

THE EFFECT OF THE INCUBATION TIME AND TEMPERATURE ON THE DETERMINATION OF PSYCHROPHILIC BACTERIA IN MILK BY THE AGAR PLATE METHOD[1*]

J. C. BOYD[2*], C. K. SMITH, AND G. M. TROUT
Departments of Dairy and Bacteriology
Michigan Agricultural Experiment Station, East Lansing, Michigan
(Received for publication May 17, 1954)

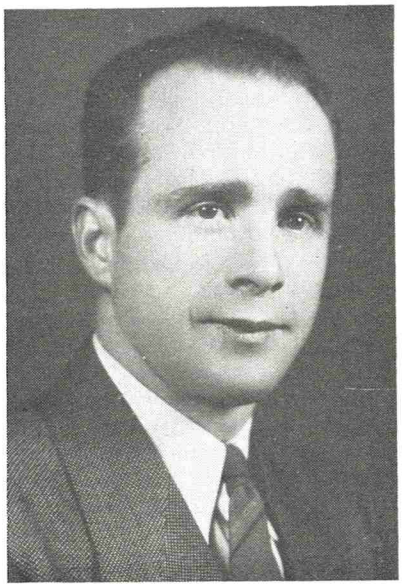
A study has been made of the effect of incubation time and temperature on the determination of psychrophilic bacteria in milk.

The incubation of agar plates at 10° C resulted in the detection of a group of thermoduric organisms which was not found when agar plates were incubated at 5° C. These organisms are not considered to be true psychrophiles.

Bacterial counts on milk obtained using the 5° C and 10° C incubation temperatures did not coincide regardless of the incubation period. The counts obtained using the 10° C incubation temperature were always higher than those obtained at 5° C for a similar period.

Maximum bacterial counts on milk samples stored at 5° C for 10 days or less were not obtained in less than 20 days when the agar plates were incubated at 5° C.

Marked variations are found in the temperatures and incubation periods used by different investigators for determining the numbers of the so-called "psychrophilic" bacteria in milk. Pennington[8] incubated agar plates prepared from raw milk at 0° C for 4 to 6 weeks. Thomas and Chandra Sekhar[10] used incubation temperatures of 3 to 5° C, and obtained higher counts at the end of 21 days than at 7 to 14 days. Ten-day incubation periods at 5° C were used by Watrous, Doan, and Josephson[11], while Burgwald and Josephson[3] and Dahlberg *et al.*[4] used incubation temperatures of 8 to 10° C for 10 days. The ninth edition of the *Standard Methods for the Analysis of Dairy Products*[1] recommends incubation of the agar plates for 10



Dr. J. C. Boyd received his B. S. degree from the State College of Washington in 1939, and his M. S. degree from Montana State College in 1942, and his Ph. D. degree from Michigan State College in 1952. He has had considerable commercial experience in dairy manufacturing plants and as a milk sanitarian. He served in World War II and the Korean War and is presently employed as associate professor in charge of Dairy Manufacturing at the University of Idaho.

1*Published with the approval of the Director of the Michigan Agricultural Experiment Station as Journal Article No. *1565*.

2*Present address: Department of Dairy Husbandry, University of Idaho, Moscow, Idaho.

to 14 days at 5 to 10° C. The tenth edition includes incubation for 7 days at 5° C[9]. Shorter incubation periods of seven days at 10.5° C and 4.5° C were used by Erdman and Thornton[5]. Kennedy and Weiser[6] used an incubation temperature of 10° C and found that the colonies continued to develop on the plates after 72 hours. An interesting paper by Nelson[7] on this general subject appeared after this work was completed.

In view of the variations found in the methods used to determine psychrophilic bacteria in milk, this study was undertaken to determine, if possible, the relationship between the bacterial counts obtained using incubation temperatures of 5° C and 10° C for 7, 10, 15, and/or 20 days.

EXPERIMENTAL PROCEDURE

Commercially pasteurized and homogenized milk samples from four milk processing plants were collected during the summer, fall, and winter months, and stored at 5° C for extended periods of time. The samples were obtained in one-quart paper containers, taken in succession from the filler from three of the plants, and in glass bottles from the fourth. The milk from two of the plants was pasteurized by the high-temperature short-time system, using 71.7° C or more for at least 16 seconds, and the milk from the other two plants was pasteurized by the holding system (61.7° C for 30 minutes).

Immediately after the samples arrived at the laboratory one container was opened and a portion removed for bacteriological analysis. At the end of 3, 7, 10, 14, 17, etc., days of storage, another previously unopened container was removed from storage, opened, and analyzed.

The bacteriological analysis consisted of the preparation of two sets of agar plates, in duplicate, in accordance with the 1948 edition of *Standard Methods for the Analysis of Dairy Products*[1]. One set of plates was incubated at 5° C and the other at 10° C. The plates were counted after 7, 10, 15, and 20 or more days of incubation. For tests on the fresh milk samples a maximum of 0.1 ml of milk was used per agar plate. Because duplicate plates were prepared, 0.2 ml of milk was analyzed per sample.

To minimize the effect of the plates warming up while counting, no more than 24 petri dishes were taken from the 5° C or the 10° C incubators at one time. Because of the fogging of the glass when the plates were taken from the cold room, it was necessary to remove the tops of the petri dishes during counting. Based on a relatively large number of control plates it was considered that no significant contamination resulted from exposure during counting.

The colony counting was done with the aid of a colony counter having a magnification of 1½ times. When no colonies were found on the agar plates prepared from 0.1 ml of fresh milk, where 1 colony would equal a count of 10 per ml, an arbitrary count of 5 per ml was assigned to the sample.

Early in the study it was found that on the agar plates incubated at 10° C, there were some colonies that developed within 7 to 10 days, and another group which did not appear on the plates until after 15 days of incubation. To determine some of the characteristics of these two general groups, colonies were transferred into litmus milk, and incubated at 22.2° C to obtain cultures of these organisms.

All the cultures isolated were laboratory pasteurized at 61.7° ± 0.5° C for 30 minutes to determine their ability to survive pasteurization. Their ability to grow at 35, 10, and 5° C was also determined. This was accomplished by making loop transfers from the original culture into a series of nutrient broth tubes. One set of nutrient broth tubes was laboratory pasteurized at 61.7 ± 0.5° C, allowing not more than 2 minutes to reach 61.7° C. At the end of the 30-minute holding period, the tubes were cooled, allowing not more than 2 minutes to reach 15° C. The tubes were then incubated at 22.2° C for 10 days. A visible growth in the nutrient broth tubes at the end of the incubation period was taken as evidence that the organisms were not killed by pasteurization. The other sets of inoculated tubes were placed without pasteurization at the incubation temperatures of 35, 10, and 5° C.

These tubes were examined for growth periodically up to 10 days, when incubation temperatures of 35° C were used, and 20 days or longer when incubation temperatures of 10 and 5° were used.

RESULTS

The logarithmic averages of the bacterial counts obtained from milk of different ages, when the agar plates were incubated at 10° C for various periods of time, are shown in Table 1. These results show that up until the time a marked increased in bacterial content is evident (tenth to fourteenth day of storage) an incubation period of 7, 10, or 15 days results in only a fraction of the bacterial counts obtained after 20 days incubation. However, after considerable bacterial growth had taken place in the stored milk, 10 or 15 days of incubation of the agar plates at 10° C gave bacterial counts that were comparable to those obtained after 20 days of incubation. The bacterial counts obtained after 7 days of incubation at 10° C were consistently lower and more difficult to count because of the smallness of the colonies than those obtained at the longer incubation period. Data on the milk samples from each individual milk plant are not shown. However, it should be stated that the days of storage at 5° C, before a distinct increase in the bacterial count was evident, varied, depending upon the plant from which the milk samples were obtained.

The logarithmic averages of the bacterial counts obtained when agar plates prepared from the same milk were incubated at 5° C for 10, 15, and 20 days are shown in Table 2. These results show that the bacterial counts obtained after 10 days of incubation of the agar plates at 5° C were considerably lower than those obtained after 15 and 20 days of incubation. The bacterial counts obtained after 15 days of incubation of the agar plates at 5° C were slightly lower, but comparable to those obtained using 20 days of incubation. During the early part of the study, the agar plates incubated at 5° C were counted after 7 days of incubation, but due to the smallness of the colonies and difficulty experienced in counting, the 7-day incubation period was considered impractical and was discontinued.

Data in Table 3 show the bacterial counts obtained from the same milk samples when agar plates prepared under identical conditions were incubated at 5° C and 10° C for 10, 15, and 20 days. These results show that in all cases, regardless of the length of the incubation period, the bacterial counts obtained using 10° C incubation temperature were higher than the bacterial counts obtained using a 5° C incubation temperature.

On the agar plates incubated at 10° C there were some colonies that developed during the first 10 days of incubation and another group which did not appear until after 15 days of incubation.

A comparison of some of the characteristics of the organisms which develop during the first 10 days of incubation of the agar plates at 10° C with those of the organisms that developed colonies between the tenth and twentieth day of incubation is shown in Table 4. These results show that the majority of the organisms which develop during the first 10 days of incubation at 10° C did not survive laboratory pasteurization at 61.7° C for 30 minutes, and that most of them were capable of growing at 35°, 10°, and 5° C. The organisms which developed colonies on the agar plates incubated at 10° C, only after 10 days or more of incubation, were found to resist laboratory pasteurization and grow at 35 and 10° C. However, only a small number (17.9 percent) of these heat-resistant organisms were capable of growing at 5° C during a 20-day incubation period.

TABLE 1—BACTERIAL COUNTS OBTAINED FROM COMMERCIALLY PASTEURIZED MILK OF DIFFERENT AGES WHEN PLATES WERE INCUBATED AT 10° C FOR VARIOUS PERIODS OF TIME.

Time (days) milk stored at 5° C	Number of samples	Logarithmic average of bacterial counts obtained when the plates were incubated at 10° C for			
		7 days	10 days	15 days	20 days
0	16	35	70	520	5,840
3	16	23	96	1,080	10,600
7	14	310	390	1,100	7,930
10	14	6,500	8,200	10,800	21,000
14	11	665,000	672,000	676,000	742,000
17	10	5,480,000	7,120,000	7,200,000	7,940,000
21	9	16,700,000	19,000,000	20,900,000	21,300,000
24	9	39,300,000	43,500,000	48,800,000	47,500,000

TABLE 2—BACTERIAL COUNTS OBTAINED FROM COMMERCIALLY PASTEURIZED MILK OF DIFFERENT AGES WHEN PLATES WERE INCUBATED AT 5° C FOR VARIOUS PERIODS OF TIME

Time (days) milk stored at 5° C	Number of samples	Logarithmic average of bacterial counts obtained when the plates were incubated at 5° C for		
		10 days	15 days	20 days
0	16	7	9	11
3	16	11	18	25
7	14	59	130	220
10	14	1,120	6,230	6,390
14	13	99,700	198,000	236,000
17	13	1,840,000	3,270,000	3,520,000
21	12	2,200,000	9,600,000	10,000,000
24	13	3,300,000	26,800,000	27,900,000

DISCUSSION

Differences in incubation temperatures used by various investigators appear to account, in part, for variations in counts of psychrophilic bacteria. The results of this study showed that incubation temperatures (10° C) resulted in the inclusion of an additional group of organisms which were not included in the counts obtained when incubation temperatures of 5° C were employed.

Many of those organisms that grew on agar plates incubated at 10° C appeared to be thermoduric and therefore are not considered to be true psychrophiles, as true psychrophiles are considered to be killed by proper pasteurization[5, 11].

TABLE 3—BACTERIAL COUNTS OBTAINED FROM COMMERCIALLY PASTEURIZED MILK OF DIFFERENT AGES WHEN PLATES WERE INCUBATED AT 5 AND 10° C FOR VARIOUS PERIODS OF TIME

Time (days) milk stored at 5° C	Logarithmic average bacterial counts obtained when agar plates were incubated at 5 and 10° C for					
	10 days		15 days		20 days	
	5° C	10° C	5° C	10° C	5° C	10° C
0	7	70	9	520	11	5,840
3	11	96	18	1,080	25	10,600
7	59	390	130	1,100	220	7,930
10	1,120	8,200	6,230	10,800	6,390	21,000
14	99,700	672,000	198,000	676,000	236,000	742,000
17	1,840,000	7,120,000	3,270,000	7,200,000	3,520,000	7,490,000
21	2,200,000	19,000,000	9,600,000	20,900,000	10,000,000	21,300,000
24	3,300,000	43,500,000	26,000,000	48,800,000	27,900,000	47,500,000

These thermoduric organisms did not grow well at 5° C. This is in agreement with Atherton, Doan, and Watrous[2], who state that thermoduric organisms do not show growth in 15 days when incubated at 45° F (7.25° C) but show marked growth at 50° F (10° C). In view of these results, it appears that if true psychrophiles are to be determined an incubation temperature of 10° C is too high, and the changes in Standard Methods[9] to an incubation temperature of 5° C are justified.

The data in this study show the bacteria counts of freshly pasteurized milk obtained by incubating the agar plates at 5° C were low, and that maximum counts were not obtained in less than 20 days of incubation. Shorter incubation periods for plates held at 5° C may be justifiable in the interest of time. However, it appears that 15 days of incubation at 5° C is necessary for reasonably accurate psychrophilic counts on fresh milk and that 20 days of incubation will yield even slightly higher counts.

TABLE 4—HEAT RESISTANCE AND GROWTH OF TWO GROUPS OF ORGANISMS ISOLATED FROM AGAR PLATES INCUBATED AT 10° C WHEN INCUBATED AT VARIOUS TEMPERATURES

Cultures isolated	Number of cultures	Withstood Pasteurization	Percentage of cultures that grew at		
			35°C	10°C	5°C
At 10 days	40	32.5	82.5	100	82.5
After 15 days	39	100.0	100.0	100	17.9

SUMMARY

A study has been made of the effect of incubation time and temperature on the determination of psychrophilic bacteria in milk.

The incubation of agar plates at 10° C resulted in the detection of a group of thermoduric organisms which was not found when agar plates were incubated at 5° C. These organisms are not considered to be true psychrophiles.

Bacterial counts on milk obtained using 5° C and 10° C incubation temperatures did not coincide regardless of the incubation period. The counts obtained using the 10° C incubation temperature were always higher than those obtained at 5° C for a similar period.

Maximum bacterial counts on milk samples stored at 5° C for 10 days or less were not obtained in less than 20 days when the agar plates were incubated at 5° C.

REFERENCES

1. American Public Health Association. *Standard Methods for the Examination of Dairy Products.* 9th ed., American Public Health Assoc., 1790 Broadway, New York. 371 pp. (1948).

2. Atherton, H. V., F. J. Doan, and G. W. Watrous. Observations on Bacterial Population and Characteristics of Bottled Milk Under Refrigerated Holding. *J. Dairy Sci.* **37**, 570 (Abst.) (1953).

3. Burgwald, L. H., and D. V. Josephson. Keeping Quality of Pasteurized Milk. *Ibid.* **30**, 371-383. (1947).

4. Dahlberg, A. C., H. S. Adams, and M. E. Held. Sanitary Milk Control and its Relation to the Sanitary Nutritive and Other Qualities of Milk. Natl. Acad. Sci., Washington, D. C., *Natl. Research Council Publ.* 250. 174 pp. (1953).

5. Erdman, I. E., and H. R. Thornton. Psychrophilic Bacteria in Edmonton Milk and Cream. I. Numbers. *Canadian Jour. Technol.* **29** (5), 238-242 (1951); *J. Dairy Sci.* **35**, A9. (1952).

6. Kennedy, Lura and H. H. Weiser. Some Observations on Bacteria Isolated From Milk That Grew Within a Psychrophilic Temperature Range. *J. Milk & Food Technol.* **13**, 353-357. (1950).

7. Nelson, F. E. and M. P. Baker. The Influence of Time and Temperature of Plate Incubation Upon Bacterial Counts of Market Milk and Related Products, Particularly After Holding Under Refrigeration. *Ibid.* **17**, 95-100. (1954).

8. Pennington, M. E. Bacterial Growth and Chemical Changes in Milk Kept at Low Temperatures. *J. Biol. Chem.* **4**, 353-393. (1908).

9. Robertson, A. H., Chairman, *Standard Methods for Examination of Dairy Products,* Personal communication. New York State Department of Agriculture and Marketing. Albany, New York. 1952.

10. Thomas, S. B., and C. V. Chandra Sekhar. Psychrophilic Bacteria in Raw and Commercially Pasteurized Milk. *Proc. Soc. Appl. Bact.* **1**, 47-50 (Abst.) (1946).

11. Watrous, G. H., Jr., F. J. Doan, and D. V. Josephson. Some Bacteriological Studies on Refrigerated Milk and Cream. *Pa. Agr. Expt. Sta. Bull.* 551 16 pp. (1952).

IMPORTANT PUBLICATIONS ON FOOD LAW

The manuscript of the sixth Food Law Institute research book has been completed and delivered to the Commerce Clearing House in Chicago, for 1954 publication in the "Food Law Institute Series." It is an annotated compilation of the special federal food and drug laws which supplement the major Federal Food, Drug, and Cosmetic Act; and in turn, it supplements the Kleinfeld-Dunn compilations of the legislative, administrative, and judicial record of that Act. This new book is jointly edited by Professor Thomas W. Christopher of the Emory University Law School at Atlanta, and Charles Wesley Dunn. A FLI basic research study on the constitutionality and court decisions of the federal and state food and drug laws is now being written up, scheduled for publication in 1955.

The seventh book now being published is an annotated compilation of the *general* state food and drug laws, giving their legislative and judicial record in each instance. Annotated compilations of the special state food and drug laws are being prepared for publication in 1955. This book is authored by David H. Vernon and Franklin M. Depew.

The eighth research book is a compilation of the product liability cases, relating to food and drugs and cosmetics. It is divided into two parts. The first part includes all the reported cases decided during the years 1947-1953, inclusive. The second part includes leading cases previously decided. This book will contain guiding tables of these cases and a comprehensive index to them; and it is also an invaluable reference manual on its subject. It is a book jointly edited by Frank T. Dierson and Charles Wesley Dunn. It will supplement the comprehensive research study of these cases, now being prepared by William J. Condon. The latter book will require several years for its completion.

RELATION BETWEEN REDUCTION TIMES AND PLATE COUNTS OF MILK BEFORE AND AFTER PASTEURIZATION

C. K. Johns
Department of Agriculture, Ottawa, Canada

(Received for publication, August 20, 1954)

The correlation between methylene blue and resazurin (triple reading) reduction times and the plate count before and after laboratory pasteurization has been studied. Both dye tests gave closely comparable "r" values. These were higher during the warmer months, especially for thermoduric bacteria. Although both tests were effective in detecting excessive numbers of these organisms, their efficiency was lower during the cooler weather.

A reasonably close agreement between the results of the modified methylene blue or the resazurin (triple reading) reduction tests and the plate counts of raw milks has been generally accepted. It has been contended, however, that reliance on dye reduction tests leads to higher counts on the pasteurized milk, since many thermoduric organisms are only weakly reducing[4, 9a, 10, 14]. So far, few data have been published concerning the effectiveness of these tests in detecting excessive numbers of thermoduric organisms, although the need for such was emphasized by Abele[1]. This paper presents some findings obtained in connection with other investigations in 1951 and 1952, wherein plate counts before and after laboratory pasteurization were compared with methylene blue and resazurin reduction times for the raw milk.

Methods

Except where specifically indicated, the various tests were conducted in accordance with the *Standard Methods for the Examination of Dairy Products*[3]. Samples of mixed herd milks were obtained from the weigh-cans of local dairies, brought to the laboratory at once, and dispensed into test-tubes. Reduction tests were usually started at once, and plate counts made without delay. In laboratory pasteurization 10-ml portions of milk were heated to 61.7°C for 35 minutes in a thermostatically controlled water-bath, then quickly cooled and plated. Resazurin colour readings[9] were recorded every 30 minutes during the first 3 hours and then every hour. Methylene blue readings were made every 30 minutes and were so recorded. For convenience in analysing the data, the time required to change the colour beyond the Munsell P 7/4 shade of mauve has been taken as the resazurin reduction time. Plates were incubated at 32° C for 48 hours.

Results and Discussion

To facilitate comparison of results, scatter diagrams were prepared showing the corresponding reduction times and plate counts obtained for each sample. In addition, the data were analysed statistically. The coefficient of correlation "r", together with the corresponding transformed value $z = \frac{1}{2} \log_e \frac{(1+r)}{(1-r)}$, is shown on each graph. The coefficient of regression is also represented by the dotted diagonal line. Where reduction time is plotted against log. plate count, the solid diagonal line indicates the equivalent values specified in the *Standard Milk Ordinance* of the U. S. Public Health Service[15]. Where reduction times by methylene blue are compared directly against those by resazurin, least squares regression lines were determined; these also are shown as dotted diagonal lines.

In addition to measuring the sensitivity of each dye test to change in observed plate counts by regression coefficients, reproducibility of results was examined by means of standard deviations of variations of reduction times about the respective regression lines.

In Figures 1 and 2 are shown the data for plate counts and reduction times for raw milks in May and June 1951. The "r" values of −0.87 and −0.92 indicate good agreement. In Figure 3 the results by the two reduction tests are compared against one another. The reduction times generally approach the 1:2 ratio for resazurin : methylene blue postulated in the *Standard Milk Ordinance*, with an "r" value of +0.88. This relationship deteriorates beyond 3 and 6 hours respectively but this is of minor importance since there is ordinarily little interest in values beyond these limits. Where reduction time with resazurin was unusually short, leucocytes in excess of 500,000 per ml were frequently encountered;

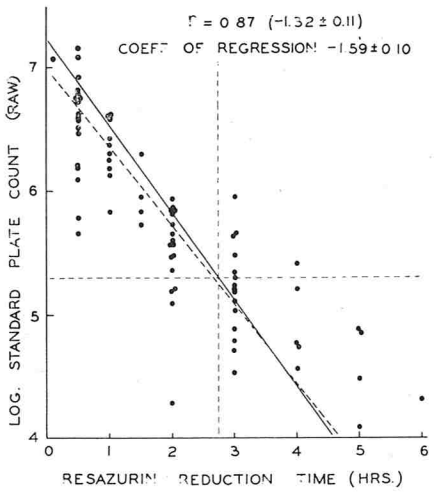


Figure 1 — Resazurin reduction times and log. plate counts on 75 samples. May — June 1951.

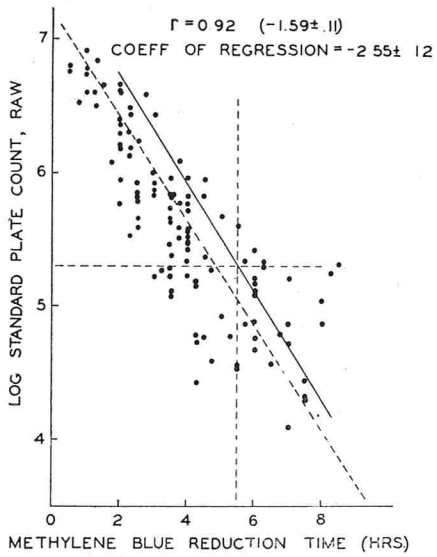


Figure 2 — Methylene blue reduction times and log. plate counts on 116 samples, May — June 1951.

this is known to hasten resazurin reduction to the Munsell P 7/4 end point [5, 6, 7, 9, 10]. (By excluding milks with more than 500,000 leucocytes per ml, Hempler[7] obtained a very high correlation coefficient, "r" = +0.970.) This sen-

*Contribution No. 378, Bacteriology Division, Science Service, Canada Department of Agriculture, Ottawa.

sitivity to 'abnormal' milk adversely affects the correlation with the plate count (Fig. 1); methylene blue reduction time (Fig. 2) is not appreciably affected by the presence of leucocytes.

Of the 148 milks produced in a cooler period (March - April, 1952) (Figures 4 and 5) a much higher percentage of samples with plate counts exceeding 200,000 per ml failed to reduce resazurin in 3 hours, or methylene blue in 6 hours, even though the correlation coefficients ($r = -0.80$ and -0.79 respectively) are fairly high. They compare quite well with those of $r = -0.758$ and -0.767 respectively reported for winter "normal" milks[7].

The longer average reduction

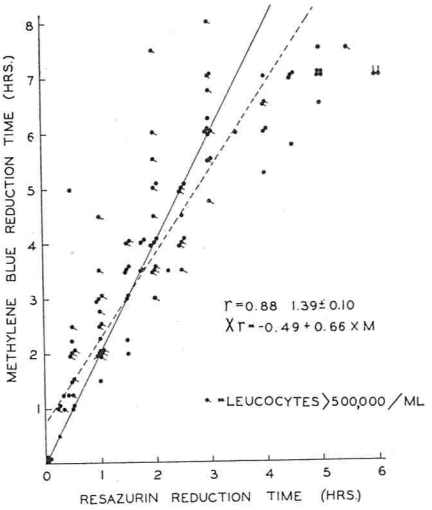


Figure 3—Methylene blue and resazurin reduction times on 101 samples, May — June 1951.

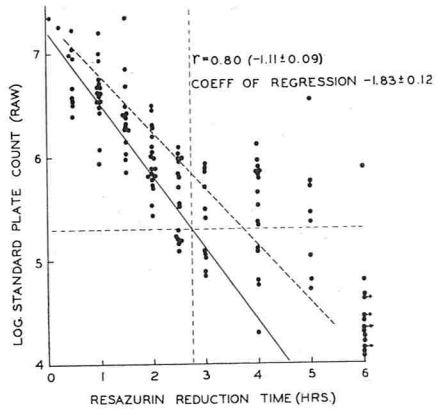


Figure 4 — Resazurin reduction times and log. plate counts on 125 samples, March — April 1952.

time in the cooler months for a given plate count is of interest. Hempler[7] obtained similar results,

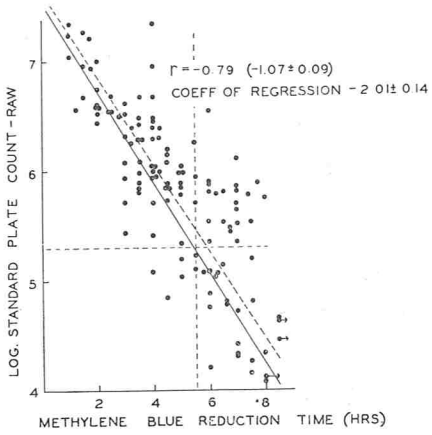


Figure 5 — Methylene blue reduction times on plate counts on 125 samples, March — April 1952.

although his equivalent plate count values were much lower than ours, since he incubated his plates at 37°C, while we used 32°C. Abele[1], on the other hand, reported higher average equivalent counts in summer. The use of the older procedure—incubation of methylene blue tubes without agitation — in his studies scarcely explains the difference.

The correlation between the results of the two dye reduction tests for March — April 1952 is shown in Fig. 6. Comparison with Fig. 3 indicates a slight but insignificant decline in the "r" value during the cooler months (0.88 to 0.83). The 1:2 ratio is again maintained fairly closely up to the 5½ hours reduction time for methylene blue; beyond this there is an increasing degree of scatter. Here again a high leucocyte content is frequently associated with a shorter-than-average resazurin reduction time.

These findings support the view that for the raw milks there was no statistically significant difference in correlation between either of the two dye reduction tests and the plate count at 32°C during either sampling period.

In Figures 7 to 10 the reduction times of the *raw* milks are compared with the plate counts *after* laboratory pasteurization. Figures 7 and 8 show that during the warmer period, all samples with plate counts over 30,000 per ml reduced resazurin in 3 hours or methylene blue in 5½ hours. Consequently, a milk supply meeting these reduction test standards should have no difficulty in meeting a 30,000 per ml limit for the pasteurized product. Practical studies recently carried out at the University of Manitoba[2] support this view.

For the cooler months, (Figures 9 and 10) it is evident that although the slopes of the regression lines for both dye tests are similar to those for the warmer months (Figures 7 and 8), in Figures 9 and 10 a given reduction time represents a much higher plate count. Consequently, more samples with counts after pasteurization exceeding 30,000 per ml failed to bring

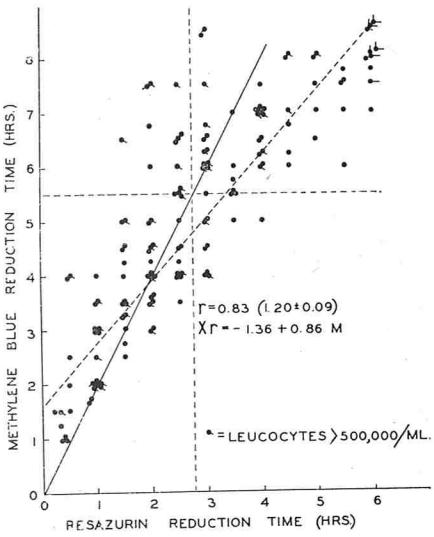


Figure 6—Methylene blue and resazurin reduction times on 148 samples, March — April 1952.

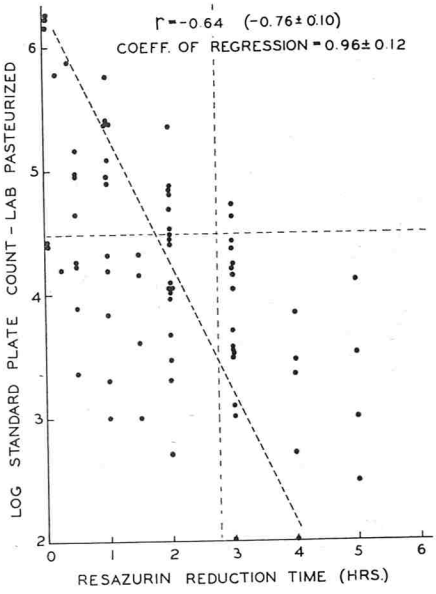


Figure 7 — Resazurin reduction times (raw) and plate counts (pasteurized), May — June 1951.

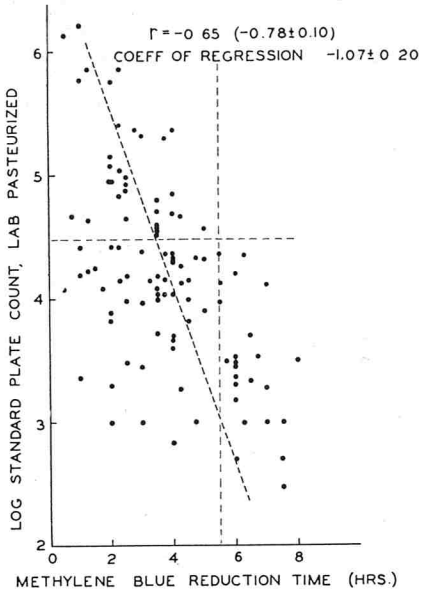


Figure 8 — Methylene blue reduction times (raw) and plate counts (pasteurized), May — June 1951.

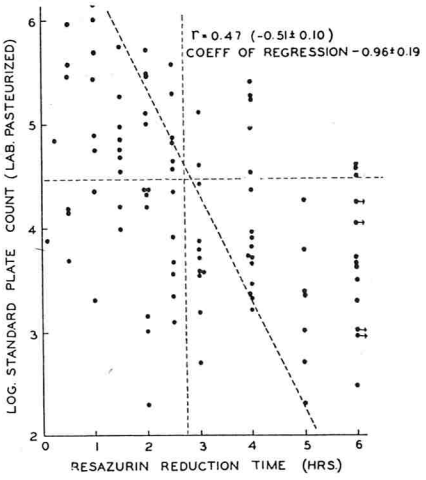


Figure 9 — Resazurin reduction times (raw) and plate counts (pasteurized), March — April 1952.

about reduction in 3 or 5½ hours respectively. Nevertheless, each test detected nearly 75 percent of the high count samples. These seasonal differences suggest that consideration should be given to the use of longer reduction time standards for the cooler months.

The comparative reproducibility of results by the two reduction tests is indicated by the standard deviations measuring the variations of recorded reduction times about the respective regression lines. These were as follows:

	S.P.C. Raw	
Methylene blue	0.82	1.22
Resazurin	0.69	1.04
	S.P.C. Pasteurized	
Methylene blue	1.63	1.71
Resazurin	1.14	1.64

Considered collectively for both years, this residual variation was significantly greater for methylene blue than for resazurin reduction time, i.e., the resazurin results were generally more reproducible. Results were significantly less variable in 1951 than in 1952.

SUMMARY AND CONCLUSIONS

Reduction times by the resazurin triple reading test and the methylene blue reduction test approximated a 1:2 ratio. Results by both tests showed higher correlation with the plate count at 32°C during the warmer months. This held true also when the reduction times of the *raw* milks were compared with the plate counts *after* laboratory pasteurization. No milks with over 30,000 per ml thermoduric bacteria showed reduction times in the warmer months in excess of 3 hours for resazurin, or 5½ hours for methylene blue; during the cooler weather, however, over 25 percent exceeded these limits.

ACKNOWLEDGEMENTS

Grateful acknowledgement is made to Mr. C. Reimer of the Biometric Unit, Science Service, for statistical analysis of the data, and to Mr. J. G. Desmarais for technical assistance.

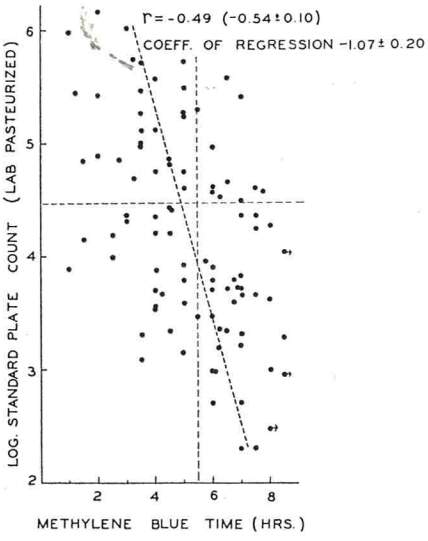


Figure 10 — Methylene blue reduction times (raw) and plate counts (pasteurized), March — April 1952.

REFERENCES

1. Abele, C. A. *J. Milk Tech.* 8, 67-79, (1945).
2. Brown, R. W. Unpublished results furnished by Manitoba Dept. of Health and Public Welfare, July 20, 1954.
3. American Public Health Association. *Standard Methods for the Examination of Dairy Products.* 9th Ed. New York, N.Y. 1948.
4. Egdell, J. W. and Bird, E. R. *Dairy Ind.* 16 (2), 143-156, (1951).
5. Frayer, J. M. *Vt. Agr. Exp. Sta. Bull.* 435, 1938.
6. Hempler, P. *Resazurin As Indicator in Reduction Tests of Milk.* Mortensen, C. A., Copenhagen (1950).
7. Hempler, P. *Proc. XIIIth International Dairy Congr.* II, 255-263, 1953.
8. Johns, C. K. *Amer. J. Pub. Health* 29, 239-247, (1939).
9. Johns, C. K. and Howson, R. K. *J. Milk Tech.* 4, 320, (1940).
9a. Johns, C. K. and Howson, R. K. *J. Dairy Sci.* 23, 295-302. (1940).
10. Ramsdell, G. A., Johnson, W. T., Jr., and Evans, F. R. *J. Dairy Sci.* 18, 705, (1935).
11. Thomas, R. C., Levine, B. S., and Black, L. A. *Amer. J. Pub. Health* 38, 233-238, (1948).
12. Thomas, S. B., Thomas, B. F., and Davies, J. *Proc. Soc. Agr. Bact.* 31, 1939.
13. Thomas, S. B. and Probert, D. *Ibid.* 34, 1940.
14. Thomas, S. B., Griffiths, D.G., and Thomas, B. F. *J. Soc. Dairy Tech.* 5, 331-334, (1952).
15. U.S. Public Health Service. *Standard Milk Ordinance and Code.* Public Health Bull. 220, 1951.

OREGON DAIRY SHORT COURSE

The 44th annual dairy industries short course and convention will be held at Oregon State College, Corvallis, February 14-17, 1955. A committee with Robert Stachwick of Damascus Milk Company, Portland, as chairman, has been active in planning the program for the four-day meeting. Several top-flight men from different parts of the United States will appear on the program. Professor H. B. Henderson, head of the Dairy Department, University of Georgia, will be one of the visiting instructors. The last day will be devoted to discussions on merchandizing and selling dairy products. The main speaker at the annual banquet of the Oregon Dairy Industries Association on February 17 will be Dr. Richard Werner, Executive Director, Milk Industry Foundation, Washington, D. C.

A BACTERIOLOGICAL STUDY OF COTTAGE CHEESE WITH PARTICULAR REFERENCE TO PUBLIC HEALTH HAZARD*

P. Robert Lyons, M.S. and W. L. Mallmann, Ph.D.
Lansing Ingham County Health Department
and
Department of Bacteriology and Public Health
Michigan State College, East Lansing, Michigan
(Received for publication, September 3, 1954)

Bacterial contamination of public health significance was determined on 150 samples of market cottage cheese. The study was made over a period of one year, and the packaged cheese was obtained from eight different manufacturers.

Line runs were made at the dairy plants to determine the exact areas of contamination in the manufacturing process.

Various pathogenic organisms were introduced into cottage cheese to determine if cottage cheese would support the growth of such organisms or if it could act as a means of transmission of such pathogens.

Few city ordinances provide specifically for the sanitary production and handling of cottage cheese. The ordinances specify careful sanitary inspections of milk plants, and although the inspections cover all phases of milk processing, emphasis is always placed on fluid milk production.

Cottage cheese manufacturing and packaging in most milk processing plants is a hand process wherein contamination by the workers is possible. The process is in marked contrast to the modern mechanical methods used in processing fluid milk.

Years ago milk was sold in bulk to retailers for resale to their customers. The retailer would then ladel the milk into the customer's own container. Recognition of the health hazards involved in such practice was quickly followed by the enactment of regulations prohibiting bulk sale to the consumer and the requirement of approved containers. Yet today, thirty-seven years after bulk milk sales were outlawed, in Michigan the sale of bulk cottage cheese is still permitted[1].

The fact that the handling of cottage cheese is still a hand process has not been due to negligence by the manufacturer and health official. It has been assumed that the acidity of cottage cheese protected the product against contamination. It is true that cottage cheese in the past was more acid than the present product. Incomplete cooking of the curd resulted in a larger amount of lactose being incorporated in the curd. The lactose made possible a later fermentation and an increase in acidity.

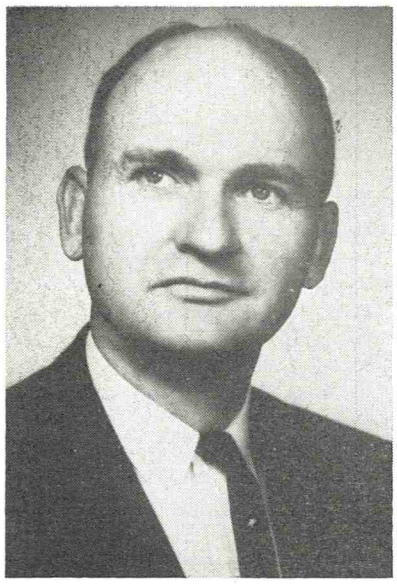
More recent practice, undoubtedly motivated by consumer demand, is for completely cooked curd with thorough rinsing and draining. This results in most of the lactose being expelled with the whey in the draining operation, and checks the rapid production of acid in the finished product. This bland cheese is quite different from the cottage cheese of twenty or thirty years ago, and yet the manufacturing methods used are essentially the same. Without the protection of high acidity in the finished product, greater care and stricter sanitary precautions are necessary to produce a safe product.

Examination of Samples

In view of the above facts this study was undertaken to determine if the commonly used methods of cottage cheese production and packaging actually constitute a public health hazard, or if, on the other hand, the product still remains sufficiently acid to warrant its casual handling by the manufacturer and disinterest on the part of the public health official.

Samples of cottage cheese were obtained from eight dairies, six of which were under public health inspections as required by city ordinances, and two creameries which were without such inspections.

Packages of cheese were obtained at plant storage points and retail outlets. The samples were collected at intervals over a twelve-month period, and tests were made within twenty-four hours of the time collected.



Robert Lyons received the B. S. degree from Michigan State College in 1940 and the M. S. degree in 1953.

From 1940 to 1942 he was employed by the Sealtest Corporation in dairy plant supervision, and from 1942 to 1945 was Laboratory Director for the McDonald Co-op Dairy at Flint, Michigan. Since 1945 he has been associated with the Lansing-Ingham County Health Department, and at the present time is Chief Dairy Sanitarian for that department.

He is Secretary-Treasurer of the Michigan Association of Sanitarians, a member of the Board of Directors of Michigan Allied Dairy Association, and a member of Lambda Chi Alpha.

According to *Standard Methods for the Examination of Dairy Products*[2] the coliform test constitutes by far the most delicate method available for detecting recontamination of dairy products. Inasmuch as the problem is entirely one of recontamination by handlers and improperly sanitized equipment, the coliform test was chosen as the most exact instrument to obtain the necessary data.

Cottage cheese was tested for the presence of coliforms through the use of 2 percent brilliant green bile broth tubes or desoxycholate agar in accordance with the standards set up by the A.P.H.A.[2]. Both media were used so that comparative counts could be obtained and, if deemed advisable, isolation from the solid media could be accomplished by picking off individual colonies and subjecting them to

*Journal Article 1630, from the Michigan Agricultural Experiment Station.

further study. Inasmuch as the results were similar only those obtained with 2 percent brilliant green bile broth are reported.

Every effort was made to obtain samples representative of the production of each plant. Nothing was said or done to persuade the cheese processors to alter in any way their usual methods of handling. Samples were selected at random from the total day's production. Of course, the fact that samplings were being made would tend to make the handlers a little more careful in their methods, but, as will be shown, this does not seem to have made any significant difference in the final results.

A Waring blendor was sterilized by washing thoroughly with a detergent wetting agent, and soaking for thirty minutes in a 500-ppm sodium hypochlorite solution. After soaking, it was rinsed in running water for about ten minutes. Checks for free chlorine and possible carry-over of alkali from the chlorine solution were made by thiosulphate titration and by checking with the Beckman pH meter. There was no indication that the chlorine solution was carried over after the blendor had been rinsed for ten minutes in running water.

One hundred ml of sterile distilled water was put into the sterile Waring blendor. The machine was run a few seconds and then 1-ml amounts of the water were placed in each of three brilliant green bile broth tubes. Dilutions of 1-10 and 1-100 were made on desoxycholate agar by putting 0.1 ml of the water into a Petri dish and by putting one ml of the water into a 99-ml dilution blank and transferring 1 ml of this dilution to a Petri dish. Desoxycholate agar was then added to these Petri dishes and mixed with the water being tested. These two tests constituted a sterility control on the Waring blendor.

Using aseptic precautions, 10 gm of cottage cheese to be sampled were weighed out and added to the 90 ml of sterile water in the Waring blendor. After rendering the mixture homogeneous, 1.0-ml amounts were transferred to each of five brilliant green bile fermentation tubes, and dilutions of 1-10 and 1-100 were made into desoxycholate agar by the same methods described above in plating the water used as a sterility control. These samples, as well as all samples in this study, unless specifically stated otherwise, were incubated at 37° C.

A sufficient quantity of the mixture was also removed at this point to determine the pH of the cheese with a Beckman pH meter. The pH determination on over 150 samples of market cottage cheese revealed that the pH was between 4.7 and 5.5, with over 80 percent of the samples falling between 5.0 and 5.5. The pH of such cheese, consequently, was within the range tolerated by the coliform organisms.

Counts on the brilliant green bile tubes were taken at twenty-four and forty-eight hours. It was found that about 67 percent of the samples collected contained coliforms in the amount of 220 organisms or more per hundred grams of cheese. The percentage of positive samples collected from each dairy varied from 33 to 100 percent (Table 1).

There seemed to be no correlation between the individual dairy plant's ability to produce coliform-free bottle products and its ability to produce coliform-free cottage cheese. Plants with excellent records for bottled products had rather high percentages of coliform-contaminated cheese samples at times, and this was variable from plant to plant.

CONTAMINATION

Ninety-five percent of all samples of cheese that were obtained from bulk displays in meat markets, groceries, and delicatessens were found to be contaminated with coliforms (Table 2). These samples showed heavier contamination than those obtained from plant-filled cartons.

The mechanization of all steps in the processing and packaging of cottage cheese can do much toward eliminating this contamination if the product is finally packaged into a single-service container at the plant. This was demonstrated by Dairy 5 (Table 3). This dairy converted its cheese processing from hand process to a completely mechanical one. Prior to this mechanization there was no evidence that Dairy 5 was able to produce cheese samples with fewer than 64 percent being contaminated with coliforms. After complete mechanization, the percentage dropped to 33.

The degree of contamination can easily be reduced to zero by closer application of the same sound cleaning and sanitizing practices that are commonly used on other milk-handling equipment used in this plant.

Inasmuch as a large percent of market cottage cheese samples was contaminated with coliforms, tests were made to determine the source of the contamination. With such information, control measures could then be more intelligently applied directly to the points that need improvement.

If, for example, the coliform organisms were getting into the cheese during processing, a study could be made of methods of cheese processing that might eliminate this contamination. If, on the other hand, the source of contamination was found at the packaging table, then efforts could be directed toward more sanitary packaging procedures.

Line samplings were made in six of the eight dairies from which cottage cheese samples had been obtained previously. The samplings followed the line of production through the dairy plant.

The line sampling was as follows: (1) raw skim milk in vat before pasteurization; (2) the same milk after pasteurization; (3) milk in cheese vats after passing through piping and pumps, but before starter had been added; (4) the same milk after starter had been added; (5) the milk after processing into curd and with the curd draining in the vat; (6) cream to be used in creaming the finished curd; and (7) the finished package.

These samples of milk and cheese were brought into the laboratory and tested within twenty-four hours after collection. All samples were collected in sterile tubes or water bottles using sterile pipettes or wooden tongue depressors to convey the sample into the tube or bottle. Brilliant green bile broth was used and all samples were incubated at 37° C for twenty-four and forty-eight hours, reading being taken at the end of both periods.

One-ml amounts of milk were put into 10 ml of brilliant green bile broth in fermentation tubes. The cheese was tested in the same manner as described, with the exception that desoxycholate agar was not used.

Coliform organisms were fairly plentiful at all sampling points in the line of production, with the exception of those samples taken out of the pasteurizing vat at the end of the pasteurizing period. All test runs made followed the pattern indicated in Table 4. Raw skim milk, as would be expected, was found to contain coliforms in all samples taken. After pasteurization, this coliform count dropped to zero. After the milk had reached the cheese vats, having passed through pumps and piping, 80 percent of all samples collected yielded coliforms. The addition of a starter did not change this figure. It is apparent that the piping, pumps, and vats concerned contributed heavily to the increase in coliform-positive samples.

After the skim milk had been processed into curd and the curd was piled at the side of the vat to drain, only 18 percent of the samples taken at this point yielded coliforms. This drop in coliform-positive samples may be attributed to two factors. One would be the cooking of the curd, in which moderate heat (120° to 130° F) gently shrinks the curd and expels the whey and occluded bacteria, and, secondly, the washing of the curd with clear water to free the curd of whey, which follows the cooking.

The cream used to cream the curd just prior to packaging showed a significant coliform content in 45 percent of all samples collected. This cream was taken from the same vat as that which is bottled for market cream sales. It is important to note that the cream, when it was ready to be used for cottage cheese creaming, had a high coliform content, although the cream taken from the same vat for bottle use did not. This was due primarily to the fact that it was stored and handled in ten-gallon milk cans of questionable cleanliness.

TABLE 1—THE COLIFORM INCIDENCE OF COTTAGE CHEESE PACKAGED AT PLANT

Dairy no.	No. of samples	No. of positive samples in 5 tubes of brilliant green bile broth					Total no. positive samples	Percent positive samples	Av. MPN
		1/5	2/5	3/5	4/5	5/5			
1	16	..	..	7	..	2	9	56	1060
2	18	1	1	2	..	2	6	33	810
3	25	4	1	2	..	8	15	60	850
4	12	3	..	..	2	2	7	60	690
5	14	4	2	1	1	1	9	64	480
6	12	2	1	1	2	4	10	83	940
7	16	..	1	1	2	10	14	87	1530
8	18	..	1	1	2	14	18	100	1040
Totals	131	14	7	15	9	43	84	64	

84% of all samples had a pH of 5.0 to 5.6.

TABLE 2—THE COLIFORM INCIDENCE IN COTTAGE CHEESE IN BULK AT RETAIL OUTLETS

Dairy no.	No. of samples	No. of positive samples in 5 tubes of brilliant green bile broth					Total no. positive samples	Percent positive samples	Av. MPN
		1/5	2/5	3/5	4/5	5/5			
1	10	...	3	1	1	4	9	90	1080
2	11	...	2	2	3	4	11	100	1220

TABLE 3—COMPARATIVE COLIFORM INCIDENCE IN COTTAGE CHEESE PROCESSED AND PACKED BY HAND AND MECHANICALLY

Dairy no.	No. of samples	No. of positive samples in 5 tubes of brilliant green bile broth					Total no. positive samples	Percent positive samples	Av. MPN
		1/5	2/5	3/5	4/5	5/5			
		Hand processed and packaged							
5	14	4	2	1	1	1	9	64	480
		Mechanically processed and packaged							
5	12	3	1	...	...	...	4	33	262

TABLE 4—THE COLIFORM INCIDENCE IN THE VARIOUS STAGES OF PROCESSING AND PACKAGING COTTAGE CHEESE

No. of runs	Raw skim milk	Skim milk in vat after pasteurization	Skim milk with starter added	Washed curd	Cream to be added	Finished Package
11	100	0	80	18	45	60

The finished package showed an additional increase in coliform content due to the bad packaging methods employed in all plants. Sixty percent of all such samples collected contained coliform organisms.

The line-run samplings in this study indicate a need for more complete sanitizing of all equipment used in cheese making. With properly sanitized piping and pumps, milk from the pasteurizing vats should reach the cheese vats with only a slight increase, if any, in coliform content. The processing of cheese, with comparatively mild heat and constant hand manipulation by the cheese maker would be expected to contribute coliforms to the product. This, however, is more than overcome by the thorough washing which the curd receives before being piled at the side of the vat to drain. The careful sanitization of all milk cans that are to be used for the storage of cream will aid in obtaining a more sanitary product. Hand packaging is admittedly the weakest link in the processing-packaging procedure. Here again, elaborate precaution such as a separate clean, light room, stainless steel equipment and packaging machines, and the careful and repeated sanitization of equipment and hands of the operator during the packaging procedure will possibly result in much higher-quality product. There is, of course, no substitute for complete mechanization throughout from pasteurization to the finished package.

INDICATED HEALTH HAZARD

It is apparent that growth of the bacteria used as test organisms is not a problem in cottage cheese handling. Survival was of sufficient duration to be considered a potential public health hazard. Cottage cheese is usually manufactured and consumed within a seven-day period. After that time, unless special storage precautions have been taken, the cheese may develop off-flavors and become generally unmarketable. Inasmuch as all the bacteria used as test organisms in this work survived for a sufficient length of time to be conveyed from packager to consumer, under the conditions in which cottage cheese is usually handled, it must be concluded that insanitary packaging of cottage cheese is a potential public health hazard.

Where hand methods are used in producing cottage cheese, extraordinary precautions must be taken if a clean, sanitary product is to be obtained. The thorough washing and sanitizing of equipment is, of course, of first importance. The careful scrubbing and sanitizing of milk cans for the storage of cream to be used in cheese production is essential. Beyond the use of clean sanitized equipment the most difficult part of the sanitary production of cottage cheese is the training of personnel to be used in this work. Because the sanitary quality of the work is so completely dependent upon the care of the operator, he should understand the necessity for clean hands, clean clothing, and constant watchfulness for minor errors in handling which will contribute to the poor sanitary quality of the finished package of cottage cheese.

The usual processing and packaging methods used in cottage cheese production leave several avenues through which various organisms may be introduced into the finished product.

Some of the organisms which may be introduced in this way include those of the enteric group, as well as various streptococci and staphylococci.

It was decided, therefore, to introduce some of these organisms into cottage cheese in the laboratory and determine the length of time that they would survive or possibly multiply.

The organisms used were *Escherichia coli*, *Streptococcus faecalis*, *Salmonella typhosa*, and *Micrococcus pyogenes*, var. *aureus*.

A number of studies have been made on the survival of various organisms in various types of media. Several of these studies reveal the importance of pH in the survival or growth of organisms. Fabian and Winslow[3], in 1939, determined the influence of anions on bacterial viability. They found that a bacterial population of over a hundred and sixty million on media at a pH of 4.9 dropped to a fifth of this number when the pH of the media was lowered to 4.6. A further drop of the pH to 4.4 lowered the number of surviving bacteria to approximately 7 percent of the original number.

Darby and Mallmann[4], in 1939, in their studies on media for coliform organisms, demonstrated that, at a pH of 6.8, an initial planting of 38 coliform organisms in a selective medium resulted in the growth of these organisms in forty-eight hours to 880,000,000. In this same experiment repeated at pH 7.8, the culture tubes being seeded with 35 organisms, resulted in the growth of the organisms to over 2.5 billion. This again demonstrated that, although bacteria may survive at extremes of pH, the optimum pH for their growth or for their destruction lies at a critical point or within very narrow ranges of pH.

Pure stock cultures of each of the four types of bacteria used were transferred to agar slants, and after forty-eight hours incubation at 37° C, each slant was rinsed with 5.0 ml of normal saline. One ml of this saline-bacteria mixture was transferred to 99-ml sterile water blanks, and from these blanks 1.0-ml quantities were transferred to agar plates to obtain a gross count of the numbers of bacteria present in 1.0-ml quantities.

M. aureus was plated on blood agar; the other three cultures were plated on nutrient agar.

Cartons of cottage cheese were tested, and only cartons free from coliforms and *S. faecalis* were selected for these experiments.

Twelve lots of 100 gm of cheese were mixed in the Waring blendor with 100 ml of sterile water. To each of these lots of cheese, 1.0-ml quantities of the bacterial suspensions were added. The four bacteria-cheese mixtures were divided into three groups so that each mixture would have a representative sample incubated at each of the three temperatures: 37° C; 10° C, the approximate temperature found in a mechanical refrigerator; and room temperature, 24° C.

After incubation at these temperatures, transfers were made from the cheese-bacteria mixtures in the amounts of 1.0, 0.1, and 0.01 ml into suitable media for the recovery of the viable bacteria.

The dilutions of the *E. coli*-

inoculated cheese were planted into brilliant green bile broth fermentation tubes.

The dilutions of the *S. faecalis*-inoculated cheese were planted into dextrose azide broth[5], and after incubation for twenty-four hours all positive tubes were transferred into ethyl violet azide broth[6].

The dilutions of the *M. aureus*-cheese mixture were also divided into three lots which were incubated at the three temperatures mentioned above. Survival was determined by smearing a loop from each sample on blood agar, incubating for forty-eight hours at 37° C, and identifying by hemolysis and microscopic examination.

The dilutions of the *S. typhosa*-cheese mixture were incubated in the same manner as described above. After incubation, 1.0-ml amounts were transferred into tetrathionate broth, and, after twenty-four hours incubation in this medium at 37° C, transplants were made into Kligler iron agar slants. Survival of the *S. typhosa* was determined by characteristic appearance on the Kligler slant.

The survival of bacteria in cottage cheese seemed to be closely linked to pH. When samples were incubated at 37° C, the pH dropped rapidly, and in ninety-six hours coliform organisms were destroyed at a pH of approximately 4.0. Cottage cheese, however, is stored and handled generally at temperatures ranging from 40 to 50° F. At these temperatures coliforms survived for about 182 hours, with the pH dropping to a minimum of 4.6.

This same picture seemed to hold true in the case of each of the other bacteria used. *S. faecalis* survived until a pH of 4.0 had been reached, and required 192 hours to reach this pH, when incubated at 37° C. When incubated at 10° C, *S. faecalis* required 240 hours to reach a pH of 4.6, at which point it was apparently destroyed.

The *M. aureus* survived until a pH of 4.2 had been reached. This pH was reached at an incubation temperature of 37° C in ninety-six hours. At 192 hours, samples incubated at 10° C reached a pH of 4.6, and when the pH dropped to 4.5, *M. aureus* was apparently destroyed.

S. typhosa survived for the shortest time of all the bacteria used. In forty-eight hours the samples incubated at 37° C and 24° C had dropped to a pH of 3.8, and the bacteria were apparently destroyed. At incubation temperature of 10° C *S. typhosa* survived until a pH of 4.8 had been reached. This required ninety-six hours of incubation.

SUMMARY

Consumer preference has brought into practice the production of a bland cottage cheese. The pH of such cheese lies within the range tolerated by the coliform organisms. With coliforms as the indicator, the foregoing data show that cottage cheese may well be considered a potential public health hazard.

Large percentages of all cottage cheese samples collected contained coliforms in amounts of 220 organisms per 100 gm of cheese or more.

Nearly all samples of bulk packaged cottage cheese were heavily contaminated with coliform organisms.

The mechanization of cottage cheese manufacturing and packaging is undoubtedly part of the solution to the production of a more sanitary cottage cheese; however, it must be conceded that elaborate precautions with hand methods may result in fairly satisfactory cheese production. Such production may compare favorably with average production by machine methods.

In general, however, judging from the data presented, an unsatisfactory condition exists in the field of cottage cheese manufacturing and packaging.

LITERATURE CITED

1. Act 258, *Public Acts of 1952 of the State of Michigan.*

2. *Standard Methods for the Examination of Dairy Products.* 9th edition, American Public Health Association, 1948.

3. Fabian, F. W., and C. E. A. Winslow. The Influence Upon Bacterial Viability of Various Anions in Combination with Sodium. *J. Bact.* 18 4, 275-77, (1929).

4. Darby, C. W., and W. L. Mallmann. Studies on Media for Coliform organisms. *J. Amer. Water Works Assoc.* 31, 696, (1939).

5. Mallmann, W. L., and E. B. Seligmann. A Comparative Study of Media for the Detection of Streptococci in Water and Sewage. *Amer. Jour. Pub. Health.* 40, 2, (1950).

6. Litsky, W., W. L. Mallmann, and C. W. Fifield. Submitted for publication. Dept. of Bact., Mich. State College; 6: 1952.

CODE FOR FARM MILK TANKS

(ADOPTED BY THE 39TH NATIONAL CONFERENCE ON WEIGHTS AND MEASURES, MAY 17-24, 1954, WASHINGTON, D.C.)

A. APPLICATION.

A.1. — This code applies to farm milk tanks, as defined, only when these are used, or are to be used, under an express contract between the producer and the purchaser and on the premises of the producer, for the commercial measurement of milk or other fluid dairy product. If such measurement is accomplished by means of a fluid meter, this code does not apply; in such case the meter shall be subject to the applicable provisions of the code for liquid-measuring devices.

D. DEFINITIONS.

D.1. *Farm Milk Tank.* — A unit for measuring milk or other fluid dairy product, comprising a combination of (1) a stationary tank, whether or not equipped with means for cooling its contents, (2) means for reading the level of liquid in the tank, such as a removable gage rod or a surface gage, and (3) a chart for converting level-of-liquid readings to gallons; or such a unit in which readings are made on gage rod or surface gage directly in terms of gallons. Each compartment of a subdivided tank shall, for purposes of this code, be construed to be a "farm milk tank." (These units are variously known commercially as "farm bulk milk tanks," "farm cooling tanks," "farm holding tanks," and "producers tanks.")

D.2. *Gage Rod.*—A graduated, "dip-stick" type of measuring rod designed to be partially immersed in the liquid and to be read at the point where the liquid surface crosses the rod.

D.3. *Surface Gage.*—A combination of (1) a stationary indicator and (2) a movable, graduated element designed to be brought into contact with the surface of the liquid from above.

S. SPECIFICATIONS

S.1. *Design.* (See also S.2.4.)

S.1.1. *Level.*—A farm milk tank shall be in normal operating position when it is in level. The tank shall be equipped with suitable special means by which this level

can be determined and established, such as a permanently attached two-way or circular level, a plumb bob, leveling lugs, or the like; or the top edge or edges of the tank shall be so constructed throughout as to provide an accurate reference for level determinations. The tank shall be so constructed that it will remain in level under all normal conditions of loading.

S.1.2. *Discharge Valve.*—A farm milk tank shall be equipped with a discharge valve through which the tank may be completely emptied when the tank is in level.

S.1.3. *Gage-Rod Bracket.*—If a farm milk tank is designed for use with a gage rod, a substantial gage-rod bracket shall be rigidly and permanently attached to the tank. The bracket and rod shall be so designed that, whenever the rod is placed in engagement with the bracket and released, the rod will automatically seat itself at a fixed height and will hang in a vertical position with a clearance of not less than 3 inches between the graduated side of the rod and the tank wall which it faces.

S.1.4. *Surface-Gage Bracket.*—If a farm milk tank is designed for use with a surface gage, a substantial surface-gage bracket shall be rigidly and permanently attached to the tank. The bracket and gage shall be so designed that, when the gage assembly is placed in engagement with the bracket, the indicator, if not permanently mounted on the tank, will automatically seat itself in correct operating position, and the graduated element will be vertically positioned and will be securely held at any height to which it may be manually set.

S.2. *Indicating Means.*

S.2.1. *Gage Rod.*—When seated on its bracket, the gage rod shall not touch the bottom of the farm milk tank. The rod shall be graduated throughout an interval corresponding to the gallonage range within which the tank is to be used, and in no case shall this range be less than the upper one-half of the tank capacity.

S.2.2. *Surface Gage.*—When properly engaged with its bracket and set to its lowest position, the surface gage shall not touch the bottom of the farm milk tank. The gage shall be graduated throughout an interval corresponding to the gallonage range within which the tank is to be used, and in no case shall this range be less than the upper one-half of the tank capacity.

S.2.3. *Spacing and Width of Graduations.* — On a gage rod or surface gage, the spacing of the graduations, center to center, shall be not more than 0.0625 (1/16) inch and not less than 0.03125 (1/32) inch; the graduations shall be not less than 0.005 inch in width, and the clear interval between adjacent edges of successive graduations shall be not less than 0.015625 (1/64) inch. (See also G-S.4.2.3.)

S.2.4. *Values Of Graduations.*— On a gage rod or surface gage, the graduations may be designated in inches and fractions thereof, or may be identified in a numerical series without reference to inches or fractions thereof. In either of these cases there shall be provided for each such rod or gage and each farm milk tank with which it is associated, a gallonage chart showing values in terms of gallons of liquid in the tank, corresponding to each graduation on the rod or gage. If a rod or gage is associated with but one farm milk tank, in lieu of linear or numerical-series graduations and gallonage chart, values in terms of gallons of liquid in the tank may be shown directly on the rod or gage. The value of a graduated interval (exclusive of the interval from the bottom of the tank to the lowest graduation) shall not exceed 1 gallon for a tank of a nominal capacity of 500 gallons or less, and shall not exceed 2 gallons for a tank of a nominal capacity of more than 500 gallons.

S.3 *Gallonage Chart.*—A gallonage chart shall show values at least to the nearest ½ gallon for a farm milk tank of a capacity of 500 gallons or less, and at least to the nearest 1 gallon for a tank of a capacity of more than 500 gallons. All letters and figures on the chart shall be distinct and easily readable, the chart shall be substantially constructed, and the face of the chart shall be so protected that its lettering and figures will not tend easily to become obliterated or illegible.

S.4. *Installation.* — A farm milk tank shall be rigidly installed in level without the use of removable blocks or shims under the legs. If the tank is not mounted permanently in position, the correct position on the floor for each leg shall be clearly and permanently defined.

S.5. *Identification*—A farm milk tank and any gage rod or surface gage and gallonage chart associated therewith shall be mutually identified, as by a common serial number, in a prominent and permanent manner.

N. NOTES

N.1. *Gaging and Testing*—Farm milk tanks shall be originally gaged and officially tested "to deliver."

N.2. *Testing Medium* — Water shall be used as the testing medium in gaging and testing farm milk tanks.

N.3. *Approval Seals* — When a farm milk tank is officially tested and approved, the gage rod or surface gage, and the gallonage chart if a chart is utilized, as well as the tank itself, shall be suitably marked to indicate such approval.

T. TOLERANCES

T.1. *Minimum Tolerance Values* —On a particular farm milk tank, the maintenance and acceptance tolerances applied shall be not smaller than one-half the value of the minimum graduated interval on the gage rod or surface gage.

T.2. *Basic Tolerance Values* — Basic maintenance and acceptance tolerances on underregistration and on overregistration shall be as shown in Table 1.

TABLE 1. BASIC MAINTENANCE AND ACCEPTANCE TOLERANCES FOR FARM MILK TANKS

Indicated gallonage	Tolerance Gallon
500 or less	½
501 to 1,000 incl.	1
1,001 to 1,500 incl.	1½
1,501 to 2,000 incl.	2
Over 2,000	2½

R. REGULATIONS

R.1. *Level Condition* — A farm milk tank shall be maintained in level.

AFFILIATES OF

International Association of Milk and Food Sanitarians

American Indian Sanitarians Association

Pres., Joseph Medina, Bernallilo, N. M.
1st. Vice-Pres., Richard Teboe,..... Fort Yates, N. D.
2nd. Vice-Pres., Willis Titla,....Bylas, Ariz.
Sec.-Treas., Frank C. Estes, ... Lower Brule, S. D.
Auditors:
Mike Ford, ... Gallup, N. M.
Louis Zimmerman ..... Rosebud, S.D.

Arizona Association of Milk and Food Sanitarians

Pres., George W. Marks ..... Phoenix
Pres.-Elect, Claude C. Cox, Cave Creek
Sec.-Treas., O. V. Cooper, 4103 N. 20th St., Phoenix.
Executive Board Members:
Lane C. Hanson ..... Phoenix
M. A. Lang ..... Kingman

Associated Illinois Milk Sanitarians

Pres. Harold B. Richie, Swift & Company ..... Chicago
Pres.-Elect., Charles A. Abele, Diversey Corporation .....Chicago
1st Vice-Pres., Harry Cohen, Chicago Board of Health, ...Chicago
2nd Vice-Pres., Noah B. Chambers, Springfield Health Dept., Springfield
Sec.-Treas., P. E. Riley, 1800 W. Fillmore St., Chicago, Ill.
Sergeant-At-Arms, Edward Malm, Oak Park Health Department, Oak Park
Auditor, Robert Coe, Illinois Dept. of Public Health .....Carbondale
Auditor, S. J. Conway, Chicago Board of Health .....Chicago

California Association of Dairy and Milk Sanitarians

Pres., D. A. Cordray, 1215 Jennings Ave., Santa Rosa, Calif.
Vice-Pres., Saul Gavurin, 1269 Queen Anne Pl., Los Angeles 19, Calif.
2nd Vice-Pres., E. R. Eichner, 445 Michigan Ave., Berkeley 7, Calif.
Sec.-Treas., Mel Herspring, 1072 Clarendon Crescent, Oakland 10, Calif.
Auditors
Elmo Moen
T. J. Therp

Connecticut Association of Dairy & Milk Sanitarians

Pres., Friend Lee Mickle.....Hartford
Vice-Pres., S. A. Washburn .....Cheshire
Sec., H. Clifford Goslee, ...356 Palm St., Hartford
Treas., Curtis W. Chaffee.....Hartford

Dairy Sanitarians Association of the Del-Mar-Va Peninsula

Pres., W. L. Ulsh, ...Ridgely, Md.
Vice-Pres., W. Baumgart .....Dover, Del.
Sec., Stephen J. Racz .....Goldsboro, Md.
Treas., Harry G. Ricker .....Rehoboth Beach, Del.

Florida Association of Milk Sanitarians

Pres., C. O. Stoy, Dairy Supervisor, ... Miami
Vice-Pres., H. H. Rothe ..... Gainesville of Florida .....Gainesville
Past-Pres., L. L. Chaffee, St. Petersburg
Sec.-Treas., H. H. Wilkowske. University

Directors:
R. D. Lundy .....Moore Haven
J. S. Massey .....Pensacola
S. O. Noles .....Jacksonville
J. D. Robinson .....Plant City
W. R. Thompson .....Jacksonville

Georgia Chapter of the International Association of Milk and Food Sanitarians, Inc.

Pres. .....Mrs. Louise Stephens
Sec.-Treas. .....Dr. John J. Sheuring Dairy Dept., U. of Ga., Athens, Ga.
Board of Directors:
N. E. Region .....Roy Perry
N. W. Region .....G. T. Knowles
W. Central Region .....James Brown
E. Central Region .....Lamar Hartley
S. W. Region .....Jimmy Drake
S. E. Region .....George Weatherly

Idaho Sanitarians Association

Pres., C. J. Hammond .....Boise
1st Vice-Pres., Orlando Dalke .....Boise
Sec.-Treas., C. E. Cotton, Idaho Dept., Public Health, Box 640, Boise

Indiana Association of Milk and Food Sanitarians

Pres., John M. Schlegel.....Indianapolis
Pres-Elect, William Geller.....Ft. Wayne
1st Vice-Pres., Edmund H. Stoy ..... New Albany
2nd Vice-Pres., David E. Hartley ..... Indianapolis
Sec., Karl K. Jones, 1330 W. Michigan St., Indianapolis
Treas., Harold S. Adams.....Indianapolis
Auditors:
Leo Biever .....Michigan City
Clifford W. Friend.....Evansville

Iowa Association of Milk Sanitarians

Pres., Ray Belknap .....Des Moines
Vice-Pres., Bill Reed .....Mason City
Sec.-Treas., Burton Haglan, City Health Department .....Cedar Rapids

Kansas Association of Milk Sanitarians

Pres., Frank Kelley, Milk Sanitarian, ...Parsons, Kansas
1st Vice-Pres., John Mullinix, Milk Sanitarians, ...Kansas City
2nd Vice-Pres., Kenny Ticknor, Milk Sanitarian, Shawnee County, ...Topeka
Sec.-Treas., Ivan Van Nortwick, State Board of Health, ...Topeka
Auditors:
Roy Mitchell, Milk Sanitarian, Cowley County Health Dept. .....Winfield
Ray Fair, Milk Sanitarian, Labette County Health Dept. .....Parsons

Kentucky Association of Milk and Food Sanitarians

Pres., T. R. Freeman ..... Lexington
Vice-Pres., H. L. DeLozier .... Louisville
Sec.-Treas., H. B. Morrison, Dairy Section, U. of Kentucky, Lexington, Ky.

Michigan Association of Sanitarians

Pres., Clifford Bracy, Dept. of Agriculture ..... Lansing
1st Vice-Pres., Dale Brooks .....Flint
2nd Vice-Pres., Dr. Clyde Smith ..... East Lansing
Sec.-Treas., Robert Lyons .....303 Bailey, East Lansing
Asst. Sec.-Treas. Robert Brunner, Dairy Dept. M. S. C., ... East Lansing
Directors:
Lyle Littlefield .....Lansing
William Wade .....Flint
Emerson Teal .....Romeo
Don Foster .....Saginaw
Gale Mosey .....Lansing
Past Pres., Winfred Ettesvold ..... Grand Rapids

Minnesota Milk Sanitarians Association

Pres., C. H. Holcombe .....St. Paul
Vice-Pres., A. L. Ratzlaff.....Rochester
Sec.-Treas., Dr. J. C. Olson, Jr., Department of Dairy Husbandry, University of Minnesota, St. Paul, Minnesota.
Board of Directors:
Orlowe M. Osten
Peter Hanson
Thomas J. Stibal
E. C. Omundson
Carl Mattson
Richard Novak

Missouri Association of Milk and Food Sanitarians

Pres., Vernon D. Nickel .....St. Louis
Vice-Pres., Marvin Campbell ..... Cape Girardeau
Sec.-Treas., John H. McCutchen, Mo. State Health Dept., Jefferson City
Auditors:
Calvin B. Ages ..... St. Louis
Paul W. Klusmeyer ....Jefferson City

New York State Association of Milk Sanitarians

Pres., Paul W. Corash .....New York City
Pres.-Elect, Fred E. Uetz ..New York City
Sec.-Treas., C. W. Weber, 18 Dove St., Albany 6, N. Y.

MEMBERS OF THE BOARD

Fred Uetz ..... New York City
George H. Hopson, D.V.M...Poughkeepsie
Prof. James C. White ..... Ithaca
Mr. Claud Woodward, Past President

Oklahoma Association of Milk and Food Sanitarians

Pres., R. L. Howell ..... Tahlequah
1st. Vice-Pres., Berl I. Poe ..... Muskogee
2nd. Vice-Pres., T. T. Potter ..... Okemah
3rd. Vice-Pres., N. W. Amadon .... Tulsa
Sec.-Treas., Tim Green, 206 New County Building, Oklahoma City 2, Okla.

Oregon Association of Milk Sanitarians

Pres., Virgil Simons.....Salem
Vice-Pres., Dr. P. H. Elliker ....Corvallis
Sec.-Treas., Ellis Rockleff—Office of Meat and Milk Inspector .....City of Eugene, Oregon

Pennsylvania Dairy Sanitarians Association

Pres., Henry Albert ..... Johnstown
Vice-Pres., Clarence Moss .... Philadelphia
Sec., William Boyd ..... Box 289 Lewistown, Pa.
Treas. Clark Herbster ..... Selinsgrove

ROCKY MOUNTAIN ASSOCIATION OF MILK AND FOOD SANITARIANS
(Colorado, New Mexico, Utah, Wyoming, Nebraska, Montana)
Pres., Gene Tuttle.....Ogden, Utah
Pres.-Elect., Ray Iams ....Sheridan, Wyo.
1st Vice-Pres. William Hoskisson
.....Salt Lake City, Utah
2nd Vice-Pres. Wayne Stell
.....Albuquerque, N. M.
Sec.-Treas., Peter G. Stevenson
3298 Holly St., Denver, Colorado.
Auditors:
Hugh Templeton.....Omah, Neb.
Warren E. Harrisberger
.....Helena, Montana

SANITATION SECTION TEXAS PUBLIC HEALTH ASSOCIATION

Chairman, C. A. Bruning .....Dallas
Vice-Chairman, Loreta Gaillard, Corsicana
Sec., Virgil Moody .....Arlington
Section Council, Lige Fox.....Big Springs

SOUTH DAKOTA ASSOCIATION OF SANITARIANS

Pres., Ira DeHaai ..... Spearfish
Pres.-Elect, Howard Froiland, Aberdeen
Sec.-Treas., T. A. Evans, State Dept of Health .....Pierre
Executive Board
Past Pres. Fred Hansen ..... Sioux Falls
Elected Member, Fred Jolly .. Rapid City

TENNESSEE ASSOCIATION OF SANITARIANS

Pres., Leon S. Blankenship.....Knoxville
Pres.-Elect., Richard Mansfield....Clinton
Vice-Presidents:
Robert Householder.....Sevierville
E. C. Seaton.....Jonesboro
Sec.-Treas., Otis E. Skiles,
.....303 Haworth Drive, Knoxville
Auditors:
P. R. York.....Knoxville
David Buttram.....Wartburg

VIRGINIA ASSOCIATION OF MILK AND FOOD SANITARIANS

Pres., J. F. Tolley .....Abingdon
1st Vice-Pres., W. P. Whitmore.....
..... Woodstock
2nd Vice-Pres., M. K. Cook.....Roanoke
Sec.-Treas., A. A. Pais,
State Health Dept. .....Richmond
Auditors:
L. A. Huff .....Roanoke
R. A. Johnson .....Fredericksburg

WASHINGTON MILK SANITARIANS ASSOCIATION

Burdette L. Fisher ..... Kiel

Pres., Gene C. Locke .....Yakima
Pres.-Elect., W. J. Oldenburg ....Seattle
Sec.-Treas., George Andrews, 1626 Smith Tower, Seattle 4, Wash.

WISCONSIN MILK SANITARIANS ASSOCIATION

Pres., Jack Keenan ..... Madison
Vice-Pres. (and Pres.-Elect) Harold E. Calbert ..... Madison
Sec.-Treas., L. Wayne Brown .... Madison
(421 Chemistry Bldg., Madison 6)
Past Pres., Chester L. Anderson
..... Oconomowoc
Directors:
Phillip C. Newman ..... Beaver Dam

NEWS AND EVENTS

3-A SANITARY STANDARDS EXPLAINED AT DAIRY INDUSTRY EXPOSITION

Attracting attention from dairy processors and public health officials during the 19th Dairy Industries Exposition (Atlantic City, October 25-50) was a 3-A Sanitary Standards Booth. For nearly a quarter of a century "3-A" has signified a widening cooperation among health officials, equipment manufacturers and equipment users in assuring that dairy processing equipment incorporates effective sanitary design.

The groups involved in 3-A Sanitary Standards work are: International Association of Milk and Food Sanitarians; United States Public Health Service; and Dairy Industry Committee, the organization members of which comprise the leading national milk processing associations and also include Dairy Industries Supply Association, the last named counting among its company membership U. S. and Canadian manufacturers of dairy processing equipment.

C. A. Abele of Chicago, Chairman of the Committee on Sanitary Procedure of the Sanitarians group, spent much time in the booth in discussion with health officials from many of the states and Canadian provinces and from several other countries. Conspicuous also in these discussions were Dr. E. H. Parfitt, chairman of the Dairy Industry Committee's Sanitary Standards Subcommittee; G. W. Putnam, chairman of the DISA Technical Committee, and, during the early part of the week, Mr. John D. Faulkner, Chief of the Milk and Food Program of U.S. Public Health Service. Assisting them were M. R. Fisher of the Sanitarians; L. S. Houser and H. B. Robinson of U. S. Public Health Service; H. L. Thomasson, managing editor of the Journal of Milk and Food Technology and Executive Secretary of IAMFS; D. H. Williams of the staff of International Association of Ice Cream Manufacturers, newly appointed Secretary of DIC Sanitary Standards Subcommittee; John Marshall, Secretary, and Dr. John L. Barnhart, Alternate Secretary of the DISA Technical Committee, and many other members of the various groups concerned.

The questions most often asked by those who happened to be unfamiliar in detail with the 3-A program, according to Mr. Abele and the others in charge, were; "Basically what are the 3-A Standards?" What does "3-A" mean?"

The responses were that the 3-A Sanitary Standards are a product of cooperative effort by the three national groupings of industry and public interests that hold major responsibility in the matter, to assure sanitary effectiveness in the design and construction of dairy equipment. Joint collaboration in the development of standards brings into active consideration the views of all of these primarily interested groups — public health authorities, dairy equipment manufacturers and the users of dairy equipment. Thus the specialized knowledge of each group is fully utilized in the formulating of a standard, so that public health and other regulatory authorities as well as the users of conforming equipment share a recognition, based upon their own criteria, that equipment of 3-A identification is acceptable on sanitary performability grounds. The "3-A" as a term reflects the collaboration of maker, user and regulatory officer.

Another question frequently asked was: "How does a standard start?" It was explained that it is the manufacturer of equipment who usually asks that a standard be set up for a type of equipment. He requests Dairy Industries Supply Association to set up a Task Committee to give tentative study to the elements of a possible standard. DISA calls together qualified engineers of all known manufacturers of the equipment for discussion. This Task Committee proceeds to a preliminary drafting of a standard in accordance with 3-A procedures, dealing in the draft with materials suitable for construction, fundamental sanitary design features and in some instances with construction and fabricating methods. Particular at-

tention is paid to the ready cleanability of the equipment, its having smooth surfaces and no sharp corners or creases where there will be contact with the dairy product. There is no effort to establish a uniform design for all equipment makers, of course.

The second step in the development of a standard is a study of the preliminary draft by the user group, through the Dairy Industry Committee, and by the regulatory officials, through IAMFS and U. S. Public Health Service. These groups submit written suggestions, and the DISA Task Committee revises the prospective standard accordingly.

A further step is the coming together for lengthy analysis, discussion and often for repeated amending of the revised draft, of the spokesmen of these groups.

Many months of concentrated effort are devoted by engineers of the makers and users and by the sanitarians to achieve even a relatively simple standard and in a few instances a difficultly arrived-at standard has occupied the three groups of formulators for a period of years. As sanitary science advances, or materials or processes having new properties become available, existing standards are brought up for modification.

Only when all the pertinent criteria have been dealt with by the three groups, and acceptable to each, does any standard become ready for signing.

No compulsion attends any standard's acceptance, it was explained.

AMERICAN DIRECTORY OF RESEARCH AND DEVELOPMENT FACILITIES TO BE PUBLISHED

The National Academy of Sciences—National Research Council is now compiling the tenth edition of "Industrial Research Laboratories of the United States", a directory of American industries and businesses which maintain scientific research and development facilities.

The directory will include non-governmental laboratories devoted to industrial research. *Research* for the purposes of this directory includes industrial development work on processes and products, as well as fundamental and applied research. Laboratories engaged primarily in routine testing and control but carrying on research activities as well will also be listed in the directory.

The directory will indicate the type of ownership of the laboratory, the kind of research activity performed and the nature of the services offered, and the number of professionally trained members and technical personnel of the scientific research staff.

Industry purchases a large percentage of each edition; scientific and technical societies use it in their studies; and government agencies often refer to it when awarding contracts for research and development.

Publication is scheduled for mid-1955. There is no charge for listing in the directory. The book is a nonprofit undertaking; the price will be determined by the cost of publication. Industrial laboratories that may wish to be included in the directory but have not received a questionnaire may do so by writing to James F. Mauk, Staff Associate, National Academy of Sciences—National Research Council, 2101 Constitution Avenue N.W., Washington 25, D. C.

KLENZADE WILL HOLD EIGHTEENTH SEMINAR NEXT MARCH

Plans for the Klenzade Eighteenth Educational Seminar to be held at French Lick, Indiana, are now under way. As in the past, the seminar will extend over a period of three days, Thursday, Friday, and Saturday, March 24th, 25th, and 26th, 1955.

An unusually fine roster of speakers is being assembled and, while at this early date complete information is not available, we are informed that many of the country's leading scientists and leaders in sanitation education will participate in the various programs and panel discussions. A preview of the program includes eleven general topic classifications: sanitation chemistry; sanitation bacteriology; dairy plant sanitation; dairy farm sanitation; corrosion of food equipment; special cleaning procedures; canning plant sanitation; food processing plant sanitation; mechanical dishwashing, institutional sanitation, etc.

Panel discussions will be devoted to the sanitation requirements of today's newer equipment and processes. Since the last seminar, held in 1953 at Kellogg Center, Michigan State College, East Lansing, Michigan, both equipment designs and sanitation procedures have advanced considerably. This Eighteenth Klenzade Seminar will be concerned chiefly with the progress made in sanitation chemistry and its application to the newer techniques of cleaning and sanitizing.

Due to the tremendous popularity of these seminars and the record attendance which they attract, Klenzade management has decided to hold them on a bi-annual basis. Registrations at the 1953 seminar well exceeded 500 and it is anticipated that even a larger number of registrants will be present at French Lick. Additional details will be made available later.

3-A SANITARY STANDARDS GROUP MEETS IN EVANSTON TO CONSIDER AMENDMENTS

A regular meeting of the 3-A Sanitary Standards Committee, held November 10-12 at the Georgian Hotel in Evanston, Ill., considered tentative revisions in standards for ten items of dairy industrial equipment, as well as a number of procedural matters.

The Committee is composed of representatives from the U.S. Public Health Service, International Association of Milk and Food Sanitarians, and Dairy Industry Committee and meets usually semi-annually to consider new standards —or revisions in existing standards— for dairy industrial equipment.

Dr. E. H. Parfitt, Chairman of the Committee, and Executive Director of Evaporated Milk Association, presided during most sessions, though he was occasionally relieved by George W. Putnam of the Technical Committee of Dairy Industries Supply Association.

Pivotal parts also were played by C. A. Abele, representing International Association of Milk and Food Sanitarians and John D. Faulkner, representing U. S. Public Health Service; John Marshall, Dr. John L. Barnhart and Don Williams, specialists from the staffs of national

trade associations having offices in Washington, also had very active roles.

Discussion and task groups considered the following:

1. A tentative first revision of amendments to the 3-A Sanitary Standard for Farm Holding and/or Cooling Tanks, presented by L. T. Gustafson who serves as chairman of an appropriate task committee.

2. A fifth revision, presented by E. R. Andre for the appropriate task committee, of a proposed 3-A Sanitary Standard for Paper Milk Container Fillers and Sealers, which is to be further modified before a later meeting of the 3-A group.

3. A suggestion that the existing tentative 3-A Sanitary Standard for Installation and Cleaning of C-I-P Sanitary Milk Pipelines for Use on Dairy Farms be modified to become a "Suggested 3-A Sanitary Method" or a "Recommended 3-A Sanitary Procedure."

4. The development of a test for efficiency of check valves which prevent back flow in air lines, and on which a further report will be made at the next meeting.

5. The appointing of representatives from USPHS, IAMFS, and DIC to consider further revisions of tentative standards for HTST pasteurizers, as reported by G. S. Bixby, Chairman of a task committee.

6. A report on a tentative 3-A Sanitary Standard for Separators and Clarifiers, delivered by task committee chairman Walter C. Hoeltje.

7. A tentative 3-A Sanitary Standard for Bulk Milk Dispensers, with the chairman requesting the responsible task committee to develop suggested revisions by December 15.

8. A third draft of suggested amendments to the 3-A Sanitary Standard on Storage Tanks, presented by task committee chairman Tom Burress.

9. A report from the task committee on 3-A Sanitary Standards for Fittings, through its chairman, Fred Hinrichs.

10. A fourth revision of a tentative 3-A Sanitary Standard for Batch Pasteurizers, presented by task committee chairman Frank A. Selke, which will receive further consideration at a later meeting.

11. Recent approvals by Dairy Industry Committee, International Association of Milk and Food Sanitarians and Dairy Industries Supply Association of a projected early formation of a 3-A Symbol Council to administer the 3-A program of voluntary sanitary standardization of dairy industrial equipment.

Dr. Parfitt, as chairman, announced that the next general meeting of the 3-A Sanitary Standards Committee will be held April 26-28, 1955, at the Kenwood Country Club in Bethesda, Maryland, (a suburb of Washington, D.C.). Meanwhile, he reported, the continuing work of re-drafting and revising existing 3-A Sanitary Standards, and the developing of new ones will go forward through some thirty task committees.

REPORT OF INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC. COUNCIL MEETING

Hotel Morton, Atlantic City, New Jersey
7:30 PM, October 21, 1954

1. Meeting called to order by H. J. Barnum, Chairman of the Council. Those present are listed on the Attendance List attached hereto.

2. The reading of Minutes of the last meeting were dispensed with, no important matters pending.

3. Mr. Barnum read portions of the Constitution pertaining to the Council. He pointed out that two temporary Committees had been appointed during the past year, as follows:

I. Committee on Ways and Means of Improving Services of IAMFS. T. A. Evans, Chairman; Clarence Weber; Wayne Brown; J. C. Olson, Jr.; George Andrews; Loretta Gaillard.

II. Special Committee of Council on Committee Appointments. John J. Sheuring, Chairman; Clifford Goslee; Karl Jones; Harold Richie.

4. Mr. Weber reported for the Committee on Ways and Means of Improving the Services of IAMFS for the local Sanitarians. This report suggested (a) develop a "grassroots" section in the Journal for the man in the field, (b) interchange ideas on programs and membership among the various affiliate secretaries, (c) familiarize the local sanitarians with all information from the IAMFS, such as 3A standards, (d) appoint affiliate council committees, (e) coordinate committees of IAMFS and similar affiliate association committees, (f) exchange committee reports, (g) hold regional meetings, (h) have IAMFS represented at all local meetings. Motion to accept report was made by Ivan Van Nortwick, seconded by Mr. Livak, and passed.

5. Dr. Sheuring reported for the Special Committee as follows:

A. Our committee recommends that the Chairman of the Affiliate Council appoint six members to serve as a Steering Committee for the Affiliate Council. The members shall consist of two members appointed for one year, two for two years, and two for three years. The functions of the Steering Committee shall be as follows:

a. To coordinate the activities of the Affiliate Chapters;

b. To stimulate the exchange of programs, newsletters, publications, etc. between Affiliate Chapters; and

c. To plan the programs of the Affiliate Council with the approval of the Council Chairman.

B. Our committee, believing in the principle of establishing and improving the professional status of sanitarians, recommends that the Affiliate Council of the International Association of Milk and Food Sanitarians approve the principle of professional classification for milk and food sanitarians.

After discussion of this report, Mr. Goslee moved, seconded by Mr. Weber, and carried, that the Chairman of the Council appoint a six member Steering Committee for three year staggered terms. The following Council Steering Committee was appointed: Dr. John Sheuring, Georgia; H. Clifford Goslee, Connecticut; Karl Jones, Indiana; George Andrews, Washington; Wayne Brown, Wisconsin; Loretta Gaillard, Texas.

After further discussion of the recommendation that the Council approve the principle of furthering the Professional Status of the Sanitarian, adoption of the committee recommendation was so moved by Mr. Goslee, seconded by Mr. Richie, and carried.

6. Dr. Shrader discussed the Journal activities with respect to "grassroots" articles and urged all

Secretaries of Affiliate Associations to send in "newsy" items to the new Editor. Dr. Shrader also urged all Secretaries to be on the lookout for good practical papers and strive to get the author to send it to the Editor of the Journal. He further invited brief summaries of important papers presented at local meetings.

7. Dr. Joe Olson, Jr. pointed out that the Journal was first of all a Technical Publication and must maintain the high professional character and reputation developed in the past. He also urged that material must be sent in to the Editor in order to provide news of interest to the local sanitarian.

8. Mr. Wilkowske restated the position taken at the last year's Council meeting that all Secretaries of Affiliate Associations remember and strive to send copies of their annual programs to all other Secretaries and members of the Executive Board. This to be done on a direct exchange basis by mail, the addresses being available in each issue of the Journal. He further described a Citation Certificate award used by the Florida Association with good success in stimulating interest in Association work. Copies are available upon request.

9. Mr. Thomasson gave a short talk on the activities of IAMFS as related to the local sanitarians and the Affiliate Associations.

10. Mr. Adams reported on certain aspects of the proposed Scholarship plan as related to the Secretaries of the Affiliate Associations. Several ways of establishing a system for obtaining financial aid were discussed. It was the concensus of opinion that a method should be developed which would be either voluntary or on a per capita basis rather than a fixed contribution from each Affiliate Association. It was emphasized that the amount would be small in order to get as many participants as possible, and this cooperative endeavor would be further aided by contributions from IAMFS.

Meeting adjourned at 9:30 P.M.

Respectfully submitted,
H. H. Wilkowske,
Secretary of the Council

ATTENDANCE LIST

Ivan Van Nortwick, Kansas; Curtis W. Chaffee, Connecticut; H. Clifford Goslee, Connecticut; H. E. Calbert, Wisconsin; W. A. Hoskisson, Utah; Nelson Hall, Michigan; Joseph C. Olson, Jr., Minnesota; Al Ratzlaff, Minnesota; C. W. Weber, New York; H. L. DeLozier, Kentucky; J. F. Tolley, Virginia; H. J. Barnum, Colorado (Rky. Mt.); H. B. Richie, Illinois; H. S. Adams, 2nd VP, IAMFS; J. J. Sheuring, Georgia; Charles Livak, Pennsylvania; Robert Lyons, Michigan; Loretta Gaillard, Texas; Oneta Barlow (visitor), Texas; John D. Faulkner, Pres., IAMFS; Ray Belknap, Iowa; Karl Jones, Indiana; J. H. Shrader, Editor, J. Milk and Food Technology; V. D. Nickel, Missouri; H. H. Wilkowske, Florida; H. L. Thomasson, Ex. Sec., IAMFS; Milt O'Connor, Washington.

Associations not represented at Council Meeting: American Indian, Arizona, California, Del-Mar-Va, Idaho, Oklahoma, Oregon, and South Dakota.

FOURTH ANNUAL SANITARIANS TRAINING CONFERENCE HELD AT MONTANA STATE COLLEGE

A Conference cooperatively sponsored by the Montana State College, State Board of Health, Dairy Division of the Department of Agriculture, Livestock Sanitary Board, and United States Public Health Service was held at Montana State College December 1 - 3, 1954.

The program included panels, demonstrations, and discussions relating to the sanitary aspects of milk, food, water, sewage, and garbage disposal. One of the main speakers was Professor Harold S. Adams of the Department of Public Health at the Indiana University Medical Center, who spoke on the subject of "New Needs and Trends in Sanitation". Professor Adams is First Vice-President of the International Association of Milk and Food Sanitarians, Inc.

Other speakers included those from the Board of Health, United States Public Health Service, Montana State College, and Industry.

An informal get-to-gether was held Tuesday evening, November 30.

DAIRY TECHNOLOGY CONFERENCE AND SHORT COURSES AT OHIO STATE UNIVERSITY — 1954-1955

Market Milk Short Course— November 8-19, 1954:

This two-week short course is designed for persons employed in market milk plants, in production, procurement or sales. It is conducted as lecture, demonstration, and laboratory, and concerns all aspects of handling and processing milk in a market milk plant from a practical standpoint. Discussions will deal with milk composition, receiving, grading, sampling, standardizing, clarifying, pasteurizing, homogenization, bottling, special milk products, elements of dairy chemistry and bacteriology, and plant sanitation. A text book and note book will be included in a $25 registration fee. The enrollment will be limited to approximately 25 students. Further information will be limited to approximately 25 students. Further information may be obtained by contacting The Department of Dairy Technology, The Ohio State University, Columbus 10, Ohio.

Ice Cream Short Course — January 10-21, 1955:

This two-week short course is designed for people employed in ice cream plants in plant production, procurement and sales. It is conducted as lecture, demonstration, and laboratory, and the subject nature will deal with all aspects of ice cream processing and manufacture. Discussions will concern ingredients and composition of ice cream mix; ice cream mix calculations; processing methods including pasteurization, homogenization, and freezing; and elements of dairy chemistry and bacteriology. Attention will be given to plant sanitation and the operation and maintenance of dairy equipment. A text book and note book will be included in the $25 registration fee. Enrollment will be limited to about 25 students. Further information may be obtained by writing The Department of Dairy Technology, The Ohio State University, Columbus 10, Ohio.

Dairy Technology Conference — February 8-11, 1955:

This four-day program will deal with problems of interest to dairy plant operators, superintendents, technicians, and other plant employees; fieldmen, milk inspectors, and sanitarians. Emphasis will be placed on the latest developments important to the Dairy Industry along the lines of research, plant production, equipment, and associated commercial developments. Off-campus and out-of-state speakers who are recognized authorities in their field will handle the various topics of current interest on the program.

Milk Sanitarians Short Course — March 14-18, 1955:

The course is designed for persons directly concerned with problems of sanitation and employed by public health and regulatory agencies and by dairy organizations. Specific attention is given to law enforcement policies and practices as they relate to the Dairy Industry, to methods and techniques of inspection of

dairy plants and farms, to problems of uniformity of regulations, laws, inspection methods and interpretations, to sanitation procedures, to the use of laboratory and field methods of determining milk quality, and to the interpretation of the results. This course is arranged cooperatively with the Ohio State Department of Health and the Ohio State Department of Agriculture.

WASHINGTON INSTITUTE OF DAIRYING

The State College of Washington Institute of Dairying (24th annual), will be held at Pullman, Washington, March 7-10, 1955. The dairy products scoring contests are open to the world. Further information may be obtained from H. A. Bendixen, Department of Dairy Science, Washington State College, Pullman, Washington.

PIPELINE CHATTER

Communications to this column must bear the signature and address of the writer. Short letters are most interesting. The right is reserved to condense letters if space limitations require it.

To the Editor:

Recently we heard about the idea of the Association sponsoring one or more scholarships for undergraduate college students majoring in public health. This sounds like a good idea. I understand this subject was discussed a great deal at the annual meeting in Atlantic City. We need to encourage young men and women to pursue a career in public health or more specifically milk and food sanitation. The question of financing this project needs to be considered carefully. According to the recent announcement about this proposal it was suggested that each affiliate association might contribute twenty-five dollars each year toward a scholarship fund. I would like to suggest a more fair way for the affiliates to contribute; namely, by putting the contributions on a per capita basis. In other words, make it twenty-five cents per member. Thus, if an affiliate association has 100 members, then that association would be assessed $25. If an association has 200 members, then that association be assessed $50. This is fair and each member, whether in a small or large affiliate association, would be treated equally. I wonder how others feel about this?

John Kiskinen
Minnesota

HELPFUL INFORMATION

Listed below are sources of information on a variety of subjects. Requests for any of the material listed should be sent by letter or postcard to the source indicated.

Spray Insecticides for Dairy and Food Plants. Bull. 171. Klenzade Products, Inc., Beloit, Wis.

Recommended Maintenance Painting Systems for Milk Plants. The Tropical Paint and Oil Co., 1170 W. 70th St., Cleveland, Ohio.

Estimating the Solids Not Fat Content of Milk. Rep't. No. 65, U. S. Dept. of Agr., Agricultural Mktg. Serv., Washington 25, D.C.

Booklet on Sodium Benzoate in Foods. Monsanto Chemical Co., Box 478, St. Louis, Mo.

Veterinary Education in the South. Southern Regional Education Board. 830 West Peachtree Street, N. W. Atlanta, Georgia. (A booklet describing the history, need, scope, and opportunities relative to veterinary education in the south.)

Rewarding Careers Await Technical Men in Food Industry. Frank K. Lawler, Food Engineering, pp. 63-70, Feb. 1954. (Reprints available from Food Engineering, McGraw-Hill Co., Inc., New York, 36, N.Y.

Diversey News Topics for Dairy Fieldmen. The Diversey Corp., 1820 Roscoe St., Chicago, 13, Ill.

Sugar in Breadmaking. A 46 page discussion on the role of sugar in baking technology by R. T. Bohn, Sugar Information, Inc., 52 Wall Street, New York, N. Y.

Marketing. The 1954 Yearbook of Agriculture. U. S. Department of Agriculture. Available from Supt. of Documents, Government Printing Office, Washington, D. C. 508 pages – $1.75.

PENN STATE CHALLENGES MILK AND DAIRY PLANT OPERATORS

Are you in need of training in milk bacteriology and milk technology to better understand your job?

Are you lacking in an understanding of the factors involved in milk quality as it comes from the farm?

Do you know too little about the cause of defects in the quality of bottled milk, market cream, homogenized milk, buttermilk, sour cream, and by-products?

Have you never had the opportunity of attending a dairy school for one of the regular two year or four year courses?

Do you feel that a lack of background is interfering with your chances of advancement in the industry?

If the answer to any of these questions is yes, then Penn State has the answer to your problem.

ATTEND THE TWO WEEKS MARKET MILK SHORT COURSE AT PENN STATE, JANUARY 24 to FEBRUARY 5, 1955.

If you act promptly your registration is assured. Write to David R. McClay, Director of Short Courses, College of Agriculture, The Pennsylvania State University, State College, Pa. for a short course bulletin and application blank.

JOURNAL OF MILK AND FOOD TECHNOLOGY
VOLUME 17, JANUARY 1954 TO DECEMBER 1954

AUTHOR INDEX

CONTENTS

JANUARY NO. 1

FEBRUARY NO. 2

MARCH NO. 3

APRIL NO. 4

OCTOBER NO. 10

NOVEMBER NO. 11

DECEMBER NO. 12

INDEX TO ADVERTISERS

JOURNAL OF MILK AND FOOD TECHNOLOGY
INSTRUCTIONS TO CONTRIBUTORS

Manuscripts.—Manuscripts should be submitted on suitable 8½″ x 11″ paper. The original typewritten copy double or triple spaced with wide margins not less than 1″ on all four sides should be submitted. Tabular material and illustrations should accompany the manuscript; also, each manuscript should be accompanied by (a) a glossy personal photograph of the author, (b) a brief biographical sketch of the author not more than 50 - 75 words, and (c) an abstract of the paper not to exceed 75 words. These will be used at time of publication of the paper. All material should be sent by first class mail in flat form to the Managing Editor, H. L. Thomasson, P. O. Box 437, Shelbyville, Indiana.

Authors should make every effort to present their material accurately and in a clear and concise form. In preparing manuscripts, use of the first person should be avoided. Manuscripts should be proofread carefully before they are submitted. Each manuscript will be reviewed by one or more Associate Editors. Anonymity of reviewers will be preserved.

Manuscripts reporting the results of experimental work, generally, should be divided into sections, for example: Introduction; Experimental; Results; Discussion; Summary and Conclusions; References.

Figures, Tables and Photographs. — Tables should be clear and concise. Excessively large tables, as well as those consisting of only one or two lines, should be avoided if possible. Headings should be brief but fully descriptive. Avoid presenting the same data in a table and again in a figure. Place each table or figure on a separate sheet—not in the body of the manuscript.

Figures consisting of drawings, diagrams, charts and similar material should be done in India ink on 8½″ x 11″ tracing paper or cloth. A lettering guide should be used for all written material on figures. Submit original figures rather than photographs of such figures.

Photographs should be glossy prints free of imperfections.

Legends. — Legends for figures and photographs should be typed on a separate sheet. The legends should be brief but fully descriptive.

References. — References should be double spaced and arranged alphabetically as to authors. References to papers by a single author should preceed references to papers by the same author and associates. References to papers by multiple authors should be listed in the alphabetical order of the several authors. Initials rather than the full first names of male authors should be given. Reference citations in the text should be made by a number in parentheses, corresponding to that number in the reference list.

Sample of journal citation: (1) Mallman, W. L. Sanitation in Bulk Food Vending. J. Milk and Food Technol., *16*: 267-269. 1953.

Sample of Book citation: Adams, H. S. *Milk and Food Sanitation Practice.* The Commonwealth Fund. New York, New York. 1947.

Sample of Experiment Station publication citation: Watrous, G. H., Doan, F. J. and Josephson, D. V. Some Bacteriological Studies on Refrigerated Milk and Cream. Penn. Agr. Exp. Sta. Bull. 551. 1952.

Publications should be abbreviated according to the form given in CHEMICAL ABSTRACTS, vol. 45. no. 24, part 2. 1951.

Abbreviations.—Common abbreviations to be used in the text are: cm., centimeter(s); cc., cubic centimeter(s); C., Centigrade; F., Fahrenheit; g., gram(s); log., logarithm; lb., pound(s); μ, micron(s); μg., microgram(s); mg., milligram(s); ml., milliliter(s); oz., ounce(s); sp. gr., specific gravity.

News items and announcements. — Items of general interest should be submitted in the same manner as indicated for manuscripts. An informal writing style is preferred. News of the activities of affiliate associations, members and events is particularly desirable.

Letters to the Editor.—Letters to the editor are encouraged. Letters should be addressed to the Managing Editor and must be signed by the writer. Excessively long letters should be avoided due to Journal space limitations.

Notice

Attractive Membership Lapel Button and Decal

Now Available

Convolution — Blue . . . . Circle & Bar — Silver . . . . Field — Blue
Letter "S" — White . . . . Lettering — Blue

ACTUAL SIZE

No. . . . . 3 1/4" Decals @ 25c each =$. . . . . .

No. . . . . Lapel Buttons @ $1.00 each = $. . . . . .

International Association of Milk & Food Sanitarians, Inc.
Box 437, Shelbyville, Indiana

Notice

Every Milk Sanitarian should have a complete set of

3A Sanitary Standards. DO YOU HAVE YOURS?

Order Blank on the back of this notice.—Order Now!!!

Application for Membership

INTERNATIONAL ASSOCIATION OF MILK & FOOD SANITARIANS, Inc.

Box 437, Shelbyville, Indiana

Name ..... Date .....
Please Print

Address ..... ☐ New

..... ☐ Renewal

Business Affiliation ..... ☐ Re-instatement

Annual Dues $5.00 ☐ Check ☐ Cash

(Membership Includes Subscription to Journal of Milk & Food Technology.)

(Please Print)

Recommended by .....

Subscription Order

Box 437
Shelbyville, Ind.

JOURNAL OF MILK & FOOD TECHNOLOGY

Name ..... Date .....
Please Print

Address ..... ☐ New

..... ☐ Renewal

Educational & Institutional Libraries (Annually) $3.00. Individual Subscription (Annually) $5.50.

☐ Check ☐ Cash

(Please Print)

I. A. M. F. S. & J. M. F. T.
Box 437, Shelbyville, Ind.

Change of Address

FROM

Name ..... Date .....
Please Print

Address .....

TO

Name .....
Please Print

Address .....

(Please Print)

I. A. M. F. S. & J. M. F. T.
Box 437, Shelbyville, Ind.

Order for 3A Standards

Name ..... Date .....
Please Print

Address .....
( ) Complete Set @ $1.75= ..... ( ) Complete set bound (durable cover) @ $3.50 = ...

Order for Reprints of Articles

Amt. ..... Title .....

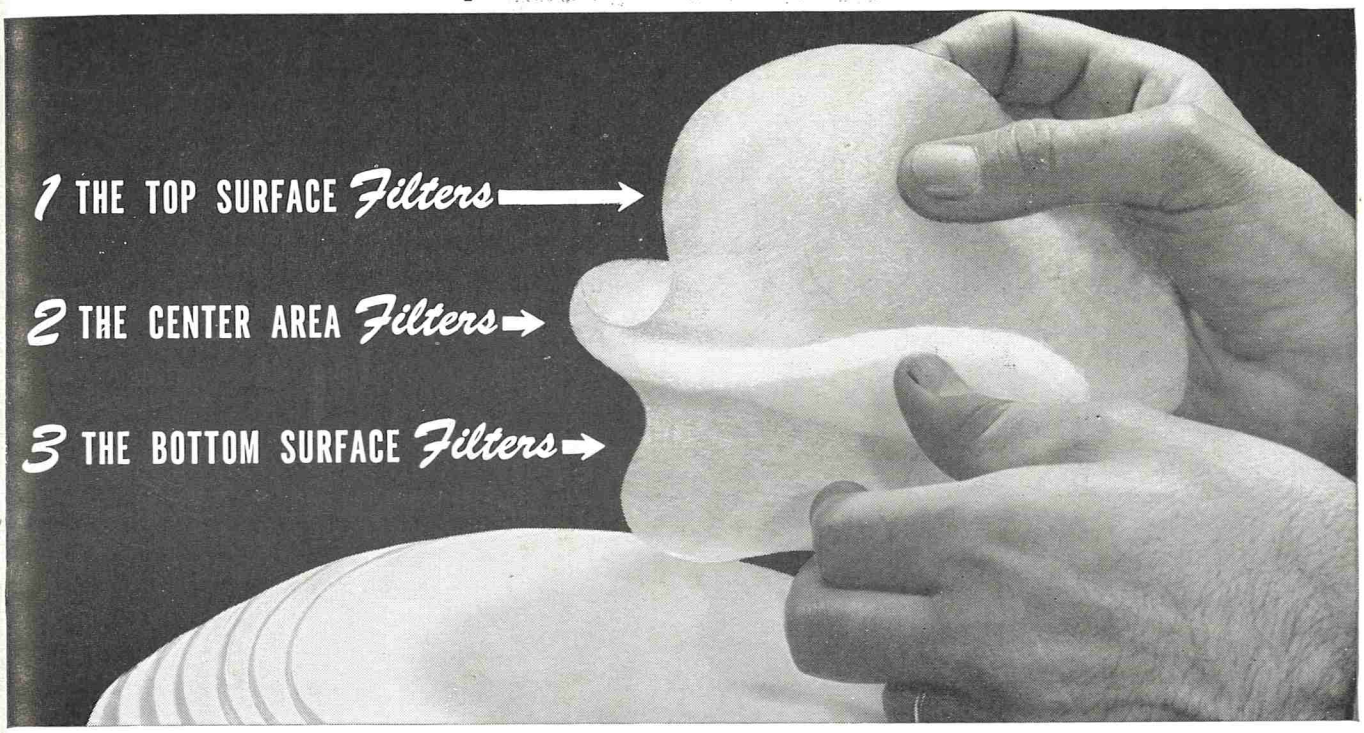
Schedule of prices for reprints F. O. B. Shelbyville, Indiana

	1 Page	2 Pages	3 & 4 Pages	6 & 8 Pages	12 P.	Cover
100 or less	$ 8.50	$15.00	$21.00	$30.00	$50.00	$21.67
Add'l. 100's	1.60	1.60	3.00	4.20	7.00	3.37

HELP YOUR MILK PRODUCERS TO PROTECT QUALITY THREE WAYS with

Perfection DUBL-CHEM-FACED FILTER DISCS'

NEW "Tripl-Filtring®" ACTION



NO OTHER FILTER DISCS CAN CLAIM TO FILTER MILK BETTER

Milk producers welcome these efficient, economical, easy-to-use filter discs. Top and bottom surfaces are identical . . . either surface can be UP in the strainer . . . there's no chance to put them in wrong-side up . . . they save time . . . they *cost* less and *fewer filters are needed* . . . save money at every milking . . . and they assure THREE-WAY PROTECTION of milk quality! *Available through authorized Perfection Filter Disc Suppliers.*

Write Now for Samples: **6" and 6½" sizes.**

Note: Perfection and Elgrade Filter Discs also available, as usual, in Double Cloth-Faced, Single Cloth-Faced and Natural Finish, in all sizes: 6", 6½", 7", 7½", 8", 9".

Please include your supplier's name and address when writing us for samples.

STANDARDIZE ON DUBL-CHEM-FACED

It pays to furnish your milk producers with the best filters for dependable protection of milk quality.

SCHWARTZ MFG. CO., Dept. SF, Two Rivers, Wis. • ***America's Foremost Manufacturer of Filtering Aids for Dairymen***

"ELECTROBRAIN" T.M.

Patent Pending

The SURGE Automatic High-Velocity Push Button Pipeline Washer

"The right routine locked up in a box that has no key"

ELECTROBRAIN is a fully automatic timing device designed specifically to handle the cycles of C. I. P. (Cleaned In Place) washing of milk lines and milking equipment.

Electrobrain is never hurried — never forgets — is never careless. The right and accepted routine is the only one that it knows.

Surge

BABSON BROS. CO.
2843 W. 19th St., Chicago 23, Ill.

ATLANTA • HOUSTON • KANSAS CITY • MINNEAPOLIS • SACRAMENTO • SEATTLE • SYRACUSE • TORONTO

BABSON BROS. CO.
2843 W. 19th St., Chicago 23, Ill., Dept. JFM

Please send me further details on ELECTROBRAIN.

NAME_____
(Please Print)

ADDRESS_____

for further information on "ELECTROBRAIN"

Send this blank for a brief booklet on the new Surge system of pipeline "Cleaning in Place."