TWENTY-THIRD ANNUAL REPORT

OF THE

International Association of Dairy and Milk Inspectors

INCLUDING PAPERS READ AT THE ANNUAL
CONVENTION IN BOSTON, MASS.
OCTOBER 11, 12 AND 13

1934

COMPILED BY

PAUL B. BROOKS, M.D.
Secretary-Treasurer
STATE DEPARTMENT OF HEALTH
ALBANY, N. Y.

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"What do we live for, if it is not to make life less difficult for others?"

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International Association of Dairy and Milk Inspectors

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ADDRESS OF WELCOME

HENRY D. CHADWICK, M.D.

State Commissioner of Health, Boston, Mass.

IT IS with pleasure that I welcome in behalf of the Massachusetts Department of Public Health the members of your Association now meeting in Boston for its Twenty-third Annual Convention. As dairy and milk inspectors you make an important contribution to the health and welfare of the people. The quality and cleanliness of milk has been steadily improved as a result of your activities.

Milkborne epidemics have become less frequent since pasteurization has become more general. In Massachusetts there were but two outbreaks of disease traced to milk last year. Both of these were on the routes of small producers who retailed their milk in the raw state. On these two routes 138 persons became ill with septic sore throat, scarlet fever, or erysipelas. These diseases are caused by infection with the hemolytic streptococcus. Investigations revealed cows with chronic mastitis in the herds of both producers. These animals were slaughtered and the udders showed abscesses which upon culture showed the hemolytic streptococcus. I am, therefore, much gratified to find listed on your program papers on the subject of chronic mastitis. Without doubt, the elimination from the herds, of cows with this condition would materially reduce milkborne epidemics. Our only protection from this source at the present time is pasteurization. If it were not for this safeguard, which protects about 85 per cent of the population of the State, doubtless many more cases of illness and death would result.

Bang's disease is another subject on your program which is of interest to me. From our experience in Massachusetts it would appear to be more of a commercial and economic problem to the dairy industry than one affecting public health. There were but fifteen cases of undulant fever reported in the State in 1932 and but eleven last year. With a high percentage of dairy cows known to be infected, we can only explain the few cases among humans by assuming that but a small percentage of people are susceptible to this disease and that pasteurization is an effective safeguard against this infection.

I also note that bovine tuberculosis is not a subject for discussion on your program. This is a recognition of the success of the eradication program that has so effectively been carried out by the Federal and State Departments of Agriculture during recent years. Already this is reflected in a decrease in the number of deaths among children from bovine forms of tuberculosis and the reduction in the number of crippled children from bone and joint disease.

Under the State Milk Regulation Board a uniform system of supervision of production will be put into effect and classification according to quality will be simplified. The local authorities will have the more important responsibility of supervising the quality of the milk that is offered for sale within their community.

I regret to report lessened sales of milk as that will undoubtedly have a serious effect upon the health of the people. The Bureau of Home Economics of the United States Department of Agriculture has set a standard for the use of milk as follows:

> Adequate diet at moderate cost—305 quarts annually (approximately 1 quart per child, 1 pint per adult)
>
> Adequate diet at minimum cost—260 quarts annually (approximately 1.5 pints per person)
>
> Restricted diet, which is too low for continued subsistence, 155 quarts annually, (or .8 pint per person)

Inadequate consumption of milk among the families in Burlington, Vermont, covered by the National Milk Survey is indicated by a preliminary report made by Dr. Fred C. Howe, Consumers Counsel of the Agricultural Adjustment Administration. It was found that of 301 families investigated they were using .84 pints or 152 quarts per year per person.

The Boston Health Department reports that 356,000 quarts were used daily in the city in 1931. This dropped to 326,000 quarts in 1932 and to 293,000 quarts in 1933, a reduction in two years of 63,000 quarts.

I earnestly hope that a way may be found to distribute the so-called surplus milk to the people who need it but are unable to pay the purchase price. Instead of paying the producer the cream or butter fat value for this milk it should be distributed through welfare agencies at the farmers' minimum price plus distribution cost. I have no sympathy with the plan to curtail production for the purpose of maintaining prices. Instead of this, consumption should be increased and a market maintained for the purchase of surplus milk by welfare funds so that the people in need could have more of this food for which no adequate substitute has yet been found.

THE WORK OF EMERGENCY MILK CONTROL BOARDS—THEIR RELATIONSHIP TO OFFICIAL SANITARY CONTROL*

JOSEPH C. CORT

Sec'y and Administrator, Milk Control Board, Boston, Mass.

1 Increase of dairy farms by:

(a) Maintaining and safeguarding the farmers' price.

(b) Eliminating freight rate overcharges and providing market arrangements, which will allow the farmer to benefit by transportation improvements in both rail and truck facilities.

(c) Arrangements that will safeguard farmers from the unscrupulous practices of financially irresponsible dealers.

(d) Requiring the distribution part of the industry to make payment for milk according to the use for which it is sold.

(e) Eliminating excess country station, terminal and weighing and testing charges heretofore borne by the individual farmer and in most instances of payment for services rendered by the distribution agencies and charged out again on the operating spread of distribution.

(f) By affording reasonable price stability and protection against the past practices and ultimatum of forcing farmers to bear and carry the cost of dealers' price wars. Dealers justly carrying the costs on their own accounts would in turn be less apt to engage in ruthless price-cutting tactics.

* Outline of address furnished by speaker.

2 To maintain proper relationship between producers in the same market and between groups of producers in different markets by:

(a) Equalizing the surplus burden among producers through a pooling arrangement.

(b) Preventing one market or production area from dumping its surplus milk or cream into another market at cut rate prices.

(c) Proper supervision of the base-surplus plan in order that the effect of its proper function will be obtained by the dairymen supplying that market with its fluid requirements under the market plan.

(d) Equitable consideration and provision for the entry of new producers, into the market in such a manner as to encourage a safe and dependable milk supply.

3 To provide reasonable and considerate protection for the interest of the consumer and the general public by:

(a) Providing plans and adopting policies which will maintain normal and healthy competitive conditions among milk distributors as well as among milk producers.

(b) Adopting policies that will provide means for lowering the spread of distribution by normal and acceptable competitive operations so the general public can obtain milk at reasonable prices without impoverishing the producer.

(c) Providing ways and means for adequate consideration of the public welfare and to safeguard their interests in the milk industry.

(d) Improved public health relations because of improved producer position.

TAG Standard Dairy Milk Recorder

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"When Writing Mention This Report"

LABORATORY CONTROL METHODS FOR COUNTRY PLANTS

F. E. A. Smith

United Farmers' Co-Operative Creamery Association, Inc.

THERE is an ever-increasing demand for closer laboratory control of the quality of milk delivered to country stations. The physical inspection of farm dairy premises and equipment by official inspectors and creamery field men has, during the past few years, done much to insure a safe milk supply and has also resulted in a creditable improvement in the keeping quality of the product. This inspection work has been supplemented to a limited extent by the use of platform tests such as the old alcohol test and acidity tests of different kinds. Such tests proved helpful for a few years in eliminating the milk that had already deteriorated to the extent that there was an apparent increase in titratable acidity; but these methods have proved to be inadequate in building up a high quality supply. Development beyond this point has been very slow, because the cost of laboratory work for most country stations has been considered prohibitive. It is necessary, however, that routine inspection be backed up with dependable information regarding the quality of the product delivered, and, if possible, information indicating the probable cause of trouble.

Although a few plants have used the methylene blue reduction test to good advantage in the earlier stages of quality improvement programs, popular opinion has relegated this test to third place in favor of the standard agar plate count and the direct microscopic count as quality standards have been raised. Both of these methods require expensive equipment and especially trained help.

There is some doubt that popular opinion has been accurate in the evaluation of these various tests. In 1927

Ellenberger, Bond, Robertson and Moody of the Vermont Agricultural Experiment Station published a bulletin which concluded with the statement that: "the methylene blue reduction test shows much less (one-seventh as much) variability between check or duplicate tests than does the agar plate method. The methylene blue reduction time correlates much more closely with the keeping time of milk than does the agar plate count." In 1930 Robertson and Frayer of the same station published a five-volume bulletin concluding that: "(1) The agar plate method (logarithmic relations between the counts) is the most feasible method for use; (a) where premiums are paid for low count milk; and (b) where control agencies are examining milk samples. (2) The microscopic method and the reduction test should be reserved for rapid field work where the object is chiefly to determine whether the milk is good, medium, or poor." The confliction between these two statements leaves the subject open for further observations.

Most investigations of this nature compare the results of various tests with the actual keeping quality of the samples as determined by time and taste. Ours is not a research institution, and, therefore, our methods of comparison have not been laid out as would be in a strictly scientific method of studying this subject. However, in examining the product from almost 2,000 farmers, we have been able to make some observations that should be valuable in this study. The actual keeping quality of samples was determined by time and taste, but because it was not possible in our routine to examine samples every hour, a definite period of time was decided upon, and a definite temperature of incubation. Experience has shown us that raw milk, which will stand fifteen hours at 72° F. without being sour to taste, will be satisfactory for pasteurization; and that which will stand this incubation without showing any increase (less .01 per cent)

in titratable acidity will satisfy the most exacting customers. Comparisons of the standard plate count, the direct microscopic count (individual cell count), and the methylene blue reduction time with the actual keeping quality, determined by the above method, were made on 564 samples.

Table 1 shows the comparison of the plate counts, and microscopic counts with the actual keeping quality, and with the methylene blue reduction test as used in common practice. Wide variations may be noticed in both the plate counts and microscopic counts on both good and poor milk. There is a greater difference between the average microscopic counts on good and poor milk than between the average plate counts. The lower part of this table serves to establish a relation between average counts and reduction time. This classification of counts is used in the following table of comparison. The wide variations in counts would be greatly reduced if logarithmic values of these counts were averaged, but it is expensive for small country stations to equip themselves for plate count work, let alone hiring technicians trained to compute logarithmic averages.

Table 2 shows the accuracy with which the methylene blue test may be used in classifying samples according to keeping quality. It is interesting to note that all samples having a reduction time of eight hours or more stood up on the incubation test, while only 36 per cent of the samples having a correspondingly low plate count stood the incubation test.

Since reduction times are not ordinarily read at very frequent intervals it has been impossible to compute an average reduction time for any given number of samples that would be a fair indication of the quality of the product. This is probably the chief reason that the logarithmic average of plate counts has been preferred. Table 4 shows that if the proportion of successes to failures in

attaining a given standard is considered, rather than an average, very satisfactory results may be obtained. If nine tests out of ten show a reduction time of eight hours or better, an average plate count of 15,000 or less may be expected, while if three out of four samples attain the standard of eight hours, an average plate count of 30,000 to 35,000 may result.

From the results of these observations, the practice of running methylene blue tests on all samples was adopted. To assist in determining the source of trouble on indiviual farms, the methylene blue samples were incubated over night, and the curd examined next morning. To confirm the curd examinations, microscopic examinations were made from the samples at the time of complete reduction of the methylene blue. This comparison was made on several thousand samples. In almost every instance the microscopic findings agreed with the types of fermentation. It was noted that the presence of fecal contamination, as indicated by the production of gas in the curd, was more readily observed in the curd test than in the microscopic test. The curd test fails entirely in detecting udder trouble, while the microscope proves almost indispensable in the detection of mastitis infection from the examination of composite herd samples.

This brings us to another interesting comparison. It is commonly believed that mastitis infection has a very definite effect on the methylene blue reduction time. Microscopic examinations were made of composite herd shipment samples from all producers every month or six weeks. Table 3 shows the methylene blue classification of all samples and the methylene blue classification of samples showing positive mastitis (streptococcus and leucocyte combinations, or leucocyte counts over 2,000,000 per cc) over a period of six months. These figures indicate that, in general, mastitis infection does not affect the reduction time. It is understood, however, that

The 1940 Dairy Recorder

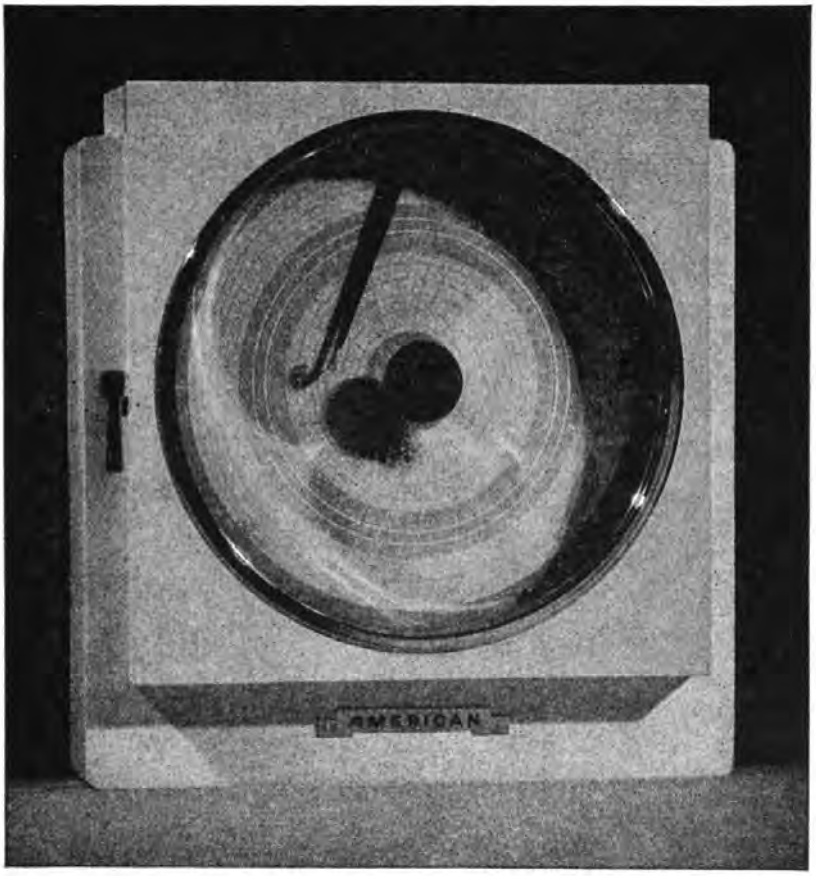

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Table 1

PLATE COUNT AND MICROSCOPIC COUNTS ON 564 SAMPLES CLASSIFIED ACCORDING TO ACTUAL KEEPING QUALITY AND ACCORDING TO REDUCTION TIME

	PLATE COUNT					*MICROSCOPIC COUNT*				
	Average	Mean Variation %		Extreme Variation %		Average	Mean Variation %		Extreme Variation %	
		Plus	Minus	Plus	Minus		Plus	Minus	Plus	Minus
Samples showing no increase in titratable acidity on 15 hours at 72°F	108,000	81.5	43.5	539	96	344,000	99.5	55	840	90.5
Samples not sour to taste after 15 hours at 72°F	123,000	60	45.5	175	96	336,000	93	81.5	155.5	90
Samples sour in 15 hours at 72°F	236,000	63	45.5	224.5	98	1,103,000	83.5	38.5	519	80.5
Over 8 hours methylene blue	83,000	84.5	54.4	278.5	94	234,000	78	57	238.5	86
6-8 hours methylene blue	115,000	56.5	45	195.5	95.5	385,000	121.5	43.5	761	74
4-6 hours methylene blue	194,000	68	44.5	271	97.5	811,000	112	46	185	84
Less than 4 hours methylene blue	329,000	37.5	40	132.5	85	2,309,000	74	53.5	196	81.5

on individual samples, particularly from individual cows, a high leucocyte content may cause a wide variation from these averages. But apparently this effect is minimized in composite herd shipment samples as received at the plant.

The conclusions that may be drawn from these observations are that (1) the methylene blue reduction test (proportion of samples attaining standard) should be satisfactory for control purposes in country plants, (2) the examination of curds from incubated methylene blue samples is a satisfactory means in estimating the probable cause of poor keeping quality, (3) the reduction time on composite herd shipment samples is not consistently affected by mastitis infection, and (4) the microscopic examination of incubated samples is necessary to supplement the methylene blue and curd tests if mastitis control is part of the program.

Table 2

KEEPING QUALITY OF SAMPLES CLASSIFIED BY REDUCTION TIME AND BY PLATE COUNTS

	Per cent of samples in each class showing no increase in titratable acidity on 15 hours at 72°F	Per cent in each class of samples not sour to taste after 15 hours at 72°F
Reduction Time		
Over 8 hours	100	100
6-8 hours	35	69
4-6 hours	6	19
Less than 4 hours	0	1
Classification of Plate Counts		
83,000 or less	36	57.5
115,000-83,000	20	38.5
194,000-115,000	17.5	41.5
Over 194,000	4.5	10

Table 3

EFFECT OF MASTITIS ON REDUCTION TIME
PER CENT OF SAMPLES FALLING IN VARIOUS CLASSES
ACCORDING TO REDUCTION TIME

	All Samples	Samples Showing Positive Mastitis
Over 8 hours	63.4	66
6-8 hours	19.8	8.9
4-6 hours	9.4	16.2
Less than 4 hours	7.4	8.9

Table 4

Average plate count on producers having 8 hour + 90% of time 14,741
Average plate count on producers having 8 hour + 75% of time 32,406

DISCUSSION

President Krueger: I could not help but think, as I listened to Mr. Smith, of Dr. Harding's discussion at our last meeting, especially in connection with Table 1, where they use fifteen hours and seventy-two degrees temperature. I know that if Dr. Harding were here he would say that that is along the lines he has often advocated. We should rather see the effect on the quality of the milk. Therefore, I was very much interested in this time and temperature proposition in relation to the milk itself.

Mr. Yates: I would like to ask Mr. Smith what method he used in making acid determinations.

Mr. Smith: On the incubation samples we used the standard titration method and we tested before and also after incubation.

Dr. Frank: Within what limitations did you consider there was no increase?

Mr. Smith: Any that could be read on the burette, (.01%).

President Krueger: We have had discussions before on the keeping quality of the bottled milk as an index of its quality, but my recollection is that this is the first that has been presented in this way.

Mr. Smith: I might add one thing more and that is on cream; it seems the incubation tests, although a little cumbersome to run on milk from all producers, seem to work out particularly well in the cream separated on farms. The bacterial test on cream, as it is received at the plants, is not a very fair measure of its quality, because cream suffers so much from odor absorption as well as from bacterial growth. We simply take the samples, put them in the incubators, and test the samples the next morning. If we find them sour to taste, or if they have any off flavors we can get all this at the same examination.

Dr. Parker: In regard to holding the samples in bottles or test tubes for observation, I think some agreement should be reached on the temperature at which those observations should be made. There is a question in my mind as to what temperature to use and whether you would get a different result if you used the ordinary incubation temperature from what you would get if you used a temperature of forty-five or fifty degrees. The question is: At what temperature would the consumer hold his milk? The old family ice chest was considerably over fifty degrees. Your modern, mechanical refrigerator, which is very common in the south and I suppose in the north as well, will hold it at fifty degrees or lower without any trouble. If these tests are going to be made I think we should arrive at some standard temperature at which to make the observations. I have done considerable work along these lines. It is a most useful test but, before one person can understand another, or a man can get consistent comparable results from one year to another, we must decide on what temperature to use.

Mr. Johns: Some years ago I happened to do work along this same line. We decided that sixty degrees would probably be the most satisfactory point at which to keep milk for all tests. We based that on this assumption, that the people who had electric refrigerators in good order were able to keep milk at below fifty degrees, and they were not the ones from whom the milk dealers were going to have complaints. On the other hand there are still a very good proportion of people who, during the summer time, use the old-fashioned ice chest and, even up in our part of the country use the cellar to keep milk. In many cases that milk is not very far from sixty degrees. We felt that it would be worthwhile to take that as a temperature rather than the optimum of storage temperature, below fifty degrees, or a higher temperature such as Mr. Smith has suggested. Although I do not know whether anybody has ever done much work on it, it has always seemed to me that when you make a considerable increase in the temperature of holding you are favoring certain types of organism at the expense of others.

President Krueger: I think the reason, too, for the difference in temperature is possibly the fact that in some cases they wish to accelerate the action so that the reading may be had as quickly as possible. To my mind, the greatest disadvantage to the use of a test of that nature is the fact that results are not obtained in time to really use them on that particular supply. This may be used as an index for future work, or for a certain condition, but it can not be used on a particular supply.

Mr. Tiedeman: As I see it, we have a tendency to weigh the tests against each other, with the idea that we ought to pick up one of them and use it exclusively and throw the others away. But I do not look at it that way at all. I believe the methylene blue test has a place in this particular field of getting milk of good keeping quality. None of the three tests, as I see it, are much good in mastitis control, if you use the microscopic examination without incubation. Of course, after

incubating the sample, the microscopic examination has its value. But, as I see it, a plant that is not exercising any control over milk delivered by producers could make a very good start by adopting the methylene blue test and bringing up the quality, and at the same time lowering the bacteria count. I do not think we can look for any good correlation between the methylene blue test, the standard plate count or the direct microscopic count, because there are organisms that will not reduce methylene blue; there are organisms that will not grow on agar; and organisms that may not be found on direct microscopic examination without incubation.

REPORT OF COMMITTEE ON DAIRY AND MILK PLANT EQUIPMENT

IN ITS REPORT for 1933, your Committee on Dairy and Milk Plant Equipment pointed out that notwithstanding the splendid progress made in recent years in improving dairy and milk plant equipment from the standpoints of sanitation and public health efficiency, some unsatisfactory equipment was on the market and the frequent changes in details of construction made it difficult for milk control officials to approve installations. The report indicated that this uncertainty was embarrassing to all concerned including officials, dealers and manufacturers.

The Committee recommended the appointment of a committee of the Association to attempt to bring about some understanding between these three interested groups as to what would be considered satisfactory by health officials. The Association adopted the resolution favoring the appointment of such a committee and the matter was taken under consideration by the Executive Committee who in turn placed it in the hands of this Committee.

After giving it consideration, the Committee decided that the best way to approach the subject was to draw up specifications from the standpoints of sanitation and public health efficiency of various pieces of equipment and parts thereof or appurtenances thereto starting with some of the more important. For this year's work the Committee has undertaken to draft specifications for inlet connections to pasteurizers or holders and for outlet valves of pasteurizers or holders.

Preliminary drafts of the specifications have been studied and criticized not only by the members of the

Committee but by members of the Plant Manual Committee and the Committee on Standardization of the International Association of Milk Dealers, and by the principal manufacturers of dairy and milk plant equipment. A draft of the specifications as tentatively adopted by the Committee, are as follows:

Tentative Specifications for Outlet Valves to Pasteurizers or Holders

All outlet valves to pasteurizers or holders

1 Shall meet the general requirements for the construction of milk plant equipment.
   (a) The metal or combinations of metals used shall not be affected by milk to the extent of pitting or corroding the metal and shall not affect the flavor of milk by electrolysis or by other means.
   (b) All surfaces with which milk comes in contact shall be smooth. There shall be no pits, crevices, cracks, open seams or threads exposed to milk.
   (c) Passages shall be so constructed as to prevent pocketing.
   (d) The assembly shall be simple and easily disassembled.
   (e) The parts shall be constructed so as to be easily cleaned.

2 Shall be readily accessible for operation and for disassembling and for cleaning.

3 Shall have the valve seat either flush with the inner wall of the pasteurizer or so closely coupled that all milk in the valve pocket is within the influence of the agitation or of convection currents. (If close coupled the diameter of the opening at the inner surface of the pasteurizer or holder shall be not less than twice the diameter of the outlet line and the distance from such inner wall to the valve seat shall be not less than one and one-half times the diameter of the outlet line.)

4 Shall prevent leakage past the valve set into the milk outlet.
   (a) The extent of surface with which leakage may come in contact and which is later exposed to pasteurized milk shall be less than half the cross-sectional area of the outlet pipe, otherwise such surfaces shall be automatically sterilized.
   (b) Grooves for diverting leakage shall not be less than 0.0138 square inches in cross-section throughout their effective length. (Equivalent to the area of a semi-circle 3/16 inches in diameter.)

(c) Mating grooves shall provide this full cross-sectional area throughout their combined length whenever the valve is in a closed position.
(d) Grooves for diverting leakage shall not be air bound.
(e) Grooves shall be so inclined as to permit free drainage.

5 Valves shall be provided with adequate necessary stops to insure proper operation.

6 Sterilizing connections shall not terminate in a channel through which milk is flowing.

7 Sterilizing connections shall be non-clogging.

Tentative Specifications for Inlet Connections to Pasteurizers or Holders

1 All pipe lines and valves used in inlet line connections to pasteurizers or holders shall meet the general requirements for the construction of milk plant equipment.
(a) The metal or combinations of metals used shall not be affected by milk to the extent of pitting or corroding the metal and shall not affect the flavor of milk by electrolysis or by other means.
(b) All surfaces with which milk comes in contact shall be smooth. There shall be no pits, crevices, cracks, open seams or threads exposed to milk.
(c) Passages shall be so constructed as to prevent pocketing.
(d) The assembly shall be simple and easily disassembled.
(e) The parts shall be constructed so as to be easily cleaned.

2 (a) Such connections shall be readily accessible for operation and for disassembling and for cleaning.
(b) Such connections shall be so located and constructed that leakage or drip, if any, will not find its way into the milk.

3 Such connections shall prevent leakage of unpasteurized milk into pasteurized or into a pasteurizer or holder other than that being filled and prevent short circuiting of unpasteurized milk into pasteurized.
(a) Dependence shall not be placed upon soldered joints to prevent such leakage. (This warning against dependence on soldered joints is extended to apply in particular to inlet connections of a pasteurizing holder when same includes a cylindrical tank divided into four or more compartments, located between the incoming unpasteurized milk and the individual holding tanks. Soldered joints in such a compartment inlet arrangement do not provide sufficient assurance to prevent the possibility of raw milk passing through the equipment.)

(b) (1) Grooves for diverting leakage shall be not less than 0.0138 square inches in cross-section throughout their effective length.
(Equivalent to the area of a semi-circle 3/16 inches in diameter.)
(2) Grooves for diverting leakage shall not be air bound.
(3) Grooves shall be so inclined as to permit free drainage.

4 (a) Pipe lines between the valve and pasteurizer or holder shall be as short as practicable and shall be pitched to drain freely therein.
(b) Such pipe lines shall be provided with automatic air relief either at the valve or otherwise to permit milk which has passed the valve to drain freely into the pasteurizer or holder when the valve is closed.

5 Milk preheated to pasteurizing temperature shall not be subject to cooling in dead lines or pockets unless adequate provisions are made for restoring such cooled milk to the required temperature before the beginning of the holding period by mixing with heated milk or other means.

If the Association favors work along this line, it is suggested that the Committee invite and consider further comments and criticisms of these tentative specifications and, if possible, present them in final form at the next meeting of this Association. It is also suggested that the Committee continue in cooperation with dealers and manufacturers, the drafting of additional specifications covering essential dairy and milk plant equipment.

Walter D. Tiedeman, *Chairman*

W. D. Dotterrer	Nelson M. Fuller
Leslie C. Frank	Fred M. Shields
George W. Grim	George W. Putnam
C. Sidney Leete	Malcolm Lewis
W. H. Marcussen	V. M. Ehlers

Discussion

President Krueger: As Mr. Tiedeman told you, the Committee this year has attempted to draw up specifications for equipment in milk plants and for use by the milk industry. It is a work that entails considerable detail and considerable time on the part of the members of the Committee. I think this first report of theirs indicates that they have gone into the subject very thoroughly and that the work should

be continued. We have very serious need for standards of control, not only in the line of machinery, but also in all phases of milk control work. The work of the United States Public Health Service, and the United States Department of Agriculture, cooperating with their ordinance, has worked along the same lines. I believe this organization should take a very definite attitude in regard to what constitutes proper practice. We have done that in the past in connection with these reports of Committees. I hope that work will be kept up in future.

Dr. Parker: I may have listened inattentively, but if so I beg Mr. Tiedeman's pardon. However, I would like to know about these multiway valves, these seven-way valves, and these five-way valves on tanks. Our department has had more trouble with that type of valve than any other. They become leaky and where they are used in delivering raw milk in a pasteurizing unit we have detected considerable contamination at times. How does your report cover those features?

Mr. Tiedeman: I will answer your question, Dr. Parker, by saying that the report does not cover any of these connections specifically; but in drawing the specifications we have had all those things in mind, and we believe that valves of that kind would not meet these specifications. Along the line of multiple inlets, one thing is where milk is introduced through these cylindrical tanks, divided into a number of compartments. Where those partitions are soldered we found them broken out and milk leaking directly from one compartment to another, and that is covered. I believe the multiple valve would also be covered by these specifications. At least, the Committee had them in mind.

Dr. Brooks: The work that this Committee has been doing and is planning to do, the definite recommending of standards, I think involves entering upon a new policy for the Association and one that I personally feel is highly desirable. But I just wanted to suggest that this idea should be thoroughly discussed, with the question in mind as to whether the Association wants the Committee to continue this kind of work, and when it comes in with its final report next year whether the Association, as an organization, will want to endorse it.

Mr. Frank: I am a member of Mr. Tiedeman's Committee and I not only enjoyed going over the preliminary drafts that were presented but also profited by many of the suggestions that were made. With reference to Dr. Brooks' statement just now, and to the same statement made first by Mr. Tiedeman, I am wondering whether we ought not to take care to do everything possible to avoid two entirely distinct sets of specifications being presented before the American control officials. The Public Health Service has been in collaboration with the Department of Agriculture for a number of years; it presented its Milk Control Code, designed specifically to give such specifications for the whole range of milk control. Now, we have no illusions whatever that those specifications are perfect or that they ever will be perfect. We will always, of course, want to improve upon them. But I am wondering whether the work of this Committee or this organization could not be

so coordinated with the departments of public health and agriculture as not to lead to two entirely distinctly competitive groups of specifications. The kind of thing I have in mind is this—to encourage this organization to continue that kind of work but also to encourage it to take the specifications that are now in the code and suggest improvements in those specifications rather than to write entirely new specifications.

Dr. Brooks: Isn't that accomplished through your membership on the Committee?

Mr. Frank: I am not sure. When we start with an entirely different model I am in an embarrassing position because I am a member of the same committee you are a member of—the Public Health Service Committee—and I am obliged to take the position with them on the Public Health Service code. Being also a member of Mr. Tiedeman's committee I find myself very desirous of approving what this committee does. But when, in doing that, I find that I have approved a set of specifications which, while they meet the general requirements contained in the code, are sufficiently different so that there may be confusion, I am not quite sure that I know what to do. I think it would be better if this organization, as an organization of local officials, were to suggest definite changes in the Public Health Service code and present them to our Advisory Board, for example, each year and ask them to incorporate them in the code, and if that Board refuses to include all the details that are dear to the hearts of the committee, then have the committee report to the organization what has transpired.

Dr. Brooks: I would not like to have it go into the record that this is an association of local officials only. It is an association of federal, state and local officials and others engaged in various phases of milk control work.

Mr. Tiedeman: In commenting on Mr. Frank's statement, I wish to say that the committee has no desire to compete with the Public Health Service Standard Ordinance. We felt that the milk inspectors were always asking "Is this piece of equipment satisfactory?" Or, "Is that piece of equipment satisfactory?" Notwithstanding, the extensive tests that the Public Health Service has made of equipment, I have never seen anything definite, in writing, as to what is satisfactory or what is not satisfactory. For instance, the other day, I had a letter from an inspector in Ohio asking where he could get a manual on equipment to tell him what was satisfactory and what was not satisfactory. In undertaking the work, the committee had no idea of duplicating any work that has been done or taking anything out of the hands of the Public Health Service. But we do feel that this Association should be on record as to what they consider satisfactory. We know that the American Public Health Association sets methods and standards for making bacteria counts and things of that kind. This appears to be a function definitely in the sphere of this organization.

Dr. Parker: I think that this Committee is doing excellent work and I am sure that none of the members of this Association would care to put either the excellent department of health of which Mr. Tiedeman and Dr. Brooks are members, or the Engineering Section of the Public Health Service "on the spot" as it were. I do think that there is a need for a committee of this kind, passing judgment on different devices as they are in practical operation, and I do not believe that this International Association of Dairy and Milk Inspectors or the men from Washington are likely to make any serious mistakes.

I *move* that this committee be commended for the work that it has done and that it be instructed to proceed with the work.

President Krueger: This is a very important question before our organization this year. It has come up to the Executive Committee during the year, and we, in a way, took a middle course and this was done with the idea that we would bring it out into the open at this meeting, so that we would have full discussion. The Committee is trying to contribute something to the solution of a difficult problem. We have, for example, in one of our Wisconsin plants the shipping of milk and cream to seven different markets, operating under seven separate and distinct sets of requirements. Take the matter of where one department requires that some particular kind of sterilization shall be used on the farm—chlorine we will say. And another one will say "No. Use steam or hot water, because that's all that is necessary on the farm." That raises one conflict. Then the question of the small-top milk pail is, in a way, amusing. Some departments require that they have it and others say they shall not have it. I could go on and talk for an hour on inconsistencies in regulations. Now, are we to say that one or the other is wrong, or shall we try to find the common meeting place? I think the point was brought up last year very clearly, when the milk control boards were formed, that the various states and cities had different requirements and while the price of milk was not a concern of the health officials, nevertheless the state or city that had certain requirements over another would find that it would cost more to produce milk and the producer would feel that he was entitled to more. It is a very important question and you men, in your line of work, have had it come before your attention, I know.

The question is this: Shall this Association take a definite stand in drawing up a manual for milk and dairy inspectors? The Public Health Service has formulated an ordinance in which general terms are used. Then in their "code" they go into a detailed clarification of the general terms, as to what is meant by satisfactory compliance. Some of the members feel that we should have a similar manual as to the standard methods of milk analysis. The code will say that the tests shall be made in accordance with the standard methods of the American Public Health Association, but they also go further and say how many counts shall be taken, how the samples shall be collected and things of that kind. I can see where there is a need for work in our own organization.

The reports of our committees on communicable diseases affecting man, for example, might go into the question as to what the health officer should do in connection with those diseases. I think that we need the information more, perhaps, than the legal phraseology. I am merely projecting here some of the thoughts which have been brought to the Executive Committee by our own membership. Dr. Brooks has stated very clearly that the policy of our organization in the past has been the one laid down by Mr. Weld, whom we all revere highly, that we do not draft standards. It was his thought that it was one way to get into a lot of difficulty. However, our milk control work has gotten to be more nearly a science than it was, say ten or fifteen years ago. One thing that has helped to make it that has been the improvement in methods of transportation and refrigeration, permitting milk and cream to be shipped long distances. We are getting to be truly national and international in scope in our regulations and it is the feeling of some of the members that we should formulate something in the nature of a manual on milk control work. This matter is open for your discussion. Whether you want to discuss it here or wait until we get into our business session, remains for your own judgment, but it is the one problem that comes up now.

Dr. Brooks: Mr. Chairman, I have rather strong convictions on this question of establishing standards. Of course the only way to keep out of difficulties is not to do anything, but even then you get criticized because you do not do anything. I have always felt that this Association, being a representative international organization and the only one dealing exclusively with milk, ought to be recommending standards and that no organization anywhere is so well qualified to do it as this one is. I do not think we ought to get into fields that are well covered by other organizations. However, there are plenty of fields like this one that are not covered except so far as this one is covered by the Public Health Service, and I can not see any conflict here. The Public Health Service ordinance is adopted in certain states and cities and there the specifications are standard. It has appeared to me that they are very excellent standards, in general, and they have been quite widely accepted. I know that we have been following them very closely in New York State. But it seems to me that this organization should be recommending standards when there is a need for them and I think Mr. Frank and this committee ought to be able to get together. He is a member of this committee and a good fighter and usually gets his ideas over pretty well. I think this committee should adopt standards for recommendation; where there is a conflict with Public Health Service standards then they should be changed to conform and, as a member of Mr. Frank's advisory committee, I certainly stand ready to vote for that.

Dr. Grim: I think Dr. Brooks has brought up some important points. I feel that something along the lines of standards should be undertaken, probably in a limited way to start with. When we have discussed it

fully why not put it to a vote tomorrow, this question of whether or not we shall adopt standards?

Mr. Frank: I do not want to be misunderstood. I meant to make it clear that I thought the work of this committee ought to be encouraged. But I also think that the committee should operate with a view to attempting to reach an agreement, so that the Public Health Service Advisory Board and this committee will bring out specifications as near alike as possible. That is the only plea I am making. To illustrate, at the last meeting of the Advisory Board you will remember that we were requested to prepare more detailed specifications on this matter of valves and present them to various national organizations between the time of the last meeting of the board and the next one, so the board could then take action on a proposed set of specifications. Now, we have taken advantage of this report of this committee and have incorporated practically all the specifications in this tentative draft and sent them to the International Milk Dealers' Association, the Association of Ice Cream and Dairy Machinery Manufacturers and also to Mr. Tiedeman's committee. I am simply pleading that we do everything we can to avoid setting up two different manuals. If we can have the one manual and this Association giving voice to any additions to that manual which it thinks ought to be made, I think that is fine. In other words, here is a national organization that has been attempting for years to set up standards. The Public Service code does that. It is not perfect but what this organization ought to do is to try to make it perfect, instead of setting up different standards. I believe that the Advisory Committee, of which you and I, Dr. Brooks, are members, is made up of sensible, reasonable people and they would be glad to adopt anything that is reasonable.

Mr. Tiedeman: I might add something to what Mr. Frank has said. Unfortunately, he was on a vacation when the committee started the work. The committee did not find anything in the Standard Milk Ordinance on this subject, or it would have given it consideration as a starting point. I believe that he has already indicated his spirit of cooperation in adopting these specifications. I do not look for any difficulty.

Mr. Frank: There is a section in the code marked "Valves." It is far from complete and this report of your committee will help make it complete. All I suggest is that when the committee takes these matters up, take what is in the code and build on that, if it can be done.

Mr. Kelly: I think that perhaps we are wasting time under a misapprehension. I understood Dr. Parker's remarks, in general, were in laudation of the work and he recommended that they continue their research work along the same line. I can not see how anybody can possibly have any objection to that. The more research and thought put on any of these subjects the better. I did not understand Dr. Parker to suggest that these preliminary recommendations be accepted now by this Association as final.

Dr. Parker: Mr. Kelly, you have shown your usual ability to get the meat out of the thing very promptly. You understood me exactly. I want this committee continued. I think it did a splendid piece of work. I think we need more of this sort of work and we need it from men like Mr. Tiedeman and his associates who are engineers and who understand the practical application of the various devices. Every inspector knows that from time to time defective devices are put in use and through such a committee attention ought to be called to them so that they could be corrected. I certainly appreciate, Mr. Kelly, your getting the gist of my argument and I wonder if you are with me enough so that you would feel you would like to second my motion, which has not yet been seconded?

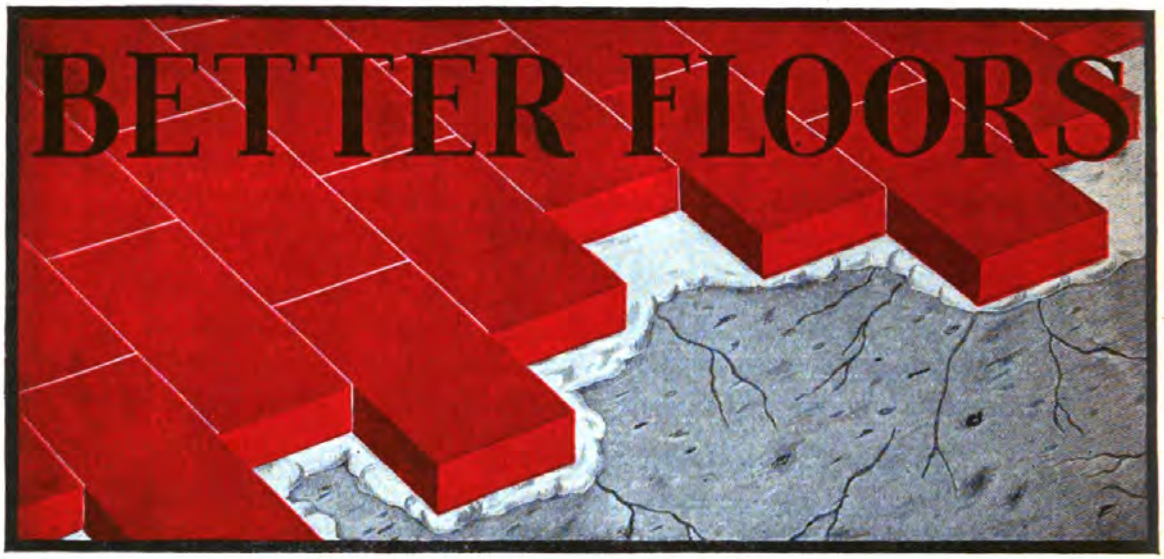
Mr. Kelly: I had presumed that the resolution should be presented to the Resolutions Committee, to be presented to the association. If I am wrong about that, I would like to be corrected. I think the procedure would be for Dr. Parker or some one else to present a resolution to the Resolutions Committee, and to report to the association at the business meeting.

Dr. Brooks: I do not know of anything in the Constitution or the By-laws that would require that. I can not see why that formality is necessary.

President Krueger: It is my understanding that when the report is given the motion can be made to accept the report and it can be adopted.

Mr. Kelly: I am very glad to second the motion that the report be received with the recommendation that the committee continue its work.

President Krueger: All those in favor will please say "aye." Contrary by the same sign. The motion is carried.



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"When Writing Mention This Report"

THE DETECTION AND CONTROL OF MASTITIS

D. H. UDALL

Cornell University, Ithaca, N. Y.

IT IS somewhat embarrassing to discuss this subject before so many who have repeatedly listened to my talks on mastitis. That there is great interest in the subject is shown by repeated attendance of the same individuals whenever demonstrations or meetings are held.

THE NATURE OF DISEASE

One of the difficult aspects of this disease is failure of laymen, and to some extent of veterinarians to understand its nature. This morning Mr. Morris has frequently used the expression, "the nature of disease." Every age has had its conception of what disease is. Primitive races regard it as a punishment for evil, or a possession of the devil. These inflictions may be imposed by a god or an enemy or the dead. The earliest forms of treatment were magic rites and magic has never completely lost its hold on medicine, even among civilized races.

One of the first definite statements of the nature of disease was expressed in the *humoral* theory of the period of Hippocrates, 460-390 B.C. According to this view, disease is a disturbance of the proper proportions of the four humors, blood, phlegm, yellow and black bile, and the doctrine of the four humors obscured medicine throughout the Dark Ages. Veterinarians meet with this conception in the spring of the year when they are asked to clear up a skin eruption in a horse, of which the owner states that "his blood is out of order." To tell the owner that the eruption is caused by lack of grooming is seldom convincing; he wants some medicine "to clear the blood." Products of the humoral theory in the form of "blood

purifiers" and "spring tonics" are still with us. An infusion of aloes, known locally as Fairman's bitters and named after the country doctor, still recalls a bitter recollection of the spring season of my early boyhood. While hunting this fall my companion carefully marked the location of a group of sassafras trees whose roots were wanted by an old lady for an infusion "to thin the blood." These therapeutic conceptions are more than 2000 years old.

Approximately twenty centuries after the presentation of the humoral theory Virchow * delivered his lectures in Berlin on cellular pathology. In the preface to the first edition he states that "they were particularly intended as an attempt to offer in a better arranged form than had hitherto been done, a view of the cellular nature of all vital processes, both physiological and pathological, animal and vegetable, so as to distinctly set forth what even the people have been dimly conscious of, namely, the unity of life in all organized beings, in opposition to the one-sided humoral and neuristical tendencies which have been transmitted from the mythical days of antiquity to our own times." The English translator of these lectures wrote that Virchow's views still remained unknown to the English medical public. Thus it appears that our present conception of the nature of disease, which is based upon *cellular pathology,* is a product of our own generation. Virchow, who was a professor of pathology and therapeutics as well as a practicing physician, showed that disease is a derangement of the function or the structure of the cells that constitute the affected part. This important scientific fact applies directly to mastitis, a disease in which the structure, and consequently the functions, of the affected tissues undergo change. These structural changes need to be kept in mind by those who would diagnose the disease by means of an examination of the milk only.

* *Cellular Pathology,* Berlin, 1858.

In meetings of this kind we hear much of the three-teated cow. There is little in the word, three-teated, that relates to Virchow's cellular pathology. The essential nature of mastitis is within the tissues of the udder, and whether it has three or five functioning teats is immaterial. Chief importance attaches to the nature of the glandular and connective tissue of which the udder is composed.

We also hear much of this or that chemical test of the milk. These reactions are merely evidence of a change in character of the secretions which come from the udder; often they fail to reveal the nature or extent of the changes in the tissues of the udder itself, and they may fail to reveal existing pathological conditions. There are also similar limitations to the bacteriological examination of milk. These comments are not a criticism of either chemical or bacteriological examinations of the milk for diagnostic purposes. They are a criticism of the prevailing tendency to ignore obvious pathological changes that exist in chronic mastitis and that are apparent to veterinarians trained in clinical diagnosis. While indirect methods of diagnosis are of great value in establishing the presence of an infection, a knowledge of the condition of the patient depends on an examination of the individual.

There are various explanations of lack of failure to examine the mammary glands for diagnostic purposes. One is that it has not been taught in veterinary schools, nor has it been required in practice beyond a recognition of the most obvious cases. Writers on the subject repeatedly mention chronic mastitis as a latent or subclinical disease where it is probable that skill to detect, rather than the mastitis, is latent. I surmise that this view, expressed by well-known authorities, who perhaps have never handled an udder, has had some influence in molding current belief. Clinical possibilities can not be determined by speculation. Another explanation is found

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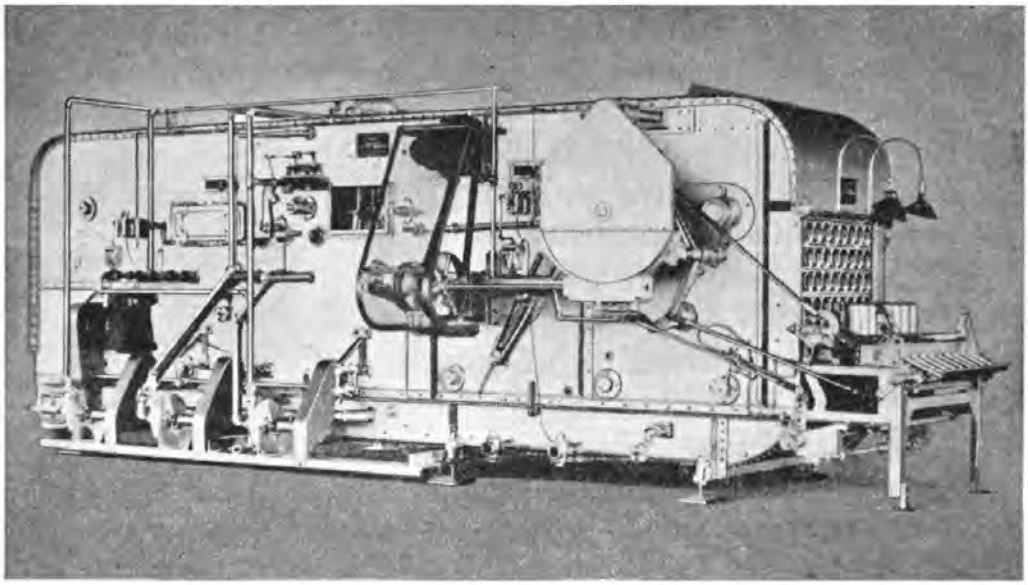

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in the conception that because we have diagnostic tests for tuberculosis and Bang's disease, maladies caused only by a specific microorganism, similar tests should apply here. Beyond the accepted behalf that *Streptococcus agalactiae* is the infective agent in more than 90 per cent of mastitis, our knowledge of the subject is limited. Just where this streptococcus may exist outside or inside the body is yet to be learned. If the tubercle bacillus is entirely eliminated from a stable the disease cannot reappear unless it is again introduced, regardless of the sanitary conditions. Starting with a mastitis-free group of cows, it is quite certain that the disease can be established by insanitary methods of milking and stabling. In this respect it resembles calf pneumonia or calf scours, diseases that may be initiated by means of insanitary feeding or stabling, and that then spread with all the characteristics of a contagion. Whether or not we call mastitis a specific disease, there is no specific test, as for tuberculosis. In tuberculosis control, our effort is to eliminate the tubercle bacillus. Our problem in mastitis control is more complex. It is doubtful that control can be entirely accomplished by elimination of *S. agalactiae*, even assuming that we have complete information of the habitat of this streptococcus. There are still other bacteria capable of causing the disease. A possible additional explanation arises from the overwhelming influence of the discovery of the science of bacteriology by Pasteur in the eighteen seventies, and a consequent confusion in some minds between the pathology and the etiology of disease. In diseases due to a specific cause, the mere presence of the causative microorganism may be accepted as sufficient reason to destroy the animal from which it comes, as in tuberculosis or glanders, but this principle does not apply to mastitis.

Special emphasis is placed upon the nature of this disease because of confusion on the subject both within

and outside the veterinary profession. It has been mentioned that certain farmers have the opinion that mastitis is an acute rather than a chronic malady. I have talked with well-known veterinarians engaged in research on animal diseases who seemed surprised to hear that the onset of mastitis is usually chronic. In the treatment of an attack of acute mastitis, it is customary to consider it cured when the acute symptoms recede.

Diagnosis and Control

The mammary gland is chiefly composed of two kinds of tissue: a special glandular tissue which secretes the milk and a framework of connective tissue. It may be defined as a chronic inflammation caused chiefly by *Streptococcus agalactiae* and characterized by the replacement of glandular tissue with connective tissue. At intervals this process may be active and at other times entirely suspended; there may be a suppurative inflammation of the mucous membrane of the ducts and milk cystern.

In the diagnosis of mastitis, three points are considered: the history, the milk, and the mammary gland. Often the history is not available. There may be a report of garget during some previous lactation period with an acute attack at the next time of freshening.

The Strip-Cup

The milk is examined with a strip-cup, preferably using the first streams from a full udder. Only a small percentage of cows affected with mastitis are detected with the strip-cup on one examination only. If the strip-cup is used daily by the owner the vast majority of cases will be recognized at some time. Flakes and clots are most liable to appear when the cow is drying off or when she freshens or is overfed or improperly milked or exposed to cold. Advanced cases show flakes or clots on the screen at

frequent intervals, yet they may escape detection at the time of routine inspections made occasionally. One sometimes hears that the strip-cup test is of little value in the diagnosis of mastitis. There are comparatively few "tests" that by themselves give a high degree of accuracy. The value of any test depends on the evidence that it may reveal, and the significance of such evidence when interpreted by an experienced person. While the limitations of any test must be recognized, no test should be judged by its limitations. In the diagnosis of disease the examiner, rather than the test, is the limiting factor. In any case of mastitis the milk varies from time to time, and consequently any examination of the milk may show corresponding variations. While milk from udders affected with mastitis in an advanced form usually is abnormal in some respect, such udders may give milk at some particular time that fails to react to any of the tests.

The Bromthymol-Blue or Other Similar Tests

From the many "tests" employed to determine increased alkalinity or other chemical change in the milk, I ordinarily use the bromthymol-blue test. Any of the others may have equal value, but the multiplication of "tests" is unnecessarily expensive and may be confusing. In conducting this test the first ten or twelve streams should be discarded. Preference is given to the test-tube method, using about 5 c.c. from each teat rather than to the blotter method. Before adding the fluid examine the milk in the tubes in good light. Often the milk from an affected quarter is lighter in color (watery) or more yellow than the milk from the normal quarters, and it may contain flakes. When the test fluid is added to normal milk it takes on a yellowish color. Deviations from the normal are light green, green, and dark green. While the presence of flakes on the strip-cup is rarely observed except

in mastitis, the bromthymol-blue test may give slight reactions in milk from quarters that are free from the disease, or that are so slightly affected that the milk is entirely fit for human food, even in a raw state. On the other hand, milk from a badly diseased quarter may not react to this test at some particular time. Since the introduction of this test owners of valuable animals have been needlessly deprived of cows through the use of bromthymol-blue solution by ignorant "inspectors." In this solution they have found a "test," and without knowledge of its interpretation, or the use of other evidence acquired only by study and experience, they condemn the cow in the name of "public health." Here again let me repeat that regardless of numerous articles in various languages on the per cent of accuracy or error of the bromthymol-blue test, the accuracy depends on the doctor rather than the test. While writing this article I have been interrupted to examine four cows for a prospective purchaser. The seller who is a farmer bought the four cows within the month on a "blotter test," using blotters supplied by a large milk company to its producers. Three of the cows reacted to the bromthymol-blue test that I made, and even a superficial physical examination revealed the defective quarters. While these remarks may be interpreted as a deviation from the subject, they have a direct bearing on the type of technical service that the dairy industry should expect from its investment in veterinary education and research. After all this investment there is still a demand for the empirical method, based on experience only—a cheap method, but a costly service.

When a cow begins to dry off or has been in milk for eight or more months or has freshened within a week, one needs to be conservative in the interpretation of the "color" test. In herds producing special milk there is considerable evidence that a test made within 24 to 48 hours

after the cow freshens is of value in revealing entirely normal udders. If there is no reaction at this time, one may be reasonably certain of the health of the udder. Reactions occurring at this time, however, do not necessarily imply that the udder is diseased.

Keeping Qualities of the Milk

The keeping qualities of the milk held at a temperature of 37° C. for 24 hours gives useful information on the health of the udder. We collect the samples from each quarter in sterile glass cylinders 4 inches high by 1⅛ inch diameter provided with sterile rubber stoppers. The sample is taken as for bacteriological examination after wiping the quarter with a towel moistened with alcohol. Normal milk kept in this manner shows a definite milk and cream line. When the tube is inverted the bottom and sides are free from sediment. In mastitis milk, there often forms a layer of yellowish serum (whey) between the cream line and the milk; and the milk itself may appear watery. Under the influence of heat these changes may occur as early as six hours, while normal milk may appear normal after 48 hours. When incubated milk from a normal quarter is returned to the refrigerator it may retain its normal appearance for as long as two weeks. This test is perhaps safer than the bromthymol-blue test in the hands of the inexperienced, since it is less liable to be misinterpreted.

Physical Examination of the Udder

We have placed special emphasis on physical examination of the udder because the changes that occur here are permanent. In mastitis they constitute the essential deviations from the normal, and they determine the character of the milk. Furthermore, they have received comparatively little attention from students of the disease. The common statement that chronic mastitis

often occurs in a latent or subclinical form is not supported by our observations. We believe that the latent quality is human, rather than bovine, and that this "latent" view is not based on a thorough physical examination of the udder itself. While considerable practice and skill are required to differentiate the normal elastic tissue of a quarter from one containing fibrotic tissue, the task is readily within the ability of the average veterinarian who makes a serious study of the subject.

Briefly described, one first examines the udder from the rear to note whether the ends of the teats are in the same plane, and whether the hind quarters are symmetrical in size and shape. Then draw the hind teats backward and upward against the udder and note if the ends of the front teats are in the same plane. If definite lesions with atrophy are in the left half, for example, the ends of the teats on that side hang somewhat higher than their mates. Owners often regard this difference of no significance; "it is merely a shy quarter." Usually such an interpretation is incorrect. Then each hind quarter is palpated superficially by pinching the skin in folds over the surface of the gland to note any roughness that may lie undeaneath and which gives to the udder a lobulated surface. If one quarter is lobulated and its mate is smooth, it implies fibrosis of the lobulated quarter. The right hind quarter is now lifted with both hands to compare its size, weight, and consistency with that of its mate, the left hind quarter. The right hind teat is then pulled downward with the left hand and the tissue directly above and in front is squeezed firmly between the fingers and thumb of the right hand; this reveals the amount of elastic and fibrous tissue. In perfectly elastic quarters there may be little but the two layers of skin and soft elastic tissue in the grasp; the fingers and thumb approach each other closely. In fibrosis of the corresponding part of the left hind quarter, the distance between the thumb and fingers

may be from one to three inches or more, depending on the degree of fibrosis. In this manner all four quarters are examined both in front of and behind each teat. Then the entire quarter is grasped between the fingers of both hands and palpated deeply, estimating the degree of elasticity and the relative amount of fibrosis. The fibrosis may be disseminate, a frequent finding in large udders of aged cows, or it may be diffuse throughout the affected quarter. Because of variations in size and consistency of normal quarters, depending on the degree of fullness, the period of lactation, and the individual, considerable practice is required before a veterinarian can acquire speed and skill in this work.

According to the findings each quarter is marked normal, slight (suspicious), distinct, or marked, according to the amount of fibrosis present. The udder itself is classified as No. 1, 2, 3, or 4 according to the final decision based on the complete examination. As dairy and milk inspectors you are interested chiefly in udders termed No. 4, since the majority of cows with such udders are not considered desirable for milk production. Almost invariably they are shedding many streptococci in the milk; consequently they are a source of contagion to other cows, and probably to calves that consume such milk freely. Numbers 1 and 2 are considered normal. Number 3 contains lesions that may be readily identified, but the milk is suitable for human consumption.

A number 4 udder is defined as follows:* Production is below normal. History shows repeated acute attacks. The milk usually contains flakes or clots or is watery. The bromthymol-blue reaction is positive. Indurations are distinct and multiple or marked and diffuse. Atrophy and asymmetry are frequent. If the lesions are marked in two quarters, the udder is classed as 4, even if the milk is apparently normal. If a quarter leaks freely the udder

* *Bull. 79, New York State College of Agriculture,* Ithaca, N. Y. *Bull. M. S. 58, New York State Department of Health,* Albany, N. Y.

is classed as 4. Bacteriological examinations reveal streptococci or staphylococci; often they are present in stained smears. On single examinations streptococci may not be found in the milk. Leucocytes are present in millions.

Bacteriological Examination of the Milk

The methods employed for bacteriological examination are not fully discussed here, for such examinations are neither necessary nor required in routine dairy inspection for fitness to produce milk. They are suitable, however, for this purpose if done properly at frequent intervals, and they are often useful as a supplement to examinations made in the stable. In collecting samples for making cultures, contaminations occur unless it is done with especial care. The time required for taking samples is about the equivalent of that required by a skilled veterinarian to make the examinations previously described. In addition the samples must be iced, transported, and examined in the laboratory. Bacteriological examination of market milk for evidence of gross contamination with mastitis milk is useful in areas where dairy inspection has not yet reached the cow, and where milk from cows affected with chronic mastitis in an advanced form passes freely into the general supply.

Control of Mastitis

There is an abundance of proof that thorough inspection of dairy cows, combined with instructions to the owner relative to dairy hygiene, has greatly improved the quality of the milk that goes to the metropolitan area and has also reduced the losses from mastitis.

One of the chief requirements is stable construction which provides a stall of sufficient length and breadth for the cow, as well as stall partitions to protect against treading. Provide an abundance of bedding and two or three

times a week sprinkle slaked lime or land plaster on the back part of the stall beds.

The chief cause of mastitis is the cow with the disease in an advanced form. According to some of our leading authorities, the mastitis cow exceeds all other causes combined in the perpetuation of the disease in a stable. When the per cent of advanced cases reaches 25 to 40, mastitis among first calf heifers is frequent, and new acute cases appear at frequent intervals. In view of these facts, the reason for segregation or disposal of such cases, and for caution in the purchase of additions becomes obvious. Few cows offered by dealers at public auctions have normal udders. Many farmers have learned that their only protection is to buy cows subject to examination by their veterinarian.

The milker may injure the teats by the "stripping" method or by pressure with the knuckle of the thumb against the side of the teat. Wet milking should not be permitted. Cows should be milked thoroughly dry. The use of the strip-cup before milking and the dipping of teats in a mild disinfectant after milking are valuable methods in the detection and prevention of affections of the udder. As a disinfectant after milking we recommend chlorine (200 to 400 parts per million). In large dairies it is better to assign certain cows to each milker. When these precautions and methods are carefully observed, there is little difficulty in keeping the average herd relatively free from mastitis. Whenever a case is recognized, or when affected cows are still in the herd, they should be placed in a line by themselves and milked last, or assigned to a special milker.

Dairy Inspection Service

As expressed by Ostertag, "healthful milk can only be produced by healthy cows." Throughout the United States most municipalities provide regulations under

which milk may be sold within its borders, and each city is known locally to have "the best milk supply of any in the country." The regulations are fairly uniform, and this is especially true of New York State. There are two chief methods by which milk is rendered acceptable to health officials: by pasteurization, and by special supervision of the cows and the methods of production, as for certified and other special grades of raw milk. Of the total amount of milk consumed in New York State in 1930, it is estimated that 28 per cent was raw. In Massachusetts it is estimated that 85 per cent of the milk consumed is pasteurized.

Regulations for local milk control in New York State are based largely on the State Sanitary Code. Inspection service for milk sold in the metropolitan area has three provisions: regulations, instructed inspectors, and supervisors who examine both the milk and the work of the inspectors. In other parts of the State the local health officials make regulations based on the State Sanitary Code. An inspector, either a veterinarian or a layman, is appointed, and this inspector usually proceeds according to circumstances, without being answerable to any person having knowledge of sanitary milk production. As a result, the milk of a town may be produced under excellent sanitary conditions from healthy cows, or it may come from filthy stables and diseased cows. To the average health officer, knowledge of these subjects is limited to the verbal or written reports of the "inspector." Instruction and supervision are both lacking. There are two important reasons for inspection service: one is to protect the consumer against milkborne infections; the other is to protect him against the consumption of mastitis milk, or milk that may be contaminated or spoiled after it leaves the cow. It is probable that the great majority of milkborne diseases, caused by pathogenic organisms that originate in the cow's udder, and

they are few, can be traced to cows with badly diseased mammary glands. A diseased udder is predisposed to invasion by pathogenic organisms.

Pasteurization or evaporation protects the consumer against the dangers of contaminated milk. For this reason public health officials, with few exceptions, enforce processing of milk within the limits of their jurisdiction; this gives them a defense against the remote possibility of being held responsible for a milkborne infection. There is little or no proof to indicate that the special raw milks are less safe. While it is generally stated that milk for processing should come from healthy cows, this principle is ignored with respect to the udders of animals supplying milk to the average small municipality in New York State. We have frequently found herds supplying milk to up-state cities in which from 25 to 40 per cent of the udders were No. 4. Unless an inspector is instructed and supervised, regulatory service tends to become a farce. It is highly probable that with the exception of a few large cities, inspection of udders for their fitness to produce milk for human consumption is decidedly superficial.

Special responsibility attaches to the inspection of cows producing special grades of raw milk. Only raw milk is obtainable by a considerable part of the population. And much larger amounts of special forms of raw milk would be consumed, except for prohibitive prices in some instances, and prohibitive regulations in others. Since this kind of milk seems to be chosen for extermination by public health officials, and the right to sell it is not defended either by the producer or the distributor, the inspector is doubly responsible to insist that its quality be kept above the possibility of complaint. Those who are unable to maintain mastitis-free herds should produce milk for pasteurization. The market for special forms of raw milk can never be threatened by milk from distant

states or from sealed tin cans. Much is heard of the health-promoting qualities of milk, and the public is urged to consume it through a sense of duty to their constitutions and the farmer. Little emphasis is placed on providing milk for every taste in order to meet the consumer demand, and to expand a shrinking market for fluid milk. In the discussions on the shrinkage in milk consumption, little is heard of the increased sale of evaporated and other forms delivered in tin cans. If the principle that a healthy cow gives healthful milk were actually recognized by health authorities, it is quite probable that less of it would go to the condensery, and that inspection would become a more active reality.

ABORTION DISEASE AND UNDULANT FEVER

R. R. Birch
Cornell University, Ithaca, New York

A CLEARLY defined background is essential in our approach to the subject of undulant fever in man in its relation to animal disease. Undulant fever may be caused either by *Brucella bovis* which is also the cause of infectious abortion in cattle, by *Brucella suis* which causes a parallel disease in swine, or by *Brucella melitensis* which regularly infects goats. The picture presented then is that of a group consisting of three closely related types, each of which may be said to have its normal habitat in a given species of animal, and each of which, on occasion, is transmissible to man. We should add, though, that we have merely sketched definite tendencies and have by no means delineated the entire pathogenic range of any one of the three types. All are known to produce disease in various animal species other than the ones we have named.

Probably *Br. melitensis, Br. suis,* and *Br. bovis* are pathogenic for man in the order named though possibly there are some who would rank *Br. suis* first. There is a profound difference in the virulence of different strains representing each of the types, and the virulence of a single strain fluctuates considerably when observations cover long periods of time. These original differences and fluctuations, enter heavily into the epidemiology and clinical picture of *Brucella* infections both in man and in animals.

Undulant fever, or *Brucella* infection in man, regardless of the type which produces it, is characterized by general lassitude, chills, intermittent fever, night sweats, headache, dizziness, enlarged and tender spleen, and joint

pains. The attack in recognized cases tends to endure for weeks or months with intermittent periods in which there is relief suggesting early recovery.

Abortion in women has been reported only a few times but until there are more complete records of pregnant women who have sustained severe attacks of undulant fever without mishap, we dare not assume that abortions are infrequent.

Some attacks, probably the great majority, are mild and of short duration, and while recovery is the rule, severe cases sometimes end in death. Atypical cases in which fever is absent have been reported, symptoms referable to brain lesions have been observed, and architis is by no means uncommon. Apparently males are more susceptible than females. Childhood and old age suffer least, youth and middle age most. So far as we know there are no records of direct transmission from one human case to another.

Brucella infection in cattle, known as Bang's disease, or infectious abortion, is caused usually by *Br. bovis*, occasionally by *Br. suis*. General symptoms are not prominent and fever if it occurs at all is mild. In the male, localizations in the testicles and seminal vesicles produce the chief symptoms, orchitis being most prominent. In the female, localizations in the udder and genital tract with the resulting symptoms, characterize the disease. Abortion is the most prominent symptom in mature breeding females. It is referable to the localization of *Br. bovis* in the uterus and chorion. Metritis, retained fetal membranes, and other related manifestations frequently appear. In the udder the organism localizes without producing pronounced or characteristic changes though it certainly causes injury. Frequently it is confined to one quarter only, though it may involve two, three, or all. We have found the organism often in the lymph glands in various parts of the body, and twice

in the spleen, but have never observed in these organs characteristic lesions caused by it.

Calves and young heifers seldom contract permanent *Brucella* infection, though under exposure they frequently react temporarily to the agglutination test which we shall in a moment consider more fully. Some mature cows under primary exposure show a transient and low reaction, with no outward manifestations and with no evidence of spread of the infection. Some show sharp and high reactions, characteristic symptoms, and evidence of spread, but eventually completely recover. Others, and this group is proportionately large, react permanently, show outward symptoms, and spread the infection, on occasion, as long as they live, though clinical symptoms tend to disappear as the case becomes chronic. A fourth group includes those animals whose value is destroyed by their first contact with the infection. They become high reactors, active spreaders, and show pronounced clinical symptoms, from which they do not recover. Thus, in cattle, there are all grades of susceptibility, ranging between true natural immunes and the other extreme in which the life or breeding value of the cow is destroyed.

Infected cows eliminate *Br. bovis* in enormous numbers in the uterine discharges during the calving period, and, in those cases in which the udder is involved, the organisms appear in the milk, either continually or intermittently. Infected bulls with localizations in the genitals sometimes eliminate the organisms in the seminal fluid, but this method of elimination is relatively uncommon. Experimental infection is readily accomplished through the mouth, conjunctiva, vagina, and by subcutaneous and intravenous inoculations. There is some evidence that Brucella organisms are capable of penetrating the unbroken skin. Probably natural infection takes place chiefly through the mouth but this is hardly susceptible of proof. In broad terms we must regard the infection as

one spread through the barn largely by the discharges of parturient cows, or by the careless handling of infected milk, and taken up by susceptible animals through ordinary contacts, either with discharging animals or with materials, principally foods, soiled by these discharges. All attempts to control the disease on the assumption that it is acquired principally during copulation, a view widely held formerly, have ended in failure.

Routine diagnosis of *Brucella* infections, both in man and in animals is best made by means of serological reactions. Because of its simplicity and accuracy the agglutination test is used most widely. Animal inoculations, cultural methods and direct smears supplement the test, but negative findings with these methods are far less significant than they are when the agglutination test is used.

It is unnecessary here to consider the technic of the test but we may with profit point out some of the principles that govern its use. In man, and in the animal species most directly concerned in the undulant fever problem, the blood serum of normal individuals causes some agglutination. Each species has its normal range, and periodic tests of individuals usually show fluctuations. In the cow the peak of the normal range is about 1-50, but in man and swine it is much lower. There is good evidence that under exposure the agglutinin response in cattle is much more rapid and regular than it is in man and swine. I mention these differences because grave errors have come to my attention originating in the assumption that a titer sufficiently high to be regarded as positive in man is necessarily significant in cattle as well. In reality each species has its normal range which is the only true basis for determining the abnormal.

Following infection, in all species, it requires some time for the agglutinin titer to build up. In cattle that we have infected by sprinkling *Brucella* cultures on their

feed, we have found that most reactions appear between the third and eighth week following exposure. In a few instances the reaction appeared before the third week, and in an occasional one, after the eighth. Thus false negatives in cattle frequently occur early in the course of the disease, and this tendency probably is even more pronounced in man and swine, though exact data covering this point are difficult to obtain.

In all species, when once exposure has taken place, and the agglutinin response has begun, high levels, if they are to occur at all are usually reached in a short time. Thus a negative test followed by a high positive in a week or two need occasion no surprise, but declines from the high levels to the normal ones, when they take place, are gradual almost without exception.

In the United States undulant fever acquired through drinking goats' milk containing *Br. melitensis* is not yet a problem. It is with the fever caused by *Br. suis* and *Br. bovis* that we are chiefly concerned. There is overwhelming evidence that *Br. suis* infection in man is acquired through the handling of infected swine and swine fetuses either on the farm or in abattoirs. Occasionally cows acquire *Br. suis* infection which localizes in the udder and is eliminated in the milk, thus exposing man. Beattie reports 27 cases of undulant fever in man caused by *Br. suis* all on one milk route. *Br. suis* was found localized in the udder of four of the cows in the herd. Although *Br. suis* causes disease in cattle, so far as we know *Br. bovis* does not, under natural conditions cause disease in swine.

There has been considerable controversy over the power of *Br. bovis* to produce disease in man and we do not have to go back far to find vehement denials of its pathogenic power in the human species. While its pathogenicity is measurably lower than that possessed by the other two types in the group, there is nevertheless no reasonable

doubt that it exists. We have regularly succeeded in infecting cows and producing typical cases of Bang's disease with cultures procured from the blood of human cases. These cultures were *Br. bovis* according to the Huddleson method of typing and the chain of evidence is thus quite complete.

Most workers who are familiar with the histories of undulant fever cases caused by *Br. bovis,* and with the facts regarding its regular elimination from the udder in milk, have little doubt that milk is responsible for the regular transmission from cows to man, though it is quite apparent that milk is not the only agency. Unfortunately the danger is sometimes greatly exaggerated and there is a loss of a sense of proportion in failing to recognize that undue publicity which may cause the elimination of milk from the diet might cause injury which in the aggregate would transcend that now represented by the occasional case of undulant fever. Undulant fever, then, is a disease which occasionally is acquired through drinking raw milk from infected cows, one which certainly may become serious enough to the patient, and one which is to be avoided, if possible, without the use of drastic measures.

Fundamentally the control is bound up in the gradual elimination of *Brucella* disease from our cattle and swine herds, with the judicious use of pasteurization of milk as a secondary rather than as a primary line of defense. I say gradual elimination, because in our cattle herds especially abrupt and radical measures usually defeat their own purpose. It is so easy to assume that the freeing of herds from the infection can be accomplished by the simple expedient of selling or killing infected cattle that react and by replacing them with animals that do not react. It is quite apparent that some of our city ordinances take origin in this false assumption, and that there is a total failure to appreciate the dairymen's

problem. Putting it briefly he must test, remove reactors, then repeat the process until no new cases appear, otherwise the beginnings of fresh outbreaks will smoulder in his herd to threaten all new additions. Once his herd is clean he must purchase from *clean herds* for he can not safely purchase non-reacting individuals from herds that contain reactors. If he does the chances are he will include exposed animals that are not yet reacting but which will later develop the disease and become active spreaders. The effect of forcing the process is either to cause purchasing before the home herd is actually clean, or to cause the hurried introduction of supposedly clean cattle that have within them the elements of disaster.

In our herds in established dairy districts approximately 16 per cent of the cattle have Bang's disease. A considerable percentage of these will at one time or another eliminate *Brucella* organisms from their udders. Most of us who habitually drink raw milk have exposed ourselves to *Br. bovis* infection again and again without suffering injury. It is only the occasional strain that builds up virulence sufficient to produce disease in man, and when this has occurred our health officers have wisely sought out the source of the infection and thrown safeguards around other consumers of milk who are exposed to a strain definitely known to be pathogenic for man. This practice, and the more fundamental one of gradually working the infection out of our cattle herds, I conceive to be our best approach to the undulant fever problem as we understand it today.

Discussion

President Krueger: I am very much interested in the federal plan for the control of these two diseases, and undoubtedly you will have some questions to ask Dr. Crossman, as well as Dr. Birch and Dr. Udall. These papers are now open for general discussion.

Dr. E. A. Crossman: Dr. Udall and Dr. Birch have discussed the subjects so thoroughly that I do not know as I want to add to or detract from anything that has been said. We might go on almost indefinitely discussing this latest paper of Dr. Birch.

I think you may be interested, though, in the work that the Department of Agriculture has started in Bang's disease control. Under the Jones-Connally Bill, thirty million dollars has been set aside for disease control work in cattle; twelve million dollars has been allotted to tuberculosis, seventeen million dollars to Bang's disease, and a million dollars, we expect, for mastitis. The Bang's disease control project, which is now under way in nearly all the states, is a co-operative, voluntary agreement between the cattle owner and the Secretary of Agriculture, in which the owner agrees to do certain things. He agrees to slaughter all of his cattle, all of his cows and bulls over six months of age that have reacted to the blood test. He further agrees—and this is a pretty hard thing for him to do in this part of the country—to confine his replacements to virgin heifers, or cattle from herds that are Bang's disease free. If, however, he is forced to buy a cow from a herd of unknown standing, that cow must be held in quarantine for sixty days and then given the blood test. If it passes the blood test, it can then enter the herd. The owner also agrees to buy no pregnant animals. But, there is a provision which says that should he be forced to buy pregnant animals, they must be held in quarantine for sixty days after calving and then if they pass the blood test they may be added to the herd.

I can see where this program may appeal to a great many of our dairymen and breeders; but, I marvel that so many have signified their intention of adopting this plan. Another thing to which the owner agrees is to continue his blood testing under the State plan, if there be such a plan in the State, and most of the states have such a plan. I think perhaps up here in New England we will be able to apply two tests, and then after that, as I say, the owner agrees to continue under the State plan, with the idea in view of establishing a Bang's disease free accredited herd.

The owner agrees to clean and disinfect his premises and abide by all the regulations of the State Department as well as the bureau regulations, and he agrees, of course, not to assign any of this indemnity money to creditors.

This is primarily a service for the cattle owner and it is not devised to assist bankers and cattle dealers and those holding liens and mortgages on cattle.

One other thing he agrees to do is not to present any animals for the blood test that have been injected with a vaccine within six months.

Now, the Government, on its part, agrees to give this service free. I said that it will give one test and probably two, and there will be no charge to the owner. He will be expected to give a reasonable amount of help in controlling the animals while the blood is being drawn. The Government agrees to pay him the appraised value of the reacting animals, less the salvage, not to exceed $20.00 for a grade animal and $50.00 for a pure bred. In the case of pure breds, they must have a certificate of registration at the time the test is made on all animals

over three years of age, and when under three years of age, a certificate of registration must be presented before the indemnity can be paid.

Briefly, that is all there is to our program on Bang's disease.

The mastitis regulations have not been worked out. They have not been made public, and I do not know just what they are going to be. I hope that they will not be much more than the physical examination, as described by Dr. Udall. There are so many tests that I fear the ordinary dairy herd in this part of the country can hardly stand up under the numerous tests. However, from a public health viewpoint, the part that you gentlemen are interested in, it would seem to me that if we can carry on a program of eliminating physical cases of mastitis, from our herds in New England, it will be of much more importance from a public health viewpoint than even our Bang's disease program. I know that the Bureau of Animal Industry would appreciate the endorsement of an organization of this kind in mastitis control work, which we hope to get under way very shortly. I thank you.

Dr. Brooks: Inasmuch as the two papers which we are now discussing are by gentlemen of New York State, maybe I will be forgiven for breaking in on a discussion like this. So far as New York State is concerned, Dr. Udall is our authority on mastitis and Dr. Birch on abortion. Referring first to Dr. Udall's talk: in New York State our sanitary code for a long time has required a dairyman recognizing a case of mastitis in a cow immediately to exclude the milk. More recently we have had a provision that raw milk of a certain grade must be from cows free from mastitis and we were always being confronted with the question "What do you mean by mastitis?" That is a perfectly reasonable question, but it is not such an easy one to answer. It might mean almost anything, from nothing up. This classification that Dr. Udall has worked out with the assistance of a committee of veterinarians is the culmination of a long discussion on this question and it gives us something to start with. We have agreed, administratively, that mastitis so far as our code is concerned means the mastitis that Dr. Udall calls Class 4, which probably includes most of the dangerous cows. Whether that is going far enough or not I do not know, but at least it is going somewhere and from the standpoint of results I feel pretty sure that we are going to get further than we ever have before.

Dr. Udall was altogether too modest when he said that the manual he showed you was issued by the New York City Department of Health. It was written by Dr. Udall and the New York City Department of Health has adopted it, as we are also doing in the State Department of Health. We will be very glad to mail you copies, if you are interested enough either to write in and ask for them or give me your names here.

With reference to Dr. Birch's subject, I was much surprised to hear Dr. Chadwick say this morning that Massachusetts had only eleven cases of undulant fever reported last year. In New York State, during the same period, my recollection is that we had 240 cases in "upstate" New York, which means outside of New York City, and something

like seven reported in the same period in New York City where all of their milk, excepting a small amount of certified milk, is pasteurized. The number of cases reported in upstate New York has been progressively increasing every year since they first began to be reported but I am quite sure that it does not represent an increase in cases. I think they are increasing as the physicians become more familiar with the disease and diagnose more cases. The fence between New York and Massachusetts is not very high and I am not quite able to figure out why some of these bad bugs from New York State do not jump over the fence into Massachusetts.

Dr. Holford: The American Association of Medical Milk Commissions, in their methods and standards for the production and handling of Certified milk, require that all Certified herds be physically examined once every thirty days. I am associated with a large milk company and we have come to the conclusion that the only way to keep abnormal milk out of the supply—in other words, milk from diseased udders—is by making frequent physical examinations of the herds. We are following a policy at the present time under which, for our higher grade of pasteurized milk, we are examining our herds every ninety days. We all realize that pasteurization may kill the streptococci causing mastitis but it will not remove the abnormal milk produced by diseased udders. Mastitis may not have public health significance as long as the milk is pasteurized, but at any rate there is an esthetic side. Where the consumer discovers it is possible that he is getting milk from diseased udders it is likely to affect consumption. I believe, in municipalities where the pasteurized milk is being graded, that the people who are paying more money for the higher grade of pasteurized milk should expect a better product, and one way of making a better product is by more frequent physical examinations of the herd. I believe that mastitis is one of the greatest, if not the greatest economic problem that we have among our producers. If it were possible to eliminate that like tuberculosis the problem of mastitis would be a different story.

President Krueger: Do your own men make the examinations?

Dr. Holford: Yes, we have our own veterinarians. I might add that for seven or eight years we had been making physical examinations of the higher grade herds every six months and we have found, from our previous records, that there were about twice as many diseased udders when we made examinations once a month. Another big problem is the replacements: to know where to go out and get healthy cows. It is better, if possible, to raise cows, because we know we have less trouble with the young stock than we do with older animals.

President Krueger: How many herds can your men examine in a day?

Dr. Holford: That depends on the size of the herds and the distance from one dairy to another. These herds are examined after they have been milked. We do not feel that we can make an efficient examination on a herd where the udders are full. Our men cover from three to four

hundred herds a day, more or less, depending on the number of animals in a herd. The average in New York State is seventeen cows to a herd.

President Krueger: The reason I am asking that question is because the thing has its economic side. I think we are all agreed that if we could examine our herds every ninety days or oftener it would be an advantage. The question is how many men it would take and how large an increase would be necessary in the budget. That is the problem with most of us, I am sure.

Dr. Holford: The point that I did not make clear, perhaps, is that it is only in the herds from which we get our higher grade of pasteurized milk that we are doing this. On our other herds the examination is once a year. As a rule the consuming public buys the higher grades for children and babies and I believe, as I said, that where the consumer is paying more and the farmer is getting more money for that kind of milk we owe that control to the consumer.

Unidentified Speaker: Isn't it true that they put the cost of that work back on the farmer? Isn't he the one that pays the bill?

Dr. Holford: We ask the farmer to qualify his milk for the market where it is going. If the market for that milk requires semi-annual physical examination for Grade A Milk then we pass the expense on to the farmer. He pays part of it, but the amount the farmer pays is only a small portion of what it costs.

Mr. Moyer: I, like Dr. Holford, am employed by a large milk company. Our company has made physical examinations of cattle for the last twelve years on the Grade B as well as the Grade A milk, without any additional cost to the producer. We have at the present time a buying plan being controlled by the Milk Control Board, and the price to the consumer is no higher than before. This work was done in order to put out what they thought was a better grade of milk to the consumer and we believe we have a better grade of milk because of these physical examinations. I went over the records of examinations for the past ten years and found that the percentage of cattle rejected as not being fit to produce milk—ordinary market milk—ran in some cases as high as eight per cent, especially where the physical examinations had not been made more than once a year. We find where the physical examinations for Grade A milk are made twice a year the percentage of cattle rejected for mastitis and all other troubles which may have any influence on milk runs anywhere from two per cent to five per cent every six months. In our section of the country, where physical examinations are made every six months, we find that the farmers in buying replacements are careful not to buy cows with crippled udders, which in itself has a tendency to reduce the amount of mastitis in the herds. I was extremely interested in Dr. Udall's talk and I agree with what he said regarding mastitis.

Mr. Tiedeman: I would like to ask Dr. Birch a question: whether or not he feels that in cases of undulant fever it is sometimes due to

a greater susceptibility of some people to the disease.

Dr. Birch: I do not think we can absolutely establish that as the only explanation. There is a definite tendency when one case appears for others to appear with the same milk supply. That is what gives substance to the belief that increase in virulence plays a part.

President Krueger: In that connection, Dr. Frost of Wisconsin made a statement that he never had a case of undulant fever traced definitely to milk. Dr. Frost is quite closely associated with the Certified milk industry and I was surprised to hear that, because that had not been my own experience.

Dr. Brooks: It is not the experience in New York State either.

Dr. Birch: We can look back not much more than a year to a considerable number of statements of the same kind in our literature, especially in the agricultural press. It all depends upon how much proof a person wants. I do not consider it proof simply because a person is drinking raw milk and has undulant fever that the undulant fever came form the raw milk. It may not be in this one case a cause and effect relation. But I do not think any one could look over the data that exist in this regard—any one who is accustomed to examining and interpreting data—without being convinced beyond any reasonable doubt that it has occurred. We have taken, as I mentioned in the paper, the cultures which Dr. Gilbert in the Department of Health furnished, from typical cases of undulant fever, and we have infected cows regularly with them and produced typical cases of Bang's disease. I would disagree, in substance, with Dr. Frost's remark very decidedly, though I would hate to have to prove that any particular case of undulant fever came from milk.

Mr. Kelly: I just wanted to ask a question in regard to mastitis. Am I right in understanding that the mastitis bacteria consume butter fat in the milk, and if so, is that butter fat consumed before the milk is drawn or after and is it consumed in any great amount?

Dr. Brooks: There is another sort of evidence on this question of relationship between abortion and undulant fever and that is the epidemiological sort. I happen to recall where we had some twelve or thirteen cases of undulant fever in a small community in which, if I recall correctly, there were several milk dealers all selling raw milk, and the twelve or thirteen cases occurring one after the other were all using the milk from one herd and it was found to be infected. That is presumptive evidence.

President Krueger: Dr. Udall, will you answer the question relative to butter fat?

Dr. Udall: I do not know that the explanation that was suggested is the correct one, but mastitis does change the character of the milk and by virtue of that change the butter fat is reduced. For example, if you run a butter fat test on each quarter the butter fat in the mlk in the affected quarter will be half a per cent less than the milk in the normal quarters. It is interesting in the mastitis cows to take the butter

fat test and then pick out the corresponding quarters on examination. It lowers the butter fat because the glands do not secrete the material from which the butter fat is made.

Mr. Fuller: I want to ask Dr. Udall if he thinks the general requirements of health control officials for the construction of concrete floors in cow barns is contributory to the occurrence of mastitis in dairy herds.

Dr. Udall: I doubt if it is. Our most modern construction of concrete is where we find our best herds.

Dr. Parker: I would like to ask Dr. Udall if the amount and the type of housing that the cow receives is contributory in any way to mastitis. In Florida, where the cows are out of doors practically all the time, would you expect to find less mastitis than in New York, where they are housed a considerable portion of the time? That is, how would you expect the climate to affect mastitis? Would you expect to find less mastitis in a herd that was out of doors all the time than one that was confined a large part of the time?

Dr. Udall: I would expect to, on the face of it, but from observations I have made in herds in the south the percentage of mastitis in those herds does not confirm that theory. In California, for example, the cows are out much of the time and I know that they have plenty of mastitis there. And that brings us up to the cause of mastitis. The source of infection is the mastitis cow and the channel of infection is the hands of the milker, or the milking machine, or perhaps the dirty floor. Even eliminating the floor entirely, it would cut out that factor, but it wouldn't control mastitis.

Dr. Mitchell: Would you permit the use of milk from any cow in any stage of mastitis in a raw supply, or not?

Dr. Udall: Yes, I would. If milk comes from an udder that has an induration in one quarter, that is as big as a goose egg, we will say, and that is all she has and the milk is normal in every respect, so far as we can tell, there is no reason why the milk should not be used for human consumption in the raw state. Of course, we have to determine where to draw the line. The chief objection to mastitis milk is the change in character of the milk. There are certain organisms like the streptococci that cause septic sore throat that are the sources of milkborne epidemics. But, if we follow from the epidemic back to the cow we nearly always arrive at a cow badly diseased. One objection to mastitis milk is that it is not milk; it is pus and various other things.

Dr. Mitchell: I would like to ask Dr. Birch a question. I wonder if he considered the facts regarding undulant fever sufficient to warrant boards of health in requiring that all herds producing milk be tested and how long such a program should take.

Dr. Birch: That is a pretty broad question. If I had my choice between drinking raw milk from a cow affected with Bang's disease and one that was not, I would choose the one that was not. If I had my choice between getting no milk or drinking milk from a herd where I

knew there was Bang's disease and to which no cases had been traced, I would rather have that than do without milk.

As to the question of how long it would take a board of health to establish such a program, that would depend somewhat on the size of the herds. The smaller herds can be cleaned up considerably more rapidly than the larger ones. I think, as near as I can put it in general terms, that it would take about a year and a half. I have been told that it did not make any difference whether you gave them one month or a year or three years; they would not begin until a month before the time set as the dead line. I have had a number of milk producers come to me all heated up about the new regulations which say that after a certain time their herds must be clean. I have gotten rid of them by asking what they have already done; the answer has been that they have done nothing. But any person who has ever had a badly infected herd and has had it cleaned up is never going back to the old methods voluntarily, because he knows he can produce milk very much more economically with the clean herd.

Dr. Brooks: Isn't the ability to get replacements a considerable factor? I know they are telling us that in New York State now.

Dr. Birch: It always has been. Some men are so situated that they can not raise replacements and there are a great many so situated that they do not want to; they want to go around the corner and buy a cow just as they buy a cake of soap and they expect about the same uniformity of quality. It simply can not be attained.

President Krueger: From a public health standpoint what should be done with the milk from the cows that react?

Dr. Birch: If it is pasteurized the organism is killed. The question of whether it is all right for use goes back to the old problem of whether it is changed.

President Krueger: I recall a dairy company that was opposed to taking that milk and one of the arguments was that if undulant fever turned up on their route somewhere they would be subject to criticism.

Dr. Birch: I can not quite see the difference between using milk from cows that we have tested and found to react and that from herds which we have not tested whose history indicates the presence of Bang's disease. If you clamp down too hard in tested herds the testing will be stopped. The testing, if it is to be most valuable, must be on a voluntary basis.

President Krueger: I will ask another question. Many codes require milk from healthy cows. After a cow reacts to the test, may she be considered as healthy?

Dr. Birch: That depends on the interpretation.

Dr. Brooks: In New York State we have the provision in our code that milk must be from healthy cows. But our practical interpretation is that if the milk is pasteurized the reacting cow is a healthy cow. It is not logical but it is practical.

Mr. Frank: I was going to ask the question whether or not Dr. Birch would feel that precautions in regard to testing should apply only to raw milk—whether it would be impracticable to apply it to pasteurized.

Dr. Birch: Temperatures ordinarily employed in pasteurization kill the organism, we can be very sure.

REPORT OF COMMITTEE ON COMMUNICABLE DISEASES AFFECTING MAN

I

Statistical Data on Milkborne Diseases

THESE are available to members of the Association from several sources but a summary of them has also become a fixture of this report in recent years. The figures for 1933, as given in Table 1, have been compiled from two sources, the annual report of milkborne disease outbreaks prepared by the United States Public Health Service (1), and the report presented to the Conference of State and Provincial Health Authorities of North America by its Field Secretary, Dr. S. J. Crumbine (2). There were forty-eight epidemics with 1,426 cases and forty deaths.

Table 1

Milkborne Epidemics—1933

Diseases	No. of Epidemics	No. of Cases	No. of Deaths
United States			
Typhoid fever	25	306	26
Septic sore throat	7	515	5
Scarlet fever	4	242	4
Diphtheria	2	19	3
Paratyphoid	1	17	0
Diarrhea	1	30	0
Milk sickness	2	10	1
Milk poisoning	2	250	0
Undulant fever	4	37	1
TOTAL—United States	48	1,426	40
Canada			
Typhoid fever	4	63	3
Septic sore throat	1	27	0
TOTAL—Canada	5	90	3
GRAND TOTALS—United States and Canada	53	1,516	43

The figures for the United States show a large increase over those for 1932: the number of epidemics increased by 45 per cent, and is the largest since 1926; the number of cases by 122 per cent, the greatest for over 10 years; and the number of deaths by 42 per cent, the most since 1930. There are a number of reasons for this. Whereas last year typhoid fever, septic sore throat and scarlet fever accounted for all but one epidemic, this year there are listed six additional diseases. For the first time since 1928, undulant fever is included in this summary as an epidemic disease, being responsible for four outbreaks and thirty-seven cases; two outbreaks of "milk poisoning" are responsible for 250 cases of illness, and we again find reported that old time disease, milk sickness or "trembles," due to white snakeroot poisoning and responsible for two epidemics, ten cases and one death.

Types of Milk Supply Involved

In the United States, all milkborne outbreaks were associated with raw milk supplies, none being traced to either pasteurized or certified products. In Canada, two were reported as having been caused by pasteurized milk, and three by raw milk. In one case, the pasteurized milk was reported to have been improperly processed; no definite information is available about the second pasteurized milk involved.

As might be expected, most of the communities involved in the epidemics were small; 77 per cent occurring in towns and cities of less than 10,000 population.

II

Are Epidemics Overlooked

Dr. Brooks in a paper on " 'Missed' Epidemics of Septic Sore Throat" (3) points to the wide disparity in the number of epidemics of this disease recorded as occurring in different states and often in adjacent states, and expresses

the opinion that many more epidemics occur than are recorded and reported. Of seventy-two milkborne septic sore throat epidemics reported in United States Public Health Reports for a period of 25 years ending with 1932, forty-five or over 60 per cent, were recorded as occurring in Massachusetts and New York, while very few were reported from adjoining states. New York State, he believes, is as well organized for the discovery of epidemics as most states, but, he said, it had narrowly escaped "missing" several fairly extensive epidemics, in one or two instances having learned accidentally of their occurrence after they were over. As he pointed out "state lines obviously offer no bar to the spread of infection."

III

Undulant Fever or Brucellosis * as an Epidemic Disease

Only a part, perhaps about 50 per cent, of the undulant fever cases annually reported are traceable to infected dairy products. Ordinarily, undulant fever is not thought of as a disease capable of taking on epidemic proportions; a number of factors operate toward this, such as differences in susceptibility of persons consuming dairy products containing Brucella organisms and the low pathogenicity for man of the bovine type of organism, the type most frequently encountered in dairy products.

Since undulant fever this year appears again after five years in the statistical summary as an epidemic disease, it is felt that some special mention of this phase of its occurrence may be of interest. Although the United States Public Health Service has reported a variable number of cases occurring throughout the country during

* Although the name undulant fever has largely replaced and is preferable to the terms Malta fever and Mediterreanean fever for obvious reasons, "brucellosis" is a better and more accurate term to denote disease due to the Brucella group of organisms, whether in man or animals. Undulant fever is objectionable, as pointed out by Giltner (5) "except as a name for certain types of human brucellosis, since the descriptive adjective is usually not applicable to the animal brucelloses and not always to human brucellosis."

the past few years, it is evident that most of them have been more or less isolated in occurrence. Even when two or three cases have occurred on one milk route, it is open to question whether such occurrence has the proportions of or should be classified as an "epidemic." However, Beattie and Rice (4) have reported a bona fide milkborne epidemic of undulant fever due to brucella organisms of the *porcine* type—*Brucella suis*—which occurred in Council Bluffs, Iowa, during the months of February, March and April, 1933. In all, thirty persons were involved and of these twenty-seven were known to obtain their milk from one dairyman, who supplied approximately eighty households with raw milk. One other patient obtained milk from a grocery which obtained part of the milk supply from the suspected dairy. None of these patients were known to have contact with animals or to handle raw meat.

Beattie and Rice made a thorough study of the outbreak and summarized their observations as follows:

1. In a milkborne epidemic of undulant fever thirty cases occurred. Of these patients, twenty-seven obtained their milk from the same dairy.
2. The dairy, from a herd of twenty cows, supplied approximately eighty households; in eighteen of these, cases of undulant fever developed.
3. *Brucella suis* was obtained in blood cultures from six of fourteen patients and from the milk of one of the cows in the herd.
4. The epidemic ceased thirteen days after the stoppage of the sale of milk from the dairy.
5. There is a greater virulence of *Brucella suis* than of *Brucella abortus*. The possibility of milk containing *Brucella suis* must be considered.

Emphasis is thus again given to the greater virulence of the porcine brucella organisms and the relatively few cases of undulant fever caused by the bovine strain when compared to the amount of infected raw milk that is consumed. It is evident, as pointed out by a number of investigators, that the incidence of the two types—bovine

and porcine—of brucella infections in animals differs widely in different sections of the country. Porcine strains may naturally be common in a state such as Iowa, whereas, as shown by Gilbert and Coleman (6) among others, bovine strains are prevalent elsewhere as in New York State.

Considering the 1716 cases of undulant fever reported by cities and states (1) in 1933, even if only part of them be milkborne, the need for safeguarding milk supplies by pasteurization or by elimination of infected cattle from dairies supplying raw milk is evident.

Unexplained fevers and indefinite syndromes merit greater attention since these may represent mild or chronic infections with the bovine type of brucella organisms. While relatively innocuous for the human family, the capabilities of the bovine type to produce infections should not be minimized.

IV

Mastitis

The attention of those interested in wholesome, safe milk is focused more and more each year on mastitis and its control. Control officials attempting to deal with mastitis or formulate a program for its control are frequently faced with the question: "What do you mean by 'mastitis'?" Not only is it difficult to say definitely just where a physiological congestive condition ends and an inflammatory condition begins but there is also the question as to how far it is practical and necessary to go in attempting to rid herds of mastitis. On the one hand it would be practically impossible to keep herds of cattle continuously and wholly free from mastitis; on the other hand it is obvious that the retention of cows with well-marked or advanced mastitis in the "milking line" is a detriment both to the dairymen and the milk consumer. In New York State an attempt is being made to solve

the problem in a practical way. A committee of veterinarians headed by Dr. D. H. Udall of the Veterinary College at Cornell University, has prepared a classification of mastistis which the State and New York City Health Departments have accepted as a standard. Officially "mastitis" will mean mastitis falling in "Class 4" according to the committee's designation. Dr. Udall and his associates at Cornell are also carrying out an interesting experiment in holding "mastitis clinics" and assisting individual dairymen, on request, in eradicating mastitis. Dr. Udall has explained the New York State program at this meeting and his paper will be a part of our printed proceedings.

V

Anthrax

Last year a question arose concerning the transmissibility of anthrax through milk. It is the observation of those who have had experience with anthrax in dairy cattle that there is an almost immediate suppression of milk flow as soon as the infection becomes established in the animal's body. Consequently, the disease is not known to be transmitted in milk.

Amebic Dysentery

The rather widespread distribution of this protozoan infection throughout the country during the past year is a matter of concern for those charged with the health supervision of food handlers. Your committee understands that this disease is not ordinarily transmitted by milk and that if it is at all, the source must be looked for in polluted water supplies. In other words, direct contamination of milk and other foods by carriers is not considered an active means of spreading the infection; rather, gross pollution of water supplies is the important thing to

be guarded against. The importance of pure and protected water supplies on dairy farms and in dairy plants may therefore be stressed.

VI

Tuberculosis Eradication in Cattle and its Effect upon the Human Death Rate from Tuberculosis

We are all quite familiar with the Federal-State program for elimination of bovine tuberculosis that has been carried on since 1917 but it is doubtful if many of us are aware of the marked effect which this work has had upon the human death rate from tuberculosis. State and city health officials in common have been generous with their moral support of the tuberculin-testing program of the State and Federal Bureaus of Animal Industry which has resulted in reducing the number of positive reactors in cattle in the United States from 4.9 per cent in 1918 to 1.9 per cent for the year ending June 30, 1932. This support has been forthcoming because of evidence such as that given by Park and Krumwiede (7) that the bovine tubercle bacillus causes about one-tenth of the bone, joint and lymph node tuberculosis in adults and one-fourth of this type of tuberculosis in children. Furthermore, in young children it is said to cause from 6⅓ to 10 per cent of the total fatalities from tuberculosis.

It has remained for Professor H. R. Smith, Livestock Commissioner of the National Livestock Exchange, to call attention in a convincing manner to the changes in the death rate of tuberculosis in man that have occurred in the fifteen years since 1918. He has compiled official statistics (8) from the United States Bureau of Animal Industry relating to tuberculin tests of cattle, percentages of reactors and percentages of other cattle "retained" after slaughter, along with data from the Division of Vital Statistics, Bureau of the Census. The human death

rate from respiratory tuberculosis in the United States in 1918 was 128.6 per 100,000 population, but it has decreased every year since then and last year was 56.6 or less than half the rate existing in 1918. During the same time the death rate from tuberculosis other than respiratory declined from a rate of 21.4 per 100,000 in 1918 to 6.4 in 1932. It is not claimed that the cooperative program of the government for the eradication of bovine tuberculosis has been responsible for the decline in the respiratory tuberculosis death rate but it is indeed significant that during the eighteen years prior to 1918 the death rate from tuberculosis other than respiratory did not decline; in fact, the trend was slightly higher: 21.4 per 100,000 in 1900 and 22.5 in 1917 with no fall below the 1900 rate in the intervening years.

These data are believed of sufficient interest to justify their presentation here and are given in Table 2. Commenting on these figures, Professor Smith notes that:

> According to medical authorities, cases of human tuberculosis other than respiratory such as glandular, bone and abdominal are to a large extent of bovine origin. The decline in the death rate from respiratory tuberculosis from 1900 to 1918 is probably due to improved sanitation and medical care. It is apparent that this was offset in its effect on other forms of tuberculosis by the increase in this disease in cattle, during that period, as indicated by the increased percentage retained. While there was no decline in the death rate from non-respiratory tuberculosis from 1900 to 1917, when the Federal and State cooperative cattle testing was started, the decline in the death rate from such types has since been pronounced.

This analysis does not take into account the concurrent effect that increased pasteurization of milk supplies may have had since 1918. This effect is doubtless considerable in those states where the pasteurization process has been rapidly expanded in recent years. The observations of Dr. William H. Park in New York City alone indicate marked reduction in human infections with bovine tubercle bacilli since pasteurization was applied to all milks except Certified. On the other hand, we can com-

pare the results in two states where climatic and other conditions are similar such as North and South Dakota. In North Dakota where all breeding cattle have been tuberculin tested and all counties accredited (less than ½ of 1 per cent bovine tuberculosis), the death rate from human tuberculosis is about half as high in 1932 as in 1917. In South Dakota, where there were only three accredited counties and comparatively few cattle tested (1.5 per cent still reacting in 1932), there has been no appreciable lowering of the human tuberculosis death rate. It would be interesting if the increased extent of pasteurization in the various states were also compared with the reduced incidence of bovine tubercle infection in humans.

In addition to the figures for the entire United States, Professor Smith has individual compilations for several states which are of special interest. As dairy and milk inspectors, we are concerned that the work of bovine tuberculosis eradication be maintained as efficiently in the future as it has been in the past.

VII

The marked improvement that has taken place in the quality and purity of milk supplies is reflected in the continually increasing use, in normal times, of milk and dairy products. There is a growing appreciation by the public of the importance of pure milk supplies which has resulted largely from educational work done by health officials, physicians and welfare organizations.

The effort and the cost expended in protecting milk supplies represent an essential public service. Continuous progress in promoting the quality and purity of milk must be made but, in these times of economic stress for dairymen, a discerning attitude with respect to essential and non-essential requirements for milk production is to be sought.

Milkborne diseases are being kept in hand by the vigilance of health officials and dairy inspectors with pasteurization of general market milk supplies furnishing much protection to the consumer. With the gradual extension of pasteurization, still better records will be made in decreasing the slight amount of disease attributed to milk. It is obvious, however, from the available data that greater attention must be given to the health of dairy employees, especially in the absence of pasteurization.

Carriers and cases of disease occurring on dairies are accountable for nearly three-fourths of the epidemics in 1933. Improved dairy facilities for producing and handling milk, low bacteria counts, and so on, are important in controlling milk quality but better supervision of the health of dairy employees and milk handlers, along with increased attention to the health of dairy animals, must be sought.

The fact that the 1933 epidemics were largely confined to towns of less than 10,000 population (the same trend as in previous years) emphasizes the needs of small communities for better protection. Insistence in these cases must be placed upon the health status of dairy animals and dairy employees; in addition, the importance of pure water supplies for their dairies, safe excreta disposal, sterilization of equipment and prompt reporting of communicable diseases are to be taught the dairymen.

The importance of milk as a food, not only for infants and young children but also for adults, makes it imperative that milk supplies be wholesome; they must also be safe. It is most desirable that the raw milk supply, basically, be of unquestioned purity. The expense and the difficulty of achieving a safe raw milk, such as Certified, for general use make it necessary to utilize some other less expensive and equally reliable method for protecting general supplies. Pasteurization carefully carried

out provides this method and the increasing use of this process is greatly to be recommended.

Table 2

DEATH RATE FROM TUBERCULOSIS IN THE UNITED STATES

The relationship of the number of cattle tested in the United States, the reactors slaughtered, the decline in percentage retained for tuberculosis (lesions found on post mortem) of all cattle slaughtered, exclusive of reactors, and the decline in the human death rate from respiratory and other forms of tuberculosis per 100,000 population in the United States. The Federal and State Co-operative testing program was started in 1917. This is from data furnished by the U. S. Bureau of Animal Industry and the Division of Vital Statistics, Bureau of Census.

Calendar Year	Respiratory Tuberculosis	Other Forms	Cattle Tested Fiscal Year June 30	Number Reactors	Per cent Reacting	Per cent Retained
1900	180.5	21.4				
1901	174.5	22.4				
1902	162.6	21.9				
1903	164.9	23.6				
1904	176.2	24.5				
1905	166.7	25.6				
1906	155.6	24.6				
1907	154.3	24.2				
1908	144.0	23.6				.88
1909	137.7	23.4				1.27
1910	136.0	24.3				1.42
1911	132.7	26.5				1.57
1912	125.0	24.7				1.98
1913	123.0	24.8				2.02
1914	123.5	23.7				1.98
1915	123.5	22.8				2.11
1916	119.9	22.2				2.35
1917	124.6	22.5	20,101	645	3.2	2.11
1918	128.6	21.4	134,143	6,544	4.9	1.80
1919	107.5	18.1	329,878	13,528	4.1	1.57
1920	97.0	17.0	700,670	28,709	4.1	1.62
1921	85.6	13.3	1,366,358	53,768	3.9	1.62
1922	84.3	12.1	2,384,236	82,569	3.5	1.76
1923	81.3	11.5	3,460,849	113,844	3.3	1.75
1924	78.0	11.7	5,312,364	171,559	3.2	1.56
1925	75.9	10.8	7,000,028	214,491	3.1	1.51
1926	76.6	10.7	8,650,780	323,084	3.7	1.41
1927	71.4	9.5	9,700,176	285,361	2.9	1.15
1928	70.3	9.0	11,281,490	262,113	2.3	1.04
1929	67.6	8.4	11,683,720	206,764	1.8	1.00
1930	63.4	8.1	12,845,871	216,932	1.7	.75
1931	60.7	7.5	13,782,273	203,778	1.5	.62
1932	56.6	6.4	13,443,557	254,785	1.9	.49
1933			13,073,894	255,096	2.0	.42
Totals			115,170,388	2,693,570	2.3	

(Official Statistics compiled by H. R. Smith, Livestock Commissioner, National Livestock Exchange)

John G. Hardenbergh, *Chairman*

Paul B. Brooks	Ira V. Hiscock
Leslie C. Frank	W. J. Butler
Horatio N. Parker	F. L. Mickle
A. R. B. Richmond	W. D. Dotterrer
J. P. Bushong	Russell Palmer

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OFFICIAL CONTROL OF PASTEURIZATION IN MASSACHUSETTS

HERMAN C. LYTHGOE
State Department of Public Health, Boston, Mass.

THE Massachusetts Department of Public Health recommended to the Legislature of 1927 the passage of an act relative to the pasteurization of milk. This act was passed in substantially the form recommended by the Department. The act provides, first, that persons maintaining establishments for the pasteurization of milk shall secure a license from the board of health of the town where the establishment is situated; second, that the Department of Public Health shall make regulations under this act; third, that, if the licensed establishment is operated or maintained in an insanitary manner or in violation of the rules and regulations or is not properly equipped for the business, the board of health issuing the license or the Department of Public Health may close the establishment or may suspend the license. The statute provides a penalty for operating without a license and for violating the regulations. The license fee is ten dollars, to be paid into the treasury of the town.

Shortly after the Governor signed the act and during the ninety-day period prior to which the act became law, the Department held informal hearings with boards of health and with the owners of pasteurizing establishments and a few days after the law went into effect the Public Health Council adopted the regulations.

At the time the law was signed, there were approximately 500 pasteurizing establishments in the State and in seventy of these establishments the old Park holder was used. At the time the law became effective, there were but six such holders in the State, all of which were replaced within two months thereafter with apparatus com-

plying with the law. It was necessary to apply coercive measures in only two instances.

There was one very amusing episode associated with one corporation which was operating apparatus not strictly in accordance with the law. It was stated that a new type of pasteurizer had been ordered and would be received as soon as it was built. The delay in installing this new apparatus was accounted for by delay in manufacture. At the last interview with the representatives of the establishment, a telegram was submitted stating that the apparatus had been shipped. The company was given forty-eight hours to put its equipment in accordance with the regulations or to install a new pasteurizer. Two years after this event, the representative of the pasteurizing plant was asked jocosely when the new pasteurizer was going to be installed. The reply was, "It has not as yet been manufactured."

For carrying out this work, the Department was authorized to employ an additional inspector and two years ago another inspector was appointed for this work.

During the first year, the Department made practically no prosecutions because of defective equipment but advised the proprietors to put the establishment in accordance with the regulations. It was found, after a time, that the owners of many establishments were taking advantage of this type of policy and then prosecutions were started and, as usual, the prosecutions were more effective than the warnings.

It should be borne in mind that pasteurization is a commercial rather than a public health proposition from the viewpoint of the milk dealer. This statement may seem rather strange but I do not know of an instance where a board of health has required that all or nearly all the milk sold must be pasteurized unless the majority of the milk sold under its jurisdiction was pasteurized at the time the ordinance was passed. The milk dealer

pasteurizes milk so that it will reach his customers before it sours and the public health aspect is incidental to the commercial process. It is, of course, well known that the original process invented by Pasteur was for the purpose of preventing the so-called "wine diseases" which resulted in loss of money to the wine makers and vendors of France.

The Department has had the most trouble with dealers who have been selling raw milk for years and then find it desirable or advisable to pasteurize. Such persons have considerable difficulty, at times, to understand that the sanitary methods they had been employing with the raw milk were on a much lower scale than what the Department required for the handling of pasteurized milk. We received many protests from these people that it was unfair for the Department to require sterilization of milk bottles to be used for pasteurized milk when the local board of health did not require sterilization of milk bottles to contain unpasteurized milk. These persons were informed that they could either comply with the pasteurization regulations or could go back to the selling of raw milk.

The regulations of the Department require that local boards of health send to the Department a copy of each application for a license together with a statement as to what action the board took on the application. As a rule, the boards comply with this regulation but occasionally our inspectors find a milk dealer selling pasteurized milk and the local board of health either has not licensed the person or has failed to notify the Department of the existence of the plant. A very short time ago, the Department discovered that eight plants in one town had been operating for five or six years without a license and in two instances the sanitary conditions were so bad that the proprietors were prosecuted.

There are about fifteen or twenty new plants opened each year and nearly that number go out of business either by the financial route or by being absorbed by one of the larger companies. The largest number of plants in the State was 715. At the close of 1933, there were 637 located in 154 cities and towns. All but forty-nine of these plants were inspected by inspectors of this Department during 1933. There were 1153 inspections made. Violations of the regulations were as follows:

Insanitary conditions were found in seventy-three plants.

There were sixty-three plants found to be operating without a license or the license was not posted on the premises.

There were fifty-nine plants which were pasteurizing at temperatures below 142° or for a period of less than thirty minutes.

In forty plants, there were no comparative readings of the mercury and recording thermometer marked upon the recording thermometer charts and eighteen plants did not date the recording thermometer charts.

In seven plants, at least one thermometer was absent and in six plants the leak escape feature of the inlet or outlet valve was plugged.

It should be borne in mind that in many instances more than one of the above violations existed in an individual plant.

A summary of the court cases may be of interest. In 1933, eighteen persons were prosecuted for representing as pasteurized milk certain milk not pasteurized by being heated to a temperature of 142° for not less than thirty minutes and in sixteen of these cases conviction was secured. A few of these cases were associated with a plugged leak escape valve in the outlet line filled with unpasteurized milk which was mixed with the pasteurized milk as it was discharged from the vat. There were thirty-five prosecutions for violation of the regulations resulting in thirty convictions. During the past two months, there have been a number of hearings for violation of one or more of the regluations or for violation of the law. These violations are summarized as follows:

High bacteria counts	11
Low temperature or short time pasteurization	7
Insanitary conditions	6
Operating without a license	2
Failing to date recording thermometer charts	2
Failing to check the recording thermometer against the mercury thermometer	1
Failing to filter the milk free from visible dirt prior to the holding period	1

Two of the inspectors were in one of the larger plants at the time that the efficiency expert and the technical expert were making an inspection. The inspector of the Department found that the leak escape had been plugged, the plug had been cut off and rubbed smooth. The company paid a $25.00 fine for this offense. According to information which we obtained, the experts of the company saw that the valve was leaking and that there was considerable wastage of milk. The manager of the plant was then told to have the valve ground. Instead of grinding the valve, he plugged the leak escape and the agents of the company were apparently satisfied from the absence of drip that the valve had been ground.

Early this spring, two of the inspectors were in a plant the proprietor of which had been prosecuted for violation of the law and regulations. They reached the plant while the milk in the vat was being heated, the temperature being up to about 130°. They then left the plant and returned in fifteen minutes. During that period, the recording thermometer chart showed that the milk had been heated to a temperature of 142°, had been kept at that temperature for thirty minutes and had been cooled down in the vat to a temperature of about 120°. The milk was being bottled at that time. The man doing the work confessed that when the temperature reached 142° he turned the recording thermometer chart so that the chart would show a thirty minute holding period and then immediately cooled the milk. He subsequently denied making this

confession but the proprietor of the plant paid a $50.00 fine. Since that period, the recording thermometer charts show a drop of temperature during the thirty minute holding period.

There is no doubt but that some milk sold as pasteurized has not been pasteurized at the temperature and for the time specified by statute. The reason for not doing so is a fear of its effect upon the so-called cream line and the reason it is not more frequently apprehended is due to the difficulty of obtaining the evidence. There are just about five minutes during the entire day when such a violation can be detected and occasionally our inspectors arrive at that psychological moment, as in the case which is cited.

There are many excuses offered for apparent discrepancies in the appearance of the recording thermometer charts. Recently, a man was found to be pasteurizing at a temperature of about 141½°. His recording thermometer chart bore the statement that the mercury thermometer and recording thermometer were identical with a reading of 142°. The excuse was failure to change spectacles from the long distance to the short distance variety. There is no question but that this was necessary because the man changed spectacles several times during the course of the hearing. He stated that the milk was pasteurized at 142° according to the mercury thermometer. He stated that the mercury line was so broad that he could see it, whereas, the recording thermometer lines were so small that he could not see them. He was informed that it was just about as difficult to read the scale on the mercury thermometer as it was to read the scale on the recording thermometer charts and was also informed that if he continued the violation the inspectors would eventually land at his plant at the proper time and that he would then make an explanation to the judge.

The Department periodically examines milk for the

bacteria content although, with the exception of grade A milk, the Department has no authority to control the bacterial count of milk sold on the streets. The regulations of the Department provide that no person shall use for pasteurizing purposes any milk with a count exceeding 750,000 per cubic centimeter and if so informed, he must cease using that milk until he has ascertained by examination that the count has been reduced. The regulations also provide that no proprietor of a pasteurizing establishment shall have in the plant ready for delivery any pasteurized milk with a count exceeding 50,000 per cubic centimeter.

On the whole, the bacterial counts of the milk sold in Massachusetts are fairly low and the quality of the milk used in the plants for pasteurizing purposes is good. The report of the Department for 1933 shows that there were examined 1831 samples of raw milk to be pasteurized. Of these, 885 had a count below 100,000, 1239 had a count below 250,000, 1480 had a count below 500,000 and 1581 had a count below 750,000. The geometric mean of these counts was 64,334. It is interesting to note that 86 per cent of this milk was grade A quality.

During the same period, 907 samples of pasteurized milk were obtained, 642 of which showed a count less than 25,000; 741 showed a count less than 50,000. The geometric mean was 12,034. It is also worthy of note that 71 per cent of this milk was of grade A quality.

While on this subject, I will digress for a moment and state that 5030 samples of milk were collected during the same period and were found to be free from adulteration with an average fat of 3.95 per cent which is not far from the 4 per cent fat required for grade A milk and, therefore, we can point with pride to the fact that nearly half the milk sold in Massachusetts is chemically of grade A quality and more than half of the milk, as far as the

bacterial count is concerned, is bacteriologically of grade A quality.

There are but three high-temperature short-time pasteurizing plants in the State. By regulation of this Department, such plants may be operated provided that the milk is kept at a temperature of not less than 160° F. for a period of not less than fifteen seconds. The three plants will operate under such conditions.

In some respects, I prefer this type of pasteurizer to the ordinary vat process because it is more nearly fool proof but the bacterial examinations of the milk sold by the people operating these plants show an increase in count over that which each organization sold when the milk was pasteurized in vats. Several studies on the efficiency of these plants showed that in most instances there was a periodic increase in bacterial count of the pasteurized milk when samples were taken from the outlet of the holder during fifteen minute intervals. In only two instances did the counts show either a constant or decreasing quantity. In one instance where the count showed a decreasing figure, the raw milk admitted to the apparatus decreased more rapidly in count than did the pasteurized milk and during the period of observation the apparatus showed a decreasing efficiency. Unless the cause of this peculiarity can be discovered and corrected, it may be essential for the Department to seriously consider revoking its regulation permitting this type of pasteurizing apparatus to be operated in the State.

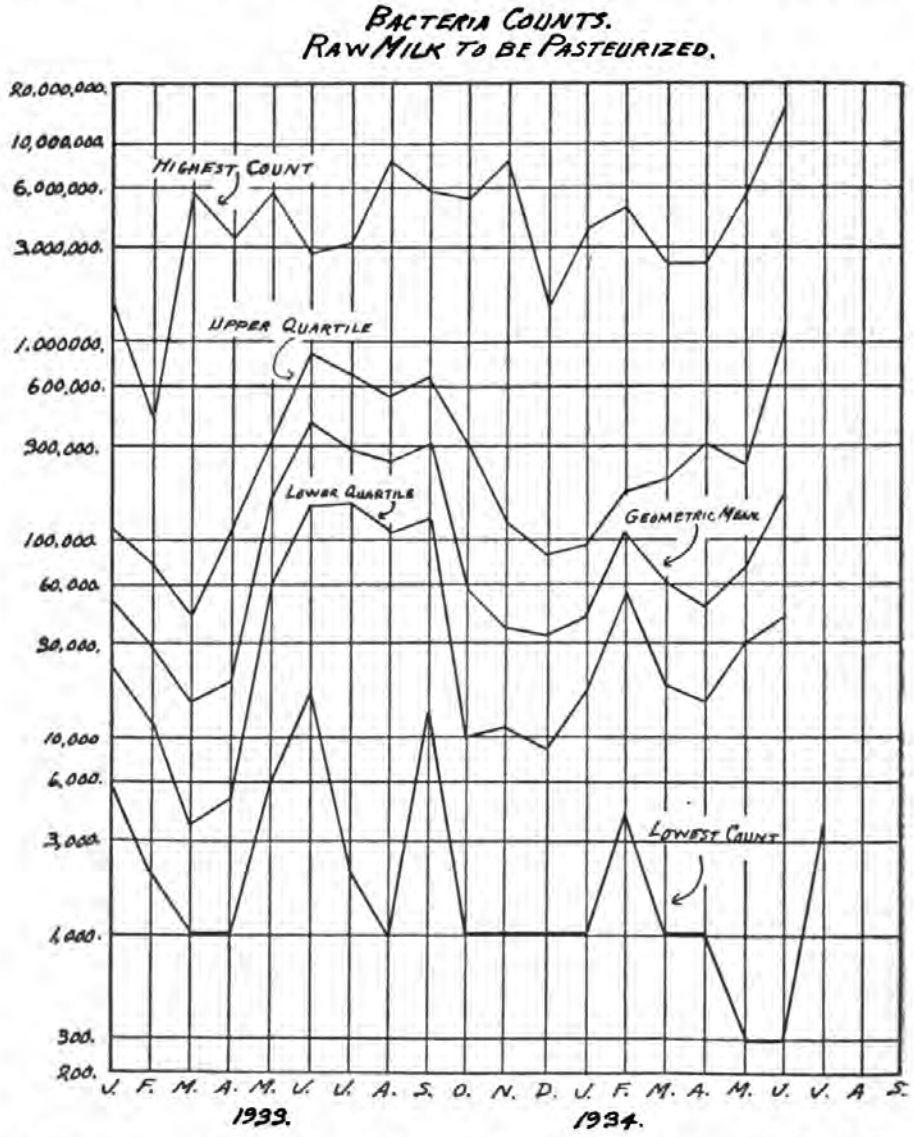
Two tables are submitted showing the bacterial count of the samples collected each month from January, 1933 to date. Each table gives the number of samples, the lowest count, the lower quartile which represents the highest count of 25 per cent of the samples, the geometric mean which is very nearly the highest count of fifty per cent of the samples, the upper quartile representing the highest count of 75 per cent of the samples and the high-

BACTERIA COUNT OF RAW MILK TO BE PASTEURIZED

	Number of Samples	Lowest Count	Lower Quartile	Geometric Mean	Upper Quartile	Highest Count
1933						
January	119	6,000	24,000	51,582	110,000	1,600,000
February	90	2,000	12,000	30,761	76,000	440,000
March	157	1,000	3,500	15,345	41,000	5,700,000
April	150	1,000	5,000	19,665	110,000	3,400,000
May	142	5,500	60,000	158,000	270,000	5,700,000
June	145	17,000	150,000	384,080	890,000	*2,800,000
July	284	2,000	150,000	284,050	690,000	*3,200,000
August	192	1,000	110,000	248,050	530,000	8,600,000
September	181	14,000	130,000	295,000	670,000	5,900,000
October	125	1,000	10,000	57,077	300,000	5,400,000
November	198	1,000	11,000	36,281	120,000	8,300,000
December	108	1,000	9,000	33,217	87,000	1,500,000
1934						
January	279	1,000	17,000	42,520	97,000	3,800,000
February	115	4,000	54,000	107,330	180,000	4,800,000
March	311	1,000	18,000	60,579	200,000	2,500,000
April	233	1,000	15,000	46,552	310,000	2,500,000
May	263	300	20,000	71,757	240,000	5,500,000
June	213	300	41,000	176,000	1,100,000	15,000,000
July	188	4,000	71,000	352,610	1,200,000	34,000,000
August	225	11,000	100,000	213,940	550,000	4,600,000
September	147	3,000	46,000	244,000	1,200,000	12,000,000

* Most of these samples from one establishment. License was suspended.

est count of all. The two tables represent the raw milk to be pasteurized and the pasteurized milk. Naturally, the summer months show the highest counts. The geometric mean of the raw milk to be pasteurized has



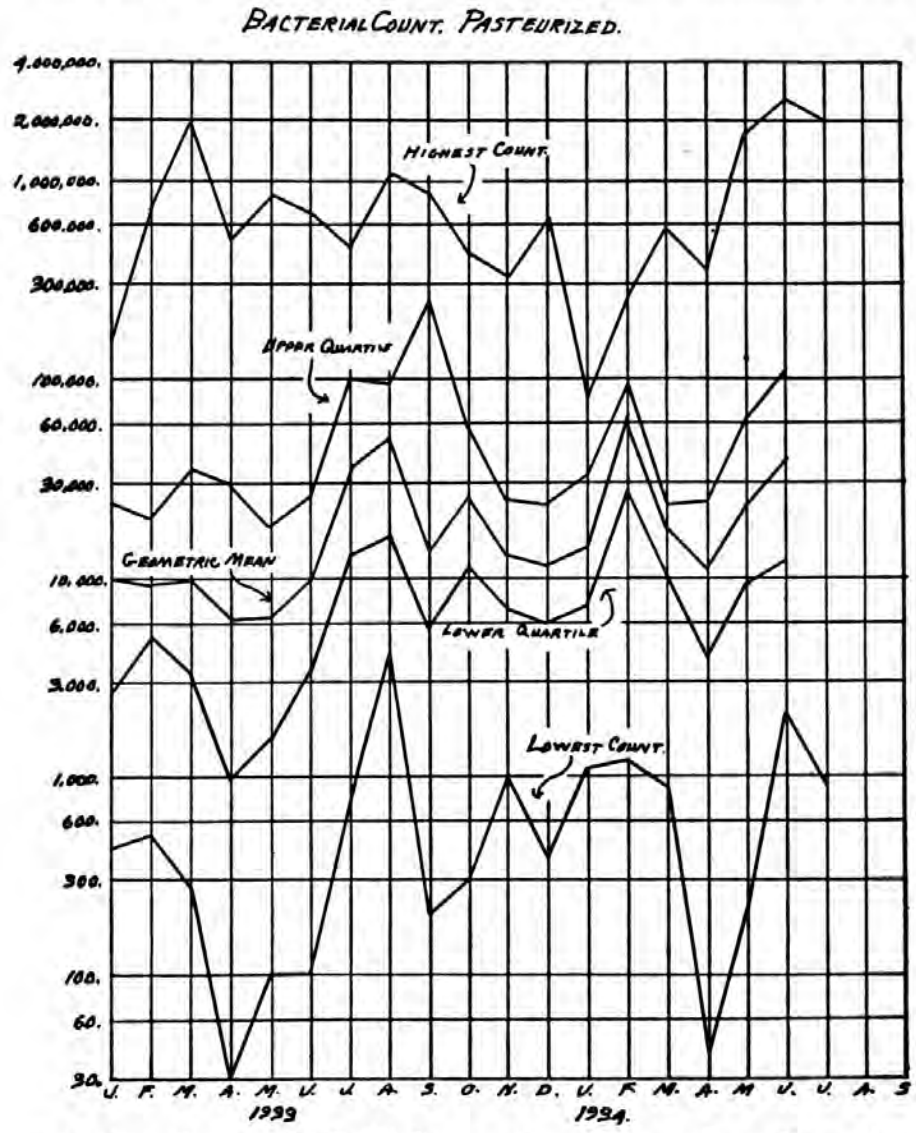
been somewhat higher during January, February, March and April of this year than it was last year. It was felt that this may have resulted from the federal milk control because at least one dealer said that he could not drop high count dairies because of fear of trouble from the

Bacteria Count of Pasteurized Milk

	Number of Samples	Lowest Count	Lower Quartile	Geometric Mean	Upper Quartile	Highest Count
1933						
January	69	450	2,600	9,613	24,000	150,000
February	84	500	4,800	9,553	20,000	660,000
March	94	300	3,400	10,106	35,000	2,000,000
April	74	30	1,000	6,112	30,000	500,000
May	108	100	1,500	6,231	18,000	830,000
June	133	100	3,400	9,995	26,000	700,000
July	21	700	13,000	36,731	97,000	470,000
August	44	4,200	16,000	50,142	94,000	1,100,000
September	62	200	6,000	13,720	250,000	930,000
October	85	300	11,000	25,158	58,000	420,000
November	54	1,000	7,000	12,505	24,000	350,000
December	114	400	6,000	11,514	23,000	640,000
1934						
January	20	1,000	7,000	14,261	32,000	79,000
February	7	12,000	29,000	65,229	93,000	260,000
March	64	900	10,000	17,151	23,000	580,000
April	66	30	4,000	11,121	24,000	370,000
May	104	200	9,000	24,249	63,000	1,800,000
June	112	2,000	12,000	40,230	110,000	2,600,000
July	200	900	23,000	41,419	96,000	2,000,000
August	146	1,900	21,000	34,481	56,000	2,400,000
September	91	1,200	16,000	56,403	150,000	4,700,000

United States authorities. This, however, may not be the reason for increased counts.

The pasteurized samples show a much more marked increase in bacterial count this year than last year. Considerable of this is due to repeated inspection on the



premises from which high count milk was found on the market. Notwithstanding the fact that the average count of this milk during the summer of 1934 was somewhat higher than what we wish it to be, it is considerably superior to what was on the market in those days when the maximum count was set at 500,000 per cubic centimeter.

A PRACTICAL TEST OF PASTEURIZATION

HAROLD W. LEAHY
Sanitary Bacteriologist and Chemist
Rochester Health Bureau Laboratories

INTRODUCTION

NO SATISFACTORY test for detecting the improper pasteurization of milk has been available. The importance of such a procedure as a safeguard to public health is obvious. It is true that several tests for the separation of raw milk from strongly heated milk, *i.e.*, milk heated to 165° F. or above, have been proposed, but such procedures will not distinguish raw milk from milk which has been pasteurized adequately at 143°-145° F. for thirty minutes. Yet it is the ability to differentiate raw milk from milks subjected to these moderate temperatures which has significance in public health administration.

Since the original observation by Koning in 1907, a number of investigators have studied the effect on the activity of the amylase in milk of heating at pasteurization temperatures. These studies have been characterized either by incompleteness or disagreement in the temperatures or the periods of time required for the inactivation of the enzyme. In general, however, temperatures of from 140° to 150° F. for from twenty to sixty minutes have been shown to inactivate the enzyme, either partially or wholly, while lower temperatures have not produced complete inactivation. Quantitative data have not been obtained, largely because suitable methods for the exact measurement of the activity of amylase in milk have been lacking.

In previous studies carried out in our laboratories, an improved method for the exact determination of the

activity of milk amylase was developed. This method, based on the original method of Koning, has since been used to determine the activity range in normal milk and to determine the effect on its activity of heating at pasteurizing temperatures. It has been possible, therefore, on the basis of these studies, to devise a test which will distinguish raw milk from milk pasteurized by the holding method, and more important, which will detect improperly pasteurized milk. This method is based upon the fact pointed out by Rothenfusser, which was later confirmed by Gould as well as by the writer, that the amylase in milk is completely inactivated by pasteurizing properly at 143° F. for thirty minutes. It is this method, together with the results of its application on 400 samples of market milk that is described in this report.

The Procedure for the Test

The procedure for the test is as follows: Ten c.c. of a well mixed sample of the milk to be examined are pipetted into a test tube with precautions to prevent contamination with raw milk or with salivary amylase. At a recorded time 0.5 c.c. of a sodium chloride-starch reagent is added, and mixed well by pouring from one test tube into another and back again. The mixture is then incubated at 30° C. for four hours. The sodium chloride-starch reagent is prepared by dissolving 0.4 gm. of soluble potato starch and 20 grams of sodium chloride in 100 c.c. of distilled water. At the end of the incubation period, 2 c.c. of a reagent consisting of equal volumes of glacial acetic acid and chloroform are added, followed by immediate shaking with the thumb over the mouth of the tube. The addition of this strongly acid reagent, which changes the pH to about 3.4, terminates completely the activity of any milk amylase present. Thereafter, at a convenient time the tube is centrifuged at high speed for about 15 minutes. The clear supernatant liquid resulting from

this treatment is poured into a test tube and the stage of starch hydrolysis effected by the enzyme determined by the addition of a few drops of a dilute iodine solution, such as a 0.5 *N* iodine stock solution diluted to about 0.005 *N* strength. This dilution should be prepared just before use as dilute iodine solutions decolorize rapidly.

The stage of starch hydrolysis indicated by the color developed upon adding the dilute iodine solution is used as a measure of the temperature at which the milk was heated during pasteurization. A distinct yellow color denotes a strong action of the enzyme and, therefore, indicates the presence of raw milk. A distinct starch-iodine blue color shows that no amylase action has occurred, thus indicating the presence of milk which has been pasteurized properly at 143° F. for thirty minutes. A purple, red or orange color denotes intermediate degrees of activity and, therefore, indicates either improperly pasteurized milk or the admixture of raw with properly pasteurized milk.

Slide 1

COLOR REACTIONS GIVEN BY ARTIFICIAL MIXTURES OF RAW AND PASTEURIZED MILKS

Color produced in the test	Mixtures of raw and pasteurized milk Figures indicate parts per hundred	
	Raw Milk	Pasteurized Milk
Blue	0	100
Bluish-purple	1	99
Purplish-red	2	98
Red	3	97
Orange	4	96
Yellow	5	95
Yellow	10	90
Yellow	100	0

Experiments have been carried out to determine the color reactions obtained with mixtures of raw and pasteurized milk. The results are shown in slide 1. It was found, as will be noted, that the admixture of 5 per cent or more of raw milk with properly pasteurized milk produced the same color as raw milk alone. Of greater significance is

the fact that color changes served to indicate the presence in pasteurized milk of as little as 1 or 2 per cent of raw milk.

The colors obtained with improperly pasteurized milks depended upon the degree of heating. Experiments have been repeatedly carried out to determine the effect of improper pasteurization upon the colors given by the test. The results of a typical experiment are shown in the next slide (No. 2). It was found, as you can see, that milk

Slide 2

COLOR REACTIONS GIVEN BY MILKS THAT WERE EITHER PROPERLY OR IMPROPERLY PASTEURIZED UNDER EXPERIMENTAL CONDITIONS

Color produced in the test	Experimental heat treatment of the milk	
	Temperature at which exposed	Time of exposure in minutes
Red	134° F	30
Purplish-red	137° F	30
Bluish-purple	140° F	30
Blue	143° F	30
Bluish-purple	143° F	25
Purplish-red	143° F	20
Red	143° F	15
Orange-red	143° F	10
Orange	143° F	5
Yellow	143° F	0
Yellow	Unheated control	

improperly pasteurized at 143° F. for twenty minutes, or at 140° F. for thirty minutes showed a slight activity, sufficient at least so that the color appeared to be a distinct purple in place of the familiar blue of the starch-iodine complex. After ten minutes exposure to the proper temperature, or for thirty minutes exposure to 134° F. the color was a distinct dextrin-iodine color. The milks heated up to 143° F. and cooled immediately upon reaching this temperature produced samples having sufficient activity to give colors ranging from orange to yellow. Milks held at 143° for the required thirty minutes, on the other hand, always gave a distinct starch-iodine blue color when tested by this method.

Examination of Market Milk

In order to procure data for estimating the value of this method in public health work, a test for proper pasteurization was made upon 400 samples of market milk all of which had been collected from distributors' wagons by official milk inspectors and delivered to the laboratory for the usual chemical and bacteriological examinations. They came from 123 separate milk dealers and ninety-six different pasteurizing plants. Upon receipt of a sample, it was assigned a serial number, the type of milk indicated on the label was recorded and the bottle was examined for evidence of hand capping, an illegal practice in New York State. Following this inspection, a bacterial count was determined by the standard plate method and a direct microscopic examination for bacteria and leucocytes was made by Breed's method. A pH measurement by the procedure of Sharp and McInerney, a butter fat test, and a determination of total solids were made, and simultaneously the test for pasteurization was carried out.

Of the 400 samples examined, ninety-nine were labeled by the dealers "raw" milk and 301 "pasteurized" (slide No. 3). The results of the pasteurization test, however,

Slide 3

Result of the Application of the Pasteurization Test to 400 Samples of Market Milk*
Distribution of Samples

According to dealers' labels		According to the results of the pasteurization test		
			Improperly	Properly
Raw	Pasteurized	Raw	Pasteurized	Pasteurized
99	301	100	9	291

* The 400 samples were from 123 separate dealers and 96 pasteurizing plants.

revealed that ten of the samples labeled "pasteurized" were incorrectly designated, and were in reality either raw milk, improperly pasteurized milk, or mixtures of raw and pasteurized milks. These ten samples came from five

separate dealers. In contrast to the samples labeled "pasteurized," all of the samples labeled "raw" were found to be correctly labeled.

An examination of the practice of the five milk dealers who had incorrectly labeled the ten milk samples, and an inspection of their pasteurizing plants, revealed the reasons for the false designations. The results of this survey are shown in the next slide (No. 4). Admissions of illegal

Slide 4

ANALYSIS OF THE 10 FALSELY LABELED MILK SAMPLES

Milk Dealer	Number of samples examined	Color reaction of Pasteurization test	Reason for false designation
A	1	Red	Holding period shortened illegally to 15 or 20 min.
B	1	Red	Holding period shortened illegally to 15 or 20 min.
C	1	Yellow	Raw milk, hand capped bottle
D	5	Reddish-purple	Inaccurate thermometers
E	2	Reddish-purple	Inaccurate thermometers

practice were obtained from two dealers who had not held the milk at 143° F. for the full thirty minutes as required by law, but had started bottling before pasteurization was completed, that is after fifteen or twenty minutes. Another dealer did not have a license to distribute pasteurized milk, although he did possess one to distribute raw milk. No admission of guilt was obtained from this individual, but it was discovered that he was guilty of hand capping. The color of the pasteurization test made on this sample was a distinct yellow, which simulated that given by raw milk. There can be little doubt, in view of this evidence, that he was actually selling raw milk under the label "pasteurized." In the cases of the last two dealers, it was found that every effort was being made to comply with the law, but that the recording thermometers in the pasteurizing tanks were inaccu-

rate. Additional milk samples taken from these tanks during the inspections confirmed the original findings and served to locate the cause of the trouble.

Summary

From the results of this survey it is evident that a test for the proper pasteurization of milk, based upon the complete inactivation of amylase during the thirty-minute period of heating at 143° F., has furnished valuable assistance in the protection of the public health. Illegal practices on the part of milk dealers have been detected and mechanical defects in pasteurizing plants discovered by its use. Thus, the method promises to be useful not only to the public health official, but also to the dairy industry.

From the standpoint of technic, the test described is very simple and easily carried out. The use of a smaller amount of starch than that used by others appears to make the test more sensitive to low amylolytic activities and thus allows the differentiation of improperly pasteurized milk, and raw milk, from that which has been pasteurized properly. Furthermore, the enzyme along with the natural buffers present in milk is incubated together with its substrate in the presence of an optimum concentration of added sodium chloride which serves to fully activate it. Unlike other procedures, however, the enzyme is completely inactivated at the end of the incubation period by the addition of the acetic acid-chloroform reagent. This reagent prevents the possibility of continued action of the enzyme while conducting the remaining steps of the test. Thus, the enzyme weakened by a slight heating, in the case of improperly pasteurized milk, is allowed to act upon a small amount of starch under conditions ideal for its action, and the color produced upon the addition of iodine to the serum is permitted to be observed in a clear serum free from a continued activity of the enzyme.

In carrying out the test it is well to keep in mind the fact that the introduction of certain substances into milk may lead to confusing results. For example, it was found by experiment that the addition to raw milk of small amounts of such antiseptics as formaldehyde or mercuric chloride inactivated the amylase. A test made on raw milk treated with these substances would, therefore, produce a reaction like properly pasteurized milk. On the other hand, small quantities of saliva, which contains a powerful amylase, introduced into milk heated at 143° F. for thirty minutes was found to produce a test that was identical with that given by raw milk.

If the milk be sour, the test may be inaccurate. It has been found that the optimum reaction for the amylase in cow's milk falls within the range of reaction of normal milk, and that the activity is markedly affected below pH 6.5 or above pH 7.5. Errors due to this cause may be avoided, however, by ascertaining the reaction of the sample to be examined simultaneously with carrying out the pasteurization test.

The possible influence of starch-splitting bacteria in the milk is at present the subject of investigation. Preliminary experiments, however, have shown that bacterial amylases do not interfere. Several examples may be cited. A tube containing 10 c.c. of milk sterilized in the autoclave was inoculated with a strain of *Bacillus subtilis,* known to exhibit strong amylolytic activity on starch agar plates. To this tube, as well as an uninoculated control, there was added 0.5 c.c. of previously sterilized sodium chloride starch reagent. Both were incubated at 37° C. for 24 hours. After this period, the sera prepared from the two tubes gave identical blue color reactions, indicating that neither tube possessed an amylase which was active under the condition of the test. An identical experiment repeated with a strain of *Streptococcus bovis* capable of splitting starch, also gave nega-

tive results. Furthermore, the values obtained from the quantitative measurement of the activity of amylase in a series of raw milks did not correlate with the count of starch-splitting bacteria determined by the starch-agar pour plate method of Allen's.

Discussion

President Krueger: I am going to ask that discussion be opened by Dr. Gould of the Massachusetts Institute of Technology.

Dr. Gould: First I want to thank you for your invitation to come here tonight and discuss this paper.

Before we can go into a critical examination of the various tests for the detection of inefficiently pasteurized milk, we must make certain points clear. In the test for pasteurization, are we interested in whether milk is merely pasteurized, that is, heating it up to a temperature of 60° centigrade or 140° Fahrenheit, or do we want to detect milk heated just under that temperature? Are we looking at it from the commercial point of view, or the public health point of view? Certainly, if we can perfect some test which can satisfy the public health man, that should also satisfy the man who is interested from the commercial angle, in that he will be able to find out whether the milk has been pasteurized, and we, as public health men, can determine, also, whether it has been pasteurized properly.

During the past few years, a few tests have made their appearance in the literature. I will try to outline briefly their essentials. Most of us are chemists. In spite of that, when we employ a test for any purpose, we usually want a simple one, which we can do at a snap, and for which we do not have to prepare different reagents; to standardize, etc.

This test, as outlined by Mr. Leahy, previously reported by Rothenfusser and also by myself, does require more care than a simple test. However, during the past two years or so, there has been proposed a test which is extremely simple. But the question arises as to whether it can detect milk which has been heated to just under pasteurization temperature. This test is called the Schern-Gorli test. All one need do is to add a bit of charcoal to the milk incubate for a couple of hours, and if the charcoal rises to the cream line, then the milk has not been pasteurized. If it falls to the bottom of the tube, it means that the milk has been pasteurized at about 58° centigrade. Essentially, that makes a beautiful test. The question arises now as to whether it can tell us if the milk has been safely and thoroughly pastuerized.

Another test, which has made its appearance, is one which depends upon the destruction of the phosphase in milk after pasteurization, by having the sample of milk act upon some phosphorus compound, like sodium glycero phosphate; then measuring the amount of inorganic

phosphorus liberated one can tell if the milk has been properly pasteurized. From an analysis of the data, it seems doubtful whether the test can be carried out simply, and whether it gives consistent results.

We have, of course, a number of other tests, including the one reported by Mr. Leahy today. Upon an analysis of all these tests, it seems to me that it has been shown by work here and abroad that this test reported today is the most accurate of all tests, in so far as detecting milk which has been inefficiently pastuerized, and moreover, it gives more information than the other tests.

I am rather sorry that Mr. Leahy's experiments, although much more thorough than my own, did not include one phase which I touched on rather briefly, the contamination by small amounts of under-pasteurized milk. In the holding process, one occasionally finds cold pockets, or dead ends in machinery and small amounts of under-pasteurized milk, milk which might have reached 56° or 54° centigrade. In my sketchy experiments, which I found sketchy in face of Mr. Leahy's, I could detect four per cent of the milk pasteurized at fifty-six degrees centigrade, which has contaminated the bulk of the milk pasteurized properly. I found, by the comparison method, that we could detect as little as one per cent of raw milk in the pasteurized product, and since Mr. Leahy has carried out the test in a somewhat different manner and yet obtained the same results, it brings out one fact clearly, and that is that the diastatic method is the only one by which we can carry out this test. Moreover, in spite of the fact that it seems that this test is difficult to carry out, you must prepare the serum, etc., it is not as difficult as it appears. I have had difficulty in impressing people with the simplicity of this test. None of them could see how a test could be carried out in so many steps and apparently with so little difficulty. I did not have the facilities that Mr. Leahy has had, in that I was working at an educational institution, where we did not get scores of samples every day. It meant making trips to the health laboratories. Consequently, the extent of our research was curbed.

But he has carried it out on a commercial basis and has found it satisfactory. It is not too time-consuming, and it has given many results which have well repaid the work that he has put in it. I can see no reason why, at this time, the test should not be taken up by other laboratories and tried out.

Now, we have three independent workers, one in Germany, who has tried out this test, as modified; we have Mr. Leahy, who has carried it out with good results. I think that it rests now with the public laboratories all over the country to take up the test, try it out and see what results they get.

I am sure the work that will be put into it will be worthwhile, because if the test is a good one, and from the data presented tonight and the data presented previously in my paper and the German paper the test seems almost too good to be true, it will be universally used.

In biological tests, one does not expect to get a sharp demarcation; yet here we can detect milk pasteurized at temperatures lower than 60° centigrade, and we can tell whether milk has been pasteurized for less than thirty minutes; we can detect one or two per cent of raw milk in the product; and we can detect as little as four or five per cent of slightly under-pasteurized milk in the product. I do not think any biological test is more accurate than that.

As I said before, the laboratories all over the country should take up the test and introduce it as a routine procedure, just as they introduced bacteriological examination of milk not so long ago.

President Krueger: I must agree with the previous speaker, that if a test is as practical as these experiments indicate it certainly is something we have been looking for for a long time and should be in use generally in a very short time. I would like to ask one question of Mr. Leahy. You said that a man was prosecuted for the improper labeling. Did this test come into court?

Mr. Leahy: I should not have used the word "prosecute." Actually his license was revoked.

Mr. Tiedeman: About a year or so ago we experimented a little in our laboratory with Prof. Gould's test and had some difficulty due to the fact that we found the color reaction was rather fleeting, and by the time we made the comparison the color was gone. Perhaps we did not do it correctly. However, recently, we have been doing some work with the other test, in which we prepare colors in the test tube and, from the very few results we have, it looks as though it would be practical. I would like to ask Mr. Leahy whether the test is applicable to cream.

Mr. Leahy: No, it is not. Undoubtedly it could be modified for use with cream, but we have made no studies on cream.

Mr. Frank: I noticed from Mr. Leahy's statement and from the charts that the test is so sensitive that it is possible to detect the difference between the milk held at 143 degrees for thirty minutes and other milk held for only 25 minutes. Is it correct that you get a change between a pure blue and a purplish blue or a bluish purple in that difference of five minutes? If that is so, then I think we ought to know his definition of "perfectly pasteurized" milk.

Mr. Leahy: In the studies we carried out prior to designing this test we standardized the method for a twenty minute pre-heating time which we found was, roughly, an average of pre-heating times in Rochester. I doubt if the test, so far as it is applicable to the flash method of pasteurizing, either flashing to 143 degrees and holding for thirty minutes, or flashing to 175 degrees and holding for fifteen seconds, could be used for that purpose, without readjustment for the particular method. As I said before, the activity of any enzyme is entirely dependent upon its concentration and that of its substrate, and by adjusting one or the other of these properties you can design practically any test you wish. The test was designed for the holding method as such, preheating up to 143 degrees and then holding at that temperature for thirty minutes.

Mr. Frank: If some of these larger plants heated up in a few seconds would that be apt to show a sort of purplish blue? Wouldn't you have to be careful in not thinking of that as improperly pasteurized milk?

Mr. Leahy: Yes, you would have to be careful in that case.

President Krueger: Do I understand you correctly that the test could be changed or modified to fit in with the particular type of equipment used? For example, if the average heating time in the plants was 15 or 20 minutes, while in some plants it would be a few seconds or a minute, could that be adjusted for all those situations?

Mr. Leahy: I think that could be done by using a smaller amount of starch.

Mr. Frank: I think this ought to be tremendously valuable, with limitations.

President Krueger: If an operator were to go to 150, we will say, for twenty minutes, would it probably give a blue color?

Mr. Leahy: The chances are it would.

President Krueger: But your thought was, as I understood it, that even though that were true, it would show up as properly pasteurized milk, which might be correct so far as the effect on bacteria is concerned.

Mr. Leahy: Yes, because at 150 in twenty minutes, surely it would destroy organisms as well as at 143 in thirty minutes.

President Krueger: Have you tested any milk of high temperature, say 160 degrees for fifteen seconds, for example?

Mr. Leahy: We are experimenting at the present time with the flash method.

Dr. Parker: We have used this test in Jacksonville and it has worked excellently. Our tests have not been extensive and they are not in shape to be published, but so far as we have gone we feel that we have a very valuable test. I would like to ask Mr. Leahy if the temperature which is selected for the four hour incubation may vary somewhat, without affecting the tests; that is, is there a range in there at which you can incubate without disaster or must you control your incubation?

Mr. Leahy: The optimum temperature for the action of the enzyme has been shown to be thirty degrees centigrade. I doubt if a lower temperature could ever be used; for example, twenty-five degrees, although you can show activity at twenty-five degrees. Our experience seems to indicate that thirty degrees is the best temperature.

Dr. Williams: Do I understand correctly that the full fifty minutes' time is necessary? Must the milk be heated for twenty minutes and then held for thirty minutes to produce the blue color?

Mr. Leahy: Yes, that is true.

Mr. Putnam: When milk is pre-heated to 143 degrees in one or two minutes and the tank takes seven and a half minutes to fill, then there is a thirty minute holding period and then seven and a half minutes to empty—that represents the combined filling, holding and emptying time. How would the test react in that case?

Mr. Leahy: I have never tried that particular experiment to see if it actually would give a blue color under those conditions. I imagine it would show some slight activity.

Mr. Putnam: We have been testing a plant in Rochester like that.

Mr. Leahy: We have tested all the milk in Rochester and we have not discoverd any plant like that, so far, giving "improperly pasteurized" reactions.

Mr. Putnam: Can you give us the approximate cost of this test and the routine?

Mr. Leahy: That I am afraid I can not do.

President Krueger: This discussion has certainly been very interesting but we must go on with our program. Mr. Leahy will be here and I am sure he will be glad later to answer any questions you may have. I, for one, believe that we are going to hear a lot more about this test at our coming meetings. I will ask Dr. Gould to close the discussion.

Dr. Gould: I would like to say one word concerning the remarks of Mr. Frank. The thing, essentially, depends upon the action of the amylase or diastase. From our experience apparently the diastase is hardly affected by temperatures very close to the pasteurization temperature; that is, you can go up to 110 or 120 degrees F. without affecting the amylase at all. After that, it is destroyed, as was pointed out. In that case, it wouldn't make very much difference how the holding process was carried out in its primary states—whether you went up slowly or rapidly—because it doesn't make any difference how long you take going up if it takes a temperature of at least 120 degrees F. before you have any effect upon enzyme. I would like to ask a question of the gentleman from Jacksonville or the gentleman from New York on one point. Unfortunately, Mr. Leahy didn't have the chance to examine milk which has been pasteurized in the bottle. In the course of my work at M. I. T. we were able to get some such samples. Among them we found one which gave a test for inefficiently pasteurized milk. I wondered if a certain amount of milk in the center of the bottle had not been pasteurized? I wondered if they have those in New York and whether the tests had been carried out on them?

Mr. Tiedeman: We have not tried this test on milk pasteurized in the bottle but we have put a thermocouple on bottles in which milk was being pasteurized and we found almost invariably a difference of several degrees between the milk in the top and the milk at the bottom, because the milk at the neck was heated first and the recording thermometer placed in the bottle gives you an average temperature, rather than that at any one point. Also, a great deal depends upon the kind of apparatus used. The only one that gave us anywhere near uniform results was the type where you carried the bottle through a water vat, where the temperatures varied from 90 to 160 degrees, when the milk was supposed to be at 143.

Dr. Gould: I might add that the samples upon which we carried out the tests were not quite the same as Mr. Leahy's. We used one hundred samples of perfectly pasteurized milk, which all came from Massachusetts. I will conclude by saying that I hope at the next meeting of the Association we can have a full report of the value of this test for commercial purposes.

PASTEURIZATION AND THE COURTS

JAMES A. TOBEY, M.S., LL.B., DR. P.H.
Director of Health Service, The Borden Company, New York; Member of the New York Bar

PASTEURIZATION of milk is now generally recognized, both legally and scientifically, as an essential feature of good dairy practice. Physicians, health officers, agricultural scientists, nutritional authorities, judges, and leaders in the dairy industry are all agreed that modern pasteurization sets the final seal of safety on a clean milk supply, and that this process does not appreciably impair the unsurpassed nutritional qualities of this indispensable food.

The most rabid of the few remaining proponents of raw market milk will concede that heating of milk for thirty minutes at a uniform temperature of 143 degrees Fahrenheit will destroy the most resistant strains of any pathogenic organisms that might be present. A few diehards among the advocates of raw milk still assert, however, that pasteurization has some detrimental effect upon the food value of milk. The fallacy of this claim has been pointed out recently by McCollum (1), and during the past decade by numerous other scientists (2), who have demonstrated conclusively that the effects of pasteurized and raw milks are virtually equivalent in human nutrition.

Because of the undeniable significance of pasteurization to public health, laws requiring and regulating this desirable process have been adopted in many communities in the United States. The legality of such statutes, ordinances, and regulations has come before the courts on a number of occasions, with the gratifying result that almost invariably the judiciary has recognized the validity of these requirements and has sustained all reasonable provisions for the pasteurization of market milk. There

have been one or two adverse decisions, but they have been due to legal technicalities rather than to any flaws in the scientific or public health principles involved.

During the twenty years since 1914, the courts of last resort in eleven states have had before them fourteen causes of action in which it was necessary to adjudicate the constitutionality or validity of municipal ordinances or health department regulations concerning pasteurization. In 1927 there had been reported only six such decisions, which were reviewed by the author in a paper delivered in that year before the Conference of State and Provincial Health Authorities of North America. (3) The eight subsequent decisions have not altered the general legal principles enunciated in 1927, although they have brought out several new points of interest and significance.

The first recorded decision on pasteurization was handed down in 1914 by the Supreme Court of Illinois in a case (4) involving a municipal ordinance of the city of Chicago. This ordinance required that pasteurizing machinery be equipped with a recording thermometer, a provision contested by a local milk dealer on the ground that it was unreasonable. The court decided, however, that a city having the power to require pasteurization of milk is not limited to the imposition of a penalty for violation of this requirement, but may prescribe the conditions under which pasteurization shall be carried out. The power of the city to require pasteurization of milk was not questioned in this case, but was inferentially sustained by the decision.

The power of a city to require pasteurization was, however, the moot point in the next decision on this subject, a case decided by the Supreme Court of Wisconsin in 1920. (5) In this case an ordinance of the city of Milwaukee, which provided that all milk sold in the city should be either certified milk, milk from tuberculin

tested cattle, or pasteurized milk, was attacked by a group of dealers who claimed that pasteurization did not really promote the public health. The court disagreed with this absurd contention, saying that judicial notice would be taken of the facts that milk is easily infected with the germs of disease, is dangerous when thus contaminated, and that pasteurization destroys disease-producing organisms. Whereupon the court pronounced the ordinance in question to be a proper regulation of the municipal milk supply, and valid as a wise regulation to protect the health of the people.

The sagacious rule laid down in this leading case, that pasteurization of milk is a reasonable requirement in the interests of the public health, was followed in three other decisions handed down in the next few years in New York and North Carolina. In two cases in New York (6), decided in 1921 and 1922, the rule was stated to apply with equal validity to the regulations of city boards of health, adopted in conformity to law, and requiring that only certified or grade A pasteurized milk should be sold. In one of these decisions, the court pointed out that, "For adults pasteurized milk is fully as nutritious as raw milk and digestibility of the two is the same."

The North Carolina case (7), decided in 1924, not only followed the legal principles of the prior Illinois and Wisconsin decisions, but went one step further in upholding a municipal ordinance requiring *all* milk sold in the city to be pasteurized. A few years later the judiciary displayed even greater liberality in sustaining health laws of this nature, when courts of final appeal in New York and California upheld the rather drastic requirement that milk should be pasteurized within the city where it was sold. In the New York case (8), the court stated that such a city ordinance is not discriminatory, unreasonable, or unconstitutional and that its enforcement does not unlawfully interfere with property rights or hinder law-

ful trade; while in the California case (9), the court called attention to the fact that failure to enforce a similar ordinance in the city of San Francisco would seriously impair the efficiency of the entire inspection service.

This same legal principle does not, however, hold good in all states. In 1933 an ordinance of the city of Minneapolis providing that no person should sell pasteurized milk in the city unless pasteurized within the city, was held void as unreasonable and as a violation of a dealer's constitutional rights of property and contract. (10) The court felt that it was convenient for the city to inspect milk plants beyond the city limits, and that a reasonable fee could be charged for this service. There is something to be said in support of this position, because the location of a pasteurizing plant is, within reasonable limitations, far less important to the public health than the care, skill, and probity with which it is operated.

A municipal ordinance classifying milk dealers into three classes, and imposing higher fees for inspection upon those offering raw milk for sale than upon those selling pasteurized milk or milk to be pasteurized was upheld in 1931 by the Supreme Court of Oklahoma. (11) In holding that such a classification was not discriminatory, the court stated that "Public health regulations and the authorities on public health agree that the process of pasteurization is such as to kill bacteria existing in milk," and also that, "it is obvious that milk heated to the degree and for the time shown by the record to be used in the pasteurizing plants in question requires less inspection and regulation prior to its delivery to the pasteurizing plants than raw milk offered for sale to consumers."

Judicial notice of the value of pasteurization was taken in a Rhode Island case (12) in 1931, in which a milk dealer in Vermont sought to enjoin the operation of a state law requiring all milk sold as pasteurized milk to be pasteurized within the state. Because of defects in the

pleading of the cause by the state officials, the Supreme Court refused to pass on the constitutionality of this law and remanded the case to the lower tribunal. "We may," said the court, "also take judicial notice of the fact that pasteurization is one of the accepted methods of protecting the public in the use of this essential article of diet, but we may not extend the principle of judicial notice to the methods and technique of the process."

In a few instances the courts apparently have been willing to uphold pasteurization, but have been unable to do so because of unavoidable legal technicalities. An example is a Connecticut case (13), decided in 1930, in which a city ordinance requiring that all milk sold in the city after January 1, 1929 should be either pasteurized or from tuberculin-tested cattle, was found to be in direct conflict with a state law which permitted the sale of raw milk under certain conditions. In a divided opinion, the Chief Justice, speaking for the majority of the court, stated that the merit or reasonableness of pasteurization was not under consideration, as that was a matter for legislative rather than judicial determination. In the previous year this court had refused to issue a writ of mandamus to the same plaintiff to compel issuance of a license to sell milk under the city ordinance which was subsequently held invalid. (14) The two cases seem inconsistent, although the later one prevails in law.

To the same effect as the Connecticut case holding an ordinance invalid because it was in conflict with a state law is a recent Colorado decision. (15) In this instance, the manager of health and charity of the city and county of Denver had issued an order prohibiting the sale of unpasteurized milk after a certain date. While undoubtedly justified in the interests of public health, this order happened to conflict with a local ordinance which specifically allowed the sale of raw milk of certain standard. For this reason, the order was held to be null and void as a

usurpation of the law-making powers of the legislative branch of the government.

These two cases are not adverse to pasteurization, but merely emphasize certain established rules of administrative procedure. While health officials are usually granted expressly or by implication the power to make reasonable rules and regulations to carry out the purposes of health legislation, and while municipalities are given broad powers with respect to the control of public health, in neither instance can there be contravention of the laws promulgated by a higher authority. Health officials will do well to bear in mind the cogent principle that a city can not forbid what the state authorizes, nor can a health officer or milk inspector prohibit what the city allows. (16)

From this review of the court decisions on pasteurization, it is obvious that the weight of legal authority is in favor of this process as a reasonable measure to aid in the promotion of the public health. There is, nevertheless, one decision that is directly contrary to all of the others. This is a Missouri case, (17) decided in 1926, in which the Supreme Court of that state reached the conclusion, from the evidence submitted, that raw milk "as a *general thing* is more nutritious, easier assimilated, and better food, especially for children, than pasteurized milk, though it is probable that some individuals may thrive better on pasteurized and boiled milk than on raw milk." For these reasons, or alleged reasons, and because a state law defined raw milk, the court held that a city ordinance purporting to require pasteurization was unconstitutional.

Although the court's opinion in this case with regard to the relative merits of raw and pasteurized milk is not in accordance with the consensus of scientific opinion, there was considerable legal justification for the outcome of this particular case. The ordinance in question was defectively worded, the evidence presented in support of it

was inadequate and rather incompetent, and the whole case apparently was handled in such a crass manner by the city authorities that no conscientious jurist could have ruled otherwise. The court called attention to the fact that it might have been shown that the sale of raw milk in St. Louis was injurious to health, and that pasteurization was reasonable, but that this proposition was not supported by facts.

This one decision in favor of raw milk, as opposed to the safer pasteurized milk, may set a legal precedent for Missouri, but since it is contrary to the weight of authority in other jurisdictions, it should not be regarded as a persuasive contribution to our unwritten law. It is now an established rule of law in this country that some or all of the milk supply of a municipality may be required to be pasteurized in accordance with methods approved by the health authorities.

"Milk is in universal use as a food," said the Chief Justice of Connecticut in an admirable epitome of the legal principles of milk control (13). "It is peculiarly liable to contamination and adulteration. Therefore in the interest of public health and safety, the regulation of its production, marketing, and sale are held to be within the proper exercise of the police power of the state. This the state may effectuate directly by its statute, or it may delegate its regulatory power to an official board or officer, or to a municipality. It may exercise this power directly and completely, or it may delegate it directly or completely to either of these agencies, or it may act in the exercise of this regulatory power in concurrence with the municipality. The state may determine the standard of quality, prohibit the production, sale, or distribution of milk not within the standard, divide it into classes, and regulate the manner of their use, so long as these standards, classes, and regulatory provisions be neither unreasonable nor oppressive. The many recorded instances

in which the courts have sustained this power of regulation bear witness to the liberality of their viewpoint where the public health and safety are concerned. If there be room for a reasonable difference of view as to the legislative prohibition, classification, or regulatory provisions, courts will accept the legislative determination and not impose their own will."

The decisions cited above, and the many others on various aspects of milk control that could be cited, demonstrate that the judiciary realizes what scientists know, that milk is the most important food of mankind, (18) and that every reasonable effort to insure its purity and safety contributes to the improvement of the public health and thus is of primary interest and importance to the general welfare.

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Discussion

Mr. Leahy: I would like to ask Dr. Tobey if his summary showed that legally a city may permit only pasteurized milk to be sold, where the State in which that city is situated allows the sale of raw milk.

Dr. Tobey: A city ordinance or health department regulation can not be inconsistent with the state law. A city ordinance may be more stringent than the state law but it can not overrule it. That general principal varies somewhat in the different jurisdictions in the United States.

Dr. Brooks: Mr. Leahy comes from New York State so I assume that he is thinking of conditions there. I happen to know that Rochester has been going through the process of requiring pasteurization. Our milk control is covered by regulation rather than by law and, as far as this point is concerned, it is taken care of in New York State by a definite provision in the state sanitary code. The local boards of health may require pasteurization of any milk not required to be pasteurized by the code. Incidentally, that was put in the code in those very definite terms at a time when an injunction suit was pending against one of the county boards of health which was requiring pasteurization, the injunction being asked for on the ground that this was inconsistent with the state sanitary code. The change was made in the sanitary code while the suit was pending and it was immediately dropped. I bring this up as suggesting that at least the legal talent in that case recognized that it was valid.

Mr. Jennings: I would just like to mention that within the last year the city of Galveston, Texas, passed an ordinance requiring all milk to be pasteurized in the city limits and that went to the Circuit Court of Appeals and was upheld and did not go to the Supreme Court.

President Krueger: In Chicago we have had compulsory pasteurization since 1926 and our death rate for tuberculosis, other than pulmonary, has gradually decreased some 30 or 40 per cent. In a period of eight years we also have had compulsory tuberculin tests of our cattle, and pasteurization processes have improved which may account for some of the decrease.

Mr. Johns: Would it be possible that a large proportion of the non-pulmonary cases that would be reported in Chicago would be from people outside the urban districts? That, I know, has been the experience in Toronto where pasteurization has been carried on since 1916, I believe. One or two of the doctors at the University of Toronto have investigated a large number of cases and in the few cases where they have been able to find the bovine strain of organism it has been found either to have been obtained in the country in the summer holidays or in cases that have come from the country to the city hospitals.

President Krueger: The five states from which Chicago draws its milk and cream supply are all accredited states and the people who come to Chicago from that territory enjoy the benefits of their testing program carried on throughout the states, although, as you say, we do get a large number of people in the city for treatment and of course their deaths are recorded as deaths from Chicago.

Dr. Tobey: It is my understanding that not over ten per cent are due to bovine infection.

Dr. Hardenbergh: With respect to milk poisoning, both of those were due to staphylococcus infections reported in the milk; the health officers making the investigations found out that the milk apparently contained a toxin formed by the staphylococcus which had the ability to cause a sudden illness after the milk was ingested. There were no deaths in the two hundred and fifty cases.

Dr. Brooks: Were there any outbreaks of milkborne gastroenteritis in that list?

Dr. Hardenbergh: There was one epidemic of diarrhea reported.

Dr. Brooks: It struck me that those two terms meant the same thing.

Dr. Hardenberg: They probably do but this year there happened to be reported one as diarrhea and two as milk poisoning. With respect to the percentage of bone and joint tuberculosis as caused by the bovine organisms, that is just as Dr. Tobey states, approximately ten per cent of the cases are known to be due to that organism. Park and Krumwiede have some of the best statistics on that and their figures, which are cited in the report, are conclusive.

CERTIFIED MILK—PASTEURIZED

RICHARD S. EUSTIS, M.D.
Secretary, Boston Medical Milk Commission, Inc.

CERTIFIED MILK may be defined as a very clean milk of uniform quality produced by healthy, well-fed cows and handled by healthy men. The health of cows and employees is checked by frequent veterinary and medical inspection and tests, and the cleanliness of the product is assured by frequent bacteria counts. It is not intended to be a rich milk and the fat content is held very close to 4 per cent.

This supervision is carried out by a Milk Commission representing the medical profession and their work is checked by the Health Department.

In the days when other milks were a menace, certified milk in spite of its higher cost, filled a real need. It was fresh, clean, and safe in comparison with raw market milk. Then came pasteurization which when properly done made dirty milk safe. Certified milk raised its standards and held its own for a while because of the appeal made by its cleanliness and freshness. As the sanitary conditions under which market milk and Grade A milk were produced improved, this appeal lost some of its value, and from the point of view of safety, it became clear that properly pasteurized milk was preferable to the best of raw milks. It seemed a pity, however, to abandon the known benefits of certified milk and gradually a small demand developed for certified milk which had also been pasteurized.

By 1928, an average of 525 quarts of certified milk a day was being pasteurized for the consumer without any supervision by the Commission. This was 9 per cent of the total sales. The producers wished to label this milk Certified Milk Pasteurized, and after a great deal of discussion with the American Association of Medical

Milk Commissions, the Boston Commission decided to recognize the existing condition and to authorize the use of the label Certified Milk Pasteurized. This step was taken with the hearty encouragement and cooperation of the Health Commissioner of Boston, Dr. F. X. Mahoney, who in common with the overwhelming majority of the medical profession here, was strongly in favor of the pasteurization of all milk.

When we first recognized officially and approved the pasteurization of certified milk, we were told by representatives of the American Association of Medical Milk Commissions that our action would inevitably result in a lowering of the standards of certified milk. We do not believe that this has occurred. On the contrary, we think our raw milk is more nearly safe than ever before. Our farms are all accredited, abortus eradication is progressing rapidly (last test, 7 positive out of 665 head —10.5 per cent); medical and veterinary supervision seems excellent. Probably bacteria counts can be taken as the best index of a clean milk. Our figures for the first six months of 1934 show of 159 counts on raw certified milk that 127, or 80 per cent, were under 5,000, and 156 or 98 per cent were under 10,000. The highest count was 17,300.

Standards for Certified Milk Pasteurized

The milk shall conform in every respect to the requirements laid down in the Regulations of the State Department of Public Health for the Production of Certified Milk, and in the Methods and Standards of the American Association of Medical Milk Commissions. Pasteurization shall be done at the farm either in a holding tank or in the bottle, according to the Regulations of the Health Department of Boston. We have not yet lowered the bacteria count limit of 10,000 which applies to all certified milk, feeling that we wished several years' experience before setting an upper limit in the hundreds.

Effect of Pasteurization on Bacteria Count

Certified milk (raw) is required to have a count of not over 10,000. Over a period of 6 years, at least three-fourths of our counts have been under 5,000 and 92 to 98 per cent have been under 10,000. This compares very favorably with certified milk counts reported from other cities.

Our bacteria counts are made by the Department of Comparative Pathology at the Harvard Medical School, using the methods of the Public Health Association. The medium used is beef infusion agar with the addition of 1 per cent lactose. The pH is adjusted to 6.6-6.8. Six per cent defibrinated horse blood is added just before the plates are poured.

Beginning in 1929, we have had weekly counts of certified milk pasteurized made at the Harvard Medical School Laboratory. The extremely low results have surprised and pleased us.

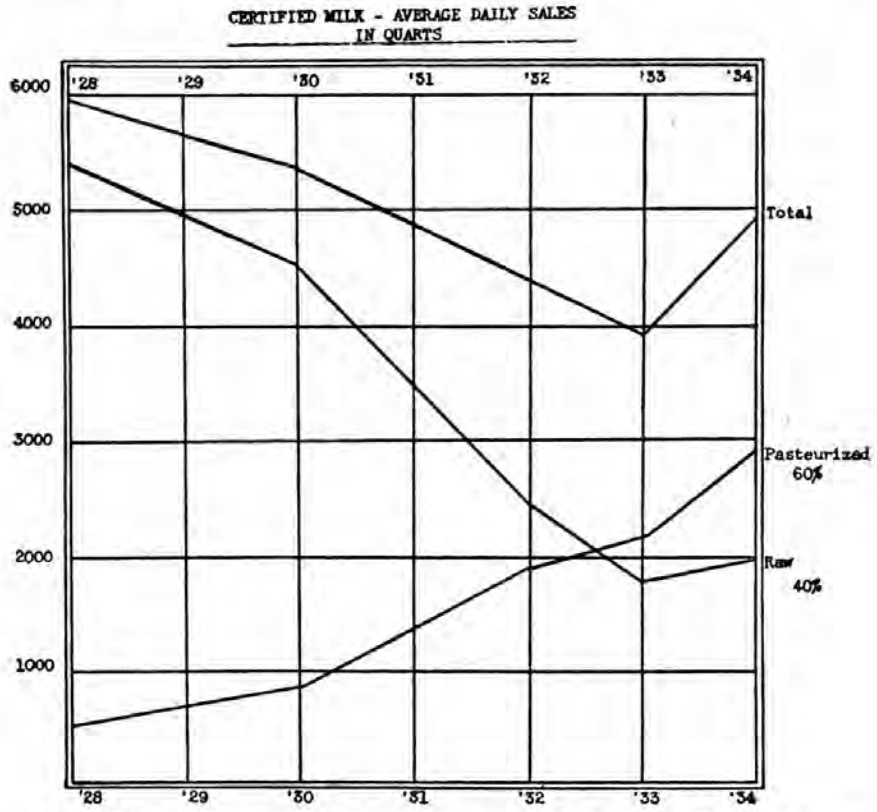
		100 or under	
1930	106 samples	90 per cent	None over 300
1931	192 samples	92 per cent	None over 700
1932	255 samples	86 per cent	None over 12,000
1933	312 samples	94 per cent	None over 13,000
1934 (6 mos.)	156 samples	98 per cent	None over 800

Effect of Pasteurization on Flavor

The taste and flavor are practically unaltered. Most of the members of the Commission and most of the children who have been tested are unable to tell the milks apart without looking at the caps. In fact, it is not uncommon to have people who are accustomed to drink ordinary pasteurized milk complain that certified milk whether raw or pasteurized is too insipid for their liking.

Effect of Pasteurization on Sales

The figures for average daily sales of certified milk were obtained from our three present producers and merged. The demand was dropping before the depression and the rate of fall was accelerated from 1930 to 1933. Then there came a sharp rise for the first six months of 1934, the cause of which I will consider later.



The line representing raw certified milk fell off still more sharply, from 91 per cent of the total in 1928 to 40 per cent of the total in the first half of 1934. Much of this raw milk is boiled in the home before being fed to infants.

Sales of pasteurized milk starting at 9 per cent of the total in 1928, rose slowly at first and then more rapidly with the open approval of the Commission from 1931 to 1933, with a sharper rise in 1934, ending at 60 per cent

of the total. This undoubtedly reflects the almost universal opinion of doctors and health authorities that all milk should be pasteurized and thoroughly justifies the action of the Commission in approving and encouraging the pasteurization of certified milk.

The percentage pasteurized is now steadily increasing but we do not believe that the sale of raw certified milk should ever be forbidden, either by law or by the Commission. There will always be a need for raw certified milk for use in boiled formulas for infants, and occasionally in nutritional problems in older children and in adults. For such cases, the best possible raw milk must continue to be available.

We now come to the consideration of the marked increase in sales during the first six months of 1934. The figures show a 25 per cent jump from 3960 to 4954 quarts a day. At the same time, pasteurized milk rose 38 per cent, from 2142 to 2962, and raw certified milk just under 10 per cent, from 1818 to 1992. The previous year pasteurized milk had made only a 14 per cent gain and raw had continued to lose. In fact, this is the first check in the downhill coast of raw certified milk since 1928 which is as far back as these figures go. Obviously some factor other than pasteurization has influenced the figures.

In 1932, the Commission became convinced of the value of Vitamin D milk from cows fed irradiated yeast, and encouraged the farms to undertake the production of this milk. The average daily sales the first year were 1514 quarts; in 1933, 2421 quarts, and in 1934, 3612 quarts. This represents a steady increase of approximately 50 per cent a year. During the first six months of 1934, Vitamin D certified milk represented 72 per cent of our total sales. Of this, 1160 quarts a day are raw milk and 2452 are pasteurized. Another way of looking at this picture is to say that 49 per cent of the total sales of

certified milk are Vitamin D pasteurized and that 23 per cent are Vitamin D raw.

The standards adopted for this milk were that it should be in all respects certified milk, the only difference being that the Vitamin D content was raised to at least 160 Steenbock units of Vitamin D per quart by the addition of the proper amount of irradiated yeast to the cows' feed. We have felt it necessary to check the Vitamin D content by bio-assays, at first three times a year, and this year only twice. These bio-assays are made for us by Professor John W. M. Bunker of the Massachusetts Institute of Technology, and have invariably shown the presence of 160 Steenbock units, and frequently of more than 160 units per quart. It is fair to say that this milk has met with fairly general acceptance among pediatricians and is frequently recommended for the feeding of infants and children. Its advantages are that no foreign material is added to the milk and that the milk is not subjected to any additional processing after it leaves the cow. Whether these advantages and this high vitamin content will outweigh its greater cost as compared with the other forms of Vitamin D milk remains to be seen.

Conclusions

1 The Boston figures on sales of certified milk show a 37 per cent drop from 1928 to 1933, with a 25 per cent increase from the low point during the first half of 1934, making the final loss in sales from 1928 through June, 1934, only 16 per cent.

2 This rise during the first half of 1934 is probably due to the increasing demand for Vitamin D certified milk.

3 Certified milk pasteurized increased from 9 per cent of the total sales in 1928 to 60 per cent in the first half of 1934.

4 Raw certified milk fell from 91 per cent of the total sales in 1928 to 40 per cent in the first half of 1934.

5 The high standards of certified milk have been maintained in spite of the knowledge on the part of the producer that part of his product was to be pasteurized.

6 Our five years' experience with the pasteurization of certified milk at the farm under the supervision of the Milk

Commission shows that the flavor is unchanged and that 92 per cent of the bacteria counts are 100 or under.

7 Certified milk pasteurized is the safest and cleanest milk available.

Discussion

Dr. Lythgoe: I am of the opinion that Dr. Eustis has not done "pasteurized certified" justice. The Massachusetts Department of Health makes the chemical examination for the Boston Medical Milk Commission and for the past couple of years I have been doing bacteriological examinations as well. We make two plates of one to ten, and one plate of one to one hundred on the pasteurized and it is astonishing what a large number show no growth on the one to ten. The geometric average of the samples over a period of a year, if my recollection is correct, is somewhere in the neighborhood of fifty and a count of one hundred and fifty is rare. I think the milk regulation board should set a standard for certified pasteurized of not exceeding fifty.

Dr. Brooks: Dr. Eustis, is pasteurized certified now accepted by the American Association of Medical Milk Commissions?

Dr. Eustis: It depends upon what you mean by "accepted."

Dr. Brooks: Are you using their label or cap?

Dr. Eustis: Their regulation is that milk pasteurized shall not carry the copyrighted seal of the Association.

Dr. Brooks: You do not use the seal?

Dr. Eustis: We do not use the seal.

Mr. Jennings: Several years ago, probably in 1929, I wrote to the health department of the city of Boston as well as the health departments of the cities of Cincinnati, Dayton, Ohio, and the National Medical Milk Commission, stating that I understood that certified milk was now being pasteurized, asking for information about it. The National Medical Milk Commission wrote back that Boston was pasteurizing a little, as well as some of the other places, under unsatisfactory conditions and it certainly was not approved by the National Medical Milk Commission.

Dr. Grim: I would like to ask Dr. Eustis whether the samples are taken from the delivery wagons or whether they are taken to the Commission's laboratory by the dealers.

Dr. Eustis: We used to collect from the delivery wagons in Back Bay here but we found it very difficult to get samples off the wagons. Our man spent a great deal of time doing this, as many times the driver had only enough to cover his orders, so we now send our collector to the distributing centers and he takes samples from those lots and carries them out to the laboratories of the medical school. The same method is used to get the samples to Dr. Lythgoe at the State House.

Dr. Grim: It seems to me very difficult to be sure that your samples really are representative of certified milk as the consumer gets it when

samples are not taken from the wagons on the streets. We find in our work considerable difference in reports that we get from samples of certified milk. I sometimes wonder whether or not we should not check more carefully by actually taking wagon samples.

Dr. Eustis: All I can say is that there was no marked change in results when we made the change from wagon collections to the distributing center collections.

REPORT OF COMMITTEE ON LABORATORY METHODS

TAKING cognizance of propositions from several quarters for the substitution of media to be used in plate counts of milk which would probably yield much higher counts than the present standard medium, your Committee has devoted its time to a partial study of one of the substitute media advocated.

The medium selected for comparison was devised by English workers * and Bowers and Hucker report that its use would increase the colony count secured from both raw and pasteurized milk. It was simply the present standard medium to which is added about 0.5 per cent sterile skim milk just prior to final sterilization.

If such greatly higher counts could be obtained it would obviously necessitate the liberalization of present ordinances. In default of this either our time would be monopolized by punitive measures or the situation become farcical.

Seven members of the Committee have submitted the results of their work in time to be considered in this report and such are summarized in the accompanying table.

It will be seen that in the case of raw milk the highest percentage of increase was 83 per cent gradually falling off from that figure to an actual decrease of 15 per cent.

In the case of pasteurized milk, the highest percentage increase was 133 falling off rapidly to a decrease of 42 per cent.

The foregoing refers to results obtained at an incubation temperature of 37°.

Two laboratories report working at an incubation temperature of 32°, as a lower temperature than the

* Guide to the conduct of clean milk competitions. Bull. 46, 9-11, Ministry of Agric. and Fisheries, London, 1934. (Obtainable through British Library of Information, 5 East 45th Street, New York, Cost 15 cents.)

present standard of 37° has received strong advocacy from several quarters. The percentage increases in the cases of pasteurized milks reported by these two were 23 per cent and 73 per cent. In the case of pasteurized milk the highest increase at both temperatures reported with the enriched medium was but one-third of the claim of its sponsor.

The great variation in results reported by the collaborators is most striking. The laboratory reporting most consistently differing values for the enriched media is located several thousand miles distant from the others; the question has been raised if in this instance, the types of organisms which would grow better on the enriched medium were not absent in the milk of that section.

As enforcement officials, we should be vitally interested in any change which would throw our present ordinances into the discard.

The results here presented indicate the necessity of additional study covering more thoroughly the middle and western parts of the United States and Canada.

The members of this Committee are about evenly divided on the question of advisability of any change from the present official medium. Some believe as it is now we are simply fooling ourselves and getting nothing like the actual count. Others believe the present medium has well served the purpose of comparing any dealer's product with others and has directed attention to undesirable conditions in plants and dairies.

It is apparent to both groups that no one medium or incubation at any one temperature will reveal the actual numbers of bacteria present in any given milk; for to obtain even an approximation of the actual numbers in milk would entail labor far beyond the means of the average enforcement official.

For what has been said of books, the making of them "has no end" applies with equal aptitude to media

SUMMARY OF RESULTS ON COMPARISON OF MEDIA IN PLATE COUNTS OF MILK
INCUBATED AT 37°

Laboratory	Collaborator	Raw Milk				Pasteurized Milk			
		Number of Samples	Standard Medium	Standard + 0.5% Skim Milk	Per cent Increase	Number of Samples	Standard Medium	Standard + 0.5% Skim Milk	Per cent Increase
Baltimore	J. H. Shrader	25	100,400	126,900	26	25	1,050	990	−6
Cleveland	H. O. Way	9	144,900	212,800	47	13	104,000	158,800	53
Jacksonville	H. N. Parker	30	15,700	10,300	−35	85	20,800	33,500	60
Los Angeles	F. P. Wilcox	51	13,700	12,000	−13	21	2,600	1,500	−42
Oakland	R. L. Griffith	314	24,500	27,900	14	56	10,200	9,700	−5
Somerville	H. E. Bowman	6	480,000	881,600	83	32	34,600	45,800	32
				INCUBATED AT 32°					
Brockton	G. E. Bolling	25	19,000	40,000	110	25	9,900	17,100	73
Ottawa	C. K. Johns	..	.....	.....	.....	45	160,700	197,400	23

giving higher counts than the standard; the literature is most replete with such innovations.

So, argue this second group, as long as perfection can not be reached, why change at all, when it is highly evident that any change is in all likelihood but temporary. Another point to be taken in consideration is the effect on some dealers and the general public of what they might deem a policy of vacillation on the part of enforcement officials.

As empowered by this Association in 1923, we have continued to examine dehydrated media intended for use in plate counts of milk. Our approval was given to the product of the Digestive Ferments Company.

Discussion

Chairman Johns: Thank you, Dr. Bolling. You have heard the report of the Committee on Laboratory Methods. The subject is now open for discussion.

Dr. Breed: This report is of very great interest to the Committee that is concerned with the preparation of Standard Methods of Milk Analysis. Studies of this type are very helpful to us. In fact, we must secure even more extensive data than this before the Committee on Standard Methods will feel justified in making any recommendation for a change either in the temperature of incubation of the Petri plates or the composition of standard agar.

Two types of agar are under consideration as possible substitutes for standard agar. One suggested by English workers consists in the addition of 5 cc. of skim milk to each liter of agar. The other consists in the use of a Tryptone- glucose-skim milk agar suggested by Bowers and Hucker in a bulletin from the Experiment Station at Geneva now in process of publication.

At the Dairy Congress in Rome the first week of May of this year, I was able to get in contact with the group from England, the group from Germany, and the group from Italy that are responsible for the preparation of official laboratory procedures for the examination of milk in these countries. There is a very real possibility that we may be able to work out uniform laboratory methods satisfactory to these as well as North American countries. But, before we can do this we must have a thorough study of the composition of the agar in its relation to incubation temperatures.

Some of you may have seen the preliminary report on standard agar media presented at Indianapolis before the American Public Health

Association by Mr. Bowers and Dr. Hucker,* and you may also have seen a preliminary report on incubation temperatures by Dr. Pederson and Dr. Yale † presented at the same time. The incubation problem involves many difficulties, and is more serious than Dr. Bolling has indicated in his report.

Mr. Bowers is here and will give you a brief summary of what he and Dr. Hucker have done during the past eighteen months in their studies of standard agar media.

Mr. Bowers: I think that we are all agreed that the present standard agar has fulfilled many of the expectations of those who devised its formula. For a number of years it has given sufficiently accurate results to make it a very useful method of controlling milk quality and it has been assumed to give a count that represents a reasonably constant preparation of the number of bacteria present.

However, inasmuch as the number of bacteria in milk is used as an index to its sanitary quality, their enumeration should be as accurate as possible. Repeated observations are available which indicate that there are a number of other easily prepared media which will give a larger colony count than the so-called standard agar. The mere presence of this higher count indicates that standard agar does not give a true picture of the total number of organisms present. In addition, work in recent years on thermophiles and mastitis has shown that the organisms of these types do not readily develop on standard agar. Large numbers of thermophilic types and mastitis streptococci may be present in a given sample with no evidence of their presence as shown by growth on standard agar. With these recent developments in sanitary milk control, it is evident that our present standard agar does not give a constant proportion of the total number of organisms present.

Cooperative studies by the New Britain (Conn.) Department of Health, the Connecticut State Department of Health, and the New York State Agricultural Experiment Station (Geneva) have shown that there are a number of modifications of the standard agar which are much more efficient than the present standard agar from the standpoint of the number of colonies which develop on the plates.

Of the large number of modifications of standard agar which have been suggested, there are two, which according to our investigations have shown the most promise. One of these is the so-called English modification of our present standard agar which consists of the addition of 0.5 per cent skim milk to our present agar. The other modification, which has developed as an outgrowth of our investigations, is a medium composed of Tryptone (a digested casein), glucose, and agar. To this medium may, or may not, be added 0.5 per cent of skim milk.

The English modification was found to give a colony count of 146 per cent in relation to our present standard media when raw milk samples were studied, and 245 per cent when pasteurized milk samples

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* *Amer. Jour. Pub. Health*, 24, 396-398, 1934.
† *Amer. Jour. Pub. Health*, 24, 477-484, 1934.

were studied (see table below). The Tryptone-glucose-skim milk agar under the same conditions gave, in raw milk samples, a 136 per cent count and in pasteurized milk a 420 per cent count. It was noted that the addition of skim milk to the Tryptone-glucose-skim milk agar increased its value only very slightly.

A study of the effect of adding yeast extract, beef extract, and the addition of fermentable carbohydrates, etc., to standard agar for use on a long series of samples did not increase its efficiency as much as did the use of either of the two media mentioned above.

The striking increase in the number of colonies which developed on these various new modifications of standard agar over the standard agar now employed, raises a practical problem if one of these new media should be accepted as a substitute for the present standard agar. An

RELATIVE EFFICIENCY OF VARIOUS MODIFICATIONS OF THE STANDARD AGAR USED FOR THE BACTERIOLOGICAL EXAMINATION OF MILK

Composition (per cent) of Media									Percentage, in relation to standard agar, of colonies appearing on experimental media		
Agar	Peptonized milk	Beef extract	Yeast extract	Peptone	Tryptone	Glucose	Skim milk	No. of samples compared with standard agar	Raw	Pasteurized	All Samples
1.2		0.3		0.5					100	100	100
1.2				0.5				52	62	55	59
1.2			0.3	0.5				52	91	80	86
1.2	0.5							52	109	101	104
1.2		0.3	0.3	0.5		0.1		52	125	110	118
1.2		0.3		0.5		0.1		52	135	131	133
1.2	0.5	0.3		0.5		0.1		52	132	151	142
1.2		0.3	0.3			0.1		164	137	155	145
1.2		0.3		0.5			0.5	164	146	245	195
1.2					0.5	0.1		211	136	420	278
1.2					0.5	0.1	0.5	265	134	455	294

increase in count would affect present sanitary milk standards and might entail considerable hardship for producers and dealers unless these standards are changed. The results of our investigations indicate that these new media give their most pronounced increases in count in the poorer quality, that is, the high count milk. Samples which normally present the lowest counts with the standard agar have been found also to give the lowest counts with the proposed new media. In other words, the proposed media further emphasizes the quality of the milk as indicated by the number of organisms present.

The publication mentioned earlier in this discussion, will appear as Tech. Bull. 228, New York State Agricultural Experiment Station and will suggest that the Tryptone glucose agar (either with or without the addition of skim milk) be given serious consideration as a substitute for the present standard agar for the bacterial analysis of milk.

Chairman Johns: Mr. Bowers has brought out an important point in regard to the new medium in his indication that the counts from poorer quality milk are increased to a greater extent by the use of the new agar than are the counts from really high grade milk.

Is there any further discussion in connection with this subject?

Dr. Breed: I may say that because of the fact that I have been away from my office for six months during the past year, the publication giving the details of this work has not appeared as yet. Consequently, the Standard Methods Committee has not yet sent out this material generally to public health laboratories as planned. We hope that many of these laboratories will try one or both of these newly suggested media. We already have the addresses of about seven hundred laboratories in the United States and Canada doing milk control work and the day I left home to come to Boston, separates of the papers given at Indianapolis were in the envelopes ready to be mailed to these laboratories. Within a short time, all of these laboratories will receive a questionnaire, dealing not only with the question of the incubation temperature and composition of the agar, but also with the question whether they approve the changes included in the new (sixth) edition of Standard Methods of Milk Analysis.*

May I add that certain typographical errors have been detected in the new edition of the Standard Methods Report. I have errata sheets with me which I shall be glad to supply to anyone who purchased a copy of the report before these errors were detected.

Chairman Johns: I should like to ask Mr. Bowers a question. In what little work I have done in comparing standard agar plus milk with the standard agar, I have noticed that there was a decrease in the number of small colonies present, i.e., colonies difficult to count. There was also a very much better agreement in counts from the one to one hundred dilution as compared to the one to one thousand dilution than in similar counts obtained from similar dilutions with the present standard agar. I wonder if Mr. Bowers would care to comment on this matter.

Mr. Bowers: This agrees with our results with the English skim milk medium. The Tryptone-glucose-skim-milk agar also grew large colonies that are easy to count.

†George E. Bolling, *Chairman*

A. H. Robertson	F. Lee Mickle
R. L. Griffith	H. O. Way
J. H. Shrader	†F. P. Wilcox
†Horatio N. Parker	†H. E. Bowman

†C. K. Johns

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* Amer. Pub. Health Assoc., 50 West 50th St., New York City, cost $1.50.

† Sub-committee to work with Referee for the American Public Health Association on Bacteriological Methods of Analyzing Milk.

THE VALUE OF VITAMIN D MILKS TO THE CONSUMER

JOHN W. M. BUNKER AND ROBERT S. HARRIS
Massachusetts Institute of Technology

ORDINARY milk cannot be depended upon to prevent infantile rickets. Its vitamin D content is too low. The artirachitic effectiveness of milk can be increased by any one of several methods, of which three have attained commercial development—

I. Yeast milk, secured from the cow after including irradiated yeast in the feed
II. Zucker process milk, prepared by adding to cows' milk a concentrate of cod liver oil
III. Irradiated milk, subjected to the action of ultra violet light before bottling.

Because each of these three milks has been found to have enhanced antirachitic effect on young animals, and because the antirachitic principle first discovered was named "vitamin D," it is natural that these milks should be classed as vitamin D milks.

Vitamin D is the name given by McCollum, twelve years ago, to a substance associated with certain fats which possesses the power to initiate the healing of rickets. Cod-liver oil was found to be the natural source of the most concentrated vitamin D principle; later the oil of the liver of certain other fishes was found to be in a similar category; butter was proved to be a variable but relatively low source of D; and egg yolk a somewhat less variable but more potent source than butter. The other natural sources of this vitamin in foodstuffs have been shown to be extremely limited.

At about the same time that vitamin D was located—but not isolated—and named, Zucker devised a method

for recovery of an antirachitic principle from the non-fat portion of cod-liver oil. Patents covering this method protect the Zucker process.

Approximately contemporaneously with the isolation of vitamin D came complete corroboration of the earlier reports that ultra violet light on the skin of animals can cure or prevent rickets. Next there developed the combination of these two findings in the irradiation of foods leading to the Steenbock patent for irradiating foods with ultra violet such as is obtainable from a quartz mercury vapor lamp. An application of the Steenbock process is the irradiation of yeast which in dried form is then fed to cows to enrich the antirachitic potency of milk.

In 1927 ergosterol, associated ordinarily with cholesterol, found in various plant and animal tissues, was hailed as the established precursor of vitamin D, since upon suitable exposure to ultra violet light, ergosterol takes on antirachitic properties. Three years later there was derived from irradiated ergosterol a crystalline substance of still more concentrated antirachitic potency, now called calciferol, and popularly regarded as pure vitamin D.

Vitamin D, however, is the name given to the antirachitic principle in cod-liver oil and its identity with calciferol has never been established. In 1931 the late Dr. Alfred Hess (1) stated "I have for the past five years or more frequently brought up the question of whether this vitamin D is really a vitamin. In fact, some may have noticed that I have for years spoken of it as antirachitic factor." In 1932 the same author stated his belief that there is in the etiology of rickets a factor quite apart from a lack of vitamin D. In the same year Steenbock stated unequivocally his conviction that the vitamin D produced by irradiation is a different substance from that found in cod-liver oil. In 1934 Kon (11) in England presented convincing evidence that "at least two

factors, antirachitic for the rat, are present in butter; a factor which is not recoverable in the non-saponifiable residue, and" . . . (another factor) . . . "the usual vitamin D (whatever this term may imply)." Kon found, in agreement with Zucker, that he was unable by the Zucker process to extract from butter its entire antirachitic principle, and contrary to Zucker, was by the same process not able to extract all the antirachitic potency even from cod-liver oil.

In our own laboratory we have found by repeated trials that the inclusion of casein freed of detectable "vitamin D" factor, in a diet otherwise rachitogenic, tends to prevent the development of decided rickets in rats.

In July of the current year, Waddell (17) reported that the action of ultra violet light upon cholesterol freed of ergosterol renders the cholesterol itself antirachitically effective in treating the bone weakness of chicks, a finding which is in accord with the report of Bills *et. al.* (21) in 1928.

It is well known that the administration to children of irradiated ergosterol meets with less clinical success than the older therapy of cod-liver oil unless the unit dosage of the former is greatly increased over that of the latter.

Thus, at the present time, it is an established fact, through laboratory and clinical evidence, that not all antirachitics are identical. Each has one efficiency for chicks and another for rats and perhaps a third for infants, but irrespective of the proposed use, any antirachitic is ordinarily evaluated in terms of rat therapy.

The reasons for the use of the white rat as a test animal are many and need not be detailed at this time. It should be sufficient that the method of assay of the United States Pharmacopeia and of the League of Nations Health Organization prescribe the use of the albino rat as a test animal. Repeated assays can be duplicated with some degree of consistency with rats. Different laboratories

are able, by employing rigorous precautions in the use of the rat, to derive comparable values from duplicate samples. Likewise, it is only too true that there are many pitfalls in the technic of the assay with rats into which the inexperienced may unwittingly fall. For determining the effectiveness of such substances for the cure of rickets in rats, the rat test is satisfactory, but unfortunately the problem faced by the medical profession is not the cure of rickets in rats, but the prevention of rickets in babies. The bio-assay with albino rats is the best tool we have for estimating comparative potencies of different batches of the same kind of material, but for comparing the effectiveness of different materials it often distorts the picture.

In the standard bio-assay, there is determined the weight of material under test which when fed to rachitic animals over eight days, will, by the tenth day, have produced a specified degree of healing. Such a determined weight of the substance under assay is said to contain one Steenbock Rat Unit of vitamin D. This is a quantity that can be measured. A different unit consists of one milligram of a standardized solution of irradiated ergosterol prepared at the National Institute for Medical Research in London, the International Unit of the Permanent Commission on Biological Standards of the League of Nations Health Organization. The weight of any antirachitic substance fed in the above manner which brings about a degree of healing equal to the healing from one milligram of the standard solution, or its equivalent, is said to possess one International unit. Beginning January 1, 1935, the U. S. P. Unit will equal the International Standard, and by custom such equivalence is recognized today. Since, however, the effect of one International unit cannot be exactly measured, while the Steenbock unit can be measured, it is customary to

feed enough unknown to develop a healing corresponding to the latter. This is substantially 2.7 International units.

Milk rated as having 160 units per quart has the equivalent of 160 Steenbock rat units or 432 International or U. S. P. units. The custom of rating milks for human consumption in terms of rat units is tolerated only because at present no better method of evaluation is known. A more reliable criterion for clinical units is urgently needed, and its lack is responsible for many misunderstandings regarding the relative values of vitamin D milks to the consumer.

From the point of view of the consumer, the value of such milks lies in the benefit that can be confidently expected from the consumption of a given reasonable quantity of vitamin D milk over that obtainable from normal cows' milk. In evaluating the published clinical evidence on the three kinds of vitamin D milk now readily available, such a basis has been adopted. The comparison is made between a pint of one kind and a pint of another. The unit value placed on each milk is of no moment, provided that for a given kind of milk the value, whatever its phraseology, is always the same, and provided that said unitage represents adequate human protective potency.

May we recite to you the trite, but truthful, saying that statistics can be made to prove anything. It is equally true that sweeping conclusions drawn from too few statistical observations are often erroneous conclusions.

With this preamble, the following analysis is offered of that part of the existing published data which applies to the evaluation of any of the three kinds of vitamin milks specified, excluding the interesting but not germane observations on other matters which some of these reports include.

In chronological order of date of publication, the first clinical test on the feeding of infants with vitamin D whole milk produced in this country is that of Hess, Lewis, McCleod and Thomas (1) in 1931. Selecting from this report all the material pertinent to this discussion, it is found that 19 out of 102 infants of one and one-quarter to six months of age at the start of the test, selected from baby clinics in New York, in the month of January had prescribed for them daily for approximately three months, an average of twenty-four ounces of milk from cows which had received a ration supplemented with irradiated yeast, (full strength yeast milk). Feeding was carried out in the homes of the patients under the supervision of one nurse for over 100 infants. In an eight hour day this nurse could have spent not over four and three-quarters minutes with each case if she took no time to travel between homes. Obviously the supervisor could not humanly know all about the entire diet of each case. Of the nineteen in the group, of whom three showed, at the outset, x-ray evidence of rickets, all are reported to have been free from this disease at the end of three months. The authors conclude that the results are clear cut; the yeast milk was found to prevent as well as to cure rickets.

With every wish to avoid captious criticism, and with the realization that this test represents an important beginning of a series of tests, which could properly be expected to improve in technic with experience, nevertheless, it must be confessed that the potency of the milk administered, expressed in any form of unitage imaginable, can only be estimated and not definitely known from any data available today.

The yeast milk was presumed to be of potency equivalent to 160 rat units per liter, which is substantially 151 rat units per quart. The fragmentary data on bio-assay findings consist of weights of butter fat fed to rats to

produce healing of varying degrees. Even if the butter fat content of the milks had not been omitted from the report one could not estimate with any degree of accuracy what these line-test findings mean. In a later paper, the same authors state that a bio-assay was not carried out on the identical milk fed in this, the first test (10). The irradiated yeast fed to the cows in this test is reported to have been for the group reviewed, 60,000 rat units per cow per day.

In 1934, Russell, Wilcox, Waddell, and Wilson (12) report that feeding 60,000 measured units of yeast per day to cows secured for them a milk of thirty-five units per quart potency. According to this finding, if the milk supplied to Dr. Hess was from cows fed actually 60,000 units in yeast, then the potency of this yeast milk was of the order of thirty-five units per quart. Likewise Russell and his collaborators found that 180,000 units in yeast per cow per day was necessary to give a milk of 156 units per quart average potency. If then the milk used by Dr. Hess was actually of 160 units per liter potency, the yeast fed must have been of three times its rated potency. While it is probably true that yeast in the early days was rated conservatively on a basis of "at least" so many units per pound, does it seem likely that the margin of safety adopted by the manufacturer was 300 per cent?

The questioning of the validity of the assumed potency of the milk of this test is supported by the yeast feeding schedule supplied to licensees under the Wisconsin Alumni Foundation in 1934 for producing milk of 160 units per quart potency from cows which give daily thirty-five pounds of milk. This schedule calls for 4.7 ounces per day of 70 D yeast, equivalent to approximately 124,000 rat units per day. Is it reasonable to suppose that in 1934 there is required twice the unitage of irradiated yeast that was needed in 1931 to produce milks of identical potency?

Under the conditions of this first clinical test, yeast milk of undetermined antirachitic potency, when fed in average quantities of twenty-four ounces per day, apparently cured three cases of roentgenologic rickets in three months, and was not followed by the appearance of rickets in the sixteen other cases.

The second clinical report is that of Wyman and Butler (2). Four cases of definite rickets under hospital care throughout, were each fed thirty-two ounces of yeast milk per day (in one case, forty ounces) for approximately five weeks. Each of the cases was observed prior to feeding until it was evident that no spontaneous healing was under way. Blood calcium and phosphorus determinations are given. In one case the milk was boiled. The authors report that on the yeast milk administered at thirty-two or forty ounces per day to infants or children with definite rickets, there was in two weeks' time definite evidence of healing which progressed throughout the test.

The milk used was not subjected to bio-assay. From original data supplied to us by the Walker-Gordon Company in one of whose herds this milk was produced, we calculate that "at least" 59,328 rat units per cow per day were fed in the yeast, placing the potency of this milk presumptively on a parity with that used by Hess in the paper previously reviewed.

In August 1932 there appeared the third report on the clinical use of vitamin D milk, this time irradiated milk, by Hess and Lewis (3). Out of 100 cases, the clinical findings and final roentgenogram interpretations are tabulated for thirty-six infants showing no initial evidence of rickets and fourteen others who showed roentgenographic rickets at the start. The cases were of the same age group and from similar clinics as in the first Hess report. One nurse supervised the home feedings of ninety-eight cases reported.

The report indicates that of the thirty-six non-rachitic infants thirty-five failed to develop rickets in three months with twenty-four to thirty-two ounces of irradiated milk per day; of the fourteen rachitic cases all are reported to have shown definite signs of healing in four to six weeks. One cannot be sure that such signs of healing would not have been detected earlier had the cases been under such close observation as those of Wyman and Butler, but the findings are presented as reported by the authors.

The irradiated milk was reported to be of fifty units per quart potency. The identical milk fed to the infants was not made the subject of bio-assay (loc. cit.), but based on our experience with various samples of irradiated milk on the market in 1934 this value is quite reasonable.

The authors state their belief that from this test and the one previously reported by them it is not possible to compare the efficacy of irradiated milk with that of yeast milk.

The next clinical test reported is that by Mitchell, Eiman, Whipple and Stokes (4). In our opinion, the report fails to present sufficient data from which to draw conclusions, and may be postponed for consideration until such time as the final findings are presented, which the authors state their intention to do at a later date.

The next paper of Hess and Lewis (10), reports a test planned to compare the relative efficiencies of irradiated and yeast milk in curing roentgenographically diagnosed rickets, the evidence of healing being additional x-ray examinations after a period of four weeks. Infants selected from clinics were fed at home under nurse supervision as in the previous test by these authors.

Of four infants fed twenty-four ounces per day irradiated milk of reported value fifty-six units per liter (fifty-three units per quart), three with marked rickets at the

outset showed marked healing in four weeks and the remaining one, with slight rickets at the start showed some healing in the same time.

Of five infants fed twenty-four ounces per day of yeast milk of reported value 120 units per liter (113.5 units per quart), three with initial diagnosis of moderate rickets showed definite to decided healing in four weeks; the other two with initial slight to moderate rickets showed some healing in the same time.

Of five infants fed twenty-four ounces per day of "eighty" units per liter yeast milk (75.6 units per quart), two with initial moderate rickets showed definite healing at four weeks; two with slight to moderate rickets showed some healing, in the same time, and the remaining infant with initial slight rickets showed healing at six weeks.

Six other infants receiving each only *sixteen* ounces per day of irradiated milk of the above potency (53 units per quart) did not do so well.

No data are presented in support of the reported unit values of the milks used. The authors describe conditions of irradiating milk calculated to produce fifty to sixty units per quart. In the text of the report they state that irradiated milk of this kind (used by them) "is rated at 56 units per quart" but in the table presented the value is given as fifty-six units per liter. In regard to the yeast milk they state that based on their experience in their last investigation they felt that 160 units were unnecessarily high and accordingly fed the cows an amount of yeast sufficient to yield about 120 units per quart. The amount of yeast selected is not stated. The authors further state that repeated assays proved that this milk varied from 110 to 120 units per quart and the weaker yeast milk seventy-five to eighty units. In view of the importance which has been attached to interpretations of these findings, it is a source of regret that the data in support of these reported bio-assay values are not available.

From the evidence presented it can be deduced that some healing of roentgenographic rickets came about in four weeks after feeding twenty-four ounces per day of irradiated milk of substantially 50-56 units per quart, and likewise after feeding twenty-four ounces per day of yeast milk reported to be of 75 or 80 units per quart.

The number of observations in this study is small and the conditions of feeding not sufficiently susceptible of rigid control to warrant a general comparsion of the relative benefits to be expected by the consumer of a given quantity of either kind of milk. Each was shown to be capable of benefit to a child subject to rickets.

The next report, that of Kramer and Gittelman (6) involved the use of yeast milk from the same herd as the low level yeast milk of Hess, 1933, reported as of eighty units per quart potency diluted with Grade A milk to give a mixture of fifty-five or of forty units calculated potency, compared with irradiated milk reported as of fifty-five units per quart, sometimes diluted with grade A milk to give a calculated potency of forty units. The number of cases is not large, but all were hospitalized throughout the test. All were observed for a preliminary period before treatment until evidence was conclusive that spontaneous healing was not present. Three cases of rickets on thirty-two ounces of forty unit yeast milk and two cases on the same amount of 40 unit irradiated milk were studied. Convincing evidence is reported of healing in each case in from two to four weeks, as shown by x-ray findings and serum Ca and P determinations.

The conclusion offered by the authors that rachitic infants showing a low serum calcium or phosphorus or a decrease in the level of both elements in the serum responded equally well to both types of milk when fed at either high or low level, seems to be well supported by the evidence presented.

In the spring of 1934 an investigation was inaugurated under Wyman (19) of the Infants' and Children's Hospital in Boston, designed to compare the actual effects of prescribing to alternate cases of definite rickets in infants, yeast milk and irradiated milk of equal rat unit potency, in the amounts called for by the ordinary pediatric procedures indicated for each case as it came along. The report of this work is in press and reference to it is made herewith by permission of Dr. Wyman.

Like the previous clinical tests of similar nature by the same author, the recently concluded test is marked by close attention to detail, and by data which are unusually complete.

The work met an unexpected handicap in the failure to locate a large number of cases of sufficiently clear cut definite rickets to make statistical evaluation of results possible.

Between January and April, six cases of clear cut rickets uncomplicated by other disease were hospitalized, and these were divided equally between the two kinds of milk, which had been planned to be of equal potency. Six bio-assays of each milk, with numerous parallel International Standard comparisons were made during the clinical test at the Biological Laboratories of the Massachusetts Institute of Technology. The yeast milk was definitely between sixty and sixty-five Steenbock rat units per quart; the irradiated milk remained at substantially fifty units per quart.

Each case at the outset was definitely high calcium-low phosphorus rickets diagnosed by x-ray, clinical findings, and blood chemistry evidence; each case was given twenty-six, twenty-eight, or thirty-two ounces of vitamin D milk per day and followed in hospital with frequent roentgenologic and blood tests and each case showed by the end of the fourth week, or earlier, definite evidence of healing from rickets irrespective of which

kind of milk was used. The products of serum CaxP show a *tendency* to rise more sharply on irradiated than on yeast milk. Whether this tendency is of significance is discussed in the forthcoming paper.

Apparently contemporaneously with the latest Wyman test is that of Gerstenberger, Krause, and Bethke (18) reported briefly at the Cleveland meeting in June 1934 of the Certified Milk Producers Association, a full report of which is now in press. The investigation was planned to study irradiated and yeast milk of the same potency when fed to hospitalized cases in amounts of twenty-four and sixteen ounces daily. The milks were produced at the Ohio Agricultural Experiment Station and furnished to the Department of Pediatrics of the University Hospitals, Cleveland.

According to the report of Bethke made at Cleveland, it is our understanding that fifty-five units per quart was the potency designed for each type of milk. Regulation line test bio-assays were further checked by feeding butter fats to rats in prophylactic dose. The tentative conclusions of Bethke in June were that the irradiated milk was slightly more highly fortified than the yeast milk in the ration of 6:4 but it is understood that further work has continued during the summer, the results of which are not yet available, to secure an accurate comparison of the rat unit potencies of these two milks.

It may be assumed, however, that the potencies of the two kinds if milk were as nearly identical in terms of rat units as in any clinical case to date, involving undiluted milk.

It is our understanding of Dr. Gerstenberger's verbal report that at each level each milk showed complete healing in terms of serum Ca and P in sixty-six to ninety days, and that either yeast milk or irradiated milk of substantially the antirachitic potency represented by fifty-five rat units per quart, when one pint per day is fed was

able to bring about slow but complete healing of rickets in infants. The actual statistical report is awaited with interest.

The literature on the efficacy of Zucker milk is less prolific. In April 1933, Barnes (7) published a note to the effect that fifteen rachitic infants had been given each twenty-four or thirty-two ounces of Zucker milk prepared to have a potency of 150 rat units per quart, and that all recovered promptly. No data were furnished pertaining to the test.

In the current year, Wilson (13) reports a study of thirty-three infants from two to thirteen weeks of age, fed in their homes under nurse supervision over a period of from three to six months with Zucker milk of potency calculated to equal 150 Steenbock units per quart. From seventeen to thirty-two ounces per infant per day were administered, the average intake being twenty-six ounces.

The author reports that more than half the cases observed developed some degree of rickets as determined by x-ray findings but without serum Ca and P determinations.

Also in 1934 there has appeared an article by Barnes (14) which reports that thirty-two normal infants were protected from November or December to the following April on one pint of Zucker milk daily, a reputed daily intake of fifty units. Six other infants, entering the same test under like conditions, but with initial rickets are reported to have healed gradually and definitely. A control group of twenty-five infants picked at random from clinics showed fourteen with active rickets in April.

The abstract form of the sole publication on this study precludes the inclusion of the data necessary to make possible an evaluation of the reported findings.

Thus the published evidence to date on the efficacy of whole milk containing Zucker concentrate is insufficient for comparing its record with that of the other two

Summary of Clinical Reports on Vitamin D Milks
To October 1934

Author	No. Cases R.	Non-R.	Type of Milk Amt. per day	Steenbock Units/qt.	Blood CaxP	Test Period	Reported Results
Hess, '31	3	16	24 oz. Yeast	35-151(?)	none	12 wks.	3 cured; 16 prevented.
Wyman '32	4	0	32 oz. Yeast	35-151(?)	28-66	5 wks.	4 def. healing 2 weeks.
Hess '32	14	36	24-32 oz. Irr.	50	none	12 wks.	14 healing; 33 prevented.
Hess '33	4	0	24 oz. Irrad.	53	none	4 wks.	4 healing.
	5	0	24 oz. Yeast	113.5	none	4 wks.	5 healing.
	5	0	24 oz. Yeast	75.6	none	4-6 wks.	4 healing 4 weeks; 1 healing 6 weeks
	6	0	16 oz. Irrad.	53	none	4 wks.	5 some healing; 1 question.
Kramer '33	3	0	32 oz. Yeast	40	34-55	4 wks.	3 adv. healing.
	2	0	32 oz. Irrad.	40	31-59	6 wks.	2 adv. healing 4 weeks.
	2	0	32 oz. Yeast	55	28-58	6 wks.	2 adv. healing 4 weeks.
	3	0	32 oz. Irrad.	55	27-57	8 wks.	2 adv. healing 3 weeks; 1 in 8 weeks.
Barnes '33	15	0	24-32 oz. Zuck.	150	none	?	15 "recovered promptly."
Wilson '34	0	33	26 oz. Zucker	150	none	3-6 mo.	½ developed some rickets.
Barnes '34	6	32	16 oz. Zucker	100	none	4 mo.	6 healed; 32 prevented.
		25?	none				
			? oz. regular	5(?)	none	4 mo.	14 developed rickets.
McBeath '34	16 mothers from 6 months pregnancy through six months lactation.		32 oz. Zuck.	160	none	12 mo.	6 inf. dev. rickets.
	26 mothers control group no vitamin milk, as above				none	12 mo.	23 inf. dev. rickets.

kinds specified. In view of the apparent conflict between Wilson's findings on the one hand, and the two papers by Barnes on the other, it is only fair to withhold judgment until further and convincing data are available.

Summary

In appraisal of the avaliable evidence concerning the value of vitamin D milks to the public, in respect to their antirachitic effect when fed to infants, it is our opinion that yeast milk and irradiated milk, as obtainable on the market today, have each been proved to be useful in curing and in preventing rickets when used in the amounts and in the manner usually indicated for milk in infant feeding: that the more carefully controlled experiments fail to show any distinct difference between the relative efficacies of the two types of milk mentioned, in terms of rat unit equivalent potencies; that evidence is still needed to determine the minimum antirachitic potency of milk in terms of rat units required to protect surely all infants against rickets; that it is not yet known with certainty what potencies are required to bring about in rachitic infants the most desirable rapidity of healing.

Before Zucker milk can be evaluated in terms comparable with the two other kinds of vitamin D milk discussed, more clinical data must be available. We are informed that such data are now before a committee of the American Medical Association, and the report of this committee is eagerly awaited.

Concerning the value of vitamin D milk to the *adult* human consumer, evidence is not conclusive. The relation established between vitamin D and bone development has suggested a similar relation in respect to teeth. Among the reports of work upon this subject, the recent papers of Mellanby (15), especially, attach a certain value to antirachitics in warding off dental caries, and

one may cautiously assume that such values of this sort as may exist ought to inhere in vitamin D milks. If such values do reside in antirachitics, then the antirachitic of milk should be in an especially favorable medium, since it is recognized by all that among the dietary factors of definite importance in the formation and retention of a sound dentition, calcium and phosphorus take high rank.

The effect of vitamins in the diet upon the incidence and severity of *common infections* has received attention and investigation. In a recent publication, Clausen (20) presents an excellent review of the published evidence in this regard. In respect to the relation of vitamin D to adult infections this author states, "It seems obvious that there is no good reason to expect that the resistance of non rachitic animals to infection can be increased by antirachitic agents; neither is there, from experimental work quoted, any very striking evidence for the general belief that lack of vitamin D predisposes to infection."

In the pregnant woman there exists an unusual need for calcium, phosphorus, and vitamin D because of the requirements of the developing embryo. For such a case, it appears to be of advantage to be able to obtain in vitamin D milk a supply of all of these factors. It is, however, not a matter of record how much vitamin D milk of any particular potency will be entirely adequate to supply all the special nutritional needs of pregnancy.

Likewise for the nursing mother, milk is an approved element of her diet, and the potency of her breast milk has been shown to vary with her intake of vitamin D. As demonstrated by Bunker, Harris and Eustis (8) "the antirachitic potency of human breast milk can be augmented in a simple and acceptable manner by including vitamin D milk in the diet of the mother."

Lewis (16) has very recently stated that "the administration of vitamin D milks to nursing mothers does not necessarily protect their infants against rickets; anti-

rachitic agents must be given directly to breast-fed infants to insure protection."

McBeath and McMahon (9) feel that they have shown a "definite reaction against rickets in the young by the use of yeast milk during pregnancy, lactation, and as a complemental feeding." In sixteen cases, mothers were furnished with one quart per day of 160 unit yeast milk from about the sixth month of pregnancy to the sixth month of lactation. The babies of this group showed less incidence of rickets than those of the control group without vitamin D milk, although the authors report that the majority of the latter (control) group received some cod-liver oil at various periods.

These results suggest to us the desirability of further clinical tests to determine whether the prenatal use of vitamin D milk confers a prenatal antirachitic benefit which will be to the advantage of the infant after its birth.

On the other side of the picture there remains unanswered the question of whether there are qualities in any type of vitamin D milk which in the long run may prove undesirable. There is to date insufficient evidence upon which to base a decision. Such evidence must be obtained in order to definitely dispose of this question conclusively. There are those, also, who look askance at what they term "a tendency of manufacturers to avail themselves of the publicity value of recent vitamin research by adding vitamins empirically to a variety of foods without due consideration of the results which may accrue from such haphazard practices." (5) In Denmark vitamins are regarded as drugs, to be administered under prescription by the physician. Their addition to milk is not permitted by law. (Balt. Health News, June 1934).

Vitamin D milk, proved to be useful in the diets of infants and their mothers, and not yet shown to produce undesirable effects by its use, has an apparent definite

useful value. What the most desirable antirachitic potency of such milks may be has not yet been proved. Whether or not there reside in such milks values to the normal adult not inherent in ordinary milk, only the future can tell.

If the full benefits from this recent addition to our food supply are to be realized, it appears that all health officials entrusted with any aspect of the conservation to the public of a wholesome milk supply must enlist in the service of informing both producer and consumer of the truth about vitamin D milk of definitely maintained standard of antirachitic potency. This is a duty to the public whom we serve.

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Discussion

Chairman Johns: Dr. Bunker, I feel sure that everybody in the audience feels exactly as I do and we are grateful indeed to you for the comprehensive survey of this very interesting subject. The discus-

sion will be opened by one of the real old-timers of the Association, Dr. J. H. Shrader of the National Dairy Products Corporation, Baltimore.

Dr. Shrader: I am put somewhat in the position of attempting to "paint the lily," when I try to discuss these excellent papers. Having had occasion to search the literature and to study this matter, I can appreciate something of the volume of the work that Dr. Bunker has done on this subject.

In any discussion of the relative effectiveness of any of the treatments to fortify milk with Vitamin D and compare it with the effectiveness of cod-liver oil, I feel that we should know more about the effectiveness of cod-liver oil itself. Those of you who attended the Milwaukee meeting of the American Medical Association must have seen that chart which was displayed, summarizing the results of a questionnaire sent to their members as to what is a therapeutic dose of cod-liver oil. That chart showed that it varied between a half teaspoonful to four teaspoonfuls. With all due appreciation of the lack of exactitude in biological and medical practice, I think it is stretching such tolerance unduly when recommendations of dosage range from one-half to four teaspoonfuls. I can not see how we can get anywhere by comparing these other products with such an indefinite standard.

With regard to the excellent discussion by Dr. Bunker of the mathematical difficulties concerning that first work of Dr. Hess, I might point out that the methods of manufacturing yeast in the last couple of years have been so greatly improved that its potency has been stepped up several times, so that the yeast now sold is somewhere between two and three times stronger than that produced at the time Dr. Hess made the study. Therefore, present standards cannot be used to interpret what might be thought to be fallacies in the earlier work. That earlier work had a lot of questionable aspects in it; I am not doubting that at all. But I mean comparing it from the standpoint of the amount of yeast which is recommended by the people who sell yeast—and I have no particular interest in that—with the earlier practice, this fact must be borne in mind, that the present yeast is much stronger than the old yeast. Furthermore, the recommendations of the present yeast sellers as to the quantity of yeast that must be fed to the cows must, necessarily, be accepted as merely general averages. We know that the quantities that they recommend do not necessarily have to be maintained in actual feeding practice to give the resultant potency, because it varies with the cow, the quantity of milk production, the amount of butter fat, and the time and method of feeding.

With regard to the criticism of the rat bioassay as a method for the evaluation of the potency of Vitamin D milks, and although we could say more against it than for it, I have been forced to recognize it as being in somewhat parallel case with the plate count in our milk control work. This method may be full of loopholes, but it is workable and

it is somewhat duplicative between the laboratories. One of the main difficulties in the situation, as it strikes me, is the way it is being set up now and practiced. The emphasis is to make it useful for the bioassay of Vitamin D pharmaceuticals, in contradistinction to the Vitamin D in milk. You see, Vitamin D milk carries a large amount of calcium and phosphorus itself, and this fact complicates the bioassay procedure.

So any laboratory that tries to be a little more precise than merely to apply the official method has to introduce features that are not in the official method, and of course that, as you know, brings trouble between one laboratory and another, to some extent.

The present method of that assay is changing somewhat from the earlier ones in this degree, that the earlier work was based upon a separation of the butter fat from milk.

With regard to what would seem to be the discrepancy between clinical findings and bioassays, this may exist more in appearance than in reality. The biochemists have gradually developed this method to a higher plane of accuracy, until it has reached a point where it does not have as many inaccuracies as the present clinical practice in rickets diagnosis and prognosis. It is difficult to get different pediatricians to interpret x-rays similarly. Therefore, we are using different indicators, and, obviously, it is extremely difficult to compare the clinical work by one set of workers with the work done by another set. They have not standardized their practice nearly as well as we chemists have standardized our own in this assay.

If I caught some of the points in Dr. Bunker's paper correctly, it seems to me that he holds, particularly in some of the later work, that there is a pretty strong indication that at least yeast Vitamin D milk and irradiated milk have about equal potencies, clinically, as determined by the rat assay, indicating that probably insofar as those two milks are concerned, the bioassay paralleled the human clinical findings.

I think that I observe in the whole situation a tendency to favor a higher level of Vitamin D potency in the milk. It is unfortunate that there has got into practice the standardization or fixation, if you can call it that, of different levels for the different methods of Vitamin D fortification of milk.

In closing, I wish to point out, that with all of the clinical work that has been done, we have not found a single case where the use of this milk has caused any harm. There have been over four hundred infants who have been the experimental animals in these cases, and, no matter what differences there are in conclusions as to the effectiveness of the various methods, the facts are that those differences are more in the nature of degree than of general fact. It does seem quite significant that in a new development of this kind, you do not find some people bursting into the literature and showing us that the idea is all wrong. Dr. Newman has made some statements which are in the other direction, but the facts are that when we read his reasons, they were based on the use of viosterol and have nothing to do with milk, as such. In

other words, there are difficulties that he forecasts may happen, and he attempts to illustrate them by using a situation concerning the use of viosterol, which is a standardized medical practice. So it seems to me that such attempt to weaken the use of Vitamin D milk does not seem quite consistent.

I do feel that we should be careful in exploiting Vitamin D milk. We should be sufficiently conservative so that we do not try to make too many broad claims that it will do too much, and thus stimulate an adverse reaction to what now seems to be a tendency for it to have a place in public consumption and in public health needs. I thank you.

Dr. Bunker: That is a hard question to answer. My feeling is this, that since Vitamin D milk has been proven to be of benefit to a large group of the population who otherwise would not receive, perhaps, equivalent benefit, until it has been shown that there is some "nigger in the woodpile" we do not know about I feel it is a thing to be encouraged. Whether or not some over-zealous manufacturers are tempted to stick other things in the milk, it seems to me that is something else. I do not see that we have any right to deprive a large section of the population of a possible benefit because there is a danger that we can not in the future regulate manufacturing practices. That is an off-hand opinion.

Mr. Ownbey: Will the cost of irradiated milk be prohibitive if we put it on a commercial basis as market milk? Also do you know, approximately, what the cost of irradiated milk is per quart?

Dr. Bunker: Is Mr. Harris here? I think he can answer that better than I.

Mr. Harris: I understand that irradiated milk costs less than a cent a quart above the usual price of milk. Yeast milk has cost two cents a quart more. Those prices may have changed lately.

Dr. Shrader: I should say that the average cost of irradiated milk is something under a half cent more, depending on volume sold, and yeast milk, I think, is somewhere in the neighborhood of a cent higher.

President Krueger: The luncheon is scheduled for twelve o'clock and we have yet to hold the business session, so I am going to call on Prof. Bunker to close the discussion.

Dr. Bunker: Mr. Chairman, I think it should be pointed out again that in evaluating the accuracy of these reports in terms of yeast feeding, a comparison was made of the actual units in yeast, not a calculation from the yeast milk. The present yeast milk of at least one hundred and sixty units per quart, in our experience, runs generally well over that. There is a safe margin there.

In regard to the unit test and its value in this work, I feel that in all of this work the chemical laboratories, in polishing up the unit test and ironing out discrepancies and making it less unreliable, are in the position of the amateur lens grinder who has a mirror to be used in a telescope and he polishes and uses the utmost art to make that surface as well finished as he can make it, and when it is all done he finds

that the calculation of the curve of that mirror is such that the best picture he can get is distorted. It is the best we have, but it is a very poor best.

I think that the point brought out by Dr. Shrader regarding the accessory factors in milk is a point well taken. There are accessory factors. For that reason, I omitted some papers which deal with reconstituted milk. I am not sure that the accessory factors in the reconstituted milk are the same as the factors in whole milk.

My general feeling about the whole situation is that we have something here which is useful. I have a communication, indirectly, from Dr. McCollum, which expresses the view that Vitamin D milk, proved to be of use, might well be regarded as a suitable food for the normal child and infant and that the special cases requiring therapy still ought to be in the hands of the pediatrician.

Chairman Johns: I am sure that we all thank Dr. Shrader for so ably opening the discussion on this subject, touching on so many of the important points in connection with it. The paper is now open for general discussion.

Dr. Tobey: I think it would be of interest to all of you to know of the most recent study of this subject, which came out a day or two ago, probably subsequent to the preparation of Prof. Bunker's paper. This is a study by Drake, Tisdale and Brown, three Toronto pediatricians, who had five hundred and twenty-nine Toronto infants in their test. They fed these babies with various types of antirachitics, including cod-liver oil, viosterol, and irradiated Vitamin D milk. They found that the same units of Vitamin D in cod-liver oil and viosterol were equally efficacious. They fed one hundred and forty-one Toronto infants, ranging in age from three weeks to eight months, with from twenty to forty ounces of irradiated Vitamin D milk. The children were largely of European and British descent. No infants, say the authors, developed marked rickets and they concluded, that in irradiated Vitamin D milk we have a valuable agent for the control of rickets. Of course, the expert flaw-pickers can pick a few flaws in this study, as they do in everything. The children were Nordics; they were not Italians or Negroes, who are particularly susceptible to rickets; and you can find some mathematical inconsistencies in the unitage reported for the milks, but these are trivial errors. I think that this study of the one hundred and forty-one infants on the irradiated Vitamin D milk is good and conclusive evidence of the value of this product. This investigation gives a total of some five hundred infants who have been subjected to beneficial experimentation with Vitamin D milk of various types. As I said last week in Syracuse at the New York State Association meeting, of three hundred and forty-two infants who have been on irradiated milk, only three have failed to be protected, which is less than one per cent, and an excellent indication of the practical value of this form of anti-rachitic.

In addition to the various clinical tests outlined so ably by Prof. Bunker, there have been numerous bio-chemical assays on the irradiation of milk. It is necessary, for example, to know the proper thickness of the film of milk, its rate of flow, the distance from the milk at which the lamp is placed, and many other factors, such as the time of exposure, etc. All of those have been worked out very carefully and I think certainly approach standardization.

Health officials can, therefore, be assured of specifications which will practically guarantee that these milks will be potent for the purposes used. Irradiated milk is, of course, further subject to check by meters of various kinds, such as the ultra-violet ray meter, recently developed by the Westinghouse Company, which shows the potency of the ultra-violet light employed. It should also be pointed out that Vitamin D milk is a prophylactic and a food, and not a medicine. In it we have a practical method, which offers valuable nutritional results, and is, I believe, worth promotion as a proven product of great significance to the public health. The *Canadian Medical Association Journal* for October, 1934, page 368, bears out these rather sketchy statements.

Dr. Brooks: I have been interested in this matter for quite some time now, looking at it not as a scientist—because I am not a scientist—but as a public health official concerned particularly with the question as to what degree of regulation, if any, is necessary and desirable from a public health standpoint. It seems to me that this discussion today is particularly valuable in bringing out and emphasizing how much we do not know about Vitamin D milk yet, and it seems to justify the position we are taking back home that we do not know enough about it yet to attempt to regulate it intelligently. It seems to me fairly obvious that there is no possible danger—that is, physical danger—in the use of Vitamin D milk and there is certainly some evidence of value, at least for children. It seems to me from the administrative standpoint that the only serious question at the moment is as to whether the consumers are getting what they are paying for. But it seems to me that the problem is not serious enough at the moment to warrant our jumping in with premature and half-baked regulations.

Dr. Frandsen: I am wondering if there is not another side that should have a little more attention here. We think of milk as an ideal food and, naturally, we want it so. I just want to ask Dr. Bunker if he thinks this opens the gateway for other Vitamin C milk and Vitamin E milk, iodinized milk, maybe magnesium milk and things of that kind.

MILK SANITATION IN EUROPEAN COUNTRIES

ROBERT S. BREED, PH.D.
New York Agricultural Experiment Station, Geneva, New York

MILK sanitation in European countries is in a process of rapid development, especially in Great Britain and in Italy. The changes that are taking place in these two countries parallel the changes that began in North American countries about 1900. While cleanly methods of production and holding pasteurization at approximately 143° F. for 30 minutes were not introduced as early as in the United States and Canada, the improvement in milk sanitation in recent years in the two European countries named is truly remarkable. In Germany and other continental countries, there has been less development of pasteurization by the holding process and such pasteurization as is used is ordinarily by the flash process at a temperature of 170-175° F. The lack of a cream line and cooked flavors is not regarded as important. Veterinary inspection of cattle and inspection of stables have played a more important part in the development of farm sanitation than have laboratory methods of control. Few of the continental countries have used bacterial count standards for grading either raw or pasteurized milk.

The almost universal custom on the Continent is to bring milk to a boiling temperature immediately after its receipt in the home. In countries like France, Switzerland and Italy, there is extensive use of hot milk with coffee, the coffee and hot milk being mixed approximately half and half. Children are taught to drink hot milk. It is a rare thing to see an adult in any of the continental countries drinking a glass of milk with a meal, or, in fact, at any time.

A few pictures chosen from a large collection taken in travels through European countries will illustrate some pertinent facts. The picture (Fig. 1) of the "donkey boy"

Figure 1

The term "donkey boy" is applied indiscriminately to the men, women and children who deliver the milk to this butter factory at Tipperary, Irish Free State.

at Tipperary in the Irish Free State was taken in 1928 when a party of delegates from the World's Dairy Congress in London visited Ireland. This shows the large milk churn used throughout Great Britain and Ireland. The milk was being delivered to a modern, well-equipped butter factory, the butter being exported to the London market.

I have time to mention but one other interesting dairy plant in Ireland and that is the cooperative dairy plant which supplies Belfast with a large part of its fluid milk. This is also a modern, well-equipped pasteurizing and bottling plant, the machinery having been supplied by an American dairy equipment company. Milk was pasteurized by the holding process and its quality was being controlled by laboratory methods similar to those in use in the United States and Canada.

The London milk supply includes certified and Grade A raw milk and milk pasteurized by the holding process. This milk is delivered by men who push small milk carts through the streets or sold through dairy stores. While a large amount of the milk is bottled, I found that in the stores in the region of my hotel in London, the dairy maid reached under the counter for an empty milk bottle

Figure 2

The milking short horns found in the London area are usually roan, or red and white in color. Dairy Research Institute Herd, Reading, England.

which was then filled by dipping from a can or rather churn of pasteurized milk when a request was made for bottled pasteurized milk. The only milk in these stores that had been bottled at the place of origin was Grade A raw milk.

Two pictures are given which illustrate conditions at the Dairy Research Institute in Reading, England. These were taken in 1923 just at the time when the new dairy stable was being built. The herd of milking short horns (Fig. 2) maintained at this Institute is a high class dairy herd of the sort that supplies the greater part of the London milk market with milk testing 3.7-4.0 per cent

fat. Black and white cattle from across the Channel are also being used to some extent while Jersey and Guernsey cattle from the Channel Islands are popular breeds for the production of rich milk.

Figure 3
High Class raw milk was produced with simple but clean equipment in this old, thatched-roof stable at the Reading Institute.

The late Dr. Stenhouse Williams, Director of the Institute, was very much interested in the fact that he found it comparatively simple to produce high grade, low count raw milk in the old thatched stable (Fig. 3) which had been used for many years on this estate, *provided* the cattle and the stable were kept clean, and milking was done in a cleanly manner in sterilized utensils.

We pass across the Channel to France, and stop a brief time in this country to note the developments that are taking place. In and about Paris, an effort has been made to develop high class raw milk but the greater part of the milk that reaches the Paris market is not produced

or transported under conditions that would be regarded as satisfactory in the regions about the larger American cities. Delegates to the Dairy Congress in 1928 were told that a very large amount of milk brought into the dairy stores in Paris during the summer months can not be used as fluid milk because it sours and curdles before it reaches the consumer.

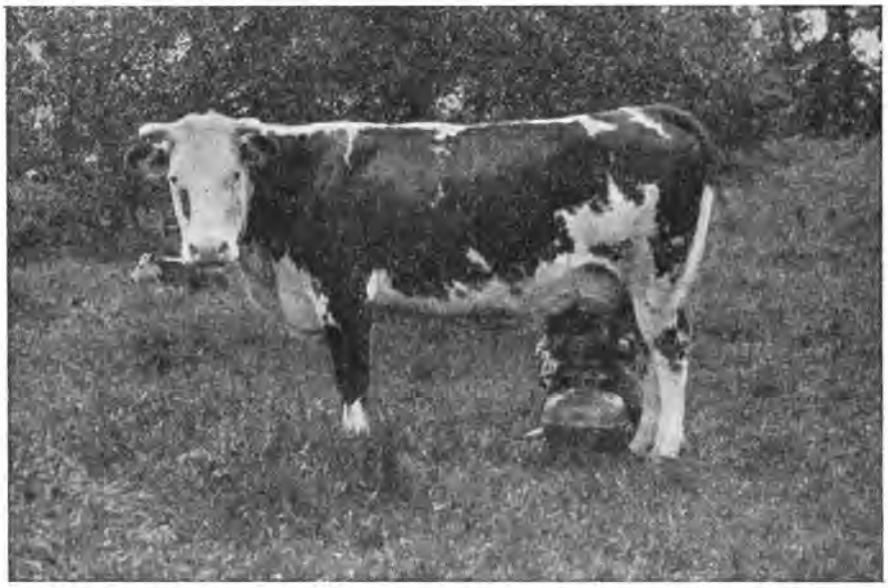

Figure 4

The milk of this Norman cow was being used for butter for the London market. Camembert and other famous French cheeses are also manufactured throughout Normandy.

Figure 4 has interest because the animal is a cow of the Norman breed which is dark brindle red and white. Animals of this type produce a fairly rich milk and they are found throughout Normandy. The larger part of the Paris supply comes from animals of this and closely related native breeds. Brass utensils of all kinds are found in Normandy homes. It was surprising, however, to find that the milk pail in use at this place was of a small top variety. Pails of this sort have probably been

used in this area since the time of William the Conqueror. Apparently the relation of copper to oxidized flavors has not yet reached the ears of the dairymaid milking this cow.

Boiling of milk before use in the home is such a universal custom in Switzerland that there has been little development of modern pasteurizing plants. As in many continental countries, a large part of the milk that is produced is used as cheese, large quantities of cheese being exported.

Certainly the most interesting of the recent developments in milk sanitation in European countries have occurred in Italy. Soon after the World War, the city of Milan subsidized the ownership and management of a large herd of cattle, the milk being handled in a modern municipally owned milk plant. This undertaking, however, was not successful because high quality milk was not appreciated, poor quality milk being sold throughout the city at a lower price. The municipal herd was sold after a short time and the plant was operated as a pasteurizing plant, milk being purchased from several high class dairies. This plan of operation was first developed into the new plan of "Milk Centrals" at Naples and Milan.

The Naples plant was erected under the guidance of the Fascist Government seven years ago and similar modern pasteurizing plants are now to be found in twenty-three Italian cities, e.g., Rome, Milan, Florence, Venice, Palermo, etc. The installation of the Neapolitan plant did away with the picturesque delivery of milk, followed for centuries in this area and carried out by driving cattle and goats through the streets. Even now the tourist finds it difficult to believe that all of the milk used in Naples is taken to the central pasteurizing plant, pasteurized in American-made machinery by the holding process, bottled in liter bottles and capped with aluminum caps; and that the quality of the milk is maintained

by means of dairy inspection and laboratory examination. However, these facts are easily verified by a visit to this modern plant in operation in this city.

Tourists who have not seen the marvelous changes that have taken and are taking place in Naples through the maintenance of clean streets and the tearing down of old tenements should be prepared for a great change the next time they visit that city. Similar changes will be noted throughout Italy.

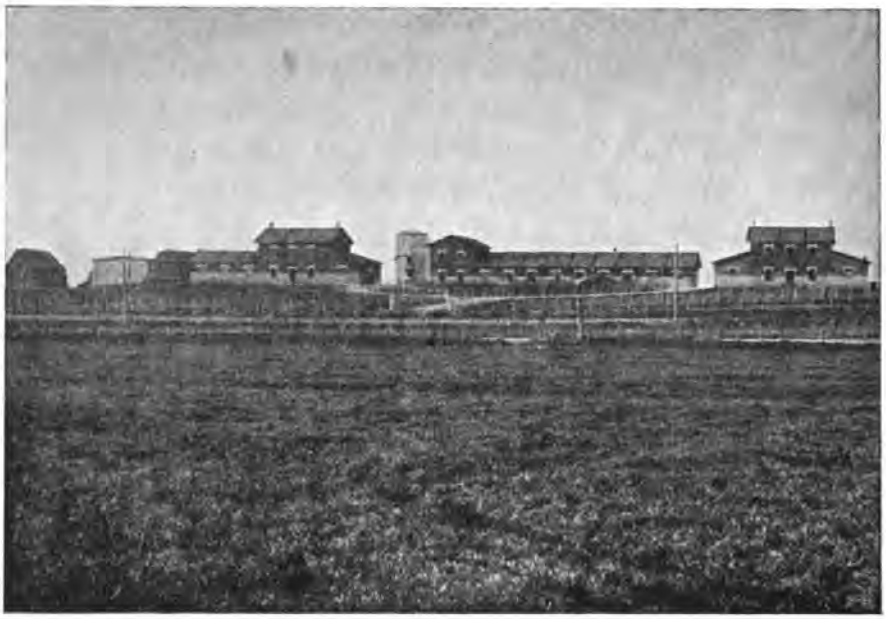

Figure 5

These modern dairy buildings are found on one of the fine dairies established on the Maccarese drainage project, near Rome, Italy.

One of the finest of the Milk Centrals is the one opened in Rome about three years ago. This handles approximately 130,000 liters of milk daily for a city with a population of 1,008,033 persons as given in the latest census. The milk comes from dairies whose sanitary equipment and cleanly conditions compare favorably with those found in the dairies about any of the larger cities of the world.

About one-fifth of the supply comes from the newly drained area north of the mouth of the Tiber River known as the Maccarese project. Large farms under co-operative management have been developed in this area. In 1934, there were 681 of these farms with an average of forty-five animals and a maximum of 2,500 per herd. As shown in the picture (Fig. 5) these stables are of the best, modern, well-ventilated and well-lighted types and are kept clean under the supervision of an effective dairy inspection service. The dairy animals are usually of the Brown Swiss type, although many Holland cattle have been imported recently. Some milk comes from the smaller model farm holdings that have been developed in the drained areas of the Pontine marshes, south of the mouth of the Tiber; and many other very fine dairy farms are found in the Tiber Valley north of Rome. High class "certified" raw milk is delivered in Rome in small quantity from a farm in the Maccarese area.

Pasteurization is carried out in the Rome Milk Central by the holding process, the milk being preheated in an A.P.V. (York plate type) preheater and is held for thirty minutes in vacuum tanks. The laboratory control is well developed and effective. Milk sells in Rome at a price of about 11 cents per liter, and is put out in aluminum-capped, liter bottles. It reaches the householder largely through small dairy stores.

It is hard to realize the changes that have taken place in Italy since dairy inspection services have been started and these Milk Centrals have been installed. One result has been to increase the consumption of milk. Even yet, however, the householder normally follows the old custom and brings the milk to a boil before it is used.

The problem of the dissemination of undulant, or so-called Malta fever through the use of cows' and goats' milk is well recognized in Italy. Some cases of this disease do occur in persons using unheated milk, but they

are not common. No European country has yet found it possible to undertake the systematic eradication of bovine tuberculosis on the scale now being carried out in the United States so that heating of milk before use is also necessary to protect users against infection from tuberculous cattle.

Primitive dairy conditions are met with in the countries of the Near East although it was interesting to find the Agricultural College in Athens, Greece, putting out a

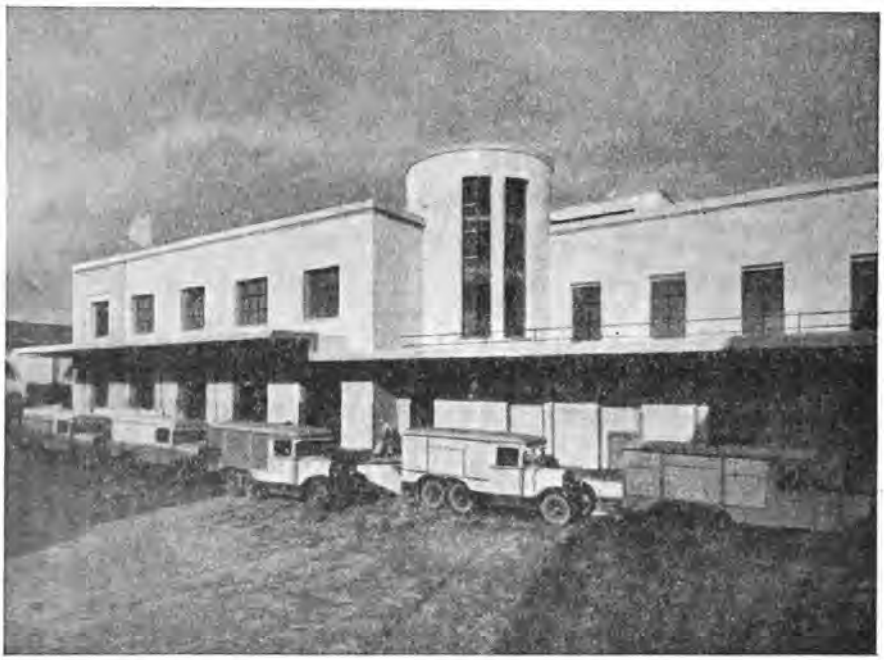

Figure 6
The exterior of the new "Milk Central" in Rome, Italy, showing trucks used for delivery of bottled, pasteurized milk to stores.

bottled cows' milk. There is, however, a much greater use of goats' milk in this rugged, rocky country than of cows' milk. Sheep milk is also used extensively for cheese making both in southern Italy and in Greece. The water buffalo that finds such extensive use as a dairy animal in Egypt and India is also found in some of the coastal plains of southern Italy and in Macedonia in Greece.

A Strauss milk pasteurizing plant and health center is to be found in Jerusalem under the direction of Dr. I. J. Kligler, formerly of the Rockefeller Institute for Medical Research in New York City and now at the Hebrew University in Jerusalem. A limited number of really high class dairies are maintained by the Zionist group in Palestine under good dairy conditions. There is, moreover, extensive use of goats' milk in Palestine and Syria.

Throughout the warmer countries in the Near East, milk is frequently soured after being brought to a boiling temperature. This soured milk is known in the various languages of the Near East by different terms, such as "yahourti" in Greece and "leben" in Arabic speaking countries.

Improvements in milk sanitation are taking place rapidly in all of the European countries in the years since the World War. Development of high class milk supplies would be much more rapid if money could be obtained for financing these projects. Other cities than Milan such as Strassbourg in Alsace and Darmstadt and Stuttgart in Germany, have tried out municipal ownership of dairy herds. However, it is only in Italy that the Government has supervised the financing of milk centrals on an extensive scale, and it is in the latter country that there has been the greatest change in recent years.

REPORT OF COMMITTEE ON INTERSTATE SHIPMENT OF CREAM

AT THE Indianapolis meeting of the Association, last year, Mr. Strauch remarked that this Committee had hold of something that is full of dynamite, which may be interpreted to mean that the interstate shipment of cream involves several conflicting interests, and that it therefore imposes on the Committee the necessity of reporting without prejudice and with circumspection. Those of us brought up in the atmosphere of the New England town meeting will believe that free discussion is the natural and best way to reach a solution of the vexed problem. It is with the idea of stimulating the members to express their views that this report has been prepared. Except for certain statistical matter on sour cream it deals wholly with sweet cream.

Fundamentally, five factors have been of prime importance in developing this problem. They are first, that certain dairy regions can produce milk more cheaply than others; second, the development of quick, cheap, dependable transportation; third, the advance that has been made in refrigeration; fourth, the application of science to dairying and dairy manufactures; thus, the introduction of the hand separator, and of pasteurization of milk both have occurred within the memory of many of our members; and fifth, the enormously increased use of cream, especially in the large cities, for the family, at soda fountains, restaurants and hotels, and as ice cream.

Good, fresh, sweet cream of low acidity is a commodity that with proper care can be handled without much danger of spoilage; it is shipped as 40 per cent cream which has a serum solids content of about 4.6 per cent as compared with serum solids content of about 8.6 per cent for 4 per cent milk. The serum solids are food for

bacteria which break them down and induce the changes that make cream, milk and dairy products inedible or unsalable. So, the interstate trade in cream developed because there were good markets for the product which could be shipped with comparatively little loss from spoilage. Those to whom this business is a matter of concern are: the cream gatherer or shipper, the dairy farmer, the distributor, milk plants, health departments, and the public. Let us endeavor to get their several viewpoints of the question.

The Shipper

The shipping of cream probably began in a somewhat desultory way but ere long developed into established business conducted from favorable points. In the beginning, conditions were naturally crude; insanitary practices attended the production, handling and transit of the cream. The use of preservatives and neutralizers was not unknown, but with the growth and firm establishment of the industry abuses were corrected and improvements introduced until today the large well-organized and well-equipped shippers place clean, unsophisticated, good flavored cream, which does not require repasteurization, in distant markets that in many instances challenges comparison with locally produced cream. Those who have built up this business feel that it is legitimate, and that the very considerable investment they have in it should not be impaired by laws enacted in the several states, designed to protect local markets for their citizens. How far the states may go in this direction would seem to be a matter for the courts to decide. The shipper has to put up with multiple inspection. Inspectors from several cities, working under different codes, visit the same territory and give orders that are in part conflicting, thus producing confusion. Furthermore, the expenses of these inspections are often, perhaps usually, borne by the

shippers. It seems to some of them that federal inspection would solve the difficulties of the situation. Some shippers have even considered abandoning the shipped cream business and venturing into other dairy fields. No doubt they would hesitate long before actually doing so. However, this attitude definitely raises the question as to whether the states and cities are ready to forego the service the shippers have rendered.

The Dairy Farmer

The dairy farmer is undoubtedly the most vigorous protestor against permitting the interstate shipment of cream for the tendency of shipped cream is to undersell cream locally produced and so to depress prices. The dairyman regards his local market and state market as his own and he does not propose to have them invaded by outsiders. His argument is that he has been compelled by municipal and state health authorities to go to great expense to comply with their regulations and that having done so, it becomes the duty of the health officials to prevent the sale of milk from all sources where producers have not complied with the letter of the law under which he works. This attitude has compelled health departments to make extrastate inspections and has perhaps tended to make their inspectors captious in their criticisms. Also, the dairyman has demanded state legislation to protect his markets and naturally his cry has not been in vain.

It is only comparatively recently that the cream market has become of vital interest to the dairyman. The time was when his trade was almost wholly in milk, for he produced only a little cream for his more wealthy customers. It is true his cream business gradually grew, but since hard times came upon us he has had a surplus of milk which was best disposed of as cream. That brought him in competition with outsiders. So far, the

dairyman has been most successful in the bottled cream trade which is the most valuable part of the eastern cream market because of its stability.

The Distributor

The milk distributor or milk plant manager, in some states, got his cream supply almost wholly from extra-state sources, and as the art of handling cream was perfected, reached farther and farther for his supply, till cities on the Atlantic seaboard got large quantities of cream from interior states, such as Wisconsin, Michigan, Illinois, Indiana, Missouri and Tennessee. Good quality and good price were the governing factors in the trade. Of late, there has been a tendency to limit purchases of cream for the bottle trade, and for ice cream, to intrastate sources. Thus, in Baltimore ice cream is manufactured from locally inspected cream. In other cities, as for instance, Birmingham, Alabama; Jacksonville, Florida; Miami, Florida, and others, cream for the bottle trade at present comes almost wholly from local sources. Evidently, under present economic conditions there is a definite tendency to curtail the use of shipped cream in the eastern states.

In the manufacture of ice cream, enormous quantities of sweet cream are used. The demand for this cream fluctuates violently, for the consumption of ice cream is seasonal and even varies somewhat with daily weather conditions. So, it has been considered unwise to attempt to produce enough milk locally to supply the ice cream trade, for there would be recurring periods when the milk producer would find himself with a large quantity of surplus milk on his hands. In some markets where bottled cream must be locally produced, ice cream manufacturers are permitted to import sweetened sweet cream for manufacturing but they have come to feel that they must have

a supplementary supply of butterfat. This comes in the form of frozen cream or a very high grade of sweet butter It may be that the shippers of sweet cream will turn their attention to the latter product.

Control Officials

Control officials have but comparatively recently been interested in cream quality. Their funds and energy have been concentrated on the problem of procuring clean, safe milk for the citizenry. However, the cream question has been put upon them and they are much concerned about it. Let excerpts from your Committee's correspondence tell the story.

The following statement has been prepared, at the Committee's request by state health department officials in an eastern state which stands among the first three states in the union, in quantity of milk produced, and into which, in the past, large quantities of cream have been imported from the Middle West.

In beginning the sanitary control of milk and cream supplies, this department devoted attention first to milk as that product was more generally consumed than cream and was the principal food of infants. As our milk supplies improved, it became evident that something should be done about cream.

After cream was placed under the same supervision as was given milk, we were faced with a situation in which persons producing cream in compliance with our regulations had to sell cream in competition with that coming into the state and produced under conditions about which we had no first hand information. Our producers claimed that in order to comply with our regulations, they had been forced to spend considerable money in the improvement of their stables and milk houses, for equipment, cooling facilities and veterinary services.

We were forced to admit in all fairness that if we were justified in placing local cream supplies under supervision, we should see that cream brought into the state was produced under the same supervision and inspection as cream produced within the state.

Consequently in 1930 our sanitary code was revised to provide that no milk or cream shipped into the state could be sold or offered for

sale unless such milk or cream had been produced and handled in conformity to the requirements of the state code, had been subject to the same standards of supervision and inspection as was required for milk or cream produced within the state, and at the time of delivery conformed to the provisions of the code.

We have refused to accept certifications from agencies in other states which are interested principally in promoting sale of the products of that state but have agreed to accept certification of state health departments to the effect that cream is produced and handled in conformity to the requirements of our state sanitary code and has been subject to the same standards of supervision and inspection as required for cream produced within this state.

It was apparent that some distinction should be made between cream used for manufacturing, in which it was subjected to processing which would kill any disease organisms which might be present, and cream for table purposes where the consumer was interested in both safety and quality. Consequently in 1932 a chapter was added to the sanitary code defining manufacturing cream as cream which does not meet the requirements of the sanitary code and providing no restrictions as to its sale and use except (1) that it shall not be sold as "fluid" cream, (2) that it must be labeled "manufacturing cream," (3) that it be resold only under permit from the state department of health, and (4) that the dealer keep records of all purchases and sales and report to the state commissioner of health as required.

Under these regulations dealers have had no difficulty in securing from out-of-state sources all the manufacturing cream they have needed, and with careful supervision by the department there has been little diversion of manufacturing cream to use as "fluid" cream. Since it has not been possible to sell "uninspected" cream in the "fluid" or domestic cream market, there has been a decline in importation from distant sources.

A state official in another state regards laws designed to prohibit cream importations, except for manufacturing purposes, and only when so labeled, as an arbitrary restriction of a legitimate interstate trade, and believes such restriction should have come from Congress, or the Interstate Commerce Commission. He believes further, in free trade between the states based on health requirements, leaving economic restrictions to be taken care of by distance, seasonal variations and other similar factors.

An official in the health department of still another eastern state, says that the question of the interstate shipment of cream has not been considered from a public health standpoint but from an economic one. He said, too, that in his state cream of better quality is frequently received from Wisconsin and adjoining states than is supplied from some of the stations within a few miles of the ice cream plants. This official believes that the problem of interstate shipment of cream should be handled from the quality standpoint and that the economic questions involved should be dealt with by market bureaus in State Departments of Agriculture.

Another state officer in the course of conversation suggested that cream entering interstate trade should be federally inspected, in the manner that meat products are, by the Bureau of Animal Industry. This idea has been voiced by others. It would be a tremendous job properly to inspect all cream moving interstate, but no doubt the federal government would do it efficiently should it undertake the work. This same officer suggests that next year, in place of the committee on the Interstate Shipment of Cream, there be a committee appointed to draw up rules regulating the shipping of sweet cream interstate.

Last year the Committee reported on the daily average receipts of western cream in Metropolitan Boston. This year, that our members may know something of conditions during the last twelve months in the South, figures on the cream situation in Jacksonville, Florida; Miami, Florida, (by C. B. Matthews); and Birmingham, Alabama, (by L. C. Bulmer) are presented. Jacksonville got all of its bottled cream from local sources; it imported 109,000 gallons of 40 per cent cream from Tennessee and Indiana.

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The Double Unit Controller contains two thermometer controllers actuated simultaneously by both circulating water and outlet milk temperatures.

The Single Unit Controller is recommended (1) to control temperature of circulating water in (a) single stage heater, (b) two stage heater, (c) preheated. or (d) line to holder system; (2) to shut down milk pump automatically at predetermined low temperature limit; or (3) to control the temperature of the cold milk.

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Model 240M Recording Dairy Thermometer incorporates many improvements well designed to modern dairy requirements.

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Universal Dairy Chart 1992 has a range of 30 degrees F. to 220 degrees F., with one-sixteenth inch per degree graduations at 140 degrees F. to 145 degrees F.

This permits recording the temperatures of heating, holding, cooling and sterilizing on one chart. The system is so designed that a sterilizing record can be included within the limits of the scale without the pen going outside of the chart range. This feature offers an effective aid in determining whether sterilizing has been done.

Chart 1993 has a reversed scale. 130 degrees F. to 220 degrees F., with wide open readings between 130 degrees F. and 170 degrees F. It is used in connection with heating and holding, flash pasteurizing, heating of cream, buttermilk, and with ice cream mix.

Chart 3761 is suggested for cooling and storing temperature. It possesses unusually wide time areas in the cooling range. It records sterilization up to 220 degrees F.

INDUSTRIAL TYPE MERCURIAL THERMOMETERS

Insulated for working temperatures below 32 degrees F., these Industrial Mercurial Type Thermometers are free from frosting of glass. For protection against danger of temperature exceeding 220 degrees F., an expansion chamber is furnished if specified.

Cases are nickel plated. Bulbs and parts exposed to milk are tinned. Bulbs fit standard I. A. M. D. sleeve for vats, with sleeve lengths to fit standard or glass lined vats as specified.

In several ranges from—40 degrees F. to 220 degrees F.

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BRISTOL'S Handy Portable Thermometer, using small 4-inch chart, is just the thermometer for recording refrigerator, ice box, ice cream hardening, can or room temperatures.

A Brief Summary of Sweet Cream Supply of Miami, Florida, September 1, 1933 to August, 1934

During this period dairymen in the Miami area produced approximately 864,535 gallons of milk more than that necessary to supply the demand for fluid milk, milk in chocolate milk and milk in ice cream. Of this amount 196,503 gallons were churned and the remainder, 668,032 gallons were separated yielding 68,046 gallons of 40 per cent sweet cream. To supplement this local supply it was necessary to import 136,319 gallons of 40 per cent cream. These importations were divided as follows:

9,887 gallons Florida produced, 127,032 gallons out of state. Disposition of 40 per cent sweet cream as follows: 118,336 gallons for table use, 17,673 gallons churned, 44,566 gallons used in ice cream, 2,542 gallons exported.

For your further information to complete the picture, I am giving you these figures month by month on a following page. (See Table 1, page 184.)

Information and Data Pertaining to the Interstate Shipment of Cream Relative to the City of Birmingham, Alabama

There has been a considerable surplus of milk in the City of Birmingham for several years, due largely to the excessively low milk consumption per capita and in consequence it has not been found necessary to import from outside the state any cream for distribution as such.

Such cream as has been received through interstate shipment has been entirely used for either ice cream or butter making purposes. The volume involved is comparatively very low.

During the three summer months interstate shipment of cream received in this city for such purposes has amounted to, in terms of butterfat, 3,339 pounds butterfat in the form of sweet cream, and 3,315 pounds butterfat in the form of sour cream, all of the former being utilized for ice cream purposes and the latter for butter making purposes.

This volume of cream has been derived principally from Mississippi with a small volume also from Missouri.

The following shows in tabulated form the approximate volume of sweet and sour cream, in terms of butterfat, arriving in the City of Birmingham daily from the various cities designated in Mississippi and Missouri based on the average of the three summer months. It should be noted that this volume is approximately cut 50 per cent during the winter months.

Town	State	No. of Shippers	Total Pounds of Butter Fat Sweet Cream	Sour Cream
Blue Springs	Miss.	8		830.0
Corinth	Miss.	2		23.4
Heidelburg	Miss.	1		17.4
Hickory Flat	Miss.	1		36.0
Inka	Miss.	9		303.1
Kolola Springs	Miss.	1		67.4
Mantee	Miss.	1		59.5
Neshoba	Miss.	1		37.5
Nettleton	Miss.	4		192.0
New Albany	Miss.	1		73.6
Pachuta	Miss.	3		195.5
Paden	Miss.	4		144.0
Potts Camp	Miss.	15		697.8
Red Banks	Miss.	1		13.2
Serastopal	Miss.	2		56.8
Sherman	Miss.	3		217.8
Steens	Miss.	2		24.0
Tishmingo	Miss.	2		48.0
Vosburg	Miss.	4		167.3
Wonborn	Miss.	1		60.0
Total		66		3,264.1
Thayer	Mo.	1		51.0
West Plains	Mo.	1	3,339.0	
Total		2		
GRAND TOTAL		68	3,339.0	3,315.1

On the basis of the above interstate shipment the pounds of butterfat, namely, 3,315 pounds, utilized for butter making purposes in this city represents only 8 per cent of the total of 38,250 pounds of butterfat daily processed in this form; while the said pounds of butterfat utilized for ice cream making represents only 12 per cent of the total so utilized.

It may be of interest to note further, in comparison with these figures, that Birmingham imports approximately 70 per cent of its total butter supply from outside the state, from which fact it is evident that interstate shipment of cream would otherwise be greatly increased. In other words, Alabama, and particularly, the City of Birmingham, receives most of its interstate shipment of butterfat in the form of the finished product, namely butter.

As previously stated, there is a large overproduction of fluid milk in this territory since the sharp decrease in milk consumption is apparently such that dealers can not afford to utilize the surplus for butter making purposes and compete with out-of-state sources of supply. Much of the surplus, however, is manufactured into sweet cream by local milk dealers and sold to ice cream manufacturers.

While not in a position to speak for the State of Alabama as a whole at the present time, the writer was concerned in directing the Alabama Dairy Market Survey in 1930, at which period the City of Birmingham

Table 1

Miami, Fla.

1933	Gallons Milk Churned	Gallons Milk Separated	Gallons Cream from Separated	Gallons Florida 40 Per Cent Cream Imported	Gallons Out State 40 Per Cent Cream Imported	Gallons 40 Per Cent Used Table	Gallons 40 Per Cent Cream Churned	Gallons 40 Per Cent Cream Ice Cream	Gallons 40 Per Cent Exported
September	14,466	43,067	4,254	0	2,652	3,834	543	2,302	200
October	14,504	46,551	4,608	320	3,020	4,505	641	2,569	220
November	14,461	58,039	5,624	710	5,140	7,150	956	2,792	60
December	14,048	42,453	4,243	1,131	12,700	11,742	1,106	3,294	140
1934									
January	15,500	31,169	3,060	1,750	27,320	17,600	1,162	5,089	370
February	12,739	24,554	2,400	560	33,970	22,507	1,032	6,110	180
March	16,679	48,652	4,896	620	28,130	20,266	1,612	5,589	135
April	13,275	98,560	10,045	1,970	10,120	9,903	2,289	4,044	45
May	20,379	100,257	10,579	583	1,320	6,086	1,784	3,312	330
June	19,115	72,463*	7,513	460	1,980	5,415	2,471	3,848	492
July	20,907	56,477*	6,156	150	1,370	4,961	2,649	2,701	310
August	20,430	45,880*	4,710	1,633	1,310	4,367	1,428	2,916	60
Totals	196,503	668,122	68,088	9,887	129,032	118,336	17,673	44,566	2,542

* During the months of June, July and August, 44,222 gallons of milk were evaporated being withdrawn from what would ordinarily have been separated.

was practically the only center of population concerned in the interstate shipment of cream. Further information of the situation in this respect as it prevails at present may be obtained from the Alabama State Board of Health.

The Consumer

The cream using public is primarily interested in getting moderately priced cream and ice cream of good quality. Since he is not fighting for it, it is tacitly assumed that he will pay without undue grumbling.

H. N. Parker, *Chairman*

H. E. Bremer	John M. Scott
William H. Price	H. E. Erickson
Roy F. Leslie	L. C. Bulmer
Ralph E. Irwin	H. B. Switzer
C. S. Leete	L. R. Lang
Clyde Beardslee	C. L. Witham

Discussion

President Krueger: Dr. Parker has given us a very stimulating report on this much discussed matter of interstate shipments, and I particularly like the way in which he has attempted to present the points of view of the various interested parties. The paper is now open for discussion.

Mr. Frank: I think that this is one of the finest and most dispassionate reports on a problem which, as stated in the report, has much dynamite in it, that I have heard for some time. I have some convictions on the subject myself. I think that the problem of the interstate shipment of cream is very closely related to the problem of the standardization of milk ordinances. The same sort of thing exists. I do not see how any local or state health department can ever lend itself to exclusion of out-of-state cream or milk, except in the interests of public health. I am quite sure that ultimately it will be disclosed that the Constitution of the United States makes exclusion for economic reasons alone impossible, as a restraint of free interstate trade. Furthermore, it has long seemed to me that ultimately the consumer, the distributor and the producer will profit more by permitting the free flow of cream, limiting it only on the basis of public health requirements, than by attempting to set up so-called Chinese walls of any kind. The consumer is certainly interested in getting any of these products at as low a price as can be had consistent with satisfactory quality and a reasonable

profit. I think it would be found that most distributors would prefer to have as flexible a source for their products as possible and eventually even the producer would find that it would be to his benefit not to maintain such walls. If those walls are maintained, as I see it, what happens is an increase in nearby competition, because whenever such walls are set up the price of the product within those walls is maintained above a level which the average standard of living demands and as soon as that is done the producers of the product simply come inside the wall and begin producing. In the end nobody gets anywhere.

Now, as to the State paying for the cost of inspection, I do not think that is a serious problem. Many states have not the funds that will permit them to go far afield in making inspections. But, if the groups of industry located at distances are really very anxious to ship to the market, they should be willing to pay for the inspection. So I think that such states as would like to receive more distant cream or milk can simply insist that the distant producers pay for the entire cost of inspection. I know that this is dynamite, but I do not think any of us need to be scared of it. I think that the more frankly and openly we discuss this question the sooner we will reach a proper conclusion.

Dr. Brooks: When we talk about admitting or excluding cream back in our "neck of the woods" we are talking in terms of milk sheds, rather than New York State; that is, we accept milk or cream which is subject to New York City or other New York State municipal inspections. I agree, thoroughly, with Mr. Frank's view that there probably is a constitutional limitation which comes in here so far as exclusion on purely economic grounds is concerned. That is in our understanding and so far as we deal with the matter we deal with it only on the grounds of public health.

In our State whoever wants to sell fluid cream has to get, in each instance, a permit from the health officer of the municipality in which he wants to sell it. There is no such thing as a "blanket approval" or a "blanket exclusion" by the State Department of Health. We cooperate in various ways in this respect with the health officers. Two or three years ago we made a rather hasty but still fairly comprehensive survey of sources in the middle west from which cream had been coming to New York State. Our representatives found some shippers of cream that had excellent plants but where conditions at the farms would not meet our sanitary code requirements. This would not apply to all but our position has been that we should not be expected to go outside of our milk shed to make inspections unless we actually need the cream. Mr. Frank said that he thought we ought to favor a free flow of cream between the states. In New York State our producers claim that if there were an entirely free flow of cream, considering the fact that western cream—for some reason which I am unable to understand—is sold considerably more cheaply in New York State than cream produced within the State, there would not be a market for our own cream because people buying cream naturally will buy it where they can get it the

cheapest. The shippers who want to bring in cream are quite willing to do what Mr. Frank suggested and pay for inspections but we have felt that it would be poor policy to let them do it. We have taken the position that we would recommend to the health officers in our State accepting cream when the State Department of Health in the state from which it comes is willing to certify that they had made inspections and find that the conditions under which it is produced and handled conform to the requirements of our sanitary code for fluid cream. That seems like a reasonable position, but actually it does not help the shippers much. The state health departments usually do not make the inspections and are, apparently, not willing to certify. In the old days before we had our present requirements we used to get a great many so-called certificates of approval from health departments and departments of agriculture with the broad, general statement that the cream referred to met all reasonable sanitary requirements. We soon found out that that sort of a certificate was not worth anything at all.

Mr. Bowman: Inasmuch as you are meeting in Boston, perhaps some of you would like to know something about the cream here. I was very much interested in Dr. Parker's paper, also in the remarks made by Mr. Frank and Dr. Brooks. It seems to me that interstate shipment of distant cream is largely an economic proposition. When the prices are good they try to get into the eastern markets; when the prices are poor they go elsewhere. The producers of cream in New England, of course, object to shipment of western cream. They have tried to exclude it by a Legislative Act without success. We are trying, at the present time, to control this matter more or less by a questionnaire which we send to these creameries who apply for admission. After we receive the questionnaire we write to the state departments of health for a certificate of approval. Those certificates usually state that they comply with the Massachusetts requirements, but they always state that they comply with their own regulations. In the past we have had questionnaires returned which have been very satisfactory. These permits in Massachusetts are issued for cream for manufacturing purposes only but I should hate to guarantee that you had not had some of it in your coffee while you have been here. This may seem more or less like going through motions without practical results, but I will say that the cream that comes in here—the bulk of it—is of excellent quality and that it compares very favorably with nearby cream. New England is unable to provide sufficient cream, I would almost say, for the bottle trade. Of course, in the warmer weather, when the ice cream business is at its height, it is absolutely necessary to have cream from a distance. This matter of collecting expenses for the inspection of farms and creameries from the people who wish to ship in, I feel is most unsatisfactory and is the dynamite part of the situation. We have never tried to do that here.

Dr. Brooks: I had hoped to hear something from the folks from the middle western states who take the other point of view.

Mr. Beardslee: I would be expected, naturally, to take somewhat of a different attitude, perhaps, than a lot of the gentlemen here who are enforcement officers. I happen to be in charge of a division that produces a large amount of cream in the middle west, as well as in the east. But it is a funny thing; I do not believe that I differ so much from the fellows here when it comes to the standpoint of a health controlled product. I have made a statement two or three times and am rather proud of the fact that I have been able to make it and really mean it, that I believe that the boards of health of the states and cities, during the past twenty years, have been one of the most constructive factors in establishing safe, honest-to-goodness methods in milk production. I believe they have been of the greatest value to the industry because we could not have accomplished what we have accomplished over the years in giving the consumer a satisfactory product, without their cooperation. I have heard men who were in the cream business criticize efforts made to improve the quality of the milk going into cream, and the proper handling of the cream, when in fairness to the industry, the criticism should have been directed at the operator. I believe the consuming public is entitled to a safe, sanitary milk product supply, and I feel that any man in the milk or cream business who does not attempt to get it is a menace to the industry. The interstate shipments of cream are quite a problem right now. My Division has cream at a number of production points east of the Mississippi River and it has to go into some market. We are very strong for board of health inspection. We have had our troubles in getting these territories up to the point where we want them but we have pretty well accomplished it. We offer no apologies for our product. When we ask to come into some other market we welcome inspection from any source, whether it is state or municipal. I have always felt that when a market was well provided with local cream, at a fair price, supplies from the outside had no right to go into that market and break it down. But I do feel, equally, that when that market offers an opportunity for outside production every one should have an equal right to come in, provided they have a product that will satisfy the consumer and meet the health requirements.

Facing the problems of milk shed control today in various parts of the country I can only say that I believe we should be given a fair break; the farmer should be given a fair break, and the consumers should be given a fair break. We believe the future of the dairy industry is in giving the consumer high grade dairy products at reasonable costs.

There comes a time in most areas when there is a shortage. At present there is decreased consumption and in many cases increased production, but the time will come again when the market will have to be opened up. I believe the best interests of all can be served by a reasonable transfer of commodities between different sections of the country. For example: as one section buys dairy products it gives

another section the opportunity to purchase commodities from the section needing dairy products.

This is the first time I have talked before this gathering, and I do not know how you all feel about it, but I feel a lot will be accomplished by your organization. I can assure you full cooperation of myself and the organization which I represent.

Mr. Chumlea: I do not believe there is a whole lot more I can add. We are in the same situation out in Indiana. Our attitude has been that, although we are 800 miles from the market, we have some rights if we meet all the health requirements. But our situation has been that after we comply with these rules and regulations we come up against the milk control situation. This is something that we have not been able to iron out and get around.

Mr. Dotterrer: I do not believe I like the implication that those of us who have been called on lately are on the other side of the question. I think that is rather a left-handed compliment. Our company has shipped a lot of cream to the east for a number of years. I think that we have shipped a fairly satisfactory product. I agree with most of you that the question should be based on sanitary measures, rather than economics. I believe that men in public health work should see that the sanitary quality and safety of all their dairy products is unquestionable. Beyond that I do not know that they should go. Any region that wants to ship cream should, for its own good, refuse to ship cream that is not of good quality.

Dr. Shrader: I think I shall take the position Dr. Brooks takes of not being radically on either side. When I was in this kind of work down in Baltimore I found that I could not take any position on controlling interstate shipments that was based entirely upon the public health standpoint. I found that I had to recognize the economic standpoint and that the two are intermingled. I could not draw a sharp line of demarcation between them. Any health department regulations presumably are adopted to give the best reasonable protection that the situation affords, meaning that the health officer would be limited in the character of his regulations and the effectiveness of his enforcement by the physical means to enforce them. The appropriations given to the health officer is the measure of the public's willingness to pay for health measures.

The public has a right to expect that health measures be comprised within the enforceable limits of the regulatory facilities. To apply that specifically to cream, I felt that since the cream was to be pasteurized anyhow, the overwhelmingly preponderant factor of public health safety lay in that factor, and that the other factors that we are accustomed to think of in connection with the public health regulations such as the physical conditions on the farm, though desirable, are not nearly so necessary. Therefore, it was unreasonable and more or less indefensible for a health officer to exclude unconditionally a lot of cream from farms out west just because they did not have dairy houses, we shall

say, but produced as good a quality of cream, from the standpoint of effectiveness of pasteurization, as was produced nearby. I had begun to hear the local producers say that the exclusion of the western cream would warrant a higher price for this locally produced eastern cream—a number of dollars per can. I had to call them all together and tell them that the public would not stand for the local people charging all that differential, merely, because the cream is produced nearby, when the only difference was because the local man had dairy houses and the western people did not have them. I said that if you local men charged, we shall say, two dollars—I used that as an arbitrary figure—more per can than the western people are charging, then you are taking advantage of the local conditions and hiding under health department regulations to serve an economic end.

With regard to the suggestion of drawing up proposed interstate regulations for cream, I should like to call attention to the fact that an American Public Health Association Committee wrestled year after year with the question of drawing interstate requirements for milk. They finally drafted regulations which lie dormant and nobody ever looks at them.

Mr. Johns: There is one other aspect of the thing that strikes me. I am in a position to speak more or less impartially about the whole subject, and the point that strikes me is the possible effect upon all milk inspection work, where you have several inspectors with conflicting requirements covering the same farm. It seems to me that this is something that might well be considered by the members, with a view to getting together on the essential requirements that can be justified, from the standpoint of clean, sanitary milk and cream.

If there is no further discussion, perhaps Dr. Parker would like to say a word or two in conclusion.

Dr. Parker: I am very grateful to those who have contributed to the discussion of the paper. As I said in the beginning, it is only by free discussion that this matter will be clarified. With regard to the consumer, I had a paragraph in my report which I did not read, through an oversight:

> "He is absolutely unorganized, hardly takes cognizance of the question, and only protests when prices get unbearably high."

Theoretically, men like Dr. Brooks, Mr. Johns and myself and the rest of the inspectors are employees of the tax-paying public and we are in office to look after its welfare, but owing to the fact that the consumer is not organized, is not vocal, we do not hear everything he has to say. Consequently, the public, in my opinion, gets a short deal—not intentionally so but naturally so. Nobody protests and we assume that the consumer is satisfied. But I think it is up to health departments to see to it that prices of vital food products, of which milk is the outstanding example, are kept within reason. I do not feel that the producer always has this attitude. In our present condition families have curtailed the consumption of milk. Probably the condensed milk

business has profited considerably by the fact that milk dealers could not or did not bring their milk prices down within reach of the public purse. I know many well-to-do families that have cut down on their milk supply, or turned to canned milk. So we must consider the consuming public and we must so reorganize our businesses that we shall get within reach of the public purse. We must be very careful about supporting regulations and constructing barriers that will deprive the public of the vital necessities, because unorganized as the consumer is, when he rises he has an awful kick.

"When Writing Mention This Report"

REACTIONS FROM THE INDUSTRY

DAIRY AND ICE CREAM MACHINERY ASSOCIATION

LOOMIS BURRELL

AS REPRESENTATIVE of the Dairy and Ice Cream Machinery and Supplies Association, I am very happy to bring you its cordial greetings and to have this opportunity to speak to you gentlemen of the International Association of Dairy and Milk Inspectors.

I hope that this may mark the beginning of closer cooperation and better appreciation and understanding of each other's aims and problems. Both groups are working for the same general object—to supply the public and our families with better and safer dairy products. Both are convinced of the need of milk in the diet and we believe that the delivery of safe palatable products will result in increased consumption.

The manufacturers recognize the splendid educational work done by the milk inspectors and the remarkable progress that has been made in supplying better milk, cream, cheese, butter and ice cream which is largely due to the efforts of health authorities, and we value their approval of equipment which we manufacture.

In furthering the education of milk plant operators and the public in general, one of the essentials is that the milk inspectors who visit the plant should be agreed in the requirements, not only as to the equipment but also the way in which it is used.

In order to have the hearty cooperation of the operator he must feel that the rules stated by the inspector are reasonable and accomplish desired results.

While we recognize progress has been made, still there remain opportunities for further improvement.

I note in the program that on the first day there was a report of the committee on dairy and milk plant equipment. Investigations and reports of this kind seem to us very important.

As illustrations of varying requirements, I cite the following:

A certain health department requires that milk must be warmed before it is filtered, whereas most health departments permit the filtering of cold milk as well as warm.

One health department will not permit hot milk to be pumped from the pasteurizer holder to the top of the surface cooler, but requires that the plant be so arranged that the vat be located above the cooler and that the milk flow by gravity over the cooler.

I have received a letter from a milk plant operator located near the border line of one of our states in which he said that he had purchased a weigh can. The state in which the plant is located requires that the holes in the strainer shall not be *less* than ⅛″ in diameter. A municipality to which he wishes to ship some cream requires that the holes in the strainer shall be smaller than 1-16″ in diameter.

One health board requires that the milk pails that their patrons use must have the opening covered with cloth or cotton disc, the other requires that there shall be nothing over the opening of the pails. Also one insists that the farmers cool the milk promptly over a surface cooler, the other that the milk be cooled in the cans.

A letter has just come telling of a health department that requires that the covers of pasteurizer vats be insulated. In other states this is not necessary, providing the vat is equipped with the foam and air space heater to insure that the upper surface of the milk be kept to at least pasteurizing temperature.

These are only a few of the conflicting regulations that have been brought to my attention.

With such diverse requirements it is impossible for the dairy machinery manufacturer to settle on standards. It is an accepted fact that the lowest costs are achieved only when standard production can be maintained.

There is no doubt in our minds that the great majority of inspectors conscientiously endeavor to carry out the requirements of the Sanitary Law, but in some instances their interpretation may be unnecessarily strict, or in the

opinion of the plant operator goes beyond the requirements of the law.

Industrial manufacturing plants in New York State are examined by factory inspectors under the New York State Department of Labor. If the operator of the factory feels that the inspectors' requirements are unwarranted, he has the right to appeal to the chief inspector of the district. If his ruling agrees with the inspector, the factory operator may then appeal to a board constituted to hear such cases.

I am wondering whether some similar arrangement would be of value in the sanitary inspection of milk plants and whether it would make the proprietor feel that the inspector does not intend to be arbitrary and that his rulings may be reviewed. Are there not cases where the spirit of the law is fully met, yet some required detail is omitted?

In carrying out the campaign for increased consumption of milk, one important point that we must not overlook is the cost to the consumer. This cost is made up of many items, not only the price paid to the farmer for the raw milk, but also the cost of transportation, direct labor and the cost and depreciation of the milk handling equipment.

If because of unnecessary requirements the operator is put to additional expense, this ultimately raises the price of milk to the consumer and in a measure defeats the very thing that we are working for.

Mr. Leslie C. Frank and his associates in the United States Public Health Service have rendered the industry and public health departments great service in the exhaustive studies of milk handling equipment they have made. It is my hope that the time may soon come when requirements for equipment and methods of operation as stated in this milk code may be generally adopted as standard throughout the country.

Let us all do what we can to upbuild and strengthen the code of the United States Public Health Service, keeping it confined to essentials.

If the milk plant operator believes the requirements of the health officer reasonable, and he does not run into conflicting opinions of the different inspectors he is much more likely to cooperate enthusiastically.

It is our earnest hope that the good work that this association is doing may continue and that there may be decided progress toward standardization and simplification throughout the country.

REACTIONS FROM THE INDUSTRY

INTERNATIONAL ASSOCIATION OF MILK DEALERS

SHIRLEY W. WYNNE

MR. PRESIDENT and Members of the International Association of Dairy and Milk Inspectors, you have asked me to discuss frankly with you the milk industry's criticisms of official regulations and practices.

Let me first emphasize the fact that during recent years there has been rather close cooperation between the Industry and official departments having jurisdiction over the Industry and, I believe, there has been a growing confidence in the Industry, or at least the better element of the Industry, on the part of officials.

A frank discussion, therefore, of the complaints of the Industry may help us in arriving at a better mutual understanding of our problems.

BURDENSOME AND UNFAIR REGULATIONS

Regulations of the past, while they are not meant to be unnecessarily burdensome or unfair, do in their application discriminate against one group as compared with another; for example, the regulation of the New York City Health Department which required the date of pasteurization to be printed on the caps of all bottles of milk sold in the City of New York. The purpose is a proper one, intended for the protection of the consumer but, inasmuch as some milk was bottled at country plants and then shipped to the City, the date of pasteurization appearing on these bottles was a day earlier than on bottles of milk produced on the same day but pasteurized after it had been received in the City. The distributors of country milk were, therefore, placed at a disadvantage in selling their product.

As a specific example, milk produced, pasteurized and bottled in the country on Monday, bore the date of pasteurization as Monday, whereas, milk produced on the same day but shipped to the City and there pasteurized and bottled, would bear the date of pasteurization as Tuesday.

The country plants protested against this procedure which had been in force for many years. After several hearings conducted by the Board of Health, the regulation was changed so as to require the date beyond which the milk could not be sold to be stated on the cap. Even this procedure gives the city pasteurized milk an advantage over that pasteurized and bottled in the country, inasmuch as it may be sold a day later.

The second complaint that I should make for the Industry is the lack of technical and practical training of some inspectors.

In some industries today the employees holding even minor positions are schooled before being put to work. Our police officers of New York City, after they have passed qualifying examinations and have been appointed, are sent to a police school for a period of three months; but there is no schooling for newly appointed inspectors whose duties are far more complicated and technical than those of a police officer. This lack of training on the part of inspectors frequently puts the Industry to much trouble and expense.

An example, which comes to my mind at the moment, is that of an inspector who embargoed a plant because he claimed a sewage drain pipe running across the ceiling of the pasteurizing room was leaking sewage into the room. Upon investigation it was found that it was not the drain pipe but a cold water pipe, and that it was not leaking, but that the steam present in the room condensed on the

pipe and then dripped to the floor. Certainly an inspector should be able to differentiate between a soil pipe and a water pipe.

The third complaint that I should make is the lack of uniformity in the manner of making investigations.

The complaints which I most frequently received when I first took office were that no two inspectors agreed upon the specifications of a plant. One, for example, would require that a door be hung so that it opened outward, while the inspector who next visited the plant insisted it be hung so that it opened inward.

More serious differences of opinion frequently arose; for example, what constituted a satisfactory water supply or satisfactory sewage disposal system. We were able to overcome difficulties of this character by bringing in the inspectors for practical courses of instructions and by devising an inspection sheet which covered every item to be looked into at the time of an inspection.

Another complaint which I think the Industry is justified in making is, of officials who without knowing the facts or troubling to inquire into them, criticize the Industry. I refer particularly to the criticism, so frequently heard, of the cost of milk delivered to the home in comparison with the price the producer receives for all his milk. The facts are easily ascertained.

The large distributors of milk contract with their producers to take their entire output throughout the year. Approximately half of the total amount that is contracted for can be, and is sold, as fluid milk. The balance is converted into various manufactured products, such as cheese, butter, milk powder and evaporated milk, all of which must compete in the national market, and which, therefore, returns a low price to the distributor.

Of the half of the total supply which is sold as fluid, one quarter of the total supply is sold at wholesale to stores, restaurants, hotels and bakeries at 9¾ cents, and

the remaining quarter of the total supply is sold at retail at 13 cents.

When the prices for these various classifications of milk are averaged, the distributor receives between 7 cents and 8 cents a quart for the total amount of milk which he purchases, and out of this he pays the farmer between 3½ cents and 4 cents, so that the farmer receives approximately one-half and the distributor one-half. In other words, each receives approximately 50 cents out of every dollar which the consumer spends for milk.

Out of the distributor's 50 cents he pays labor 25 cents, leaving 25 cents to pay the cost of country plants, city plants, trucks, tank cars, delivery wagons, horses, delivery automobiles, upkeep and replacement of all equipment, taxes, insurance, advertising, selling and administration.

In short, when the true facts are elicited, the picture is decidedly a different one.

Furthermore, we, as health officials, know the service which the distributor renders both to the farmer and to the public in collecting, processing, transporting and delivering to the consumer.

There is another matter which I would bring to the attention of this group, not as a complaint, but rather as a suggestion.

Frequently, official bodies when passing new laws or regulations fail to give representatives of the Industry an opportunity to be heard. These bodies are interested in protecting the consumer, and their interest and experience are limited for the most part to the health aspects of the business. Because of lack of intimate knowledge of the Industry, the regulations passed are apt to be impractical or impossible of application.

Inasmuch as the Industry has, in recent years, cooperated wholeheartedly with health officials and, indeed, in most of the large organizations today the requirements of health departments are surpassed, it would seem

reasonable to give the Industry an opportunity to be heard before new regulations are promulgated.

From time to time we hear complaints from some producers against the stringent regulations promulgated by health departments. These complaints usually refer to pasteurizing, tuberculin testing and the embargoing of sources of supply. These criticisms are usually made by producers who have not a clear understanding of the importance of maintaining high standards for our milk supply. They believe that, if many of the regulations were rescinded, milk could be sold cheaper. It is quite possible, and indeed probable, that milk could be sold cheaper, but it would not be sold. Consumers would not buy it.

Experience in this country and, indeed, throughout the world, demonstrates that where the standards surrounding the sanitation of milk are low, there the consumption of milk is also low; where the standards are high, consumption is always greater.

For some time past there has been considerable discussion as to the advisability of continuing two grades of milk, and there seems to be a disposition to eliminate Grade "B" milk and to reduce the standards of Grade "A" milk to a level between the present standards of "A" milk and "B" milk. I personally believe this would be a serious mistake. If Grade "B" milk is to be abolished the present standards of "A" milk should be maintained and producers given reasonable opportunity to meet these standards. We have achieved success in promoting the consumption of milk by building consumer confidence in its safety and superiority. Let us not destroy that confidence by weakening our regulations.

Distributors have long recognized that the best method of increasing sales is by improving the quality of their product. Witness the advertising of certain brands of milk on the market which call attention to the high

butterfat content, greatly in excess of the requirements of the health department, the low bacterial count and the fact that the milk is produced by cattle that have been tuberculin tested.

The decrease in consumption which followed in the wake of the depression, accompanied by an increase in production, brought about a drastic drop in the price of milk with the result that several states passed control laws in an effort to protect the producer.

The health department official is interested in the price of milk because it is evident that if a satisfactory price can not be maintained, it will be more difficult for him to enforce his regulations and maintain the high standards which he desires. For that reason it is proper that we briefly review the history of the Milk Industry during the past several years.

History of the Last Ten Years

It will not be amiss at this time to review briefly the history of milk distribution in the City of New York during the past ten years. The population of the City of New York, up to a few years ago, had increased by leaps and bounds due to immigration from Europe, migration from other parts of this country and Canada and also because the city's birth rate was approximately twice its death rate.

This rapidly mounting population naturally increased the demand for all commodities. Additional impetus was given to the rising market by the increase of general prosperity and consequent enhancement of the consumers' purchasing power. As was to be expected, milk sales rose rapidly.

But, during this same period, many herds were permitted to dry up in the winter with the consequent shortage in the milk supply of the City each year. To offset this shrinkage of the milk supply during the winter

months distributors encouraged farmers who had hertofore produced milk only for manufacture to seek the approval of the Health Department to ship milk to the City. This necessary increase in the number of dairy farms in order to meet the needs of the City during the short period gave rise to enormous surpluses during the flush period.

The large dealers, however, protected their farmers by contracting to take their entire supply throughout the year, paying for it according to the classifications in which it was used; in other words, the blended price.

This gave the small dealer an opportunity to get into the milk business with a big advantage in his favor because he took care of no surplus milk but purchased at the blended price all the milk which he sold as fluid.

When the surplus of the flush period was striving for a market the "chiseler" purchased this "distressed" milk at still lower prices in order to engage in a price war for the purpose of taking customers from the ethical distributor. Indeed, in many instances they did not even pay for the milk which they received. It was possible, by means of this cheap milk and unpaid-for milk, to destroy the price structure of the City and this, of necessity, was reflected in lower prices to all farmers. In other words, the cheap and free milk which some farmers sent into the City of New York to these unscrupulous and unethical dealers was the means by which the Industry was destroyed both for the producer and for the distributor.

And then another factor became effective. The decrease in consumption resulting from the depression precipitated a further break in prices.

A few moments ago I spoke of the rapid increase in the population of the City of New York up until a comparatively few years ago. Within the last five years the population of the City has become almost stationary. The birth rate fell to 14½ per thousand for the first six

months of 1934. Immigration has ceased, emigration has increased as many foreigners thrown out of employment returned to their homelands before their savings became exhausted. Migration from other parts of this Continent has not only ceased but the tide is now running in the opposite direction. The persons who sought employment in the "Great City," when thrown out of employment, returned to their original homes.

The decrease in population, the lowered purchasing power and consequent decline in per capita consumption has decreased sales of fluid milk.

Had it been possible immediately to curtail production, prices might have held, or at least not have been subjected to the precipitate fall that occurred; but, in the face of a sharp and serious decline in consumption, production continued to increase.

The Control Law was enacted in an attempt to "peg" prices. At first it operated satisfactorily, both for the farmer and for the companies which had been taking care of surplus.

But, when those dealers who depended upon their ability to buy Class No. 1 milk at the blended price in order to remain in business found that advantage taken away from them, they sought methods of maintaining that advantage.

They sought supplies in states other than New York where the price which they paid for milk could not be fixed by the New York State Milk Control Board. Those dealers who went outside New York City not only regained their previous advantage but they also gained an advantage over the dealers who were still buying milk in New York State. Furthermore, by diverting their purchases from New York dairy farmers to those of other states, they were increasing the surplus milk in New York.

The law-abiding dealer, therefore, found himself in a position which soon became intolerable. He was steadily losing his trade to his competitors who were buying cheap milk. The New York dairy farmer was affected in two ways. He lost that part of his fluid market which was diverted to other states and, as those dealers who continued to pay Control Board prices were unable to compete in the market more and more of the milk which they purchased went into manufacture and consequently returned a lower blended price.

Therefore, it was not to be wondered at that, with such a community of interests, many farmers and dealers got together to devise some means by which they could circumvent the law in order to retain their markets. Through the organization of independent cooperatives and through brokers and by other means they shipped their milk to New York City at any price they could get for it.

The law, which was created primarily for the benefit of the farmer, has been invalidated by persons for whom it was created in an effort to save themselves from complete loss.

In other words, we have attempted by a man made law to suspend the operation of the law of supply and demand. In the emergency it accomplished its purpose but, as the surplus of milk increased like a tidal wave in the country the "Control Law dam" has been unable to prevent it from seeking its own level.

But, because the ethical dealer and ethical farmer have obeyed the law, they have been discriminated against by reason of their honesty whereas the unscrupulous dealer has taken advantage of the fact that the hands of his honest competitors have been tied and have stolen their business while they helplessly looked on.

In the past there has been misunderstanding between some producers and some distributors which has been

fanned into opposition and resentment from time to time by those who know nothing of the Industry and who are either too indifferent or who are unwilling to ascertain the facts, being satisfied to encourage bad feeling between the consumer, the producer and the distributor for the purpose of making capital for themselves.

The problems which face the Milk Industry today can not be solved except by the concerted action of both the producer and the distributor. I can not emphasize too strongly the fact that the interests of one are inseparable from the interests of the other because, if the distributor falls, the producer will be dragged down with him for the reason that, without an adequate system of distribution, the sales of milk will decline rapidly.

REACTIONS FROM THE INDUSTRY

INTERNATIONAL ASSOCIATION OF ICE CREAM MANUFACTURERS

ROBERT C. HIBBEN

THE MEMBERS of the International Association of Ice Cream Manufacturers extend greetings to the members of your Association. They appreciate the spirit of cooperation between these two international associations as manifest by your invitation for a representative of the ice cream group to appear on your program and enter into this round table discussion of ways and means of improving sanitary conditions in the ice cream industry.

This spirit of cooperation between these two organizations is of long standing and has resulted in an accomplishment of a constructive program that we know has been the means of raising the sanitary standards and enforcement in the industry to an appreciable extent. In 1929 we published the Suggested Sanitary Regulations for Ice Cream which was the result of two years work of the Sanitary Control Committees of both associations. In 1932 we published the Sanitation Manual for Ice Cream Plants which was the result of the work of our Research Committee. This Manual is a guide for ice cream manufacturers in the operation of their plants based on the requirements in the previous bulletin, No. 21 and including the ice cream plant appraisal form that has had wide use by both ice cream manufacturers and inspectors. In 1932 we published bulletin No. 41, The Suggested Ice Cream Law, as a result of the work of our Committee on Definitions and Standards. These three bulletins form the basis of a program in the ice cream

industry on which we can go forward in obtaining practical laws and regulations covering the definitions of the product and plant sanitation.

Both associations have appointed leaders in your profession and our industry on their various committees handling this work. Our own three committees referred to above are composed of men of outstanding ability, both in research work and practical plant management.

Before I proceed further I would like to give anyone here who is not familiar with Association I represent a brief picture of that group. I am here representing an association comprising over 80 per cent of the annual sales gallonage in the United States and a goodly portion of the gallonage in Canada, as well as manufacturers in several foreign countries. In this Association are the largest manufacturers in the United States, their gallonage running into millions. Working hand in hand with these large manufacturers in the Association are many of the smallest manufacturers in the country. An analysis of our membership shows that the member having the smallest annual sales gallonage is around 7,000 gallons. A further analysis of our membership shows that 74 per cent of the members are manufacturers selling less than 100,000 gallons a year and 46 per cent of our members have an annual sales gallonage of less than 50,000. It is indeed a happy family, the small manufacturer working side by side with the large manufacturer with the one purpose of improving the conditions in the ice cream industry.

Your invitation requested that I come prepared to give constructive criticism covering the different phases of the control of plant sanitation. Even though some of you may be working both with plant sanitation and defining standards, as the time is short, I will confine my remarks wholly to plant sanitation.

After we received your invitation I wrote to different members of the Association in every section of the United States and received replies from every one to whom I wrote. These letters were sent not only to large manufacturers but also small and medium-sized ones. In a considerable number of these answers there was a regret that, due to the depression, state and city budgets had been curtailed so that your work had been limited accordingly. It is the hope that as conditions improve in the country these appropriations will be extended so that you can adequately do the job. We wish to extend our cooperation to this end.

Permit me to quote from just a few of these letters which I believe will raise important points that both organizations should consider in furthering the cause that we are discussing:

Official Approval of Plant Equipment

An eastern ice cream manufacturer writes:

There is one point that I feel might well be brought to the attention of the inspectors at their annual meeting and that is the fact that it is almost impossible to get any Health Department to go definitely on record approving a particular type piece of equipment to be used in the plant or for that matter it is impossible to get a definite approval of anything. In other words, the various Health Departments, acting through their inspectors, approve of an operation or a piece of equipment only by their failure to disapprove of such an article or piece of equipment. To my mind this has a tendency to prevent more rapid development of new equipment, for it is only natural for a company to hesitate in the expenditure for development of machinery as long as they cannot get a definite approval from the particular Health Department operating in their territory.

To illustrate more clearly, I have had occasion to confer with the Department of Health as to a new type of belt we were planning to use on a conveyor. Before purchasing this belt, I naturally went to them to see whether or not they would approve the use of same. I was informed that they never approved anything, that if we cared to go ahead and buy the belt and put it in operation, they would then inspect it and would let us know if it did not meet with their approval. In other words, we had to go ahead and make a considerable expenditure of money with a very definite possibility of having this expenditure

completely wasted by an unfavorable decision rendered by one of the inspectors. If the Departments and their inspectors were willing to work with the various manufacturers and go on definite record as approving various pieces of equipment or methods, after naturally having made a thorough investigation of the particular piece of equipment or method, I feel quite definitely that more rapid strides would be made in the ice cream industry.

We are sure that the manufacturers of equipment would welcome the suggestion brought forth by this member. The organization of these groups, represented here today by Mr. Burrell, namely the Dairy and Ice Cream Machinery and Supplies Association, has long felt this need and its members will cooperate with this group to carry forward such a program.

Inspection of Raw Products

From a Pacific coast manufacturer:

Our most expensive and bewildering trouble is in over-lapping of control and oftentimes in the lack of placed responsibility. To illustrate, one city has an ordinance that allows for only one grade of cream to come into the city, and all of this cream must be inspected at its source by the city inspection department. In addition to this, we have our country officials, since the city does not cover the entire country, who likewise oftentimes inspect a portion of the same cream at its source, and in addition we may have other inspection.

To this is added the complications of a product being shipped by a medium-sized concern to two or three cities, and in some instances the officials from all the cities must inspect all the cream at its source. As a result, we have dairymen and country plants which may have to have seven different inspections in order to carry on their usual business.

A system of accredited inspectors with uniform inspection methods would put the entire health and inspection departments in good standing with the industry. Every inspector seems to have a different requirement, and as a net result the farmers and the plant are confronted with the necessity of doing a lot of things that in many instances are obviously not necessary.

The difficulties this Pacific coast manufacturer refers to are the result of the program started first by different states and then by the cities in those states, resulting in a network of farm and raw product inspection which has

in some cases become considerably confused. We regret that some of these laws and regulations were passed to establish artificial barriers around the products from other localities. This is certainly unAmerican. There should be no restriction of the flow of interstate commerce in this country. The product of one state should not be prohibited from going into the product of another state. Such barriers eventually lead to uneconomic conditions harmful to farmer, manufacturer and the public. We believe adequate inspection of the raw product is necessary for the producing of a quality product; at the same time we believe there should be serious consideration taken in this organization for an adequate system of such inspection which will not be a burden on the farmer, distributor or manufacturer.

Plant Sanitation

From a midwest manufacturer:

> The greatest inconsistency in sanitary control we find is purchase and handling of "mix." This is a real hazard and is not tolerated in the fluid milk business.
>
> The same hazard exists with much of the equipment sold in small units as no sanitary arrangements are included and seldom added.
>
> Ample facilities for sanitation have been enforced upon wholesale manufacturers and should be insisted upon for all. The menace to the public is the same from either source.

This midwest manufacturer brings out two very important points: first, that conditions are tolerated in the ice cream industry in the method of handling "mix" that would not be tolerated in the fluid milk industry; and, second, that conditions are sometimes enforced upon wholesale manufacturers that are not enforced upon the retail group. The wholesale manufacturing industry has no quarrel with the legitimate retail manufacturers. They are our friends and are cooperating with us in obtaining suitable sanitary regulations. At the same time there is an element among this group that we find fight-

ing both you and the ice cream industry in obtaining suitable regulations.

An epidemic may start in any establishment regardless of size if not properly equipped for adequate cleansing and sterilization and rigid methods followed and you, as protectors of the public against such epidemics, are aware of this. There are many outstanding examples of what our midwest member refers to. Permit me to cite only two: In a midwest state which has adequate sanitary regulations, I visited one of our members and found that he was required to follow such regulations which he was faithfully carrying out. Within two blocks of his plant was an establishment where the freezer was in the sales-room. The place of manufacture not equipped with screens was within ten feet of a dusty road. The only washing facilities was a cold water tap in the back of the building some forty feet from the freezer.

The second example is in an eastern city where the ice cream manufacturers are under very adequate city sanitary regulations. At the State Fair within the city corporate limits freezers in booths were permitted to be operated, one within twenty feet of the cattle exhibits with absolutely no protection from the dust caused by thousands of people surging by or from that stirred up by over one hundred head of cows, sheep and hogs in the exhibit. In the same state ice cream manufacturers are not permitted to operate a freezer in the same room with milk bottling equipment. A freezer in operation naturally sucks in air and therefore safeguards should be around such freezing at least to the same extent as that of bottling milk.

Sterilization of Freezers

From an eastern manufacturer:

Many in our industry believe that chlorine or other chemical sterilization is not satisfactory for freezer sterilization, because of the inaccessibility of bearings. Dr. Dahlberg, of Geneva, did a lot of research work

in this connection, and found that while chemical sterilization was entirely satisfactory for pipes and other equipment with all parts readily accessible, it did not result in satisfactory sterilization of freezers; in fact, his report indicated that sterilization of freezers could be properly accomplished only through heat, and the heat could only be furnished by liberal use of boiling water or steam.

After I received this letter I went to the files and reread the bulletin, Sterilization of Ice Cream Freezers, by Dahlberg and Marquardt, bulletin 628, April, 1933, New York State Agricultural Experiment Station. This is indeed a very thorough and general treatment of the subject of sterilization of freezers. Permit me to quote two paragraphs from the Abstract on page 3 of this bulletin:

In the present study freezers were sterilized by steam, hot water, and chlorine solution. It was found that chlorine solution did not penetrate the bearings and that bacteria subsequently developed in the wet freezer. The cold refrigerant around the freezer chilled hot water so that excessively large amounts at very high temperatures were required to sterilize freezers by this means. Heating by steam was slow, but it was entirely possible to sterilize satisfactorily by steam.

Sterilization of freezers with steam was particularly effective as it dried them and sterilized the bearings also. Rinsing with chlorine solution prior to use was found to be desirable as a supplement to steam sterilization.

Time will not permit me to discuss the various angles of bacteriological standards; however, I wish to read into the records of this annual meeting the resolution adopted by the Research Committee at our Chicago convention last year, copy of which has already been sent to your association:

While this Committee fully realizes the importance of research in the matter of determining the bacterial count in dairy products, it deplores the fact that at times the results of such research are made standard practice thereby resulting in different agencies using different methods. This Committee wishes to go on record as strongly recommending that all agencies having to do with determining the bacteria count in dairy products, adhere to the published American Public Health Association methods. The Committee feels certain that the proper com-

mittee of the American Public Health Association will at all times be glad to entertain the results of research pointing toward the need of a change in their published methods.

Our Research Committee stands ready to cooperate with any committees from your association and other organized groups in the dairy industry to accomplish the program set forth in this resolution.

We believe that criticism to be worthwhile should be constructive and I am sure that the different points brought out by these members in the different sections of the country deserve the serious consideration of this association. Let me repeat that to carry forward this program for practical and adequate sanitary regulations surrounding the manufacture and distribution of ice cream you have the hearty cooperation of the International Association of Ice Cream Manufacturers.

In closing I wish to invite members of this group to attend, as our guests, the annual convention in Cleveland opening next Thursday, October 18.

Discussion

Dr. Brooks: This discussion has brought out exactly the sort of thing we had in mind. I am sure that we can agree that the experiment has been thoroughly justified. It has brought out at least one thing that we didn't expect and that is the opportunity, through Mr. Hibben, to get reduced railroad rates to Cleveland for those who want them. Mr. Burrell and Dr. Wynne both referred to the lack of uniformity, in one case referring to equipment and in the other the lack of uniformity in regulations and the inconvenience that that causes. Well, it looks as if between the Public Health Service and the Committee on Milk Plant Equipment of this Association the problem, as far as the equipment is concerned, is in a fair way to be worked out. Concerning the regulations, it seems to me that between these two organizations, the Public Health Service and this Association, it ought to be reasonably feasible to- at least work out some uniformity standards on essential requirements, with a fair chance of such standards being ultimately adopted in the various states. But as to the possibility or feasibility of getting uniformity, in my time, between states on the detailed requirements, I have come to be rather pessimistic, for the simple reason that there are so many instances in which the states do not want uniformity. They want it so far as it benefits them, helping them get out

with their milk, but they seem to favor lack of uniformity when it makes it possible to shut out outsiders.

I was interested in Mr. Hibben's reference to the quotation from one of his correspondents on the unwillingness of health departments to approve equipment and I assume that that applies as well to other control organizations like departments of agriculture. In our own state the health department does not have jurisdiction over ice cream plants; it is in the Department of Agriculture and Markets. There is a tendency I have always observed to be unwilling to approve equipment. It is due in a very large measure, I believe, to the fear that if they approve equipment in advance when they get in operation it will not work and then they will be "on the spot." I think in our own department of health in New York we have for the last few years been getting away from that attitude to some extent. I would like to ask Mr. Tiedeman to say whether that is so or not.

Mr. Tiedeman: We have been trying but I think we can not put a stamp of approval on a piece of equipment the way the Good Housekeeping Institute, for example, might, principally for the reason that a piece of equipment is something today and something else tomorrow and it is difficult to know, because changes are being made so rapidly, what we are approving. Another difficulty is that one manufacturer may get his equipment approved a few seconds ahead of another and jealousy may result.

Mr. Jennings: I don't think that anything could be done more profitably by this organization than to have a committee on standardization of control. If there are differences of opinion between certain groups and agencies let us get something under way whereby we can iron out some of the differences and get somewhere in the unification of them.

Mr. Frank: I would like to endorse the statement just now made by Mr. Jennings. It has been made by so many people during the past three or four years, both in this organization and out of it, that it sounds to me almost like a series of hammers. I share a certain amount of pessimism which Dr. Brooks expressed but I hope that pessimism is not so deep that it shuts out the possibility of success. I think I was misunderstood to some extent the day before yesterday. I think some members of the Association thought I did not wish to see committees like the Committee on Dairy and Milk Plant Equipment go into the matter of formulating uniform specifications. Such a conclusion is diametrically opposite to what I do wish. I had already given my approval to the report of that committee and in attempting to take advantage of what the committee has done I incorporated in a letter to Mr. Tiedeman last week a re-draft of that part of the Public Health Service milk code, incorporating practically all the requirements that he read. Enlarging on that thought I believe that the whole subject of milk control should be similarly reviewed. The point I tried to make the other day was that it had to be done in such a way as to further

uniformity all over the country rather than to set up entirely separate standards from that which the committee of the Public Health Service is promoting. If such a committee as Mr. Jennings proposes can be established by this Association, I am sure the very first thing that the Public Health Service milk board would want to do would be to invite its cooperation. The message I am trying to convey is that we should do everything we can towards harmony and avoid everything we can towards disharmony.

Dr. Holford: I would like to emphasize one important point that Dr. Wynne brought out and that is, the spread between what the consumer pays and what the producer receives. There is no doubt, in my mind, but that that has been one of the causes of the reduction in the demand for milk. I think by that reduction it has indirectly affected public health. I do not know how we can get that message back to the consumer but I believe if there is any way it should be done.

Mr. Burrell: I hope this discussion may result in some practical accomplishment. If the manufacturers can be of any service in cooperating with the committee in any way I offer the services of our Association's representative.

Dr. Wynne: I was interested in the question raised by the representative of the ice cream industry, asking the health departments to approve equipment. We have long been troubled over that question. We can see the desirability of advising the manufacturer in advance that a certain equipment meets specifications of the health department but Mr. Tiedeman has pointed out several reasons why health departments are reluctant to do it. Another reason, especially in the larger cities, is that if we approved equipment there would be charges of favoritism. For that reason, health departments have considered it safer, as a rule, to refuse to approve equipment until it is actually installed.

Mr. Hibben: I presume you all know that your committee is going forward with the work on ice cream, even though Mr. Irwin is not here. I talked with him the other day on the telephone and have a long letter with me here. It is our ambition to go forward, continuing the cooperation between the sanitary control committees in both groups. I can see no reason why the machinery manufacturers and the milk distributors and the ice cream manufacturers could not sit down in joint committees and go forward with the plan set forth both in Mr. Burrell's talk and my own and as brought out by people on the floor here today.

President Krueger: There is no question about it but that this innovation, having representatives of these three organizations present constructive criticisms of our work, has been decidedly worthwhile and I wish to extend to the three gentlemen who have come here to present those views our very hearty thanks for their cooperation in our program.

THE COMPOSITION OF MEDIA FOR THE BACTERIOLOGICAL ANALYSIS OF MILK*

C. S. BOWERS
Board of Health Laboratory, New Britain, Connecticut
AND
G. J. HUCKER
New York State Agricultural Experiment Station
Geneva, New York

IF THE NUMBER of bacteria in milk is to be used as an index of its sanitary quality, their enumeration should be as accurate as possible. The American Public Health Association, through its Committee on Standard Methods of Milk Analysis, has adopted certain procedures which have become recognized as "standard methods." These standard procedures have been adopted in all public health laboratories and have served to develop a certain uniformity of technic in laboratories which are making bacteriological analyses of milk.

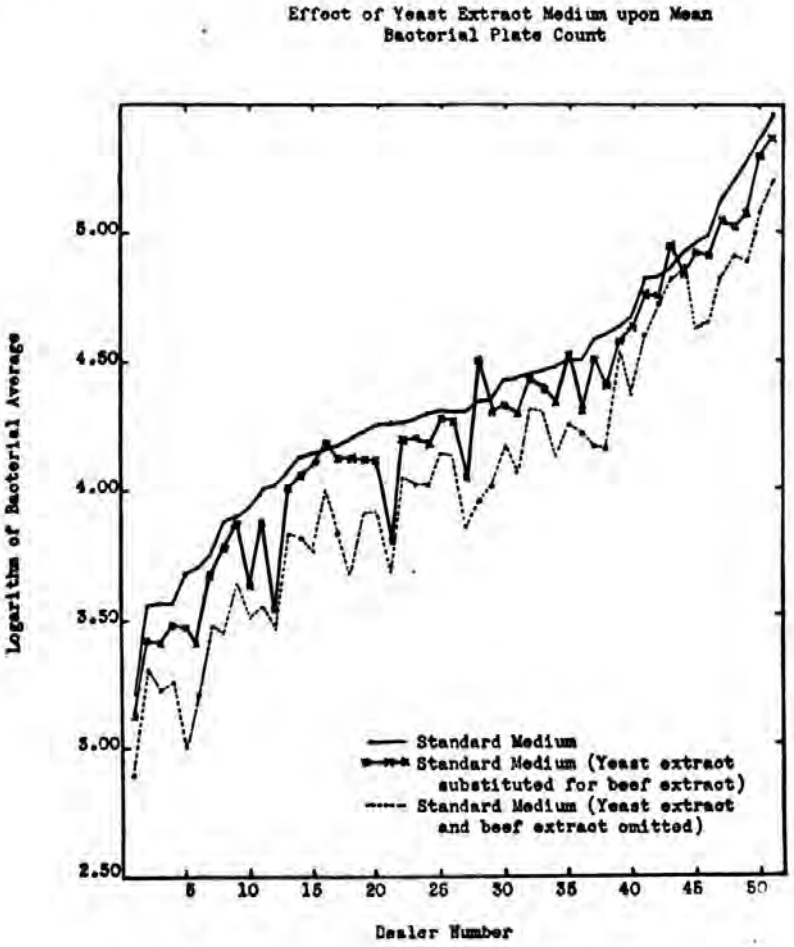
The number of colonies which will appear on the plates when the standard plating methods are used is dependent upon several factors. Many of these controlling conditions have been studied by this Committee. Chief among these factors may be considered as the temperature of incubation, method of dilution, accuracy of the measuring glassware, method of securing original sample, etc. In addition to these conditions which may affect the total colony count is the question of the type of medium which should be used in the plating procedure.

There are two divergent opinions which now exist as to the type of medium which should be used. Both of these opinions have certain grounds for their belief. There are those who believe that the present medium as recom-

* A more comprehensive report, including all data, etc., has been published as a bulletin from the New York Agricultural Experiment Station, Geneva, N. Y.

mended in the Standard Methods of Milk Analysis, meets the situation for the reason that our present sanitary standards have been based on counts as secured by this medium. It has certain other attributes, inasmuch as it is easy to prepare, can be secured adjusted to the proper reaction, gives a clear resulting medium and may be easily prepared as purchased from the supply house.

There are others who believe that if the sanitary quality of milk is to be judged on the basis of the numbers of bacteria present that a medium should be used which will grow the largest possible number of colonies. Such a medium would be a better index as to the actual number of organisms which were present.



It is the purpose of this investigation to study certain modifications of the present standard medium as recommended by the Committee on Standard Methods of Milk Analysis of the American Public Health Association to determine, if possible, if the substitution or addition of any known ingredients will enhance its growth producing properties.

Substitution of Yeast Extract for Beef Extract in Standard Media

A renewed interest has been apparent during the last decade relative to the use of yeast extract in bacteriological culture media. It has been assumed by several investigators that media which have contained yeast extract have produced luxuriant growth of many different types of organisms, some of which are important in the sanitary control of milk supplies.

If the troublesome problem of pin-point and minimo-visible colonies, which are so frequently encountered in the bacteriological examination of milk, could be solved by the simple substitution of yeast for beef extract and without a resultant loss or gain in plate count, it would be expedient to make such a change in the standard medium; a constructive change that should result in increased accuracy and conservation of time and fatigue for the worker engaged in making such counts. A study was made of 514 samples to determine, if possible, the efficiency of yeast extract when substituted for beef extract in standard medium.

The results obtained from 373 raw milk samples indicate that the counts secured with yeast extract averaged 9 per cent and the plain peptone counts were 38 per cent lower than those determined with the standard agar.

Plate counts were secured with these media from 141 samples of pasteurized milk. In this case the yeast ex-

tract counts were 20 per cent and the plain agar 45 per cent lower than the counts secured with standard agar.

A general study of the results indicated that standard beef extract produced colony counts generally higher than those determined with the yeast medium. The standard medium produced a maximum plate count from 65 per cent of all samples included in the study, while the yeast extract medium yielded the highest count in 25 per cent. Comparable plate counts with both media were obtained from 6 per cent of the samples examined. The mean ratio of the standard and yeast agar counts for both pasteurized and unpasteurized milk was 1 to 0.86.

It is evident that yeast extract is not suitable as a substitute for beef extract when employed as a base ingredient in media to determine the number of bacteria in milk.

While slightly larger colonies developed in many instances on the yeast extract medium, this advantage was generally counteracted by a lower plate count than that obtained with standard medium. No particular value to the worker engaged in plate counting results by increasing the size of colonies which ordinarily develop a sufficient size for accurate enumeration. Organisms which produced the pin-point type of colony developed slightly larger colonies in some cases on the yeast medium. It is possible that the addition of a small amount of yeast extract to standard medium might induce the development of larger colonies by thermophilic organisms and other minute colony producing types. During this study, no identification of organisms which produced generally larger colonies, or which failed to develop on the yeast medium was undertaken. It is evident, however, that this medium was of more value to some types of organisms than to others.

Of importance, in view of the reports by previous investigators to the effect that yeast extract promoted better growth of the lactic bacteria, is the observation that

the yeast extract medium counts averaged 9 per cent lower than the standard agar counts irrespective of whether high or low-count milk was concerned. It is further evident from the results of counts obtained from pasteurized milk that the yeast medium is even less suitable for use in determining the numbers of bacteria.

The effect of yeast extract medium to determine the average bacterial content of milk where premiums are paid for a low count presents an interesting consideration. Out of a total of fifty-one retail dealers, the bacterial average of 92 per cent was lower with yeast extract than with standard medium; the mean deviation from the standard medium average was 22 per cent. While these figures represent the mean values for both raw and pasteurized bottled milk, there is no reason to believe there would be a substantial difference when applied to milk as it is received at the bottling or pasteurizing station. The results from a sufficient number of samples were used upon which to compute a fair average of the number of organisms present. A graphic representation of these results more clearly indicates these relationships. Of particular significance is the general tendency of the curve representing the bacterial average computed from the yeast extract counts to follow that representing those determined with plain peptone. This pronounced trend would seem to indicate that yeast extract is deficient in some particular food element which is required by the majority of types of bacteria found in milk.

The medium with yeast extract substituted for beef extract produced the highest plate count in but 25 per cent of the samples examined. The counts of 373 raw samples of milk made with this medium were, on the average, 9 per cent lower, and counts of 141 pasteurized milk samples were 20 per cent lower than were counts secured with the standard medium.

The yeast extract medium was conducive to the development of generally larger colonies but in many instances fewer colonies developed than on the standard medium. The production of slightly larger colonies by yeast extract is not sufficiently beneficial to warrant its use as a substitute for beef extract in standard agar when employed as a plating medium for fluid milk.

RELATIVE EFFICIENCY OF VARIOUS MODIFICATIONS OF THE STANDARD MEDIUM USED FOR THE BACTERIOLOGICAL EXAMINATION OF MILK.

Medium							Percentage, in relation to standard medium, of colonies appearing on various media.		
Peptonized Milk	Beef Extract	Yeast Extract	Peptone	Tryptone	Glucose	Skim Milk	Raw	Pasteurized	All Samples
	+		+				100	100	100
			+				62	55	59
		+	+				91	80	86
+							109	101	104
	+	+	+				125	110	118
	+		+		+		135	131	133
+	+		+				132	151	142
	+	+	+		+		137	155	145
	+		+			+	146	245	195
				+	+		136	420	278
				+	+	+	134	455	294

THE EFFECT OF CERTAIN MODIFICATIONS OF STANDARD MEDIA

From the results above, it is evident that yeast extract can not be satisfactorily substituted for beef extract in standard media for milk analysis. Further study was carried out, however, to determine if the addition of yeast extract to standard media would increase its efficiency and, in addition to learn if certain other modifications might produce an increased colony count.

The modifications of the standard medium studied included addition of yeast extract, glucose, tryptophane broth (tryptone), etc.

Samples of raw milk were composite samples from the station herd, from producers supplying a pasteurizing plant in Geneva and from a receiving station at Oxford, New York. Some of the abnormal raw milk samples were

secured from cows segregated from the station herd because of mastitis, others were from different samples of raw milk which were collected immediately after the evening milking and stored at 25 C. overnight.

Samples of pasteurized milk were taken from the plant at Geneva and others were received from New York City and Boston, Mass. Samples of pasteurized milk which were held at 10° C. for twelve days, and pasteurized milk samples which were suspected of containing thermophilic bacteria were considered abnormal, pasteurized milk samples.

The number of colonies obtained from a series of twenty-seven normal and twenty-three abnormal raw and pasteurized milk samples were observed. Plates were incubated at 37° C. and 32° C. for two days.

Beef and yeast extract, peptone, tryptone, dextrose and agar allowed the development of the greatest number of colonies in 45 per cent of all samples. In no instance did the standard agar give a maximum plate count. Standard agar plus 1 per cent dextrose, however, produced a maximum plate count in 22 per cent of the cases studied while yeast agar plus dextrose induced a maximum count in 15 per cent of the samples.

Attention is called to the apparent reciprocal relationship of yeast and beef extract when employed in combination in media used to determine the number and types of bacteria in raw and pasteurized milk. The addition of yeast extract to standard agar increased the standard count of raw milk samples 25 per cent and pasteurized milk samples only 10 per cent, while the addition of beef extract to yeast extract agar resulted in only a 3 per cent increase over the yeast extract count when raw milk was concerned but the beef extract increased the yeast agar count of pasteurized milk samples approximately 40 per cent. These increases are less appreciable, however, at the 32° C. incubation.

The size of colonies was increased in all instances over those appearing on standard agar and yeast extract agar by the addition of yeast extract, beef extract or glucose. In a considerable number of cases, plain peptone agar yielded colonies which were larger than those appearing on standard medium. Colonies on the beef yeast tryptophane dextrose medium were generally considerably larger than those on any other medium, many colonies being unnecessarily large. The carbohydrate media produced colonies which were very uniform and which were of such size as to facilitate counting.

Too little consideration has been given, in the past, to the ease with which the number of colonies appearing on a plate can be counted. This is an important problem in laboratories in which large numbers of plates are counted daily as fatigue most certainly increases the personal error. Standard agar is a gross offender in this respect, and it was exceedingly noticeable in the present study since all media, with the exception of plain peptone in a few instances, yielded colonies which were larger than those on standard agar. Usually these colonies could be counted with ease by the naked eye and without the aid of artificial illumination. On the other hand, it is quite apparent that any successful attempt to do away with the troublesome problem of minute colonies must also result in an increased plate count.

The combination of yeast and beef extract in a medium for milk plating is more efficient than the use of either one separately. Neither yeast extract nor beef extract when used alone materially increases the number of colonies over plain peptone agar.

The addition of glucose to standard medium increases the count approximately two and one-half times more than the addition of yeast extract.

Standard medium does not usually allow the growth of mastitis streptococci on routine plates prepared from suspected samples.

Colony size is increased more by the addition of glucose than by the addition of yeast extract to standard medium.

The Addition of Sterile Skim Milk (English Modification) to Standard Media

The addition of skim milk powder to media was suggested by Ayers (1) and recently Mattick (2) has advised the use of sterile milk to enhance the efficiency of standard medium.

A series of ninety-one raw milk and seventy-three pasteurized milk samples has been studied using standard medium and standard medium to which has been added 0.5 per cent skim milk. In addition, a peptonized milk agar has been used in which the milk has been completely peptonized before dehydrated and combined with peptone to constitute the Peptonized Milk Agar as prepared by the Digestive Ferments Company.

The results with the raw milk samples indicates that thirty-nine of the ninety-one samples gave a higher count on standard agar than on standard agar plus skim milk. The remaining fifty-two samples, however, gave the higher count on the latter medium. It is of interest to note that the skim milk materially enhanced the efficiency of the medium, in those cases in which certain types or a large number of any types of organisms were present in the original sample. When a difference was noted in favor of the English modification, the results were striking, indicating that there were certain types of organisms in the samples studied which produced very little or no growth on standard medium, but which grew readily when the skim milk was added. In those instances in which standard medium gave an increased count, it

can be noted that the counts were all low and, in most cases, the number in favor of the standard medium was probably within experimental error.

When pasteurized milk samples were studied, the effect of the addition of skim milk to standard medium was even more striking. Of the seventy-three samples studied, fifty-nine gave the higher count on standard medium plus skim milk. On the whole, this medium produced approximately two and one-half times greater count than the standard medium.

Addition of Peptonized Milk to Standard Agar

It has been known for some time that organisms which commonly occur in milk and milk products appear to produce the best growth in a medium containing milk or some derivative of the nitrogenous constituents of milk. For this reason it seems obvious that the medium to determine the number of bacteria in the milk would be enhanced by the addition of hydrolyzed or peptonized milk. Two series of samples were secured including in all thirty raw milk and thirty-two pasteurized milk samples. This series of samples was plated, using standard agar as compared with standard agar with the addition of digested milk. These milk digests to be added to the standard agar as prepared by the Digestive Ferments Company and two special digests, together with the so-called peptonized milk, represent different stages in the peptonization process.

In the first series of samples studied it is obvious that the addition of peptonized milk enhanced the efficiency of standard agar. In fact, on fifteen samples of raw milk studied, two of the special media produced a 32 per cent increased count, while the remaining modification increased the count by 19 per cent. Of particular interest is the fact that milk digest No. 103320 produced a smaller relative count than the peptonized milk and milk digest

No. 103319. It has been shown by Hucker and Carpenter (3) that the amount of peptonization may materially affect the ability of the digest to promote growth. This earlier observation is confirmed with these results, inasmuch as the three digests used in the study of these samples represent different stages in the digestion process. The effect of the addition of these digested milks on the efficiency of standard medium was much more striking when pasteurized milk samples were studied. In these samples, the efficiency of standard medium was increased by nearly 50 per cent on the whole by the addition of digested milk.

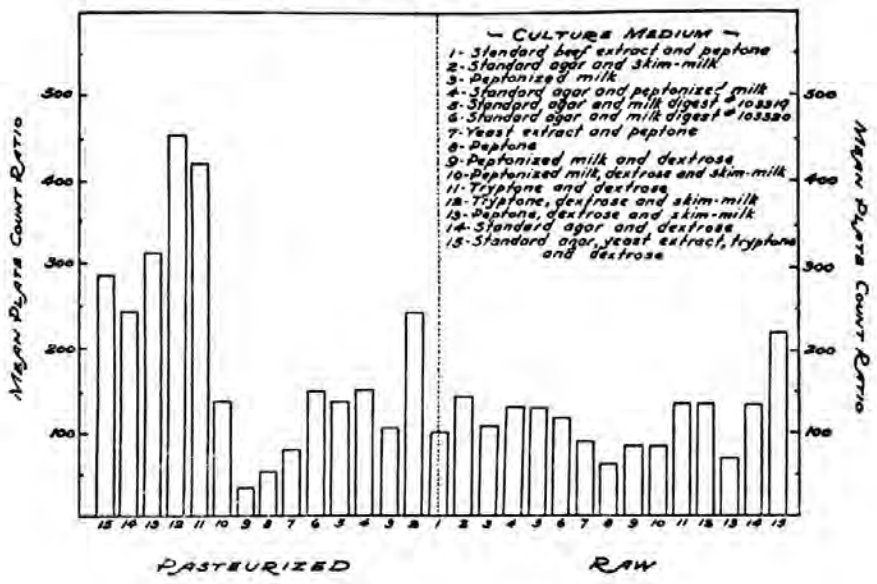
In an earlier section of this investigation, it was noted that the addition of glucose or the addition of one-half per cent of sterile skim milk to standard medium materially increased the count obtainable from the milk samples studied. It can be noted that the addition of peptonized milk will bring about a small increase in the count. It may be naturally inferred that if a medium could be devised whereby we could add both peptonized milk and glucose or one-half per cent skim milk to standard medium that the results may be far more striking than the addition of either of these accessory substances alone. To gain more information on this point, a series of fifteen raw milk samples and seventeen pasteurized milk samples were secured and the bacteria content determined by the use of these various media.

Some rather interesting and significant results were obtained by the use of peptonized milk and glucose medium and a medium composed of peptonized milk, glucose and one-half per cent milk, the number of colonies obtained from raw milk with these media being materially reduced over those obtained with standard agar. This observation has been confirmed by another series of samples not included in this investigation. These rather striking results indicate the importance of

a thorough study of the whole media question as well as the problem of the relation upon each other, of the ingredients used in the medium for the promotion of bacterial growth.

CHART

EFFECT OF PABULUM ON PLATE COUNT OF BACTERIA IN MILK



Discussion

It is obvious from these data that there are certain modifications which may be made of the present standard medium which would make it more effective in producing a larger colony count. Of these modifications there are two which appear to be the most significant, i. e., the tryptone glucose medium and the tryptone glucose medium plus one-half per cent of skim milk. These two media appear to be far superior to any other of the modifications studied in their ability to produce a higher colony count. In a study of raw milk samples there is little to choose between these two media. However, the addition of skim milk appears to enhance the growth of organisms which are commonly found in pasteurized milk.

It is interesting to note that while these two media generally produce higher counts than the present standard medium that the most pronounced increase is in samples of low sanitary quality. In other words, the samples which had a low bacteria count did not evidence so much change when the more efficient medium was used as those samples which had a high bacteria count. This is also interesting from the fact

that if such a medium were adopted in place of the present standard medium, it would not add an additional hardship on the producer of high class (low count) milk.

This suggested medium is as simple to prepare as the present standard medium and the cost is also comparable.

Conclusions

(a) There are several possible modifications of the medium as recommended by the Committee on Standard Methods of the American Public Health Association, which will give more accurately the number of viable organisms than the medium now employed.

(b) Yeast extract, either added to the standard medium or substituted for beef extract does not increase the number or size of the colonies.

(c) The addition of one-half of one per cent skim milk to standard increases the colony count approximately 17 to 85 per cent in raw milk and 41 per cent in pasteurized milk. More individual milk counts were higher with 0.5 per cent milk than with plain standard agar.

(d) The medium consisting of tryptone 0.5 per cent, glucose 0.1 per cent, agar 1.5 per cent plus 0.5 per cent skim milk increases colony count over standard medium in raw milk 33 per cent and in pasteurized milk 147 per cent over the standard medium count.

(e) Present standard medium does not generally promote the growth of mastitis streptococci when used for plating.

(f) The hydrolysis of the milk or casein prior to being added to the standard medium does not increase its efficiency.

References

(1) *J. Bact.*, 5, 96 ,1920.
(2) *J. Dairy Res.*, 4,1, 1932.
(3) *J. Inf. Dis.*, 47, 435, 1930.
(4) Guide to the Conducting of Clean Milk Competitions, Ministry of Agriculture and Fisheries, London, England. Bulletin No. 46. 1934.

REPORT OF COMMITTEE ON DAIRY FARM METHODS

THE work of this Committee has been seriously handicapped through the loss of its able chairman, the late Thomas J. Strauch. The new chairman has written to all members of the Committee at least twice and has had advice from several. It has been the almost unanimous counsel of those committee members who have participated in the discussion that dairy farm methods should be simplified and that certain essential principles should be stressed. This is not in itself a new thing, but it seems to the Committee peculiarly appropriate at this time. Not only is such a course one of wisdom and conducive to quicker results but coming at this time when dairy farmers generally are struggling out of the recent depression and are burdened with debts and lack of ready cash, such a course is necessary for the well being of the industry and the assurance of an adequate supply of milk.

The Committee feels that, generally speaking, more attention should be paid to results and rather less to methods. It is extremely desirable to be able to advise a dairyman who is in a quandary as to the proper method or equipment to accomplish his ends, but there are usually a number of ways to achieve the desired result and it is the course of wisdom to allow a free selection of methods providing the ultimate object is won. Just what are essential methods in the production of clean milk? Let us eliminate from this discussion the definite question of pathogenic organisms and direct our attention to total count. Those members of the Committee who have given their advice in the preparation of this report have mentioned two things as the outstanding lines of attack. These are the cooling of milk on the farm and the proper treatment of dairy utensils to prevent contamination of

milk. Several suggestions have been offered along both these lines.

It is needless to mention again the necessity or advantage of cooling milk. A large part of the total bacterial count of milk when it reaches the city is undoubtedly due to faulty cooling on the farm or in transportation. Ideal cooling consists of taking sufficient heat units out of milk with the least exposure to contamination. One member of the Committee is strongly inclined to believe that cooling milk in the can without the use of surface coolers is most desirable. His experience comes through extended field work in connection with a governmental regulatory act. On the other hand, there are certain arguments in favor of the surface cooler. These are that the milk can be cooled more quickly and that certain undesirable flavors and odors in milk can be minimized or eliminated by such a method. Your Committee believes that unless coolers and cooling equipment can be kept scrupulously clean, cooling in the can may have advantages which outweigh possible disadvantages. In all of this discussion we must bear in mind not what can be done but what is actually being done on the average farm day in and day out. A suggestion comes from one member of the Committee that where the usual type of wall cooler is used better results in cleaning can be obtained if the cooler is set at right angles to the wall, thus permitting ready access to both sides.

Several members of the Committee have sent in their thought and experience on the treatment of utensils to kill bacteria. One suggestion is that each dairy farmer be furnished with a dry chlorine or similar powder, together with explicit instructions for measured quantities to be put in measured quantities of water and that the solution be made fresh daily. The Committee feels that chlorine or chloramin solutions properly used have a definite place in dairy sanitation, especially among

smaller dairies where the cost of steam is rather prohibitive. It does not, however, provide any facilities for hot water, which is essential in any cleaning operation. A committee member from the Pacific coast supplies some interesting information regarding methods used in his locality for heating water, generating steam, or both. This information may be summarized as follows: Electric units have been developed to quite an extent. No data are given on the cost of electric current, but it is probably somewhat more reasonable in a section of waterpower than it would be where it is generated in other ways. A ten-gallon insulated tank equipped with a heating unit and thermostat can be obtained for $32.50 installed. Used twice daily, this outfit costs approximately $1.50 a month to operate and is adapted to herds of twenty to thirty cows. Being thermostatically controlled, this device furnishes hot water night and day and involves little fire hazard. A Diesel oil burner can be purchased for $25 and up, installed, costing $1 to $1.50 a month to operate. This outfit has the advantage of quickness, as hot water can be obtained in twenty minutes. It gives off more heat, however, than does the electric unit. In another system either compressed or natural gas may be used, which generates steam in from fifteen to twenty minutes. No data are given as to the cost of the outfit, but its operation is said to be more expensive, running from a minimum of $3 to $4 monthly for operation. Such an outfit is adapted to a herd of twenty to thirty cows. The cheapest arrangement noted is an oil drum supplied with a coil. This can be constructed for from $15 to $25, depending on whether the work is done by the dairyman or by someone outside. Chunks of wood are used with this apparatus and the monthly cost of operation runs from $1 to $1.50. This furnishes hot water only and is not available for steam. An outfit for heating water and generating

steam without the use of a boiler is probably familiar to this Association, being described in Farmers' Bulletin No. 1675 of the United States Department of Agriculture.

The treatment of milking machines is a much discussed question. Probably ideas on this subject are more diverse than on any other single item of sanitation. There are a great number of people who have advanced varying methods for keeping the milking machine in proper sanitary condition. The Committee recommends six essential precautions which should be observed, as follows:

1 Use of ample hot alkali water twice daily.
2 Constant visual inspection of the cleanliness of the machine.
3 Proper strength of chlorine solutions.
4 Clean machine immediately after use.
5 Dismantle all parts sufficiently to insure proper cleaning.
6 Clean vacuum lines when necessary. Inspect them often.

The following outline details the steps taken in cleaning the combine milking machines at the Beltsville experimental farm of the United States Department of Agriculture. This system has worked very satisfactorily to date, is experimental in nature, and would of course have to be modified with a different type of unit:

1 Immediately following the milking operation each unit is flushed with cold water by placing the cups over water jets while power is still on. Milker jars are thoroughly rinsed by releasing vacuum underneath while they contain water. Flushed until water coming from releasers is clear.

2 With power on, ten quarts of alkali solution (two and one-half pounds to ten gallons water) at a temperature of 190° to 200° F. is drawn into each unit. While solution is in milker jars, it is agitated by releasing vacuum on bottom of jars or by shutting off power and turning in live steam. The solution then passes through sanitary pipe lines to releaser jars.

3 With power off, entire machine is rinsed with warm water and drained. During this rinsing, caps on the blind ends of the sanitary pipe line are removed for a few seconds to flush out residue.

4 Entire machine is sterilized with live steam for about five minutes twice daily. (At night, three quarts of 100 parts per million chlorine solution are drawn into each unit instead of steaming. Solution is

allowed to remain in jars until morning, when it is drawn through sanitary pipe lines into releasers.)

5 Milker cups and milk hose hung in solution rack and filled with 100 p.p.m. chlorine solution.

6 Before noon and evening milkings, about three quarts of 100 p.p.m. chlorine solution are drawn through each unit. At morning milking, the solution is already in the machine. (In each case, the chlorine solution is recovered and used for wiping cows' udders.)

7 On each Saturday, the alkali solution from one washing is recovered and drawn through the vacuum line.

The entire machine is completely dismantled and thoroughly brushed once each month.

While your Committee submits these various items regarding dairy farm methods, it does not wish to imply that any one of the methods or pieces of apparatus discussed is the best for all particular fields. It is hoped that the various matters taken up will be fully open for discussion and further study by individual members or by the committee on dairy farm methods during the coming year.

Ernest Kelly, *Chairman*

George W. Grim
James D. Brew
H. N. Heffernan
Floyd C. Rath
H. B. Switzer
J. E. Blinkhorn
J. M. Lescure
R. M. Washburn

REPORT OF COMMITTEE ON MILK PLANT PRACTICE

Standardization of Milk

MILK is the only dairy product, the standardization of which is not commonly recognized by food and sanitary laws.

At the same time the necessities of the milk business, when carefully conducted, call for the regular delivery of a product essentially uniform in fat content. As a result standardization of fluid milk supplies is common.

In the milk marketing agreements signed by the A. A. A. during 1933 many if not all of them assumed the standardization of city milk supplies.

In a small but growing number of states the officials supervising milk supplies likewise are in charge of standardization.

In the remaining states this practice is essentially without official regulation.

The following acts or regulations relate to standardization in these states:

Typical Laws

Milk is the unadulterated, fresh, clean, lacteal secretion. All parts of which shall have been obtained from the udder by the complete milking of one or more healthy cows, properly fed and kept (excluding that obtained within five days after or fifteen days prior to parturition), free from foreign substances detrimental to its quality or the quality of products prepared therefrom; and containing not less than three per cent of milk fat and not less than eight and five-tenths per cent solids not fat: Provided that nothing herein shall be construed to prohibit the standardization of milk at a uniform fat content not less than three per cent of milk fat.

State Law—California.

Section 5. That no person.....shall sell or deliver for consumption as milk.....(2) Milk which has been wholly or partially skimmed or otherwise artifically, in whole or in part, deprived of its natural butterfats, which then shall become known as skimmed milk.

Provided, that nothing herein shall be construed to prohibit the standardization of milk at a uniform fat content not less than 3.25 per cent of milk fat.

State Law—Louisiana.

Standardized Milk—Section 20—Defined. Standardized milk is the product resulting from the blending of milk or skim-milk with clean, fresh, natural cream, under proper sanitary conditions, and in such manner as to afford a milk of a certain definite composition. Such milk shall conform in all respects to the standards of quality and purity as provided in section 32.

State Law—New Hampshire.

Section 45. Standardized milk is milk of which the original fat content has been changed by partial skimming or by addition of skimmed milk, cream or milk rich in fat and which contains not less than three and one-half per cent milk fat and twelve per cent total milk solids. And such standardized milk may be sold providing that on the cap or side of the bottle, can or vessel containing such milk be plainly stated the name of the person or firm who standardized such milk, together with the words "Standardized Milk," and the per cent of butter fat, which shall not be less than three and one-half per cent, a two-tenths of one per cent, tolerance being permitted on one or more bottles, cans or vessels, but an average of twenty-five bottles, cans or vessels shall contain the required stipulated per cent of fat.

State Law—Ohio.

Section 46. Definitions. The term "milk," when used in this article, means the whole, fresh, clean, lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained fifteen days before and five days after calving or such longer periods as may be necessary to render the the milk practically colostrum free.

State Law—New York.

We are advised that the State Commissioner of Agriculture and Markets of New York State will "not take exception to the use of proper means on the farm to bring about the delivery to milk plants of milk containing a larger percentage of fat than such milk would contain if all of the milk given by the cows were included."

Section 12406. Standards of purity.

2. Blended milk is milk modified in its composition so as to have a definite and stated percentage of one or more of its constituents.

State Law—Missouri.

It is our understanding from correspondence that this act is not interpreted as legalizing standardization of fat content by additions of cream or skimmed milk.

In connection with these laws there is the evident intent to require that the standardized product to be sold as milk shall comply with at least the minimum standards of composition required by the local or state laws.

It is likewise common to require that the name of the person or firm responsible for the standardization shall be on the container.

There is some tendency, as in the Ohio law, to require that the fat content of the standardized milk shall be stated and that the milk shall be in accord with the statement.

The regulation reported for New York State is so recent that little experience has accumulated in its enforcement. In the states with longer experience the enforcement officers are unanimous in stating that they have not experienced any unusual difficulty in the enforcement of the law and regard it as a reasonable and helpful regulation.

It would seem to your Committee that inasmuch as milk is being standardized very commonly it would be better to have this done under official oversight and in accord with established regulations.

Metals and Flavors

Cow's milk normally carries about one-half part per million of copper.

The ordinary diet is somewhat deficient in copper and this at times seems responsible for the failure to form proper amounts of hemoglobin.

Milk handled in copper or tinned copper utensils absorbs measurable amounts of copper and therefore should be more valuable in the diet.

In the manufacture of dairy equipment the displacement of tinned copper by other metals continues. During recent years the shift has been largely toward the use of more stainless steel.

This shift in metals used is largely due to the apprehension that the use of copper will be followed by undesirable flavor changes in the milk. At least under some conditions undesirable flavor changes are evidently produced as the results of absorbed copper.

Until somewhat recently, the use of tinned copper sanitary pipe in milk plants was almost universal.

The first tendency toward change was the substitution of white alloys, usually having a copper content of about 65 per cent and sometimes containing some lead and zinc. These alloys have been the occasion of considerable complaint regarding flavors developed.

The present tendency is toward the use of stainless steel or alloys of this containing considerable amounts of nickel. The results from the use of these latter substances for sanitary pipe, so far as reported, seem to be satisfactory from the standpoint of flavors.

Recording Thermometers and Pasteurization

In a recent survey of the requirements by the various states, in twenty-six of the forty states from which replies were obtained, recording thermometers were required in connection with the pasteurization of milk.

Fifteen of the twenty-six states require that the recording thermometer shall have a one degree scale throughout the pasteurization range and that the space allotted to a degree on the chart shall be 1/16 inch.

Recording thermometers of this type furnish records which can be read with a high degree of accuracy.

It seems desirable that these requirements be made by all agencies supervising pasteurization and states and municipalities not now making these requirements might well consider doing so.

An additional requirement, which commonly accompanies the one just discussed, is that each pasteurizing apparatus shall be equipped with engraved stem mercury thermometers in one degree scale with 1/16 inch to the degree through the pasteurizing range.

Washing and Drying of Milk Cans

The various studies which were made some years since made it evident that about 80 per cent of the germ life which was being added to milk, after it left the cow and before it reached the milk plant, was added from the milk cans.

The improved condition in which much of the milk now reaches the milk plant is fairly good evidence that considerable improvement in the condition of milk cans has been accomplished. However, at least in many instances, there is much still to be accomplished. The first requisite is the succesful washing of the cans. Earlier, confidence was placed largely in strong washing solutions. Gradually the emphasis is shifting toward the use of large volumes of water under considerable pressure.

The solvent and detergent action of chemicals is a necessary part of the process, if cooking of the casein and albumen onto the cans is to be avoided. The use of moderately hot water instead of boiling water is likewise helpful in avoiding this cooking of milk onto the metal.

The inspectors are urged, in milk plant inspection, to observe closely the cleanliness and the dryness of the cans.

Bottle Washing

A number of typhoid epidemics have been attributed to the improper washing of returned bottles with the resulting spread of the disease about the community.

Evidently, the bottle treatment should be such as to destroy any pathogenic germs which may be present.

Reliance for this work is commonly placed on chlorine. This substance is known to have little or no effect upon germs of tuberculosis and with the exception of the germ of typhoid fever its efficiency regarding the other pathogenic germs does not seem to have been tested.

For making the milk safe we require 140° F. for thirty minutes or 160° F. for fifteen seconds.

In too many cases the milk bottles are given a treatment at 110-120° F. for fifteen seconds and in some cases are handled at even lower temperatures.

The Pennsylvania requirements for bottle washing are "The use of steam or of water at a temperature of not less than 180° F. or water at a temperature of not less than 165° F. for a period of not less than three minutes."

Vitamin D Milk

Vitamin D milk is now being distributed in Canada and the United States by between four and five hundred milk distributors.

Thus far no cases have been reported in these countries where harm resulted from such distribution but on the other hand excellent results in preventing and in curing rickets have been reported from many sources.

Thus far the attitude of health officials and milk supervisors has been largely that of watchful waiting and of encouragement to the industry.

Until almost the present time the control of the vitamin D milk has rested with the Wisconsin Alumni Research Foundation on one hand and a similar group at Columbia University on the other. These two organizations have striven quite effectively to guide development along desirable lines.

Somewhat recently, there has appeared three new organizations offering vitamin D concentrates and it is entirely possible that these will be followed by others. Evidently, the control of vitamin D milk by the industry is entering into a more complex stage.

The slowness of health officials to undertake the control of vitamin D milk may be due in part to the lack of satisfactory basis for standards.

The unit of measurements most commonly used is the Steenbock rat unit. However, there has recently been adopted the U. S. P. X (1934) unit which is identical with the International unit. One Steenbock unit is equivalent to about 2.7 of the U. S. P. X (1934) units.

Vitamin D milk is produced by the feeding of irradiated yeast to cows, by the addition of concentrates of vitamin D, and by the direct irradiation of milk.

The Committee on Foods of the American Medical Association which has provided much of the control which has thus far been offered requires the presence of 150 Steenbock units per quart in the vitamin D milk fortified by feeding yeast to cows or by the addition of concentrate from cod liver oil (Vitex) and only 50 such units where the milk has been irradiated. There is at present such wide differences of opinion regarding the relation of Steenbock units to anti-rachitic effects on babies that general standards based on Steenbock units are well nigh impossible.

The plan which is being frequently followed to date is to require the American Medical Association approval of the product containing a stated number of rat units before offering the vitamin D milk for sale and further requiring monthly bio-assays at the expense of the distributor to determine that the product is fully up to the required standard. Such assays are now being furnished for approximately $25.00 each.

Pasteurization

It is some years since this Association went on record as indorsing holding pasteurization as an important protection to the public health.

Both the American Public Health Association and the Canadian Public Health Association have likewise strongly indorsed the public health efficiency of this process.

During recent years there has been a series of studies of the effect of pasteurized milk, contrasted with raw milk, upon the health and general development of children. The findings of these studies closely coincide.

They are typified by the findings of the study conducted under the general supervision of the U. S. Public Health Service, including 3700 children in which approximately half the children were fed pasteurized milk. In height and weight the group receiving the pasteurized milk was slightly the heavier and the taller but the differences were probably within the experimental error. In disease experienced by the children the group receiving the pasteurized milk was much more healthy.

On the basis of these extended studies it is evident that children fed pasteurized milk grow equally well or slightly better and escape much disease afflicting those fed raw milk.

Hood Caps on Milk Bottles

Recognition of the possibility of infecting milk through contact with infected pouring lip of the bottle is not a new idea.

It was so well appreciated in the beginning of the certified milk movement (1893) that hooded caps have been used on certified milk bottles practically from the beginning.

A number of typhoid epidemics with ordinary milk supplies have been attributed to infection of the pouring lip of the bottle by the delivery man who was a typhoid carrier.

Health authorities have hesitated to require caps covering the pouring lip of the bottle because of the addi-

tional expense involved and this is still a disadvantage.

There are now a considerable number of devices available at moderate expense which protect the pouring lip and in a considerable number of cases the distributors are voluntarily using these devices as a means of better serving the public and of getting business.

Evidently the time is about at hand when the requirement of this type of bottle lip protection should receive general consideration.

Dirt in Milk

It is generally agreed that much of the milk as delivered at the milk plants or receiving stations carries more dirt than is desirable.

It also seems generally agreed that a necessary first step toward improving conditions in this respect is to provide standards for measuring and displaying the dirt in milk so that record can be kept of the amount present and thereby provide a guide as to the results following any plan of improvement which is being studied.

The 1934 edition of the Standard Methods of Milk Analysis of the American Public Health Association provides a method by which observations may be made, results graded, and recorded and we would commend this plan to all inspectors.

Experience suggests that bringing the condition of the milk to the attention of the producer in such a way as to affect his pride or his financial returns is most effective in producing improvement in the cleanliness of the milk.

H. A. Harding, *Chairman*

C. Sidney Leete
William H. Price
Paul F. Krueger
H. R. Estes
A. R. Tolland
J. D. Brew
C. B. Matthews
D. K. Douglas

F. L. Mickle

REPORT OF COMMITTEE ON FOOD VALUE OF MILK AND MILK PRODUCTS *

PREVIOUS reports of this Committee have emphasized the important place which milk occupies in the diet. Widespread attention has been given to the problem of adequate feeding of families registered with public and private relief agencies, and it has been recognized that the nutritional needs are best served when adequate amounts of milk are used. That milk is not a luxury, nor even an expensive food, but one which yields a greater return in food essentials for money expended than any other food, needs to be impressed especially upon families of moderate and low economic status.

Pasteurization

Considerable attention has been given to the nutritive values of raw and of pasteurized milk. From the public health standpoint the desirability of using pasteurized milk has been demonstrated repeatedly because this process kills harmful bacteria, if by any chance some should be present, preventing unnecessary diseases. McCollum (1) has summarized the situation as follows:

> Since the effect of pasteurization on the food value of milk is too slight to be apparent even in specially designed experiments, and is not apparent in observations on children living under ordinary American conditions, there is no valid argument which can be brought forward in support of the marketing of raw milk for the general population. It is granted that certified milk is as safe as any ordinary foods, but if the optimum amount of milk is to be consumed by the public, the price must be made as low as is consistent with the maintenance of high

* This report contains the reviews of timely reports, contributed by committee members as follows: Milk with Enhanced Nutritive Properties, G. C. Supplee, Ph.D. and S. Ansbacher, D.Sc. (by invitation), The Dry Milk Co.; Special Laboratory and Field Studies, J. H. Shrader, Ph.D., National Dairy Products Corp.; The Processed Milks, James A. Tobey, Dr.P.H., The Borden Co.; Milk and Health Protection, Ira V. Hiscock, Yale School of Medicine, Chairman.

quality. The only method of accomplishing this objective, which has the full approval of public health officials and bacteriologists, is pasteurization of the milk supply.

It seems strange indeed that, when we accept so generally the cooking of most of our foods, there should still remain in certain areas a serious objection to the heat treatment of milk involved in pasteurization.

Krause (2) reported that pasteurization partially destroys vitamin B and that the degree of destruction of vitamin C depends on the kind of pasteurization. Sprawson (3) noted again that raw milk as against pasteurized milk is helpful in preventing dental caries. However, Kitchen and McFarland (4) find that there were no significant optical differences between the enamel of animals fed pasteurized milk and those on raw milk from the same supply.

King and Waugh (5) found no appreciable destruction of vitamin C in milk when pasteurized with the Electropure or the Stamvik pasteurization methods but that the holding method at 143—5°F for 30 minutes produced significant destruction.

Much has been said concerning the effect of pasteurization on the decreased solubility of the minerals. Tria and Zuma (6) found that pasteurization may decrease the soluble calcium to the extent of 1.5 per cent and phosphorus 2 per cent. These changes are too slight to be of any significant importance.

Digestibility

Okada and Sano (7) reported that heated cow's milk is far inferior in nutritional value to raw milk, and that the higher the heating temperature, the greater the difficulty of digestibility. On the other hand, Morris and Graham (8) state that the absorption of nitrogen, calcium, phosphorus and fats is not diminished when boiled milk replaces raw milk in the diets of infants.

Mortensen (9) working with calves having gastric fistulas, found that boiled and autoclaved milk left the

stomach faster than raw milk, and offered the explanation that such treated milk yielded a curd which offered more surface to the gastric juice.

Welch and Doan (10) indicated that curd tension is related to casein content but that such correlation is not perfect. They find that although infected udders may give a soft curd milk, curd softness in itself does not constitute evidence that it came from a diseased udder. Hill (11) described the "curd-o-meter" and other features of the Hill curd test, and reviewed the studies in this field.

Lundstedt (12) described a new method to produce a soft curded milk. He churns out the butterfat thereby removing the lecithin from the surface of the fat globules. This lecithin is then absorbed on the casein network where it acts as a protective colloid to prevent the formation of a firm coagulum, thus rendering the milk soft-curded.

Doan (13) stated that the lipase which causes the development of rancidity in homogenized milk can be inactivated by heating for 30 minutes at 53-55°, 15 minutes at 56-58°, or under one minute at 62-64°.

Iodine

Sutton and Krauss (14) reported that the presence of small amounts of iodine seems to stimulate the rate of bacterial growth. Hanford, Supplee and Remington (15) found that iodine in powered milk by the atmospheric roller process is not lost during manufacture or storage. McGhee and Ferguson (16) reported that when finely divided copper and iron are suspended in milk and fed to humans, there is a rapid rise in hemoglobin with complete recovery. There are no deleterious effects as there are when copper and iron salts are used. Bing, Saurwein

and Myers (17) found that rats anemic on low copper milk had their hemoglobin restored to normal level by taking added copper sulphate and iron in their milk.

Off-Flavors

In the last few years, in an increasing number of instances, a new off-flavor has manifested itself. This is variously described as being "cappy," "card-boardy," "tallowy," etc. Much confusion exists because of the indefiniteness of organoleptic description. Krenn (18) stated that a copper content of 0.30 mg. imparts a "suety" taste to milk. A range in copper content of 0.18 to 0.6 mg. caused a mustiness. Kende (19) found that the "tallowy" taste in milk is caused by the oxidation of the butterfat, catalyzed by heavy metals or the enzyme which he calls oleinase. Certain feeds, bacterial cultures, or reducing substances are protective against this effect. A copper content of 2-4 mg. per liter gives the maximum taste, but smaller amounts give a more pronounced taste than larger amounts.

Tracy, Ramsey and Ruehe (20) reported that when milk containing copper is incubated at 68-90° F., the tallowiness which develops at 40° F. is retarded. Such incubation before contamination with copper also retards the development of tallowiness. They hold that the metabolism of yeast and bacteria are important factors in the control of this off-flavor. Gondos (21) agreed with the above in that the "oily tallowy" taste is due to the oxidation of the fat, caused by unsaturated acids in the feed, oleinase in the fat, and contamination with heavy metals. The addition of reducing substances or an especially potent bacterial culture mitigates the trouble. Davies (22) found that the presence of 1.5 p.p.m. of copper imparts tallowiness in twenty-four hours at 0-5° C.

The effect of several metals to enhance the development of off-flavors in milk was studied by Henderson and

Roadhouse (23). The worst offender was copper, then followed nickel, and non-effective was a Ni-Cr-Fe alloy. Other flavor effects of an acidic nature have been associated with the metals used in dairy plants. Caserio (24) stated that the acidity is always lower in vessels made of Al or tinned copper than in other metals.

Enhanced Nutritive Properties

Numerous clinical experiences with the antirachitic and calcifying vitamin D suggest that irradiated milk is the most efficacious of all antirachitic agents. In the light of available data, the fact that irradiated milk and vitamin D milk, obtained by feeding irradiated yeast to cows, are superior to milk to which a concentrate of vitamin D has been added and that these three types of antirachitic milks are superior to cod-liver oil and viosterol, when appraised in terms of rat and clinical units, seems to be explained by the inherent composition of milk.

In a paper entitled "The Cholesterol Content and Antirachitic Activation of Milk Constituents," Ansbacher and Supplee (25) present data which show the cholesterol distribution throughout the milk. The authors found that a substantial part of the milk cholesterol is associated with the milk proteins and that this cholesterol, a prosthetic group of the proteins, contains matter which can be activated antirachitically by exposure to ultraviolet rays. Lactalbumin, *e.g.*, contains a relatively high proportion of the total cholesterol content of milk and this bound sterol can be made antirachitically active by exposure to ultra-violet light rays under the same conditions, involving only momentary periods of exposure to the rays, as used in the irradiation of milk. It was found also that the fatty matter associated with the lactalbumin contained more cholesterol than any other milk constituent with the exception of the butter fat. The matter which can be made antirachitically active has been shown

to be variable within wide limits, when contained in the butter fat; when associated with the milk proteins, it was found to be relatively constant. Numerous data indicate that these findings may be the basis for explaining the merits of irradiated milk in contradistinction to other antirachitic agents. The authors discussed their report in the following terms:

> The data as a whole bring into relief the subject of the differences in the effectiveness of irradiated milk, cod liver oil, and viosterol as observed clinically. The data presented must be considered adequate in showing that in irradiated milk the relationship between the active principle and other inherent constituents, especially the proteins, is different than in other antirachitic agents. The distribution of the provitamin D among various milk constituents and especially its association with the proteins, particularly the lactalbumin, may possibly be important in ultimately leading to a more thorough understanding of the merits of irradiated milk in contradistinction to other antirachitic agents. This possibility would seem to be pertinent in view of the relative physiological activity of thyroglobulin and thyroxine. Thyroxine is a prosthetic group of thyroglobulin and is, when administered in the unbound form, believed to be more easily decomposed in the body and thus rendered more quickly inactive than when administered prosthetically bound in the form of thyroglobulin. Thyroglobulin has a greater potency than thryoxine, presumably for the reason stated above. In view of this illustrative example the greater clinical effectiveness of irradiated milk, as compared with other antirachitic agents, may be due to the prosthetically bound vitamin D of irradiated milk.

The above paper is cited editorially in the *Journal of the American Medical Association,* (26) wherein the analogy is made between hematin and hemoglobin on the one hand and sterol and sterol-lactalbumin on the other hand.

Aside from the sterols, the other lipids deserve attention. Phospholipids, *e.g.*, are known to be present in milk. (27) How they contribute to the unique food value of milk remains to be determined. However, available data tend to show that they play an important biological role. (28) Kurtz *et als. e.g.*, found that "In contrast to butter fat, the lecithincephalin fraction of the milk

phospholipids contains none of the lower fatty acids. More surprising is the entire absence of palmitic acid, which not only is one of the acids most abundant in butter fat, but is widely distributed among a great many fats and oils, both of vegetable and of animal origin."

During the past year further technical data concerning the irradiation of milk became available. In a series of four papers, Supplee *et als.* (29-32) presented evidence that the vitamin D synthesis takes place substantially at the surface of the milk.

Only 20 to 40 per cent of the ultra-violet radiations between 2,500 and 2,850 Å striking the surface of the milk at right angles are transmitted by films 0.02 millimeters thick. Milk films 0.11 millimeters thick transmit 5 per cent or less of the incident radiation between these limits.

The transmission curves of certain milk derivatives of widely different character are similar to those of natural whole milk and milks containing variable amounts of fat.

Milks containing variable amounts of fat and certain milk derivatives are more transparent to long wave ultra-violet radiations than to the short wave radiations. This increase in transmission occurs rapidly and progressively in the region 2800-3300 Å.

The nature of milk necessitates the utilization of relatively high intensities of ultra-violet radiation for efficient and effective activation. Under suitable conditions a high degree of activation can be obtained by an exposure period varying from less than 1 second to not more than 2 seconds.

The fat content influences to a certain but limited degree the rate at which antirachitic properties are produced in milk by direct irradiation with ultra-violet rays.

Milks containing little or no butter fat may be activated to a substantial degree, but the degree of potency ultimately obtained is not reached as quickly as in those milks containing larger amounts of fat. The degree of potency attainable in milk with the larger amounts of fat does not increase in proportion to the amount of fat present.

Milks containing normal amounts of fat may be activated substantially to their maximum degree by a momentary exposure of less than 2 seconds, if suitable intensity of ultra-violet radiations are applied to films of suitable thickness and flow characteristics.

The flow of milk films over smooth vertical surfaces by gravity can be differentiated as films with dominant smooth flow characteristics, or dominant turbulent flow characteristics.

Milk may be activated to a 2+ degree of calcification, as determined by standard assay procedures under a wide range of properly coordinated

conditions involving film capacity, film thickness and distance of film travel, within a momentary period of exposure. There are certain optimum conditions wherein the applied energy is utilized more effectively and efficiently; such conditions are determined by the relationship between film thickness and film capacity.

Results indicate that the irreducible minimum in time necessary to give the specified degree of activation desired in these experiments was from 0.75 to 1.30 seconds. Exposure periods of 2.70 seconds gave the same degree of activation under conditions which permitted a marked increase in the amount of milk which could be activated per unit of time.

The reflection of ultra-violet radiation from the surface of milk films is of the same order of magnitude as the reflection of such radiation from the surface of water; the degree of reflection increases as the angle of incidence increases.

The average percentage reflection from angles of incidence between 15° and 45° is approximately 3 per cent; about 6 per cent from a 60° angle of incidence, 13.4 per cent from a 70° angle, 28 per cent from a 75° angle and about 34 per cent from a 80° angle.

Milk films show the property of selective reflection of ultra-violet radiation, especially throughout the range 2550 to 3300 Å. This property is most pronounced at angles of incidence of 60° or more.

Aside from the antirachitic milks, vitamin B fortified milk became recently available. Supplee *et als.* (33) in a study of "The Vitamin B Supplementation of Milk" found that milk to which a vitamin B concentrate, obtained from rice polish by water extraction, had been added, shows greater growth promoting properties than milk not containing such a supplement. This vitamin B milk was clinically assayed by Gaynor and Dennett (34) who summarized their experiences in these words:

One hundred normal infants were fed a dried milk reinforced with a specially prepared water extract of rice polish as a source of vitamin B for an average period of five months. The increase in weight was influenced favorably; metabolic efficiency was increased; anorexia and gastrointestinal disturbances were lacking; pallor was less marked; and nutrition was improved and a greater resistance to infection exhibited. They were, as a group, mentally more alert and less irritable, sleeping better and possessing practically none of the common complaints of infancy, as abdominal colic, constipation, and excessive crying. Infants do not seem capable of storing vitamin B for future use.

Among the milks the nutritive properties of which have been enhanced by the character of the feed of the cow, milk with a high iodine content deserves mentioning. In a recent study reported by Hanford *et als.* (35) cows were fed iodine in predetermined quantities in the form of milk powder fortified with iodine. It was found that the iodine recovery in the milk is affected by season, stage of lactation and by the amount of iodine ingested. Similar observations were made on cows which did not receive the iodized milk supplement. A distinctly lower total output and lower percentage recovery was found in all territories covered by these studies during the warm months. The iodine recovery in the milk ranged from 2½ to 25 per cent.

The Processed Milks

Although the consumption of fluid milk in the United States has decreased about 5 per cent since 1929, there has occurred in this same period an increase of about 10 per cent in our use of concentrated milks. This increment in the consumption of the processed milks does not, however, appreciably affect total milk consumption in this country, since only about 4 per cent of our entire milk supply goes into the manufacture of evaporated, condensed, powdered, and malted milks. (36)

Since the last report of this committee, numerous contributions have been made to the scientific literature on the clinical, laboratory, and economic aspects of the concentrated milks. As in past years, the greater part of this literature has been concerned with evaporated milk, the per capita consumption of which has increased since 1929 from 11.3 to 12.5 pounds a year. (37)

Evaporated Milk

In a general discussion of the nutritive qualities of evaporated milk, F. E. Rice (37) pointed out that the

minerals of this product are readily available, that it supplies the vitamins that fluid milk is depended upon to supply, that it is bacteriologically sterile, that it is not injured by freezing, that children and adults accept its flavor, and that its ease of digestion and other qualities make evaporated milk a successful food for normal infants and also of value in certain special conditions such as prematurity, celiac disease, allergy, and gastrointestinal diseases of infants.

Several extensive clinical tests with evaporated milk have been reported. In a series of 340 infants, 123 on evaporated milk formulas and 117 on other forms of modified cow's milk, Quillian (38) found that newborn babies and normal feeding cases seemed to thrive as well on evaporated milk as on modifications of fluid cow's milk. A series of 108 cases, half on evaporated milk modified with beta lactose and half on whole milk formulas, has been reported by Skole (39), who concluded that evaporated milk with beta lactose is a safe, suitable, and satisfactory food for the average normal infant. A third study, by Williams and Kastler (40), in which sixty infants were divided into three equal groups, one given evaporated milk and lactose, another acidified evaporated milk and corn syrup, and the third group given whole milk formulas, showed that the results in nutrition and growth obtained by feeding evaporated milk and fresh milk formulas were almost identical, although there were fewer gastrointestinal upsets on the evaporated milk. The use of sauerkraut juice as an effective acidifying agent for evaporated milk in infant feeding has been suggested by C. V. Rice (41).

In the feeding of premature infants, evaporated milk formulas, either in conjunction with breast milk or mixed with water and a suitable carbohydrate, seemed to give favorable results. According to Webb (42), eighteen premature or immature infants were successfully fed on such

formulas, while twenty-eight others were raised on breast milk supplemented by these evaporated milk formulas. The use of evaporated milk for prematures was also described by Martin (43).

Diluted evaporated milk may be employed in the same manner as whole milk in the dietary treatment of such digestive disorders as peptic ulcer, according to an investigation by Davidson, Biguria, and Guild (44). This product may also be utilized to advantage in the dietary regime employed to decrease the worm burden of children, as shown by Ahmann and Bristol (45), who report on the value of liberal quantities of milk in reducing intestinal parasites in children (46).

The stimulating action of copper upon the formation of the red blood cells has been investigated by Stein and Lewis (47) who state that evaporated milk is a better source of copper for nutrition than is fluid milk, and that the presence of copper in evaporated milk exerts a beneficial catalytic effect upon hemoglobin formation, even in the absence of a dietary source of iron. The fact that evaporated and condensed milks pick up small amounts of copper during their processing in copper apparatus has also been demonstrated by Thompson *et als.* (48). The quantity of this metal thus imparted to concentrated milk is beneficial and in no way hazardous or toxic.

Aside from its value in infant feeding and in various therapeutic diets, evaporated milk serves a useful purpose under certain conditions in providing an economical milk for school lunches. In a study of 760 children in four rural elementary schools, Wait, Merriam, and Cowing (49) found that reconstituted evaporated milk gave the same results as pasteurized milk in bringing about gains in weight and improved nutritional condition in children who received mid-morning lunches consisting of these types of milk. Atwood and Ehlers (50) have

called attention to the advantages of evaporated milk in quantity cooking.

"Extensive work done on the food value and digestibility of milk," write Anderson and Gillett (51), "has shown that pasteurized milk, unsweetened evaporated milk, and dried whole milk may be used one for the other."

Powdered Milk

A prophecy that the milk supply of the future will be dried or powdered milk is offered in a recent editorial in a medical magazine (52), the editor declaring that such a produce is sanitary, palatable, and economically desirable because of its lack of bulk.

An important clinical study on the use of powdered milk in infant feeding is that reported by Gaynor and Dennett (34), who fed 100 babies on a dried milk reinforced with a specially prepared water extract of rice polish as a source of vitamin B. During a period of five months the infants displayed increases in weight and greatly improved nutrition. The preparation of this vitamin B extract and its incorporation in dried milk without loss of potency are described by Supplee, Bender, and Flanigan (33) in a recent paper.

One of the most valuable uses of powdered milk is in the preparation of concentrated diets for infant and child feeding. Pratt (53) has employed this method successfully in the dietary treatment of childhood tuberculosis, achieving satisfactory gains in weight in forty malnourished children by the addition of powdered whole milk (Klim) to their daily food supply. Black (54) has likewise obtained good results with diets fortified with dry milk in cases of rheumatism in children.

A dry milk naturally rich in iodine has been produced in South Carolina by dessicating the milk from cattle on local feeds. Weston (55) has shown that the use of this

dry milk not only protects children against goiter but promotes their more rapid growth and development.

Therapeutic uses of malted milk, a processed blend of whole milk, whole wheat and barley malt, have been reviewed by Tobey (56), who states that this dried product can be employed in all cases where a milk diet is indicated, and that its addition to milk reduces the curd tension of the mixture and increases its nutritive value. Malted milk is, likewise, asserted to be useful in infant feeding formulas, as a carrier for barium in x-ray work, as a carrier for mucin in the treatment of peptic ulcer, and as a dietary adjunct in the therapy of neuroses, insomnia, fevers, and in all conditions where a bland, easily digestible diet is required.

Ira V. Hiscock, *Chairman*

James A. Tobey
M. O. Maughan
J. H. Shrader
G. C. Supplee
J. B. Hollingsworth
A. R. Ward

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"When Writing Mention This Report"

REPORT OF COMMITTEE ON METHODS OF IMPROVING MILK SUPPLIES IN SMALL COMMUNITIES

THIS is the third annual report of this committee. The first report was devoted to a presentation of the lack of milk quality control efforts in a vast majority of the small communities (under 10,000 population) of this country; of the conclusive evidence of higher incidence rates of milkborne disease in communities of this magnitude; to a discussion of some of the reasons for the failure of some of the efforts at milk quality control which were being made; and recommended procedure for conducting authoritative surveys of milk production and processing conditions, and developing public opinion which would compel effective control activities. The second report consisted of the results of a study of the methods in vogue for financing milk control activities in communities in this population range. Such a small sample of the total number of communities under 10,000 was covered by the second report, however, that it was decided by the 1934 committee membership to make a concerted effort to gather, from as large a number of communities in this population range as possible, data concerning the methods of financing and conducting milk quality control activities. This report, the third of the series, presents and discusses the data gathered.

The committee consists of seven members resident in the United States, and two members resident in Canada. Although it was recognized that data gathered by questionnaire is in some instances inaccurate or misleading, this appeared to the committee to be the only available means for gathering informative data. Accordingly, the questionnaire appearing on page 276, was developed

and mimeographed, and each member of the committee was assigned certain states or provinces from which to obtain data. State or provincial milk control authorities were then contacted by committee members, and were requested to cooperate by distributing these questionnaires to local milk control authorities. When filled out the questionnaires were to be returned to the distributing official, or forwarded to the committee member or mailed directly to the chairman of the committee.

Returns were received from 575 cities, but of these forty-nine had populations too far in excess of 10,000 to be included in the tabulations. The returns used in this study originated, by states, as follows:

Alabama	112	Louisiana	7	Pennsylvania	2
Arizona	8	Maine	12	Tennessee	13
California	26	Massachusetts	11	Texas	39
Connecticut	1	Michigan	8	Vermont	4
Delaware	27	Minnesota	22	Washington	1
Florida	41	Mississippi	19	Wisconsin	12
Georgia	2	Missouri	10	New Brunswick	3
Indiana	3	Nevada	1	Nova Scotia	15
Iowa	1	N. Carolina	74	Quebec	4
Kansas	3	N. Dakota	24		
Kentucky	20	Oklahoma	1	Total	526

Although returns were received from only twenty-eight states and three provinces, they were fairly well distributed from all sections of this country except the Rocky Mountain and Pacific Coast states (exclusive of Los Angeles county, Cal.); but the Canadian returns pertain only to the far eastern portion. It is regrettable that a greater number of questionnaires were not received from some of the more urban states, such as New York, Pennsylvania, Ohio, Indiana, and Illinois, for the summaries presented in this report are, as a result of lack of information pertaining to these areas, unrepresentative to that extent.

In most cases, state milk control authorities forwarded questionnaires only to communities in which they knew milk control activities to be conducted. (In Alabama, however, the data included all incorporated communities between 1,000 and 10,000, in addition to those smaller communities in which milk control activities are being conducted). Because of the fact, however, that no questionnaires were received from several of the more densely populated urban states, the data herein presented should not be taken to be representative of the milk control situation as a whole. There are listed in the U. S. Census Report of 1930, 5263 incorporated communities with populations ranging from 1,000 to 10,000, and 504 reports (from U. S. communities) do not cover a sufficiently large sample from which to draw conclusions.

The main purpose of this study has been to learn how small communities are conducting and financing milk quality control.

As was stated in the 1933 report of this committee, the extent of each local industry and the volume of work necessitated in milk control in small communities does not justify the full-time employment of personnel for this activity alone. In not one of the 346 communities covered by this report, in which milk control activities are being conducted, (180 of the 526 communities do not conduct milk control activities) is the full time of an inspector occupied by this activity. Many of the dairy inspectors are full-time employees, of a city or county health department, or of the municipal government, or of a group of municipalities, but only part of their time is devoted to this activity for any one community.

Of particular interest is the number of communities which are enjoying milk quality control as a part of a general public health program conducted by a city or county health unit. In 225 of the 346 communities (65 per cent) the inspection activities are conducted by the

health officer, the sanitary officer or food inspector, the meat inspector, or a full-time dairy inspector serving a group of communities, who is a member of the staff of a state or local health department. The greater proportion of milk control activities in Alabama, Los Angeles County, California, Delaware, Kentucky, Mississippi, St. Louis County, Missouri, New Jersey, North Carolina, Tennessee, and Texas, is conducted through such agencies.

The chief advantage of this method of conducting milk control lies in the fact that it is unnecessary to provide segregated funds for this particular activity. Milk control is financed through the appropriation for the general public health program. Of course, if the health department appropriation is seriously curtailed, milk control activities may be somewhat handicapped, but the danger of complete discontinuance is not so great, as when milk control is an independent and separately financed activity.

In fifty-five of the 346 communities (15.9 per cent) milk control is a part-time activity of practicing veterinarians or physicians (the latter usually being part-time health officers).

In thirty-seven of the 346 communities (10.7 per cent) inspection activities are conducted by the waterworks superintendent, operator, or chemist, or some other full-time municipal employee, other than a police officer. This policy appears to be most general in Florida, North Carolina, and Texas.

In only nine of the 346 communities (2.6 per cent) is a member of the police force detailed to dairy inspection activities.

In twenty communities (5.8 per cent) inspection activities are conducted by such individuals as teachers in local schools or colleges, county demonstration agents, or local citizens, on a part-time basis. A considerable propor-

tion of the control activities in Maine communities are conducted in this manner.

A summary of the types of inspection personnel employed, all on a part-time basis for the milk control of any particular city, follows:

TYPES OF INSPECTION PERSONNEL EMPLOYED

Type	*Number*	*Percentage*
Health officer	45	
Sanitation officer or food inspector	112	65.0
Meat inspector	22	
Milk inspector	46	
Practicing veterinarian	42	15.9
Practicing physician	13	
Waterworks operative, chemist, etc.	37	10.7
Police officer	9	2.6
Other individual	20	5.8
Total	346	100.0

In a striking preponderance of cases—305 of 346—the municipality was reported to be making no effort to charge the cost of milk control activities, or even a part of this cost, to the dairy industry. Such a finding might be expected in that proportion of the municipalities in which milk control activities are conducted by employees of the health department or full-time employees of the municipality; but the levy of a tax or license by less than one-fifth of the municipalities which delegate inspection activities to part-time employees, such as practicing veterinarians or those primarily engaged in some other activity, such as teaching, is somewhat surprising. Altogether, only 41 of the 346 communities reported the levy of any charges whatever against milk producers, distributors, or sellers.

It is difficult to distinguish between privilege licenses, permit fees, and inspection fees, for these terms appear to be interchangeable. But for the purpose of this study, flat-rate levies have been grouped as licenses or permit fees; and levies based upon the number of cows milked, trucks operated, quantity of milk sold, or distance at

which the dairy farm is located from the city or city limits, as inspection fees.

Seventeen cities levy a flat license or permit fee, the amount of which ranges from 50 cents to $50.00 per annum. Reedsburg, Wisconsin, levies a license fee of $2.00 per annum upon raw milk distributors, but exempts pasteurized milk distributors from a license fee. Such a policy might encourage pasteurization were the advantage of greater magnitude. Putnam, Connecticut, levies a license of $3.00 on every store, restaurant, fruit stand, etc., where milk is sold, as well as a $6.00 license upon producers and distributors. This is the only city reporting a revenue-raising levy upon milk venders other than distributors, and it may be said that this policy offers the only possibility of entirely defraying milk-control costs without placing an unreasonable and unbearable burden upon producers and distributors. Seven other cities reported that licenses are required, but did not state the amounts of the fees.

Ten cities levy an inspection fee which varies with the number of cows milked. In seven cities these levies range in amount from a fixed charge of $1.00 per dairy farm plus 40 cents per cow per annum to $3.00 per cow per annum (25 cents per cow per month). Several variations of this type of inspection fee were reported. Junction City, Kansas, levies a fee of 75 cents on the first cow of each producer, and 15 cents upon each of the remaining cows. Fairmont, Minnesota, fixes the levy on the first cow at $2.00 and $1.00 on the others. Little Falls, Minnesota, varies the procedure by levying a fee of $1.00 upon one-cow dairies, and $12.00 on dairies with herds of more than one cow.

Newton, Kansas, levies a tax of $10.00 per year on each milk delivery vehicle, in addition to a permit fee of 50 cents on each dairy. Coral Gables, Florida, levies a license fee of $25.00 on each two delivery trucks. That is,

a distributor pays $25.00, whether he operates one or two trucks, and $50.00, whether he operates three or four trucks.

Two cities fix the tax levy according to the average quantity of milk distributed. Bellefonte, Pennsylvania, levies an annual fee of $2.00 per 100 quarts of milk distributed throughout the year. Chapel Hill, North Carolina, levies an inspection fee on a sliding scale. For distributors selling an average of less than fifteen gallons daily, the tax is $5.00 per annum; for sales from sixteen to 30 gallons daily, $10.00 per annum; for sales in excess of an average of thirty gallons daily, 25 cents per gallon, in addition to the $10.00 levy.

Two cities base the amount of the inspection fee levied upon the distance the dairy farm is located from the city. Rice Lake, Wisconsin, levies a fee of $3.00 on each source of supply, and in addition, the following inspection fees: $6.00 per annum for places not more than five miles from the city; $9.00 for places more than five but less than ten miles away; and $12.00 for places more than ten and up to fifteen miles distant. Deland, Florida, levies an inspection fee on a parallel but different basis: $15.00 per annum on places up to five miles from the city; $20.00 per annum on places six to ten miles away; and $25.00 on places eleven to fifteen miles distant.

The foregoing examples of license, permit, and inspection fee levies constitute merely so much cold, uninteresting data until their relationship to the numbers of dairies selling milk, quantity of milk sold, and the cost of milk control activities is known. Except in a very few instances, such as Putnam, Conn. (referred to above), and those cities in which the remuneration of the inspector consists only of the sums collected, the total revenue from these levies falls considerably short of the cost of the milk control activities. The reason for this is the relatively small magnitude of the dairy industry. The same

levy applied to the dairy industry of a city of 50,000 to 100,000 might readily yield sufficient revenue to defray the cost of a full-time milk control program.

It is rather questionable, however, that the costs of the various essential public health activities should be separately allocated and assessed, either against the public or against the various industries or businesses directly concerned. The conception that milk control activities should be paid for by the dairy industry, applied to all other public health activities would result in a levy against the agency—private or community—supplying water; against restaurant, soda fountain, bakery, carbonated beverage plant, ice cream plant, and barber shop operators; against the owners of land drained to prevent mosquito breeding; for all private water supply protection and human waste disposal service; for all laboratory service; for all communicable disease preventive measures and maternity and infancy care; and for all the other numerous public health activities now included in well-rounded programs. It is difficult to conceive how the collection of vital statistics would be financed under such a policy. It is true that meat inspection is usually charged to each carcass inspected, although this is not true of federal inspection. It must be quite apparent, however, that if a separate levy were to be made for every public health service rendered, public health administration would become rather complicated, requiring as large an auditing staff as the field staff.

In St. Louis County five of the twenty-one communities in the League of Municipalities cooperate in a milk control program, the cost of which is assessed against the industry, a tax of $20.00 annually being levied on each delivery vehicle. Two full-time dairy inspectors, attached to the St. Louis County Health Department, carry on the inspection activities. This method of financing milk control is reported to be the subject of much discussion,

however, and prospects are that in the near future milk inspection will be defrayed through general revenue.

Although in North Carolina, Tennessee, Mississippi, Texas, and Alabama the State Health Departments have been active in developing milk control activities in many of the small communities, these local milk control programs are nevertheless still subject to the vagaries of fluctuating finances, changes in the political complexion of municipal administrations, and shifting personnel; even though in such circumstances, so far as possible, the State Health Departments carry on the local programs with state personnel. But milk control programs of so vicarious a nature are, if the truth be known, more nominal than real.

Although it cannot be said that a trend in that direction is noticeably developing, several striking examples of direct state or cooperative milk control in small communities seem to point the way to a common-sense solution of this relatively important public health problem —at least important in the eyes of the membership of this Association.

The States of Delaware and New Jersey provide milk quality control for all of the smaller communities. In Delaware, the State Health Department details an inspector to dairy farm and milk plant inspection in all the communities except Wilmington, and employs a milk sampler, who obtains samples from each town once each month, delivers them to the laboratory for bacterial examination, and makes sediment tests and occasional Babcock tests. Inspectors of the State Department of Health of New Jersey visit all dairy farms and milk plants selling milk in the State. Of the 564 municipalities in the State, approximately twenty maintain their own milk inspection services, which naturally cover the fields of many of the smaller, adjoining communities.

Geographical and population conditions in both of

these states are especially favorable for milk control programs centralized in the State Health Department. However, a number of other eastern states enjoy equally favorable conditions. In larger and more rural states a similar type of service would have to be decentralized into district or county programs, of which there are several examples.

The cooperative plan of the St. Louis County, Missouri, League of Municipalities has been referred to. In Los Angeles County, California, thirty-seven municipalities, twenty-six of which have populations of 10,000 or less, have contracted with the County Board of Supervisors for complete public health service, which is rendered by the Los Angeles County Department of Health, through twelve district health centers. Each health center is staffed with competent inspection personnel, in order that a Certificate of Approval of the inspection service may be obtained from the State Departments of Agriculture and Public Health. The dairies of raw milk producer-distributors are inspected once each month; wholesale dairies once every sixty days; and pasteurizing plants twice each month. Samples of retail milk are taken at least twice monthly, and of wholesale milk, at the receiving platform, once each month.

It must be obvious that the small community, in which possibly a very surprisingly large proportion of the total milk consumption is produced by family cows or neighborhood dairies, has had less reason to become milk-conscious than the larger cities, unless it has suffered an outbreak of milkborne disease. If the citizens have become conscious of delinquencies in milk quality and safety, they have been faced with the problem of developing machinery to correct such delinquencies. A part-time health officer does not, at best, constitute a convincing defense against unsafe milk supplies. In the face of these handicaps local enthusiasm on the subject of

milk control could hardly be expected to be either spontaneous or lively.

Even full-time health departments are seriously handicapped in conducting milk control activities. Unless the county or district is quite urban, or milk quality improvement efforts are to be extended to the producers of home-consumed milk in the rural areas, the magnitude of the undertaking is not sufficiently great to occupy more than a portion of an inspector's time and does not warrant the employment of a trained dairy inspector. Without supervision and direction of an intelligent and relatively authoritative nature, such untrained inspectors frequently muddle milk control programs of much promise.

If, however, the milk control activities of several or a group of small communities can be combined, so as to justify the full-time employment of one or more trained dairy and milk inspectors, the results are usually much more satisfactory and the cost lower.

It appears to your committee, therefore, that the failure of a large proportion of American communities in the less than 10,000 population range to provide milk quality control should not be permitted to weigh heavily upon the group consciousness of this Association. Milk quality control should not be regarded as an independent public health activity. It is, instead, an integral part of a generalized public health program. The lack of a milk control program in any community is, therefore, a reflection upon the state of the public health consciousness of the people of that locality or area.

Your committee therefore suggests that this situation be presented to public health officials and administrators, by appropriate resolution or personal representation at meetings of the American Public Health Association and other bodies, with the assurance that this Association endorses milk control as a phase of general public health programs.

Questionnaire to Obtain Data on Financing and Conducting Milk Control Activities

International Association of Dairy & Milk Inspectors
Committee on Methods for Improving Milk Supplies in Small Communities

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Dear Sir:

The above-named committee is undertaking to gather data concerning the manner in which milk control activities are conducted and the means adopted to finance these activities in cities of 10,000 and less, in the United States and Canada. Will you kindly, therefore, assist this committee by answering the following questionnaire, and mailing it to Mr. C. A. Abele, Ch'm., Division of Inspection, Alabama State Department of Health, Montgomery, Alabama?

Yours very truly,

_____

Name of City_____ State or Province_____
Estimated Population (July 1, 1934) served by dairy industry?_____
Approximate quantity of milk sold daily?_____
Approximate number of dairy farms and milk plants supplying this quantity of milk_____
In what department of your city government is milk control vested?
_____
Is a dairy and milk inspector employed?_____ Full-time?_____
If not full-time, what other duties has he?_____
_____
If no inspector is employed, who makes inspections and takes milk samples? _____
What is the average number of inspections made of each dairy farm and milk plant, and the average number of samples of each milk supply, annually? _____
_____
What is the inspector's salary?_____ Is he allowed expenses?_____
What sum do they amount to?_____
What is the source of funds for the maintenance of milk control activities? _____
_____
Are these funds appropriated for milk control only?_____
If milk producers and distributors are taxed for inspection service and milk sample examinations, please give details on the reverse.

_____
_____
(Official Title)

C. A. Abele, *Chairman*

H. J. Barnum
V. M. Ehlers
Rex D. Bushong
F. P. Wilcox
J. R. Jennings
Russell Palmer
W. D. Tiedeman

The following Committees did not submit reports:

SANITARY CONTROL OF ICE CREAM

Ralph E. Irwin, *Chairman*

Roy F. Leslie
Harold T. Pratt
Horatio N. Parker
A. D. Burke
F. W. Fabian
W. H. Price
J. M. Lescure

MILK ORDINANCES

William B. Palmer, *Chairman*

Ernest Kelly
J. H. Shrader
F. D. Holford
James A. Tobey
A. R. B. Richmond
V. M. Ehlers
Leslie C. Frank
H. N. Heffernan
Geo. E. Bolling
J. M. Lescure

PUBLICITY AND PUBLIC RELATIONS

George W. Grim, *Chairman*

Paul B. Brooks
Russell I. Prentiss
M. A. Heinzman
W. D. Dotterrer
Harris Moak
A. R. Tolland

RESOLUTIONS

H. E. Bowman, *Chairman*

J. B. Hollingsworth
I. V. Hiscock
H. N. Parker
Ernest Kelly
W. B. Palmer
A. R. B. Richmond
W. H. Price
A. R. Tolland

SECURING ADVERTISING

F. D. Holford, *Chairman*

H. R. Estes
Ralph E. Irwin

SPECIAL COMMITTEE TO SECURE NEW MEMBERS

H. N. Parker
L. R. Lang
H. C. Ericksen
A. R. B. Richmond
Russell I. Prentiss

International Association of Dairy and Milk Inspectors

CONSTITUTION AND BY-LAWS

CONSTITUTION

ADOPTED OCTOBER 16, 1911
(Amended October 20, 1932)

NAME

This Association shall be known as the International Association of Dairy and Milk Inspectors.

OBJECT

The object of this Association shall be to develop uniform and efficient inspection of dairy farms, milk establishments, milk and milk products, and to place the inspection of the same in the hands of men who have a thorough knowledge of dairy work.

MEMBERSHIP

There shall be two classes of membership in this association: Active and Associate.

The active membership shall be composed of persons who are officially engaged in dairy or milk inspection, or the laboratory control of, or the administration of such function for any country or any subdivision thereof, and of persons who are officially engaged in research or educational work related to dairy or milk inspection for any country or subdivision thereof, provided, however, that all persons who at the time of the adoption of this amendment are members of the Association, shall be active members.

The associate membership shall be composed of any persons not eligible for active membership, who are interested in the promotion of dairy sanitation. Associate members shall not be eligible to vote, serve as officers, hold the chairmanship of any committee, serve on the Resolutions Committee, or serve as majority members of any committee of this Association.

Any properly qualified person may make application for active or associate membership to the Secretary-Treasurer and if application is

accepted by the Membership Committee, said applicant may become an active or associate member, as the case may be, upon payment of the annual dues of five dollars ($5.00).

OFFICERS

The officers of this Association shall be a President, three Vice-Presidents, a Secretary-Treasurer, and two Auditors, who shall be elected by a majority ballot at the Annual Meeting of the Association, and shall hold office for one year or until their successors are elected. An Executive Board, which shall direct the affairs of the Association when not in Annual Session, shall consist of the President, the three Vice-Presidents, and the Secretary-Treasurer.

AMENDMENTS

This Constitution may be amended by a two-thirds affirmative vote of those active members of the Association who register their votes with the Secretary. Any member proposing amendments must submit the same in writing to the Secretary-Treasurer at least sixty days before the date of the Annual Meeting, and the Secretary-Treasurer shall at once notify all members that the proposed amendments will be open for discussion at the Annual Meeting immediately succeeding such notification. After discussion at the Annual Meeting such amendments, upon a majority affirmative vote of the members in attendance, shall be, within 90 days, submitted to the entire membership of the Association by the Secretary-Treasurer. All members voting on such amendments shall, within 60 days after receipt of such notification, register their vote in writing with the Secretary-Treasurer on blanks furnished by the Association. These ballots shall be opened and recorded by the Executive Committee, and the results shall be reported by the Secretary-Treasurer at the next Annual Meeting: and if the amendments are passed they shall become a part of the Constitution from the date of such report by the Secretary-Treasurer at the Annual Meeting.

BY-LAWS

ADOPTED OCTOBER 25, 1913

ORGANIZATION

The Constitution shall be the basis of government of this Association.

ARTICLE 1

MEMBERSHIP

SECTION 1. Any person eligible for membership under the Constitution who shall file an official application, accompanied by the first annual membership dues of five dollars, and whose application for membership shall have the approval of the Membership Committee, may become a member of the Association for one year.

SECTION 2. Any person having once become a member may continue membership in the Association so long as the annual membership dues are paid. Any member who shall fail to pay annual dues within thirty days after having been notified by the Secretary that said dues are due and payable, shall be dropped from membership. Any member so dropped may, within ninety days, be reinstated by the Membership Committee, upon application filed in due form and accompanied by the annual membership dues for that year.

SECTION 3. A member of the Association may be expelled for due cause upon recommendation of the Membership Committee, and a majority vote of the members at any annual meeting. Any member so expelled shall have refunded such *pro rata* part of his membership dues as may not be covered by his term of membership.

HONORARY MEMBERS

SECTION 4. Members of the Association may elect as honorary members, at any stated meeting, on the recommendation of the Membership Committee, those whose labors have substantially added to the scientific knowledge of milk supply betterment, or those who have been of pronounced practical influence in the improvement of the milk industry. From such members no dues shall be required. They shall have the privilege of attending the meetings of the Association, but they shall not be entitled to vote.

ARTICLE 2

OFFICERS

SECTION 1. The officers of this Association shall be a President, a First, Second, and Third Vice-President, a Secretary-Treasurer, and two Auditors, who shall be chosen by ballot at the annual meeting of the Association, and shall hold office for one year, or until their successors are duly elected.

SECTION 2. The Executive Board shall consist of the President, the three Vice-Presidents, and the Secretary-Treasurer.

SECTION 3. The Membership Committee shall consist of the President, the three Vice-Presidents, and the Secretary-Treasurer.

ARTICLE 3

DUTIES OF OFFICERS

SECTION 1. It shall be the duty of the President to preside at all meetings of the Association. He shall examine and approve all bills previous to their payment, appoint all committees unless otherwise directed by vote of the Association, and perform such other duties as usually devolve upon a presiding officer, or are required of him by the Association.

SECTION 2. The Vice-Presidents, in the order of their selection, shall perform the duties of the President in his absence.

SECTION 3. The Secretary-Treasurer shall record the proceedings of the Association. He shall keep a list of members, and collect all moneys due the Association, giving his receipt therefor. He shall record the amount of each payment, with the name and address of the person so paying. He shall faithfully care for all moneys entrusted to his keeping, paying out the same only with the approval of the President, and taking a receipt therefor. He shall, immediately after his election to office, file with the President of the Association a bond in the sum of five hundred dollars, the expense of which shall be borne by the Association. He shall, at the annual meeting, make a detailed statement of the financial condition of the Association.

It shall also be the duty of the Secretary-Treasurer to assist in making arrangements and preparing a program for the annual meeting, and to compile and prepare for publication all papers, addresses, discussions and other matter worthy of publication, as soon as possible after the annual meeting.

SECTION 4. The full management of the affairs of the Association when the Association is not in session shall be in the hands of the Executive Board, as provided in the Constitution.

SECTION 5. It shall be the duty of the Auditors to examine and audit the accounts of the Secretary-Treasurer and all other financial accounts of the Association, and to make a full report of the condition of the same at the annual meeting.

ARTICLE 4

MEETINGS

SECTION 1. The annual meeting of the Association shall be held at such time and place during the month of October of each year or at such other time as shall be designated by the Executive Board.

SECTION 2. Special meetings of the Association may be called by the Executive Board, of which due notice shall be given to the members by the Secretary.

SECTION 3. Quorum.—Twenty-five per cent of the membership shall constitute a quorum for transaction of business at any annual meeting. Voting by proxy shall not be permitted.

ARTICLE 5

These By-Laws may be altered or amended at any annual meeting of the Association. Any member proposing amendments must seasonably submit the same in writing to the Secretary-Treasurer, who shall then give notice of the proposed amendments by mail to each member of the Association at least thirty days previous to the date of the annual meeting.

MEMBERS

Abele, C. A., Director of Inspection, State Dept. of Public Health, 519 Dexter Ave., Montgomery, Ala.
Allard, E. U., Chief Milk Inspector, City Hall, Quebec.
Arrell, Dr. T. J., Dairy Farm Inspector, Health Dept., Hamilton, Ont.
Babcock, C. J., Associate Market Specialist, Bureau of Dairy Industry, Washington, D. C.
Baldwin, E. St. J., Sanitary Control Representative, Borden's, 110 Hudson St., New York City.
Baril, W. A., Vice-President, Wieland Dairy Co., Inc., 3014 N. Tripp Ave., Chicago, Ill.
Barnum, Harold J., Dairy Inspector and City Chemist, Health Dept., Ann Arbor, Mich.
Bemis, Robert E., Inspector of Milk and Bacteriologist, 24a City Hall, Cambridge, Mass.
Bent, Leslie D., Dairy Inspector, Dept. of Health, 94 Valley Rd., Montclair, N. J.
Bolling, Geo. E., Director of Laboratory and Inspector of Milk, City Hall, Brockton, Mass.
Bourbeau, E., General Cheese and Butter Inspector, Department of Agriculture, St. Hyacinthe, Quebec.
Bowman, Herbert E., Box 33, North Acton, Mass.
Bremer, H. E., Supervisor of Creamery Inspection, Vermont Department of Agriculture, Montpelier, Vt.
Brooks, Dr. Paul B., Deputy Commissioner, State Department of Health, Albany, N. Y.
Buckley, James P., Bacteriologist and Chemist, Supplee-Wills-Jones Milk Co., 15 S. 34th St., Philadelphia, Pa.
Bulmer, L. C., Director, Food and Dairy Inspection, Jefferson County Board of Health, Birmingham, Ala.
Burgwald, L. H., Department of Dairy Technology, Ohio State University, Columbus, Ohio.
Burke, Prof. A. D., Head of Dairy Dept., Alabama Polytechnic Institute, Auburn, Ala.
Bushong, Dr. J. P., Veterinarian and Sanitary Inspector, Los Angeles County Medical Milk Commission, 414 N. Larchmont Blvd., Los Angeles, Cal.
Butler, Dr. W. J., Executive Officer, Montana Livestock Sanitary Board, Helena, Mont.
Campbell, H. C., Assistant Professor in Milk Hygiene, University of Pennsylvania, 23d and Locust Sts., Philadelphia, Pa.
Carman, H., Milk Inspector and Bacteriologist, City Hall, Newport, Ky.
Carpenter, W. H., City Milk Inspector, 703½ W. First St., Hastings, Neb.
Cook, Alfred S., Walker-Gordon Laboratory Co., Plainsboro, N. J.
Costello, John L., Inspector of Milk, Department of Health, Binghamton, N. Y.
Daley, John P., Milk Inspector, Beverly, Mass.
Demaree, C. C., Bacteriologist, City Health Department, City Hall, Asheville, N. C.
Dinneen, Maurice, Inspector of Milk, Town Hall, Winchester, Mass.
Dotterrer, W. D., Bowman Dairy Co., 140-158 W. Ontario St., Chicago, Ill.

Dougherty, William L., Chief Milk Inspector, Department of Health, 139 Centre St., New York City.
Douglas, D. K., Milk and Dairy Inspector, Department of Health, City Hall, Regina, Saskatchewan.
Dugan, Mrs. Sarah Vance, Director, Bureau of Foods, Drugs and Hotels, State Board of Health, Louisville, Ky.
Dumont, Dr. Louis J., Health Officer, New Britain, Conn.
Ehlers, V. M., Director, Bureau Sanitary Engineering, State Dept. of Health, Austin, Texas.
Erickson, H. E., Chief Food and Dairy Division, Bureau of Health, Public Safety Bldg., St. Paul, Minn.
Eriksen, H. C., Dairy and Milk Inspector, Health Department, City Hall, Santa Barbara, Cal.
Estes, Howard R., 768 Oakland Ave., Birmingham, Mich.
Evans, Dr. Fred, 603 Summit Ave., North Sioux Falls, S. Dak.
Fabian, F. W., Associate Prof. of Bacteriology and Hygiene, Michigan State College, East Lansing, Mich.
Fee, Kenneth F., Director, Dairy and Food Bureau, State Department of Agriculture and Markets, Albany, N. Y.
Fisher, Dr. Milton R., Milk Inspector, 4405 W. Pine St., St. Louis, Mo.
Flanagan, Thos. F., Food and Milk Inspector, 550 Main St., Hartford, Conn.
Frank, Leslie C., Sanitary Engineer in Charge Office of Milk Investigations, U. S. Public Health Service, Washington, D. C.
Franklin, U. D., Dairy Inspector, Jefferson County Health Dept., Birmingham, Ala.
Frayer, James M., Dairy Bacteriologist, Agricultural Experiment Station, Burlington, Vt.
Fuller, Nelson M., Sanitary Engineer, Cattaraugus County Board of Health, Olean, N. Y.
Fulson, J. K., Milk and Food Inspector, Bolivar County Dept. of Health, Cleveland, Miss.
Gavin, Joseph S., Inspector, Gavin Dairy Lab., 200 Stockbridge Ave., Buffalo, N. Y.
Gauhn, Emmett R., Chief, Dept. of Sanitation, Monroe County, 435 E. Henrietta Road, Rochester, N. Y.
Giraud, Julius F., Chief Inspector, Division of Inspections, Dept. of Agriculture, Box 67, Fulton, S. Dak.
Gomila, Madeline C., Asst. City Chemist, 811 Louisa St., New Orleans, La.
Griffith, R. L., Chief Dairy and Milk Inspector, City Health Department, Oakland, Cal.
Grim, Dr. Geo. W., Milk Control Officer, Board of Health, Milk Control District No. 1, Ardmore, Pa.
Gruber, Dr. J. T., Dairy and Food Inspector, Dept. of Health, Marion, Ohio.
Hardenbergh, Dr. John G., Director of Laboratory, Walker-Gordon Laboratory Co., Plainsboro, N. J.
Harding, Dr. H. A., Chief Dairy Research Bureau, The Mathews Co., P. O. Box 517, Detroit, Mich.
Harding, H. G., 762 Roslyn Ave., Akron, Ohio.
Heffernan, H. N., Director, Bacteriological and Chemical Work, Pure Milk Society, 6269 Colbert St., New Orleans, La.

Heinzman, M. A., Milk Inspector, Ventura County Health Dept., Ventura, Cal.
Hiscock, Prof. Ira V., Professor of Public Health, Yale University, School of Medicine, New Haven, Conn.
Holford, Dr. F. D., Chief Veterinarian, Borden's Farm Products Co., 110 Hudson St., New York City.
Hollingsworth, Dr. J. B., Chief Food Inspector, City Hall, Ottawa, Canada.
*Hollingworth, Dr. W. G., City Veterinarian, Utica, N. Y.
Holmquist, C. A., Director, Division of Sanitation, State Department of Health, Albany, N. Y.
Honholt, Herman J., Asst. Mgr., Laboratory Field Service, Pure Milk Association, Chicago, Ill.
Hood, Dr. A. J. G., Superintendent of Food Inspections Division, City Hall, Montreal, Can.
Hyde, Robert E., Ellington, Conn.
Irwin, Ralph E., Chief Engineer, Division of Milk Supply, State Department of Health, Harrisburg, Pa.
Jennings, J. R., Chief, Milk Division, City Health Dept., Louisville, Ky.
Johns, C. K., Asst. Agricultural Bacteriologist, Central Experimental Farm, Ottawa, Canada.
Johnston, John F., Inspector of Milk, Health Department, Newport, R. I.
Kagey, Dr. J. F., Food and Dairy Inspector, Kingsport, Tenn.
Kelly, Ernest, Chief, Division of Market Milk Investigations, Bureau of Dairy Industry, U. S. Department of Agriculture, Washington, D. C.
Kelsey, Harold C., Deputy Commissioner, Dairy and Food Commission, Hartford, Conn.
Knobel, Dr. Ed., Inspector of Milk, Box 175, Dedham, Mass.
Kohler, Roy W., City Dairy and Milk Inspector, 2403 N. 70th St., Lincoln, Neb.
Krueger, Paul F., Assistant Director, Bureau of Dairy Products, Department of Health, Chicago, Ill.
Larner, Herbert B., American Research Products, Inc., 117 Liberty St., New York City.
Lawrence, Dr. Robert P., 299 Bloomfield Ave., Verona, N. J.
Lazarus, Nathan E., Director of Lacteal Analytical Laboratories, Inc., 176 Franklin St., Buffalo, N. Y.
Leahy, H. W., Sanitary Bacteriologist and Chemist, Rochester Health Bureau, Rochester, N. Y.
Leete, C. Sidney, Associate Milk Sanitarian, Bureau of Milk Sanitation, State Health Dept., Albany, N. Y.
Lehmkuhl, Henry W., 73 Howell St., Rochester, N. Y.
Lescure, John M., Director, Bureau of Milk Control, City Health Dept., Baltimore, Md.
*Leslie, Dr. Roy F., Mgr., The Northern Ohio Milk Association, 1702 Standard Bank Bldg., Cleveland, Ohio.
Lockwood, Prof. W. P. B., Managing Director, New England Dairy and Food Council, Inc., 51 Cornhill, Boston, Mass.
McCrady, M. H., Chief of Laboratories, Provisional Bureau of Health, Province of Quebec, 89 Notre Dame East, Montreal, Canada.
Marcussen, W. H., Vice-President, Borden's Farm Products Co., 110 Hudson St., New York City.

---

* Deceased.

Martin, Dr. Ivan G., Veterinarian in Charge Farm Inspection Dept., Gridley Dairy Co., Milwaukee, Wis.
Matthews, C. B., Chief, Bureau of Dairy Inspection, 261 N.W., 36 Court St., Miami, Fla.
Maughan, M. O., Executive Secretary, The Milk Council, Inc., 228 N. LaSalle St., Chicago, Ill.
Melican, Geo. D., Milk Inspector, Room 6, City Hall, Worcester, Mass.
Mickle, F. Lee, Director of Laboratories, State Department of Health, Hartford, Conn.
Mitchell, Dr. H. B., Milk Supervisor, City Hall, Lancaster, Pa.
Moak, Dr. Harris, Bacteriologist, Kings County Medical Milk Commission, 360 Park Place, Brooklyn, N. Y.
Moore, Mrs. Edith L., 1721 Park St., Houston, Texas.
Morrow, Dr. A. C., District Veterinarian, Butte District, Dillon, Mont.
Mott, Frank E., Chemist, Health Department, and Inspector of Milk, 1104 City Hall Annex, Boston, Mass.
*Oakley, Roger, Dairy Inspector, City Hall, Brockton, Mass.
Ocker, Harry A., Meat and Dairy Inspector, Department of Health, Cleveland, Ohio.
Oldfield, H. G., Associate Sanitarian, Div. of Sanitation, University Campus, Minneapolis, Minn.
Osgood, Clayton P., Assistant State Dairy Inspector, Dept. of Agriculture, Augusta, Maine.
Ownbey, James E., Dairy Inspector, City Board of Health, City Hall, Louisville, Ky.
Palmer, Russell R., Chief Milk Inspector, City of Detroit, 3919 John R. St., Detroit, Mich.
Palmer, Wm. B., Executive Officer, Milk Association of the Oranges, City Hall, Orange, N. J.
Parker, Horatio N., City Bacteriologist, Engineer Building, Jacksonville, Fla.
Pearce, Dr. C. D., Chief Veterinarian, The Borden Company, 350 Madison Ave., New York, N. Y.
Pease, Dr. Herbert D., Director of Pease Laboratories, 39 W. 38th St., New York City.
Pike, Adna B., State Dairy Inspector, New Hampshire Dept. of Agriculture, 329 S. Main St., Laconia, N. H.
Pilgrim, Dr. S. L., Chief, Bureau of Food and Sanitation, Health Department, Milwaukee, Wis.
Prentiss, Russell I., Milk Inspector, Town of Lexington, Lexington, Mass.
Price, Dr. Wm. H., Ira Wilson & Sons Dairy Co., 5255 Tillman Ave., Detroit, Michigan.
Prucha, Prof. Martin J., Professor of Dairy Bacteriology, University of Illinois, Urbana, Ill.
Putnam, Geo. W., Director of Research, The Creamery Package Mfg. Co., 1243 W. Washington Blvd., Chicago, Ill.
Quigley, J. V., President, Country Club Dairy Co., 5633 Troost Ave., Kansas City, Mo.
Rath, Floyd C., Chemist, Board of Health, 311 State St., Madison, Wis.
Redfield, Dr. H. W., Mendham, N. J., R. F. D. 1.
Regan, Dr. J. J., Chief Veterinarian and Director of Labs., Dairymen's League, 11 W. 42nd St., New York City.
Richmond, Dr. A. R. B., Chief of Division of Food Control, Department of Public Health, City Hall, Toronto, Ontario.

* Deceased.

Rigby, Dr. E. J., Dairy Inspector, Department of Health and Public Welfare, Parliament Building, Winnepeg, Manitoba.
Robertson, Dr. A. H., Director, Food Laboratory, State Dept. of Agriculture and Markets, Delmar, N. Y.
Scheldrup, Carl J., Health Inspector, City Health, Albert Lea, Minn.
Scofield, W. W., Chief, Bureau of Food and Drugs, State Department of Health, State House, Trenton, N. J.
Scott, John M., Chief Milk Inspector, 230 E. Main St., So. Gainesville, Fla.
*Shain, Dr. Chas., Chief Food Inspector, Health Department, Hamilton, Ontario.
Shaw, Alex. G., State Dairy and Milk Inspector, Tampa, Fla.
Sheehan, James F., Inspector, Milk, Food and Vinegar, City Board of Health, Everett, Mass.
Shere, Lewis, c/o Diversey Mfg. Co., 53 W. Jackson Blvd., Chicago, Ill.
Shields, Fred M., Milk Specialist, State Board of Health, Jefferson City, Mo.
Shoults, Dr. W. A., Director, Division of Food Control, Department of Health and Public Welfare, Winnipeg, Canada.
Shrader, Dr. J. H., Director, Research Laboratories, National Dairy Products Corporation, Baltimore, Md.
Shutt, Donald B., Dept. of Bacteriology, Ontario Agr. College, Guelph, Ontario.
Smith, D. R., Zone Mor., Southern Dairies, Inc., P. O. Box 152, Miami, Fla.
Supplee, Dr. G. C., Director of Research Laboratory, The Dry Milk Company, Bainbridge, N. Y.
Switzer, H. B., U. S. Department of Agriculture, Appraiser's Stores Bldg., 201 Varick Street, New York, N. Y.
Taylor, John, Bureau of Dairy Products, Indiana Div. of Public Health, Indianapolis, Ind.
Thomas, R. C., Asst. Milk Specialist, U. S. Public Health Service, Washington, D. C.
Thomson, James E., Manager, Department of Milk Supply, Borden's Farm Products Company, 110 Hudson St., New York City.
Tiedeman, Walter D., Chief, Bureau of Milk Sanitation, State Department of Health, Albany, N. Y.
Tobey, Dr. James A., Director, Health Service, The Borden Company, 350 Madison Ave., New York City.
Tobin, Michael F., Inspector of Pasteurization, 245 Canal St., Providence, R. I.
Tolland, A. R., Supervisor of Pasteurization, Health Department, Room 1102, City Hall Annex, Boston, Mass.
Trish, Dr. Karl A., Food and Dairy Inspector, Health Department, City Hall, Kenosha, Wis.
Trotter, Dr. A. M., Chief Veterinary Inspector, Corporation of Glasgow, 60 Melbourne St., Glasgow, Scotland.
Voorhees, Dr. L. A., Chemist to the Department of Health, P. O. Box 114, New Brunswick, N. J.
Walmsley, Dr. F. D., Borden's Farm Products Company of Illinois, 326 W. Madison St., Chicago, Ill.
Ward, Dr. Archibald R., Consultant on Problems of Handling Market Milk, 1986 Waverly Ave., Detroit, Mich.

* Deceased.

Ward, Willard E., Agent for Milk and Food Inspection, Board of Health, 14 Town Hall, Brookline, Mass.
Washburn, Prof. R. M., Albert Verlèy Co., St. Paul, Minn.
Way, H. O., Director, H. O. Way Laboratory Service, 309 Western Reserve Bldg., Cleveland, Ohio.
Webb, K. C., Dairy and Milk Inspector, 318 E. 28th St., Erie, Pa.
Wickham, Dr. J. C., in charge of Quality Milk Control, Producer's Milk Co., 1905 Cypress Ave., Cleveland, Ohio.
Wilcox, Dr. F. P., Chief, Division of Dairy Products, Los Angeles County Health Department, Hall of Justice, Los Angeles, Cal.
Williams, Dr. R. W., Deputy State Veterinarian, P. O. Box 923, Eldorado, Ark.
Woodward, E. G., Dairy and Food Commissioner, Hartford, Conn.
Yale, Dr. Maurice W., Bacteriologist, New York State Agricultural Experiment Station, Geneva, N. Y.
Yates, J. W., General Laboratories, Inc., 1000 Widener Building, Philadelphia, Pa.
Young, J. L., Chief Inspector, State Department of Agriculture, Trenton, N. J.

HONORARY MEMBERS

Evans, Dr. Wm. A., Health Editor, *Chicago Tribune,* Chicago, Ill.
Pearson, Dr. R. A., President, University of Maryland, College Park, Md.
Van Norman, Dr. H. E., The Borden Co., 350 Madison Ave., New York City.
Woodward, Dr. W. C., American Medical Association, Bureau of Legal Medicine and Legislation, 535 N. Dearborn St., Chicago, Ill.

ASSOCIATE MEMBERS

Beardsley, C. E., General Superintendent In Charge of Market Cream and Dry Milk Production, Borden's, 350 Madison Ave., New York City.
Capouch, Frank J., Director of Dairy Inspection, Bowman Dairy Co., 140 W. Ontario St., Chicago, Ill.
Chumlea, L. W., Indiana Condensed Milk Co., Indianapolis, Ind.
Corbin, Dr. C. I., Veterinarian in Charge Sanitary Control of Milk, 524 W. 57th St., New York City.
Eastwood, H. S., Milker Department, DeLaval Separator Co., 165 Broadway, New York City.
Hall, A. G., Manager, Certified Milk Production, Borden's, 110 Hudson St., New York City.
Hibben, Robert C., Executive Secretary, International Association of Ice Cream Manufacturers, 1105 Barr Building, Washington, D. C.
Hood, Gilbert H., Jr., Dairy Expert, H. P. Hood & Sons, Inc., 500 Rutherford Ave., Boston, Mass.
Johnson, D. H. S., Proprietor of Dairy Products Laboratory, 119 Federal St., N. S., Pittsburgh, Pa.
Jones, Vern R., Department Manager, J. B. Ford Sales Co., Wyandotte, Mich.
*Lang, L. R., Production Manager, H. P. Hood & Sons, Inc., 500 Rutherford Ave., Boston, Mass.
Moyer, Vincent C., Supplee-Wills-Jones Milk Co., Philadelphia, Pa.

* Deceased.

Myer, C. Randolph, Superintendent, Whiting Milk Co., 17 Hillside Ave., Cambridge, Mass.
Nichols, John R., New England General Manager, Walker-Gordon Laboratory Co., Inc., Charles River, Mass.
Parr, J. C., Indiana Condensed Milk Co., Indianapolis, Ind.
Phelan, Joseph F., Chief Analyst in Charge of Laboratories, H. P. Hood & Sons, Inc., 500 Rutherford Ave., Boston, Mass.
Pratt, Harold T., Technologist, Philadelphia Dairy Products Co., Inc., P. O. Box 1588, Philadelphia, Pa.
Scott, Dr. Henry T., Director, Biological Research, Wisconsin Alumni Research Foundation, Madison, Wis.
Witham, C. L., Indiana Condensed Milk Co., Indianapolis, Ind.

* Deceased.