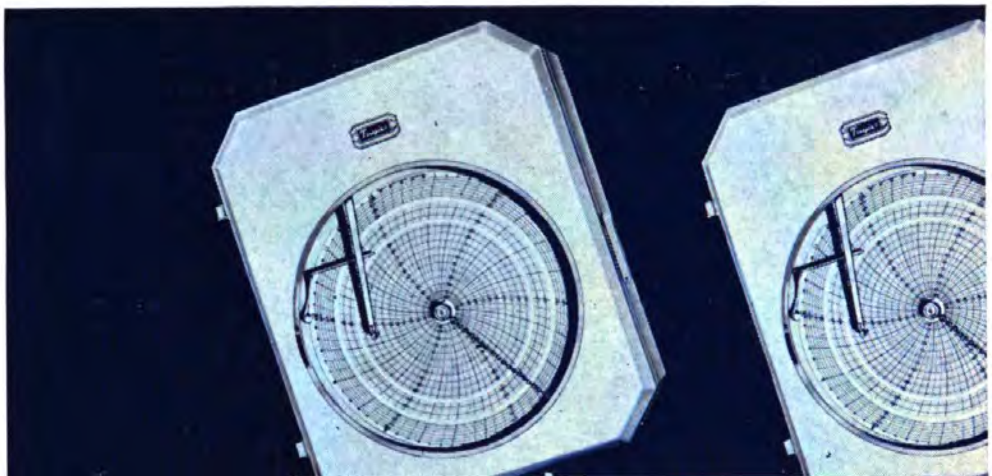
TWENTY-SECOND ANNUAL REPORT

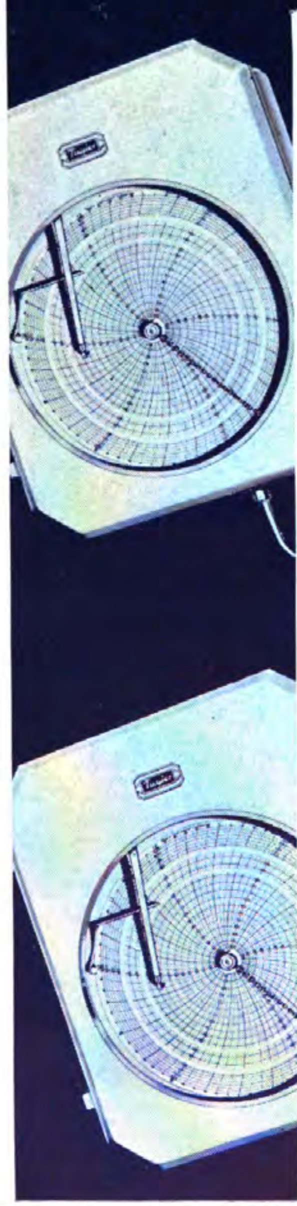
OF THE

International Association of Dairy and Milk Inspectors

INCLUDING PAPERS READ AT THE ANNUAL
CONVENTION IN INDIANAPOLIS, IND.
OCTOBER 12, 13 AND 14,
1933

COMPILED BY
PAUL B. BROOKS, M.D.
Secretary-Treasurer
STATE DEPARTMENT OF HEALTH
ALBANY, N. Y.
1934





THOMAS J. STRAUCH

BORN JULY 10, 1876 DIED FEBRUARY 24, 1934

A member of the Association since 1918
and President in 1924

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TWENTY-SECOND ANNUAL REPORT

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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

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.

International Association of Dairy and Milk Inspectors

OFFICERS 1932-1933

President, HORATIO N. PARKER	Jacksonville, Fla.
First Vice-President, PAUL F. KRUEGER	Chicago, Ill.
Second Vice-President, C. K. JOHNS	Ottawa, Ont.
Third Vice-President, GEORGE W. GRIM	Ardmore, Pa.
Secretary-Treasurer, PAUL B. BROOKS	Albany, N. Y.
Auditors: W. J. WARNER	Hartford, Conn.
F. D. HOLFORD	New York City

COMMITTEES

COMMUNICABLE DISEASES AFFECTING MAN—Their Relation to Public Milk Supplies

John G. Hardenbergh, *Chairman*	Plainsboro, N. J.
Paul B. Brooks	Albany, N. Y.
Leslie C. Frank	Washington, D. C.
Herbert D. Pease	New York City
A. R. B. Richmond	Toronto, Ont.
A. R. Ward	Detroit, Mich.
J. P. Bushong	Los Angeles, Cal.
Ira V. Hiscock	New Haven, Conn.
W. J. Butler	Helena, Montana
F. L. Mickle	Hartford, Conn.

MILK PLANT PRACTICE

H. A. Harding, *Chairman*	Detroit, Mich.
C. Sidney Leete	Albany, N. Y.
William H. Price	Detroit, Mich.
Paul F. Krueger	Chicago, Ill.
H. R. Estes	New York City
A. R. Tolland	Boston, Mass.
J. D. Brew	Albany, N. Y.
H. C. Eriksen	Santa Barbara, Cal.
C. B. Matthews	Miami, Fla.
D. K. Douglas	Regina, Saskatchewan

DAIRY AND MILK PLANT EQUIPMENT

Walter D. Tiedeman, *Chairman*	Albany, N. Y.
W. D. Dotterrer	Chicago, Ill.
Leslie C. Frank	Washington, D. C.
George W. Grim	Ardmore, Pa.
C. Sidney Leete	Albany, N. Y.
W. H. Marcussen	New York City
Nelson M. Fuller	Olean, N. Y.
Fred M. Shields	Jefferson City, Mo.
George W. Putnam	Chicago, Ill.
Malcolm Lewis	Nashville, Tenn.
V. M. Ehlers	Austin, Texas

DAIRY FARM METHODS

Thomas J. Strauch, *Chairman*	Richmond, Va.
George W. Grim	Ardmore, Pa.
Ernest Kelly	Washington, D. C.
James D. Brew	Albany, N. Y.
H. N. Heffernan	New Orleans, La.
Floyd C. Rath	Madison, Wis.
H. B. Switzer	New York City
J. E. Blinkhorn	Salem, Oregon
R. S. Craig	Baltimore, Md.
R. M. Washburn	Milwaukee, Wis.

SANITARY CONTROL OF ICE CREAM

Ralph E. Irwin, *Chairman*	Harrisburg, Pa.
Roy F. Leslie	Cleveland, Ohio
Harold T. Pratt	Philadelphia, Pa.
Horatio N. Parker	Jacksonville, Fla.
Herbert D. Pease	New York City
Thomas A. Buckland	St. Louis, Mo.
A. D. Burke	Auburn, Ala.
F. W. Fabian	Lansing, Mich.
W. H. Price	Detroit, Mich.
R. S. Craig	Baltimore, Md.

MILK ORDINANCES

William B. Palmer, *Chairman*	Orange, N. J.
James D. Brew	Albany, N. Y.
Ernest Kelly	Washington, D. C.
J. H. Shrader	Baltimore, Md.
Malcolm Lewis	Nashville, Tenn.
F. D. Holford	New York City
James A. Tobey	New York City
A. R. B. Richmond	Toronto, Ont.
V. M. Ehlers	Austin, Texas
Leslie C. Frank	Washington, D. C.
H. N. Heffernan	New Orleans, La.

FOOD VALUE OF MILK

Ira V. Hiscock, *Chairman*	New Haven, Conn.
James A. Tobey	New York City
M. O. Maughan	Chicago, Ill.
J. H. Shrader	Baltimore, Md.
G. C. Supplee	Bainbridge, N. Y.
J. B. Hollingsworth	Ottawa, Canada
A. R. Ward	Detroit, Mich.

METHODS OF IMPROVING MILK SUPPLIES IN SMALL COMMUNITIES

C. A. Abele, *Chairman*	Montgomery, Ala.
H. J. Barnum	Ann Arbor, Mich.
N. M. Parker	Jackson, Miss.
W. A. Shoults	Winnipeg, Manitoba
H. R. Estes	New York City
F. P. Wilcox	Los Angeles, Cal.
J. R. Jennings	Louisville, Ky.
Emmett R. Gauhn	Rochester, N. Y.
H. E. Bremer	Montpelier, Vt.
Russell Palmer	Detroit, Mich.

LABORATORY METHODS

*George E. Bolling, *Chairman*	Brockton, Mass.
W. A. Baril	Chicago, Ill.
H. N. Heffernan	New Orleans, La.
A. H. Robertson	Albany, N. Y.
R. L. Griffith	Oakland, Cal.
J. H. Shrader	Baltimore, Md.
*Horatio N. Parker	Jacksonville, Fla.
F. Lee Mickle	Hartford, Conn.
Donald B. Shutt	Guelph, Ont.
H. O. Way	Cleveland, Ohio
*F. P. Wilcox	Los Angeles, Cal.
*H. E. Bowman	Somerville, Mass.
*C. K. Johns	Ottawa, Canada

PUBLICITY AND PUBLIC RELATIONS

George W. Grim, *Chairman*	Ardmore, Pa.
H. A. Harding	Detroit, Mich.
Paul B. Brooks	Albany, N. Y.
James A. Tobey	New York City
M. A. Heinzman	Ventura, Cal.
H. R. Estes	New York City
D. K. Douglas	Regina, Saskatchewan

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

INTER-STATE SHIPMENT OF CREAM

H. E. Bremer, *Chairman*	Montpelier, Vt.
S. L. Pilgrim	Milwaukee, Wis.
William H. Price	Detroit, Mich.
Roy F. Leslie	Cleveland, Ohio
Ralph E. Irwin	Harrisburg, Pa.
C. P. Osgood	Augusta, Me.
W. D. Dotterrer	Chicago, Ill.
C. S. Leete	Albany, N. Y.
C. A. Abele	Montgomery, Ala.
Malcolm Lewis	Nashville, Tenn.
John M. Scott	Gainesville, Fla.
Fred M. Shields	Jefferson City, Mo.
H. E. Erickson	St. Paul, Minn.
Frank C. Wilson	Indianapolis, Ind.
H. B. Switzer	New York City

RESOLUTIONS

H. E. Bowman. *Chairman*	Somerville, Mass.
J. B. Hollingsworth	Ottawa, Canada
Ralph E. Irwin	Harrisburg, Pa.
I. V. Hiscock	New Haven, Conn.
Ernest Kelly	Washington, D. C.
T. J. Strauch	Richmond, Va.
W. B. Palmer	Orange, N. J.
W. A. Shoults	Winnipeg, Canada

SECURING ADVERTISING

F. D. Holford, *Chairman*	New York City
H. R. Estes	New York City
Ralph E. Irwin	Harrisburg, Pa.

MEMBERS

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Harwedel, Wilmer S., Dairy Inspector, No. Ridgeville, Ohio.

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Irwin, Ralph E., Chief Engineer, Division of Milk Supply, State Department of Health, Harrisburg, Pa.

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* Moved. Left no address.

Program

THURSDAY, OCTOBER 12

2:00 P. M.

Joint Session with Section on Food and Nutrition—
American Public Health Association

* *Natural and Induced Variations in the Vitamin Values of Milk*
HENRY C. SHERMAN
Columbia University, New York City

Report of Committee on Food Value of Milk
IRA V. HISCOCK, *Chairman*

Report of Committee on Inter-state Shipment of Cream (I. A. D. M. I.)
H. E. BREMER, *Chairman*

* *Report of Committee on Milk and Dairy Products (A. P. H. A.)*
WILLIAM B. PALMER, *Chairman*

The Quality of Milk Pasteurized by High Temperature, Short-Time and by 30-Minute Holding Methods
M. W. YALE
Agricultural Experiment Station, Geneva, N Y.

Chlorine Sterilizers in Dairies
M. J. PRUCHA
University of Illinois, Urbana, Ill.

Some Observations on Cleaning Dairy Equipment.
J. W. YATES
General Laboratories, Inc., Philadelphia, Pa.

8:00 P. M.

Effect of the Udder on Quality of Milk
M. J. PRUCHA
University of Illinois, Urbana, Ill.

* A. P. H. A.

Streptococci in Milk
W. D. FROST
College of Agriculture, Madison, Wis.

Mechanical Refrigeration
E. H. PARFITT
Purdue University, Lafayette, Ind.

Report of Committee on Communicable Diseases Affecting Man
JOHN G. HARDENBERGH, *Chairman*

FRIDAY, OCTOBER 13

9:00 A. M.

Bacteria Resisting Pasteurization
W. D. DOTTERRER
Chicago, Ill.

Microscopic and Plate Counts of Thermophilic Bacteria in Pasteurized Milk
A. R. WARD
F. O. ADAMS
C. T. McCUTCHEON
Detroit, Mich.

Report of Committee on Milk Plant Practice
H. A. HARDING, *Chairman*

Effective Milk Control
HENRY C. BECKER
Department of Health, Chicago, Ill.

Report of Committee on Dairy and Milk Plant Equipment
WALTER D. TIEDEMAN, *Chairman*

2:00 P. M.

Milk Price Control in New York State
KENNETH F. FEE
Director, State Milk Control Board, Albany, N. Y.

Report of Committee on Sanitary Control of Ice Cream
RALPH E. IRWIN, *Chairman*

Report of Committee on Milk Ordinances
WILLIAM B. PALMER, *Chairman*

An Extensive Test of Variations in Bacteria Counts of Identical Milk Samples
WALTER D. TIEDEMAN
State Department of Health, Albany, N. Y.

BUSINESS SESSION

Will include reports of
Committee on Publicity and Public Relations
GEORGE W. GRIM, *Chairman*

Committee on Resolutions
H. E. BOWMAN, *Chairman*

(No Evening Session)

SATURDAY, OCTOBER 14
9:00 A. M.

ROUND TABLE DISCUSSION

Is a Single Grade of Pasteurized Milk Sufficient?

Affirmative:
GEORGE A. WEST
Department of Health, Rochester, N. Y.

Negative:
LESLIE C. FRANK
U. S. Public Health Service, Washington, D. C.

What are the Essential Requirements for Clean Safe Milk for Pasteurization?

(a) *The Herd:*
VINCENT C. MOYER
Supplee-Wills-Jones Co., Philadelphia, Pa.

(b) *The Farm:*
J. M. LESCURE
Department of Health, Baltimore, Md.

(c) *The Receiving Station:*
GEORGE W. GRIM
Milk Control District No. 1, Ardmore, Pa.

(d) *The Milk Handler:*
VERNE K. HARVEY
State Health Department, Indianapolis, Ind.

Need for Uniformity in Milk Laws and Regulations

(1) *Within a State:*
PAUL B. BROOKS
State Department of Health, Albany, N. Y.

(2) *Between States:*
J. J. REGAN
Dairymen's League Cooperative Association, New York City

The following committee reports, by arrangement with the committee chairmen, will be published in the annual report but not read:

Dairy Farm Methods
THOMAS J. STRAUCH, *Chairman*

Methods of Improving Milk Supplies in Small Communities
C. A. ABELE, *Chairman*

Laboratory Methods
GEORGE E. BOLLING, *Chairman*

REPORT OF COMMITTEE ON FOOD VALUE OF MILK AND MILK PRODUCTS*

IRA V. HISCOCK, *Chairman*

NUTRITION AND ECONOMIC PROBLEMS

THE significance of diet to the health of the individual, especially the child, has become more fully appreciated with the development of modern research in nutrition. Curtailment of children's diets in European countries during the World War was followed by outbreaks of dietary deficiency diseases. But serious undernutrition may result even when such deficiency diseases do not threaten. The American Medical Association points out that, "Prolonged and general underfeeding may often be more insidious in its effects than are specific inadequacies that result in such diseases as scurvy, rickets, and pellagra." (1) (2)

Under the most favorable circumstances, a wise selection of food and the proper feeding of a family requires knowledge and skill. (3) But when every food dollar must bring the greatest return in nourishment and satisfaction, the task becomes more difficult. In the economic crisis, with its resulting reduction in income and employment, the problem of obtaining an adequate diet at a minimum cost has become universal. The U. S. Government Bureaus took the initiative early in the depression period in pointing to the necessity of spending the "food dollar" properly if it were to protect the health of citizens. (4) Other agencies rapidly followed in the

* 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. Ausbacher, 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.

crusade for adequate diets and sounded a warning to nutrition leaders of the consequences of relaxing their vigilance in maintaining dietary standards. From the first, these agencies urged that food money be spent for food that would "feed" not merely "fill" and that the so-called "protective" foods—milk, fruit, vegetables and eggs—be accorded their rightful place in the emergency diet.

Milk an Essential

There is universal agreement that the nutritional needs of people are best served when adequate amounts of milk are used. They agree further that when the food fund is reduced to a minimum, milk should still be regarded as a necessity.* Previous reports of this committee have given conclusive evidence that cows' milk contains the essential food elements in a form which is easily assimilated. It is a most suitable food for consumption by man and indispensable in the diet of infants and invalids. Careful studies of the relative merits of artificial and breast feeding for infants indicate the superiority of the latter. Breast feeding should be encouraged whenever possible. For infants who for one reason or another can not be breast-fed, however, properly modified cows' milk remains the most popular. Furthermore, milk is an indispensable part of the diet of mothers who are carrying or nursing babies, and of young children.

* "Milk does more for the body than any other food, and does it more cheaply. It safeguards the low-cost diet for children and adults." (4c) "Milk is both the cheapest and the surest protection from the nutritional deficiencies which open the way to diseases and life-long injuries to health, happiness and working efficiency." (5) McCollum states that he should recommend first of all "That no cut be made in the milk supply for this winter. Milk is one of the most valuable foods we have and poor families especially need it to maintain health." (6)

Milk an Economical Food

An adequate supply of safe milk is the first essential in planning the food needs of a family. A bulletin prepared in 1933 jointly by the U. S. Children's Bureau and the U. S. Bureau of Home Economics advises that if one has very little money for food, each dollar should be divided in a manner to give one-fourth or more for milk or its equivalent.*

Progressive community leaders, heeding the warning of nutritionists that underfeeding is a health hazard, and disregarding the unsound advice that milk is "expensive," have taken the position that milk can not be considered a luxury when it yields a greater return in food essentials, for money expended, than any other food. On the contrary, they regard it as a wise investment for the present and future well-being of their fellow citizens.

A Community Inventory

A community should periodically take account of stock of its milk consumption. The recent experience of New Haven may be of interest in this connection. The Health Committee of the Chamber of Commerce, early in 1933, secured more precise information regarding milk consumption by thirty-three districts in the city than had previously been available. The fact that an average of only seven-tenths of a pint of milk per person was daily used was a surprise, because it had been anticipated from previous records that the average would be nearer one pint. When the amount of evaporated, dried, and con-

* "Buy: For each child at least 1 pint of milk daily. He *should* have 1½ pints to one quart.

For each pregnant or nursing mother 1 pint of milk daily. She *should* have 1½ pints to 1 quart.

For each other adult ½ pint of milk daily. He should have 1 pint.

Choose the cheapest of the following forms of milk: Pasteurized fluid milk, evaporated milk, dried milk, whole-milk cheese."

densed milk was added, the average was increased to about eight-tenths of a pint.

But even more important than the average milk consumption for the entire city were the figures for certain districts. In only three residential wards was there as much as one pint of milk per person used daily, and in five wards, less than one-half pint was obtained. A large proportion of the children who most needed milk lived in the wards where milk consumption was lowest. The milk consumption was lowest in general in the negro ward and in the wards with a high foreign-born population, especially Italian.*

Economic circumstances may have had some bearing on this situation, although it is recognized that Italian groups are not, as a rule, milk drinkers. Shortly after this study was completed, a standard schedule of relief was jointly adopted by the City Board of Charities and the private relief agencies. It is gratifying to note that this schedule provided for one quart of milk daily for babies and one pint daily for children up to 16 years of age. Here as in many other cities, the Community Chest and school groups, as well as certain dairies, aided in paying for milk for selected school children on the recommendation of school officials. To acquaint the public more fully with the value of milk from an economical as well as a nutritional viewpoint, an educational program, by districts, was inaugurated by the Chamber of Commerce Health Committee through the cooperation of education, health and social agencies and the Connecticut Dairy and Food Council. (7)

* This study was made possible through the cooperation of the health department and the seventy odd dealers who supply milk in the city. Each dealer was given a map of the city divided into districts and was asked to give for each district the average amount of milk being sold there daily. This plan ruled out the inclusion of milk sales in the suburbs. A health department inspector later aided the dealers in checking the data to insure accuracy.

The Young Child Problem

The Child Hygiene Section of the American Journal of Public Health (8) observed the accumulating evidence of serious nutritional disturbances among large numbers of our preschool children. It was suggested that this is the group which is suffering most during the depression, and for whom it is difficult to secure social control to make certain of adequate and balanced ration. Their greatest lack seemed to be in their daily consumption of milk.

During the past year fresh evidence, confirming earlier classic studies, shows that a quart of milk is in general a desirable quantity to be consumed daily. (9) The results of these recent experiments indicate once more that children store calcium more satisfactorily when they are taking about one gram daily (approximately the amount supplied by one quart of milk) than when taking smaller quantities. This fact is particularly significant in light of other recent research which has brought about a new appreciation of the importance of calcium in good nutrition. A child may have a calcium-poor body without giving outward evidence of his condition; he may also be storing calcium, although in inadequate amounts. That many individuals live on the borderline between nutritional success and failure and that their state of nutrition may be improved markedly by addition of milk to the diet has been proved anew. Children of various ages and under different conditions, (10) as well as adults, have been shown to respond favorably to an increased milk intake.

Pasteurized Milk

During the past year considerable attention has been given to problems related to the nutritive values of raw and pasteurized milk. The studies of Frank and coworkers, (11) reported last year, have received favorable comment editorially in the *Journal of the American Med-*

ical Association (12) and in the *American Journal of Public Health.* (13) The latter editorial contains the following statement: "While the desirability of using properly pasteurized milk has been demonstrated repeatedly from the standpoint of public health, questions are raised frequently as to the effect of the pasteurization process upon the nutritive properties of milk. Recent studies substantiate the fact that pasteurization makes practically no change in the food value of milk and that any deficiencies which do occur as a result of pasteurization are easily overcome by proper dietary supplements. These studies show that there is no significant difference in the general growth-promoting powers of pasteurized and raw milk; that the calcium and phosphorus in pasteurized milk are as readily available as in raw milk and that pasteurization does not affect unfavorably vitamins A and G—those vitamins which are contained in milk in liberal quantities."

Krauss (14) and Krauss, Erb and Washburn (15) found that heating milk at 145° F. for 30 minutes in a closed vessel did not affect the vitamins A, G, and D but did destroy at least 25 per cent of the vitamin B originally present. It has been known for some time that pasteurization tended to destroy vitamin C, which is a variable factor even in raw milk, and that milk is a rather poor source of vitamin B.* Pediatricians have recognized these facts and have taken steps not only to supplement any deficiency of vitamin C but also to use vitamin-B-carrying supplements. Krauss and his coworkers also noted that calcium and phosphorus were as readily available in pasteurized milk as in raw milk.

* The effect of pasteurization on the vitamins in milk has been reviewed by Tobey in a paper which is in press at the time of writing this report (*Dairy World,* 1933). See also Safe Milk—Its importance to Public Health—a resumé of present information, National Dairy Council, 1933.

Ellis and Mitchell (16) observed that pasteurization of milk lowered the availability of the calcium for the growing rat, suggesting the destruction of some unknown constituent of the milk which had favored utilization of calcium by the animal body. Under conditions of a severely restricted calcium diet, however, growing rats retained as high as 98 per cent of the calcium consumed. Savage (17) also investigated the nutritive factors in milk which might be affected by pasteurization and concluded that the known changes in cows' milk produced by pasteurization are very slight and that human experiments have not demonstrated that pasteurized milk is less nutritive to the young child than raw milk. "There is a vast mass of clinical experience," he says, "which shows that heated milk has been consumed for years by infants and children without any detectable deterioration in their nutritive condition." Stirling and Blackwood (18) substantiate these conclusions. While reports in favor of raw milk continue to appear, e.g., Andrews, (19) Sprawson, (20) Cohen and Ruelle, (21) Schmidt-Nielsen, Flood, and Stene, (22) and Isaachsen, (23) the great body of evidence indicates that raw milk has no dietary superiority over pasteurized milk. Answers to 17 arguments against pasteurization have been ably presented by Parran. (24)

Special Properties of Milk

Mitchell (25) and Outhouse, (26) in discussing the generally excellent nutritive quality of milk, emphasized the high quality of milk protein, the function of lactose in regulating intestinal flora, the inorganic salts and the vitamins, calling attention to the deficiency of copper and iron and possible deficiencies in vitamins B_1, C, and D and the low energy value of milk. Van Donk, Steenbock and Hart (27) found that a milk-copper-iron diet supplemented with sucrose or milk solids improved growth, ovulation, and reproduction, suggesting a deficiency of solids in milk. Fixsen and Jackson (28) determined the "biological value" of the protein in milk, wheat, and maize and found that in milk to be the highest.

Further work has been done on the effects of metals in reducing the vitamin content of milk. In agreement with Schwartze, Murphy and Cox, (29) Schieblich (30) found that when milk was pasteurized in copper, aluminum or nickel, these metals went into solution in the milk. Copper destroyed vitamin C while aluminum had no effect. Nickel showed no effect on vitamins A, B, and C.

Nevens and Shaw (31) determined the relative digestibility by rats of the milk of Ayrshire, Brown Swiss, Guernsey, Holstein and Jersey cows. No significant differences in digestibility of the whole milk from these breeds of cattle were found. The fat and protein in these milks were about 99 and 91 per cent digestible, respectively. Interesting studies of milk curd have been reported by Weisberg, Johnson and McCollum, (32) Elias, (33) Smyth and Morris, (34) and Hill. (35)

Kline, Keenan, Elvehjem, and Hart (36) found that the addition of 40 per cent of lactose to the rachitogenic diet increased the ash in the bones from 27.5 to 39.7 per cent in experimental chicks. Smaller additions of lactose effected proportionately smaller rises in ash. A lower incidence of rickets in breast-fed infants was ascribed to the high lactose content of mothers' milk. Outhouse, Smith and Merritt (37) recently substantiated the work of Kline and his coworkers. Thus in a diet containing lactose, calcium and phosphorus in the same amount and proportion as found in 30 c.c. of cows' milk, the ash content of the bones was 8 per cent higher than in control animals on the same basal diet, but without lactose.

Under conditions in which the inorganic salts were increased and lactose formed approximately 33 per cent of the ration, the calcifying effect was about 70 per cent as great as that of cod liver oil.*

Krauss, Erb, and Washburn (15) noted that the copper and iron contents of milk were the same before and after pasteurization and that pasteurized and raw milk were equally effective in inducing an anemic condition in rats. Addition of copper to the diet prevented the anemic condition from developing.†

In studying the mechanism of the action of copper in nutrition, Elvehjem and Sherman (40) found that the addition of $FeCl_3$ without copper to the milk diet of anemic rats had no effect on the hemoglobin content of the blood, the iron being stored in the liver or the spleen in proportion to the amount fed. When copper was then substituted hemoglobin was formed at the expense of the stored iron. Consequently the copper had no effect on the assimilation of iron but acted only on the conversion of iron to hemoglobin.

Wallgren (41) analyzed human, cow, and goat milk for iron. Of these three milks, human milk contained the most iron and cows' milk the least.

Milk has also been analyzed for minute amounts of other metals which it might contain. Thus Sato and Murata (42a,b) determined the zinc and manganese content of milk. Blumberg and Rask (43) found that milk

* The mechanism by which lactose exerted this action is not known. That it was not due to the galactose component of the disaccharide was shown by the lack of calcifying action when galactose was fed in another series of animals.

† In this connection Underhill and coworkers (38) have shown that an exclusive milk-iron-copper diet maintained rats in an apparently normal condition for prolonged periods of time. Kemmerer, Elvehjem, Hart and Fargo (39) made similar observations with cows' milk supplemented with $FeCl_3$, $CuSO_4$, and $MnCl_2$, so that each 30 c.c. contained 0.5 mg. Fe, 0.05 mg. Cu and 0.04 Mn. Male white rats gave a daily gain of 3.9 gm. which was as good as that on a stock ration. Pigs reared on mineralized milk plus cod liver oil made as rapid gains as the control fed on the stock ration.

contained zinc but could not definitely demonstrate the presence of manganese by the spectrographic method of analysis which they used. On studying the role of zinc in nutrition, Newell and McCollum (44) concluded that zinc was probably not an essential nutritional factor in the growth of the rat. Blumberg and Rask (43) found one element in milk which has not been previously observed—namely, barium.

Vitamins

Natural and induced variations in the vitamin values of milk have been discussed in a comprehensive report by Sherman.(45) While studying the variation in vitamin content of butter, Baumann and Steenbock (46a) found that vitamin A variations were regular and seasonal. No loss in either component was observed as a result of storage of the butter at 0 ° C. for six months or of irradiation of the milk from which the butter was made. Carotene additions to winter butter in an effort to increase the vitamin A activity up to that of summer butter did not appear to be practical unless the public would be willing to accept a much more highly colored product than it does at present.

Wilbur, Hilton, and Hauge (46b) made comparisons of the vitamin A activity of butters differing widely in color. The Guernsey butters contained 3.6 to 4 mg. of carotene per 100 gm. of butterfat while the Ayrshire butter contained only 1.8 mg. per 100 gm. of fat. The vitamin A activity of these butters was found to be similar regardless of breed of cows or color of the butter. Olson (47) studied the seasonal variation of vitamin D in butter. The vitamin D content of summer butter was substantially higher than that of winter butter.

Cheese

McCammon, Caulfield and Kramer (48) determined the calcium and phosphorus contents of cheese made under controlled conditions. The percentage of calcium in rennet and acid types of cottage cheese was not significantly different. Cheddar cheese, however, contained about 10 times as much calcium as the soft cheeses. The quantity of phosphorus appeared to vary according to the amount of protein in the cheese. Mitchell (49) compared the nutritive value of the protein of cheese and of rennet curd and noted that the protein was slightly less digestible than that of rennet curd. It appeared that cystine was the limiting factor in the further utilization of both the cheese protein and the rennet curd protein.

Casein

Anderson, Shloss and Stuart (50) conducted experiments on the biologic relationship between cows', goats' and human caseins. Experiments in active sensitation revealed that cows', human and goats' caseins sensitized against each other. Anti-cows' casein serums gave positive precipitin reactions to human casein, and anti-human casein serums reacted positively with solutions of cows' casein. These results appear to indicate a close biologic relation between the several caseins and it is possible that this similarity may explain certain difficulties that are encountered in the treatment of allergic states by the substitution of one milk for another.

Sharp and Tomasi (51) have noted that certain creams have greater tendencies to become rancid than others. In parallel with the development of rancidity there was an increase in non-lactic acidity due to the action of lipase. Associated with the greater lipase activity of these creams was a higher chloride content. To prevent the increase in non-lactic acidity and the development of the rancid bitter flavor in stored cream, it was recommended that the cream be heated to 100°–115° F. before separation and that creams high in chlorides be eliminated.

The Processed Milks

Of the thirteen and a half billion gallons of milk produced annually in this country,* approximately 4 per cent goes into the manufacture of the concentrated milks, such as the evaporated, condensed, powdered, and malted.(53) The American people use twice as much evaporated milk as cheese and consume nearly as much of this product as of butter.

Evaporated Milk

During the period from 1929 to 1932 inclusive, there were 25 controlled clinical experiments on the use of evaporated, powdered and condensed milks. According to a review of these investigations by Tobey,(54) 3,800 infants were involved, of whom 2,700 were on evaported milk, 600 on powdered milk, and 500 on condensed milk. No adverse findings were reported in any of these studies, a number of which were outlined in our report for last year.

Kositza, (55) obtained data from 217 normal feeding cases and 17 premature babies and concluded that the average normal baby is able to assimilate evaporated milk as well as or better than cows' milk, either pasteurized or boiled, during the early months of life when milk constitutes the sole food. This author suggests that from

* About 90 per cent of all milk used in the United States is processed in a manner advantageous to the consumer. According to a report issued in 1933 by Frank and Moss of the United States Public Health Service, (52) 87.5 per cent of the milk in American cities of 10,000 or more population was pasteurized in 1931. Effects of pasteurization, from a nutritional viewpoint, have been previously noted.

the standpoint of economy, availability, sterility, uniformity of composition, and easy digestibility, evaporated milk has advantages. The advantages of evaporated milk in cases of allergy and in infant feeding generally have been set forth by Ross, (56) who states that many cases of infantile eczema are relieved by the use of evaporated milk. This physician has likewise advocated evaporated milk for use in the treatment of peptic ulcer, a condition in which a milk diet is indicated. (57).

That heated milks, such as evaporated, are less liable to cause sensitization in persons susceptible to milk has been shown by Lewis and Hayden. (58) Nevens and Shaw (59) studied the digestibility of evaporated and powdered milks in comparison with fresh whole milk and found that fat and carbohydrate were equally digestible in these milks, but that the protein in the fresh milk was more readily digested than that in any of the processed milks. The differences in digestibility of fresh whole milk and of evaporated milk do not fully explain the differences in nutritive properties in the two kinds of milk since the evaporated milk proved superior for growth. Further work must be done before an explanation can be given. No differences in digestibility of total protein, fat, sugar and total solids of spray and roller process milks were found.

Todhunter (60) concluded that pasteurized and evaporated milks were good sources of vitamin G. The diluted evaporated milk was found to contain 300 units per pound and the pasteurized milk 335 units per pound. Jeans and Stearns, (61) studied the growth and retentions of calcium, phosphorus, and nitrogen of infants fed evaporated milk. These retentions proved to be the same as in babies fed an undiluted acidified fresh milk and resulted in good muscular and bone growth. A recent editorial in a medical magazine states that "Here we have, pari passu, about the simplest, frequently the most convenient, one of the cheapest and very nearly the safest of all foods. Simply add sugar and water (in the correct proportions) and serve!" (62)

Powdered Milk

In a clinical study, Lynch (63) compared results of babies fed on powdered whole milk formulæ with those on dried citric acid milk. Both types of milk proved excellent foods for routine use, but the addition of citric acid did not appear to raise the value of the formula. This author points out that milks altered by physical means, as by drying, require less alteration by chemical means as an aid to digestion. In a study of the apparent digestibility of fresh whole milk and powdered milk, Nevens and Shaw found that the fat of both was about 99 per cent digestible, although the protein was somewhat more digestible in fresh milk. (64) Advantages of powdered milk have been discussed by Kimball in a recent review of the nutritional values of this product. (65)

Condensed Milk

A clinical study in which more than 300 babies were given formulæ of sweetened condensed milk, whole milk and water, has been reported by Evans, (66) who believes that the use of condensed milk in this way as a carbohydrate for infant feeding has many advantages. Sugar thus provided is easily digestible, pure, and readily available. As a food for premature infants, condensed milk is useful because of its relatively high carbohydrate content and its ease of digestion, according to Tobey. (67)

Milk With Enhanced Nutritive Properties

The literature dealing with irradiated milk, milks reinforced by additions, and milks the nutritive properties of which have been enhanced by the character of the feed of the cow, has increased rapidly during recent years. The many attempts to modify or control the basic nutritive value of milk have invited comparative appraisals of the specific benefits and practical utility of such procedures. At the present time much interest is centered around the comparative clinical data obtained with milk and such specifics for rickets as cod liver oil and viosterol. Aside from the intrinsic value of such comparative studies, the broader perspective which is presented may prove significant. For some years it has been known that the potency of one antirachitic agent can not be expressed in terms of another and that 35 to 40 rat units of irradiated milk are sufficient to protect infants from rickets, whereas 600 to 800 rat units of irradiated ergosterol are necessary. The establishment of this relationship has not only an immediate and practical utilitarian aspect, but it also suggests the possible importance of the role of prophylactic properties which may be conferred to foods, particularly milk.

In making an appraisal of antirachitics in terms of rat and clinical units, Hess and Lewis (68) found that the antirachitic milks, especially irradiated milk, require a surprisingly small number of rat units (from 35 to 40 daily) to confer protection or effect healing, and that viosterol requires the largest number. They state that irradiated milk seems to be the most desirable antirachitic for prevention on a communal scale. Only 20 to 24 ounces daily is needed to assure protection. This therapeutic agent has the advantage of being automatic and inexpensive and of providing calcium and phosphorus as well as the antirachitic factor. The marked distinction between clinical units and rat units implies that the present method of rating antirachitic agents is misleading. Their respective biologic potencies, as expressed in rat units, are not interchangeable. Each type must be appraised for itself. Its minimal number of therapeutic units must be ascertained clinically and then expressed in terms of rat units. The wide difference in activity between various antirachitics indicate that a clinical as well as a laboratory pharmacology must be taken into account.

Reporting on the prevention and cure of rickets through irradiated milk, Auerbacher (69) states that "Rickets will continue to exist until physicians and parents realize that every child must have food fertile in antirachitic substance." He believes

that irradiated foods, especially irradiated milk, milk being the only food for the baby, stands out as a paramount achievement in the science of nutrition. Bender and Supplee (70) have presented data which indicate that there is no significant destruction of vitamin A in milk containing 1.2 per cent butter fat resulting from direct irradiation with different carbon arcs for periods varying from eight to forty-eight seconds under stated conditions. A biochemical study of irradiated milk (71) carried out by the Department of Agricultural and Biological Chemistry of the Pennsylvania State College revealed that: "There is very little change in the composition of milk due to irradiation. Butter from irradiated milk has a shorter induction period for oxidation than that from non-irradiated milk. The variation in fat constants is slight. Digestion studies in vitro with pepsin and trypsin indicate a slight speeding up of digestion during the early stages of the process. This may be due to a destruction of anti-enzymes by ultraviolet irradiation. Normal irradiation by the method described would likely produce no detectable change in the composition or digestibility of milk.

The influence of the intensity and the character of the radiations on the antirachitic potency of irradiated milk has been studied by Supplee, Beck and Dorcas (72), who state that:

Within a given range, successive exposures to energy as applied under the conditions of these tests result in an increase in antirachitic potency of the milk. This relationship generally holds true irrespective of whether the energy was from screened or unscreened arcs, or reflected radiation only. It may be considered, therefore, that within certain limits the antirachitic potency of irradiated milk is dependent upon the amount of energy applied, provided, of course, the radiations are of sufficient intensity and within the known antirachitic range.

Mitchell, Eiman, Whipple and Stokes (73) studied the protective value for infants of various types of vitamin D fortified milk. The amount of vitamin D by assay and

the protection afforded infants against rickets by irradiated pasteurized milk and by "yeast milk" were found to be equivalent in most respects to the favorable results reported by other investigators. Preliminary investigations of milk from irradiated cows, both by rat assay and by protective and curative experiments on infants would suggest a definite increase in vitamin D potency over the milk from control cows. Twenty infants over a period of 6 to 8 months were protected from rickets by this antirachitic agent alone. One infant in a foundling home and a small number of other infants with definite rickets were cured by this same agent alone. The authors do not regard these data as conclusive until the group of infants has been followed for a longer period. "The rat assay on milk from irradiated cows approximated 22 units of vitamin D per quart of milk. The apparent effectiveness in preventing rickets in infants by such a small number of vitamin D units emphasizes the importance of certain unknown and unmeasured factors in vitamin D fortified milk which deserve further consideration and study."

In the fall of 1932, Hess (74) discussed the rôle of activated milk in the anti-rickets campaign in the following terms:

> Milk can be rendered highly antirachitic by subjection, for a period of merely 16 seconds, to the radiations of certain carbon arc rays, and in the course of this process it does not develop any disagreeable taste or odor nor is it deprived of its essential vitamins. If we would obtain a product which is reliable and constant, it is necessary, as emphasized in an investigation with Supplee and Dorcas, to carry out the irradiation under fully controlled conditions.
>
> In a clinical test carried out during two winters in baby health clinics of the Department of Health in New York, it was established unequivocally that such irradiated milk is able to prevent rickets almost without exception. Indeed, it prevented the development of this disorder in negro infants who are exceptionally susceptible. It should be added that the majority of these infants were under 6 months of age and received three-quarters rather than an entire quart of milk daily. Biologic assays of this milk showed that it did not vary to a great extent in vitamin D content.

Activated milk, in the fluid or dry form, possesses the advantage not only of providing an automatic method of preventing rickets and of supplying this essential factor in a medium rich in phosphorus and calcium, but, as has been shown, it accomplishes this end by means of an exceptionally small amount of the antirachitic factor. In view of these important advantages, I do not hesitate to recommend the general use of such milk for infants and children, especially in large communities. Whether adults, whose bones are growing at a much slower rate, require a supplement of vitamin D to their dietary must be left undecided, to be answered according to the outcome of subsequent investigation. There can be little doubt, however, that the rapidly growing organism requires this factor and that, in the temperate zones, the infant and child do not receive the optimal amount from the radiations of the sun and from the meager supply in the food.

The views expressed by the Committee on Milk and Dairy Products of the American Public Health Association are of interest in illustrating the character of thought which has attended the technical and clinical revelations indicating the possible potentialities presented by the synthesized and controlled prophylactic properties which may be imparted to milk (75). The Committee directs attention to this comparatively new phase of milk, and suggests that practically all public health officials will soon be confronted with the problem of the regulation of such products and, therefore, the necessity for study of this new phase of milk with the purpose of establishing, when practicable, standards, methods, conditions, and regulations to govern them, and the establishment of facilities for enforcement of the same is obviously evident. Caution should be exercised in such a program as products of these types may be and some still are considered in the experimental stage, and scientific progress should not be hindered.

As to the fortification of foods with minerals, the American Medical Association does not recommend the addition of minerals, either to foods in general or to milk. The Council on Pharmacy and Chemistry, on the occasion of its annual meeting, gave special attention to copper-iron compounds. (76) The Committee on Foods of the

American Medical Association also authorized the publication of the following general committee decision (77):

> The fortification of foods other than table salt with iodine or iodine compounds for dispensing additional food iodine to the public and supplementing that naturally present in foods is unnecessary and may lead to excessive iodine intake and endanger public health. Foods so fortified, other than table salt, will not be eligible for acceptance.

The nutritive value of mineralized milk, that is milk to which metals such as iron, copper and manganese have been added, has been studied primarily by workers directly or indirectly connected with the University of Wisconsin. Kemmerer and his associates (78) illustrated the possible importance of mineralized milk in experimental work and indicated that the direct feeding of mineralized milk to experimental animals will undoubtedly inaugurate many new problems worthy of study.

Iodized milk, or milk from areas with a high iodine content of the soil have been the object of many investigations. Hanford, Supplee and Remington (79) showed that the iodine content of milk dried by the atmospheric double roller process is not less than that of milk slowly evaporated to dryness at 60-80° C. after the addition of sodium hydroxide. An average recovery of about 83 per cent was obtained from both milks to which elemental iodine had been added prior to drying. Change of acidity within a range suitable for drying milk by the roller process does not affect the recovery of added iodine. No apparent loss of iodine from dry milk results from storage for as long as seven months.

Remington and Supplee (80) studied the variations in iodine content in the mixed milk of several herds sampled at each of eight different points in South Carolina, at intervals of three weeks, over a period of ten months, (November, 1931 through August, 1932) and dried by roller process. The cattle received only locally grown foods without addition of iodized salt. The average iodine content of the 117 samples was 572 ± 16 parts per billion, dry basis. Averages for two points in the coastal plain (Bamberg 353 ± 18, Cheraw 411 ± 12) were significantly lower than for six points in the Piedmont (Abbeville 712 ± 38, Chester 573 ± 35, Gaffney 548 ± 26, Greenville 744 ± 71, Newberry 545 ± 39, and Winnsboro 684 ± 55). Values obtained in April and May were slightly but significantly lower than for the remainder of the period. During the same period nine samples taken at a commercial milk drying plant in New York, and six samples at one in Wisconsin, averaged respectively 265 ± 24, and 322 ± 22; and seasonal variations were much greater than for the South Carolina samples.

The nature of many investigations noted in this report, and numerous others of a similar character dealing with the constitution of milk from the standpoint of its nutritional and biological properties, suggest that new administrative problems of a technical and official character may be encountered as the worthwhile findings are reduced to practice.

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REPORT OF COMMITTEE ON THE INTER-STATE SHIPMENT OF CREAM

H. E. Bremer, *Chairman*

In presenting this first committee report on this subject, your committee has considered only the movement of sweet cream. This has been done because sour cream shipments interstate are mainly used for butter manufacture and a study of the latter commodity presents entirely different problems than fluid sweet cream used in the retail or ice cream trade.

Due to present conditions and the fact that but a small percentage of the original committee has been able to serve, no attempt has been made to cover the many phases of this problem. It is quite likely that the members responsible for the creation of this committee have had in mind either a cream shipper, who was refused permission to ship into some distant market or some state or municipality desiring to set up a barrier against distant cream. Whatever the intentions may have been at the time this committee was created, we present herewith a brief account of the status of interstate shipments of cream up to the present time and leave to a future committee the work of formulating the recommendations and policies of the association.

The volume of cream moving interstate varies with the demand and supply of cream in the markets where it is consumed. In general there has been a steady increase in shipments interstate. Such cream is often purchased cheaper than a similar product in the local milksheds and consequently dealers have a tendency to purchase the more distant product. This very fact has brought criticism as well as laws and regulations against the importation of cream into local markets. Such regulations usually require inspection, approval and a permit before the product is allowed admission. When health authorities find a sufficient volume of local inspected cream to meet the local needs, without consideration as to its cost, no inspection or permits are given for admission of the more distant product. It is quite evident therefore that the interstate movement is largely dependent upon the economic law of supply and demand with very little relation, if any, to the public health aspect.

DAILY AVERAGE RECEIPTS WESTERN CREAM AT METROPOLITAN BOSTON
FORTY QUART CANS

	1930	1931	1932	1933
January	207	129	591	421
February	252	327	701	681
March	113	368	636	599
April	73	360	561	505
May	151	456	696	831
June	132	262	310	433
July	244	523	637	682
August	211	995	831	1,198
September	287	537	464	——
October	143	344	214	——
November	68	416	556	——
December	71	665	517	——

Annual daily receipts of 40 quart cans of western cream at Boston in 1930 was 162 and in 1931 it was 450. Twelve carloads of western cream were received in Boston one week during September 1933.

Our national government assumes to provide unrestricted commerce, and laws regarding such commerce are such that restrictions are difficult except under health requirements. Many health officials in the East have been somewhat embarrassed during the present economic condition having to restrict interstate shipments of milk and cream by using health regulations in what everyone knows is an unlawful and unjust procedure. The result of such action by health officials will no doubt weaken their prestige in the future and is developing ill will among the State Departments of Health and likewise the State Departments of Agriculture. Whether milk and cream can be continued in interstate movement in accord with a long established policy or whether that movement will be restricted by state or municipal requirements is a matter of vast importance to dairymen in the shipping as well as in the receiving areas.

In considering this subject from a public health standpoint, inconsistencies in the present program are apparent. For example, two states in New England have laws that require the inspection and registration of all dairies producing milk for consumption in those states but make no mention of a similar requirement for cream-producing dairies. Both states import cream from without their borders. Another New England state prohibits the importation of milk from the same dairies where it receives regular cream shipments. What the ultimate result of these practices will be is a matter of conjecture but it is known that retaliation has already occurred in some sections.

New York State requires cream sold in fluid form to come from inspected sources but has found it impossible to inspect sources outside of the normal New York milk shed. Manufacturing cream need not come from inspected sources but must be plainly labeled and handled by licensed dealers.

The state of Washington has issued an order effective October 5, 1933, prohibiting the importation or sale of milk, butter, cheese, ice cream, condensed milk, evaporated milk, buttermilk, or any product made of milk unless the cows that produce these products have been tuberculin tested and are free from other listed diseases. The city of Cincinnati, Ohio, has issued a regulation effective September 1, 1933, requiring that all butter sold within the city shall be made from cream from tuberculin tested cows in officially accredited areas. No mention is made in this regulation of milk, cream, cheese, condensed milk, evaporated milk or buttermilk as is the case in the Washington law.

Your committee is impressed with the lack of uniformity in the laws and regulations covering the movement of milk and cream. While it is admitted that not all of these requirements have been enforced up to the present time, it is quite likely that state or city authorities may attempt such enforcement at any time. This sectional jealousy of home markets is apparently growing if the increase in the number of laws and regulations is taken as an index of the trend of the times. No one can object to a uniform sound basis of control that would safeguard public health. Distance from market today is such a trivial factor in the matter of food conservation that some of the present trade barriers based on distance seem ridiculous.

It is evident that more laws and barriers will be made to restrict the free flow of interstate commerce unless some effort is made in a broad way to standardize the methods of inspection. It is evident further that the public health requirements as they apply to the production of milk and cream on dairy farms, the processing of milk and cream in dairy plants and other related subjects should be practically the same. State legislation could probably not undo what has already been done along this line. Federal legislation, licensing and control has been suggested as a remedy. It seems most absurd for dairy farmers or shipping plants to be inspected by as many as six health officials from as many cities or states. Federal control of interstate cream shipments to be effective must go back to the raw milk and its production in much the same way as is the case under the Federal Import Milk Act now in force. Some authorities may argue the impossibility of such a plan but we must not lose sight of the fact that we have had an efficient Federal Meat Inspection Law since 1906. Under this law the Federal

Government has supervision over the interstate movement of meat and canned meat products. Since Federal control of shipments of meat has proven satisfactory for more than a score of years, is it not feasible to consider milk and cream under a somewhat similar plan?

DISCUSSION

Dr. Harding: I might comment on the surprise I felt when I found in a New England dairy that they were getting their cream for wagon trade from Tennessee as a regular routine. It shows how things are changing. The magnitude of the shipment of cream is surprising. I used to think the limits of transportation sort of controlled these things. Now I don't know where the limit is. Centers in the Mississippi Valley, from Wisconsin and Minnesota south to Tennessee and even down into Texas are being tapped by the Atlantic Seaboard for sweet cream. The interesting thing to me was that this cream shipped from Wisconsin and observed in Philadelphia seemed on the whole to be a rather finer grade of cream, so far as one could judge from casual examination of it, than some originating in the area into which it is imported. This adds to the complexity of the situation.

President Parker: Modern transportation has so widened the circle of operations in our daily life that we are living in quite a different world from what we were two years ago. Mr. Lang, I think you both buy and ship interstate—have you anything to offer?

Mr. Lang: I never knew of the transportation of cream being a factor in its quality. It takes about thirty hours to get to the Eastern Seaboard. This makes it a better bottling cream than if you get it next day. You don't have to go very far now to get good cream but when production is down then you have to reach farther to get it—have to shop around. This movement of shipping cream has increased very rapidly and I think the amount of cream moving into New England was low rather than high for this period quoted.

Mr. W. B. Palmer: This factor of long distance shipment of cream is what has brought about to a great extent the enactment of legislation for the protection of local dairy interests and has led to the establishment of milk control boards in states, particularly in the east. In connection with the facts given by Mr. Lang, I am tempted to ask him how often the cream in these long shipment lots is subjected to high temperature, which may be either pasteurization or its equivalent. I have in mind the fact that regulations usually state milk or cream shall not be repasteurized.

Mr. Lang: I can only give my individual position on that. My policy has always been not to buy cream requiring a second pasteurization and it is not necessary to do it.

President Parker: Mr. Matthews, Miami,—have you any shipped cream in Miami?

Mr. Matthews: At Miami we have increased our production so we are able to take care of all our market milk and cream requirements. However, we do have quite a little cream during the tourist season—January, February and March. We have been inspecting sources of supply since about 1920. I am up here now on an annual inspection trip. I want to compliment these people at Indianapolis on the progress they have made in meeting the various requirements, and when I say various requirements I mean just that. I would like to see some standardization of requirements.

Mr. Strauch: In Virginia, as you know, we have been shippers of cream. We haven't purchased much cream in the last five years. We have a plant in Richmond which does not sell any cream to Richmond, but supplies and redistributes it through the south. They buy in the west and southwest. The counts we have made have been very good. You can purchase a good product outside the so-called inspected sections and I personally do not think there is any great danger in the cream, and I think we ought to be rather liberal in requirements we make for that cream. I think the appointing of the committee was a very good thing and I also think they have got something that is full of dynamite.

Mr. Russell R. Palmer: We don't have any cream shipped in for market purposes from outside of Michigan, but we do certain times of the year for ice cream manufacture. I personally do not feel I have got the personnel to take care of cream, so I put my time on the milk, which is about ninety-eight per cent of the problem, but the situation does bother us. I think there is absolute need for unified standard of requirements on farms, and I don't see why we could not have some standard requirements for all states, and just see that those requirements are observed instead of making routine inspections of every individual plant.

Mr. Jennings: A few months ago we noticed in the trade journals an item, regarding the shipment of milk in commercial quantities from Portland, Oregon, to Manila. It was served there and to the Embassy in China. It was twenty-six days in transit and the report announced that the milk was fine.

Mr. Yates: There is one aspect that has not been touched on that I think is quite pertinent, and that is the economics of this problem. If embargoes are going to be set up in various states, and we seem to be moving in that direction, this problem, as somebody said, is going to be "loaded with dynamite." It is obvious that if Wisconsin is not permitted to ship its dairy products in one form or another into other states, and about one-third of its production is shipped in the form of sweet cream and milk, they can not buy oranges in Florida or door knobs in Connecticut, or other products manufactured in other states. I think that the economics of this problem is one aspect that is not considered as seriously as it should be.

THE QUALITY OF MILK PASTEURIZED BY HIGH-TEMPERATURE, SHORT-TIME AND 30 MINUTE HOLDING METHODS

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DOES high-temperature, short-time pasteurization result in as good a bottle of milk as does 30-minute holding pasteurization? Despite increased economies, short-time pasteurization will not long endure unless this question can be answered in the affirmative.

At the request of the Laboratory Methods Committee of the International Association of Milk Dealers, a critical review of existing knowledge on this subject has been prepared. This review will be printed in full in the Annual Proceedings for 1933 of the Laboratory Section of the International Association of Milk Dealers and reprints will be available.

At the present time, at least six types of short-time pasteurizers are in use in this country for the treatment of market milk supplies. New developments are rapidly taking place. All of the short-time pasteurizers employ a minimum temperature of 160° F. for a minimum holding period of 15 seconds. In five types, the heating medium is hot water and in one type it is electricity. Milk to milk regeneration is used by all. Automatic pump stops prevent underheated milk from reaching the cooler by stopping the flow of milk when the temperature drops to a predetermined minimum.

The things that will be considered in this paper are cream layer volume, flavor, bacterial reduction, destruction of organisms of the *Escherichia-Aerobacter* group, development of thermophilic bacteria and the destruction of pathogenic bacteria.

Cream Layer Volume

Dahlberg and Marquardt (1929) and Marquardt and Dahlberg (1931) found that 30 minutes at 144° F. and 20 seconds at 160° F. were the maximum periods of time that milk could be held without appreciable reduction in the cream layer volume. The time during which the milk was over a temperature of 145° F. during the heating period directly affected the period at which the milk could be held at 160° F. without injury to creaming.

Where good methods are used, there appears to be no significant difference in the cream layer volume of milk pasteurized by either the high-temperature or low-temperature method.

Flavor

Neither high-temperature nor low-temperature pasteurization, when the proper methods are employed, impart a heated flavor to the extent that it is noticed by the average consumer. The average observer probably does not notice a heated flavor until the milk has been heated above 145° F. for 30 minutes or at 160° F. or above for periods of two minutes or more.

Bacterial Reduction

Errors inherent to the standard agar plate count may overshadow genuine differences in the bacterial reduction efficiency of various pasteurizers unless a large number of comparisons are made using split batches of the same milk.

Yale *et al.* (1933) in eighteen comparisons found that the Precision pasteurizer in general yielded slightly higher bacterial counts than did a holder vat. The average count of milk freshly pasteurized at 143° F. for 30 minutes was 17,200 per c.c., while that of milk freshly pasteurized by the Precision pasteurizer was 20,600 per c.c. In the case of the Precision pasteurizer, storage of the bottled pasteurized milk for 24 hours at 40° to 45° F. caused an average reduction in count of 58 per cent. Quinn and Burgwald (1933) in six comparisons found an average count of 35,000 for milk pasteurized by a holder vat and 50,000 for milk pasteurized by an Isotherm pasteurizer. Most investigators have reported satisfactory bacterial reduction with modern types of high-temperature pasteurizers.

Slight differences in bacterial counts are meaningless as far as the quality of the milk delivered to the consumer is concerned. Where the quality of the raw milk supply is satisfactory, bacterial counts of milk pasteurized by the short-time method are meeting public health requirements. Dealers report that the keeping quality of milk pasteurized by the short-time process is excellent.

While reliable information concerning the types of bacteria which survive the heat treatment are not available, we have no reason to believe at the present time that they are different from those surviving the low-temperature process.

Destruction of Organisms of the Escherichia-Aerobacter Group

Studies by the Pennsylvania State Department of Health (1926), the United States Public Health Service (1930), McCrady and Langevin (1932) and others show that in the large majority of cases pasteurization either by thirty-minute or short-time holding destroys the organisms of this group. There appears to be no difference between the two methods in respect to this action.

The Development of Thermophilic Bacteria

In the case of thirty-minute holding pasteurization the development of thermophilic bacteria in pasteurizing

equipment has been a problem of considerable concern especially when the pasteurizing run has continued for more than three hours. The discovery that the development of significant numbers of thermophilic bacteria was largely due to faulty plant practices has gradually brought about their control through good plant practices with the result that this problem is not as serious as at one time.

Yale and Kelly (1933) studied the development of thermophilic bacteria at nine plants in New York and Pennsylvania which were using four different types of short-time pasteurizers. Maximum agar plate counts of thermophilic bacteria per plant ranged between 40 per c.c. and 50,000 per c.c. At seven of the nine plants, the counts of the freshly pasteurized milk were less than 10,000 per c.c. and were therefore of no practical significance. The slight development which occurred took place in regenerative heaters and filters where temperatures were favorable for the development of these bacteria. The number encountered was small compared to the millions sometimes reported for plants using the thirty-minute holding process.

Destruction of Pathogenic Bacteria

There can be no question concerning the safety of milk treated by the modern high-temperature, short-time process. While early studies showed the survival of pathogenic organisms in some cases, improvements have been made in the machinery such that modern types of pasteurizers have rendered milk non-infectious for guinea pigs even when heavily inoculated with pathogenic organisms and subjected to drastic tests by state and federal health authorities.

"When Writing Mention This Report"

Summary

A general summary of existing knowledge indicates that modern high-temperature, short-time pasteurization produces as good a bottle of milk as does thirty-minute holding pasteurization when good methods are used and when other conditions are comparable.

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Discussion

President Parker: This paper by Prof. Yale is most timely. Do I understand correctly that his statements regarding the thermophilic bacteria in the milk are based upon complete counts? If so, what was the median temperature?

Dr. Yale: The plate counts were made on standard agar plates with fifty-five degree incubation. In all cases, however, we checked them by direct microscopic examination. The number of thermophilic bacteria was in all cases too small to permit the use of the microscope and therefore we had to rely on the agar plate method.

Dr. Harding: The point I have been trying to make is that in the presence of large numbers of thermophiles in milk and in some cases checking the direct count against agar plate counts made at high temperature, the agar plates fail to account for a good deal of what was evidenced under the microscope.

CHLORINE STERILIZERS IN DAIRIES

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THE disinfectants of the chlorine group, sometimes called "chlorine sterilizers" are very valuable in sanitation. As an example of their value one may mention the results obtained by the chlorination of the municipal water supplies and the results obtained by treating wounds with solutions of certain chlorine compounds.

These disinfectants are powerful germicides, destroying the germ life in very dilute solutions. They are specially well adapted for the treatment of drinking water and for the sterilization of equipment and utensils which are used for handling of public foods. In the dilutions used they are considered nonpoisonous, and if properly used, the flavor they impart to the food becomes of small importance.

The chlorine sterilizers have one property in common, namely; they all contain a certain amount of chlorine which is loosely held in their molecules. This chlorine is readily given off and is called the available or active chlorine. It is this chlorine that is concerned directly or indirectly in the destruction of the germ life. The sterilizing property of the chlorine disinfectants depends upon, and is measured by the amount of the active or available chlorine present.

There are many commercial preparations offered for sale. They come under all sorts of names. Fundamentally, it is the chlorine in them that is the germicidal agent. All the other ingredients are the vehicle in which the active chlorine is conveyed to the user of the product. Some of the accessory ingredients make the handling of the chlorine convenient. At times they are simply fillers, filling up the space in the containers.

Chemically, the active chlorine is offered for sale in the following forms:

1 *Chlorine gas.* It is a well known article of commerce. It comes in steel cylinders under the term of liquid chlorine, the gas is readily transformed into liquid under high pressure. In this form the chlorine is used for the sterilization of drinking water. It can also be used for the preparation of hypochlorites by dissolving the gas in a solution of some alkali compound.

2 *Hypochlorites.* Practically all the liquid preparations of chlorine disinfectants are sodium hypochlorites. Probably the best known commercial preparation is B-K. Only one known sodium hypochlorite preparation comes in crystals—its trade name is Diversol. There are two hypochlorites of calcium. Bleaching powder and true calcium hypochlorite, commercially known as H T H. The chemical formula for the latter is $Ca(OCL)_2$.

3 *Chloramines.* Two chloramines have been offered for sale. (a) Chloramine T. (b) Dichloramine T. Commercial products Santamine and Sterilac are a Chloramine T.

4 *Mechanical mixtures.* There are a number of commercial preparations such as chloramix, wyandotte sterilizer, H T H 15 and others which are mixtures of alkaline washing powders and one of the chlorine sterilizers.

During the past ten years or so, the use of the chlorine disinfectants has greatly increased. Most dairy plants use chemical sterilization for some purpose. This chemical sterilization is very simple and inexpensive and for certain equipments is better suited than steam or hot water. However, there are certain factors which greatly affect the results and which must be considered if effective sterilization is to be attained.

The paper is in the nature of summary of work extending over a period of twenty years.

The following factors affect the sterilizing property of chlorine sterilizing solutions:

1 Concentration of the chlorine.
2 Time exposure.
3 Temperature of the solution.
4 Nature of the chlorine compound.
5 Sensitiveness of different bacteria.
6 Presence of alkalies in the solution.
7 Presence of organic matter in the solution.
8 Condition of the surface of the utensil.

1 *Concentration of the chlorine in the solution.* There is a difference of opinion as to what causes the killing of the bacteria in the solution of the disinfectant. One theory claims that it is the active chlorine that combines chemically with some ingredient of the bacterial protoplasm, thus destroying it. Another theory claims that it is the nascent oxygen, which is liberated when the chlorine escapes from the molecule of the compound, that kills the bacteria. Whatever the explanation may be, one fact is true, namely, that the sterilizing power of the solution is directly proportional to the amount of the active chlorine in the solution.

The results in Table 1 bring out this point. As the amount of the active chlorine in the solution was increased, the destruction of the bacteria was more complete and in a shorter time.

2 *Time exposure.* Within certain limits, the longer the time of exposure of the bacteria to the solution, the better the sterilization. Solutions of about 100 parts of chlorine to a million parts of water kill vegetative bacteria instantly, a solution of 5 or 10 p. p. m. of chlorine may require several minutes to kill the bacteria.

To sterilize the surface of a utensil, the solution must come in contact with the surface for a certain definite period of time. In dairy operations not enough attention is paid to this, for example, when the solution runs down the surface of the external tubular cooler, it forms a Mississippi river and a few tributary streams and there will be dry islands on the cooler never exposed to the solution or exposed for too short a time.

3 *Temperature of the sterilizing solution.* The influence of the temperature of the sterilizing solution in the range of temperature between 10° and 120° F. has relatively small effect, there being only a slight increase in the sterilizing power of the solution at 120° F. as compared to 70° F. in temperatures higher than 120° F. the heat itself becomes a destructive agent.

4 *Different kinds of chlorine sterilizers.* The most powerful chlorine sterilizer is obtained when the chlorine gas is dissolved in water. Next come the hypochlorites. Chloramines are much slower in their action than the chlorine water or the hypochlorite solutions. There does not seem to be a great deal of difference between calcium hypochlorites and sodium hypochlorites. See Tables 2 and 5.

5 *Different bacteria.* There seems to be a very marked variation in the sensitiveness of the different bacteria to the chlorine sterilization. In the first place the spores are much harder to kill than vegetative forms. See Tables 2 and 4. Brucella melitensis is very sensitive to chlorine. Typhoid bacteria and coli bacteria are also sensitive to chlorine. Staphylococcus aureus is much more resistant. In general the gram negative organisms are more easily destroyed than the gram positive organisms.

6 *Presence of alkaline compounds.* A solution containing chlorine gas in water is very unstable. When chlorine gas is dissolved in a solution of some alkaline compound, such as sodium hydroxide, sodium carbonate or trisodium phosphate, the sodium unites with the chlorine to form sodium hypochlorite. To make the sodium hypochlorite more stable an excess of the alkaline compound is used.

The commercial preparations vary in the amount of the alkali. There are also on the market mixtures of some hypochlorite or chloramine with a washing powder. The sterilizing solutions made from such preparations will contain a certain amount of the alkali.

The effect of the alkali in the sterilizing solution upon its sterilizing property may be seen in Table 3. In general the presence of the alkaline compound in the sterilizing solution retards the sterilizing property of the solution.

Expressed on percentage basis by weight, sodium hydroxide causes greater retardation than does sodium carbonate or trisodium phosphate. We found practically no difference between the last two mentioned compounds. It should be added that the influence of the presence of alkalies in the sterilizing solutions is more pronounced with the chloramines than with the hypochlorites.

7 *Presence of organic matter.* Any organic matter in the sterilizing solutions very greatly interferes with the destruction of germ life. This is well illustrated in Table 4, where milk was added to the solutions. It seems that the active chlorine combines with the organic matter and the content of the chlorine is promptly reduced. There is also some evidence that the active chlorine that does not combine with the organic matter is not as efficient. The amount of inoculum also effects the sterilizing property of the solution.

The effect of organic matter on the sterilizing property of the chlorine solution is well illustrated when the standard method for Phenol coefficient is used. In this method ½ cubic centimeter of broth culture is added to 10 cc. of the solution. About two to five times as much chlorine is necessary to obtain a complete sterilization as when a bacterial suspension in water is used.

8 *Condition of the surface.* A smooth and clean surface is easily sterilized when it comes in contact with the

solution. Rough and pitted surface is very difficult to sterilize.

Discussion

The Chairman: I would like to ask you a question, Prof. Prucha. Is there any possibility that by the use of chlorine disinfectants a milk plant or some utensils in it might come to be infected with spores?

Professor Prucha: When there are spores you will have a hard time to kill them with chlorine. We don't have any means in general in a dairy for killing of spores. Steam, live steam, hot water, which are sometimes used, and things of that kind do not kill spores any more than chlorine does. Chlorine will kill spores if you have it strong enough—three hundred parts per million exposed for twenty minutes will kill some.

Table 1—Effect of the Amount of Active Chlorine in the Sterilizing Solution
(Organism—Staphylococcus Aureus)

PPM. of Chlorine	Time of exposure									
	5″	10″	20″	30″	1′	2′	3′	5′	10′	20′
10	+	+	+	+	+	+	+	±	−	−
28	+	+	+	+	+	±	−	−	−	−
42	+	+	+	±	−	−	−	−	−	−
53	−	−	−	−	−	−	−	−	−	−

Table 2—Effect of Chlorine Disinfectants on Spores of Thermophiles

Temperature 70° F Organism No. 12

Minutes Exposure	Diversal			B-K			Santomine			Control
	50 ppm	100 ppm	300 ppm	50 ppm	100 ppm	300 ppm	50 ppm	100 ppm	300 ppm	
1	++	++	++	++	++	++	++	++	++	++
5	++	++	++	++	++	++	++	++	++	++
10	++	++	++	++	++	++	++	++	++	++
20	++	++	++	++	++	++	++	++	++	++
30	++	++	++	++	++	++	++	++	++	++

Temperature 100° F Organism No. 12

Minutes Exposure	Diversal			B-K			Santomine			Control
	50 ppm	100 ppm	300 ppm	50 ppm	100 ppm	300 ppm	50 ppm	100 ppm	300 ppm	
1	++	++	++	++	++	++	++	++	++	++
5	++	++	++	++	++	++	++	++	++	++
10	++	++	++	++	++	++	++	++	++	++
20	++	++	++	±	+	−	++	++	++	++
30	++	++	++	−	−	−	++	++	++	++

Temperature 120° F — Organism No. 8

Minutes Exposure	Diversal			B-K			Santomine			Chlorine*			Control
	50 ppm	100 ppm	300 ppm	50 ppm	100 ppm	300 ppm	50 ppm	100 ppm	300 ppm	50 ppm	100 ppm	300 ppm	
1	++	++	++	++	++	++	++	++	++	++	++	±	++
5	++	++	++	++	++	++	++	++	++	−	−	−	++
10	++	++	+	++	++	++	++	++	++	−	−	−	++
20	++	++	+	++	++	−	++	++	++	−	−	−	++
30	++	+	+	++	±	−	++	++	++	−	−	−	++

Temperature 170° F — Organism No. 8

Minutes Exposure	Diversal			B-K			Santomine			Chlorine			Control
	50 ppm	100 ppm	300 ppm	50 ppm	100 ppm	300 ppm	50 ppm	100 ppm	300 ppm	50 ppm	100 ppm	300 ppm	
1	++	++	++	++	++	+	++	++	++	++	+	−	++
5	++	++	++	++	−	−	++	++	++	−	−	−	++
10	++	++	+	+	−	−	++	++	++	−	−	−	++
20	++	++	±	−	−	−	++	++	++	−	−	−	++
30	+	+	−	−	−	−	++	++	++	−	−	−	++

* Chlorine gas dissolved in water.
++ No reduction from check.
+ Reduction approximately half of check.
± Less than 25 colonies per plate.
− No growth.

Table 3—Effect of Alkalis on Sterilizing Action of Chlorine Disinfectants
Solutions Contained 20 ppm of Active Chlorine

\+ = bacteria survived Organism = staphylococcus aureus
− = bacteria killed
± = uncertain

Trisodium Phosphate

Minutes exposure	Per cent						
	0.0	0.02	0.05	0.1	0.2	0.5	1.0
½	−	−	−	+	+	+	+
1	−	−	−	+	+	+	+
2	−	−	−	−	−	+	+
5	−	−	−	−	−	−	+
10	−	−	−	−	−	−	+
20	−	−	−	−	−	±	±

Sodium Carbonate

Minutes exposure	Per cent						
	0.0	0.02	0.05	0.1	0.2	0.5	1.0
½	−	+	+	+	+	+	+
1	−	−	±	+	+	+	+
2	−	−	−	−	+	+	+
5	−	−	−	−	±	+	+
10	−	−	−	−	±	±	−
20	−	−	−	−	−	−	−

Sodium Hydroxide

Minutes exposure	Per cent						
	0.0	0.02	0.05	0.1	0.2	0.5	1.0
½	−	+	+	+	+	+	+
1	−	+	+	+	+	+	+
2	−	+	+	+	+	+	+
5	−	+	+	+	+	+	+
10	−	+	+	+	+	±	±

Sodium Hydroxide (No Chlorine)

Minutes exposure	Per cent					
	0.02	0.05	0.1	0.2	0.5	1.0
½	+	+	+	+	+	+
1	+	+	+	+	+	+
2	+	+	+	+	+	+
5	+	+	+	+	+	+
10	+	+	+	+	±	±

Table 4—Effect of the Presence of Organic Material in the Sterilizing Solution
(Milk in Sterilizing Solution)

Solution	Cl_2 per 1,000,000	Conc. milk %	B. coli exposed to following minutes							Staphlococcus exposed to following minutes						
			½	1	2	5	10	15	20	½	1	2	5	10	15	20
	20	0.1	++	++	++	++	++	++	+	++	++	++	++	++	++	+
		1.0	++	++	++	++	++	+	+	++	++	++	++	++	++	++
		5.0	++	++	++	++	++	++	++	++	++	++	++	++	++	++
	50	0.1	++	+	+	+	±	±	−	++	++	++	++	++	+	±
		1.0	++	+	±	−	−	−	−	++	++	++	++	++	+	+
		5.0	++	++	++	++	++	++	++	++	++	++	++	++	++	++
	100	0.1	−	−	−	−	−	−	−	+	+	±	±	±	−	−
		1.0	−	−	−	−	−	−	−	+	+	+	±	±	−	−
		5.0	++	++	++	++	++	++	++	++	++	++	++	++	++	++

Table 5—Sterilizing Property of Different Chlorine Disinfectants

Organism: E. coli

Time: seconds"—minutes'

ppm Chl.	5"	10"	20"	30"	1'	2'	3'	5'	10'	20'
B-K										
18	+	-	-	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-	-	-	-
57	-	-	-	-	-	-	-	-	-	-
71	-	-	-	-	-	-	-	-	-	-
Diversol										
20	+	+	+	+	+	+	-	-	-	-
35	+	+	-	-	-	-	-	-	-	-
50	+	-	-	-	-	-	-	-	-	-
61	-	-	-	-	-	-	-	-	-	-
75	-	-	-	-	-	-	-	-	-	-
Sterilac										
17	+	+	+	+	+	+	+	+	+	-
30	+	+	+	+	+	+	+	+	*	-
45	+	+	+	+	+	+	+	+	*	-
59	+	+	+	+	+	+	+	*	-	-
72	+	+	+	+	+	+	+	*	-	-

Organism: Streptococcus lactis

Time: seconds"—minutes'

ppm Chl.	5"	10"	20"	30"	1'	2'	3'	5'	10'	20'
B-K										
17	+	+	+	+	+	*	*	*	-	-
30	+	+	+	+	+	*	*	*	-	-
45	+	+	+	+	*	*	-	-	-	-
59	+	+	+	+	*	±	-	-	-	-
72	+	+	+	-	*	-	-	-	-	-
Diversol										
20	+	+	+	+	+	+	+	*	*	-
35	+	+	+	+	+	+	+	*	*	-
50	+	+	+	+	+	+	*	*	-	-
61	+	+	+	+	+	+	*	*	-	-
75	+	+	+	*	*	*	-	-	-	-
Sterilac										
18	+	+	+	+	+	-	*	*	-	-
35	+	+	+	*	*	*	*	*	-	-
50	+	+	+	*	*	*	*	-	-	-
57	+	+	+	*	*	*	-	-	-	-
71	+	+	*	*	*	-	-	-	-	-

EFFECT OF THE UDDER ON QUALITY OF MILK

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IN ONE community the milk as it is received at the milk plants is graded and dairymen are paid for the milk according to the grade. This has greatly stimulated the interest in quality milk production. Each dairyman wants to receive the bonus for grade A. When their milk is graded lower they seek help and are anxious to follow suggestions in order to get the premium. The milk at one time was tested five times a month. For each test of grade A the dairyman gets five cents a hundred. For each test of grade C he is cut seven cents per hundred from the base price.

The method used for grading was the methylene blue test. Milk that did not reduce the color in 5½ hours was grade A. Milk that did not reduce in 2 hours but did in 5½ hours was grade B and milk that reduced in 2 hours was grade C.

In a number of instances the dairymen followed our instruction faithfully and eagerly, but still they received a low grade. These observations lead to this study.

The procedure of the study was as follows: the milk was drawn from each quarter into a sterile large test tube. The samples were taken to the laboratory and were subjected to three tests;

1 Standard plate count method
2 Methylene blue test
3 Direct count method

About 1,800 cows were examined up to date, making 7,200 samples. These cows represented about 250 dairy farms. In addition to these samples, weekly tests were made of one herd consisting of forty-seven cows. These samples are being taken throughout the entire lactation period of each animal.

1 *Results by plate method.* There were seventy-two cows, which was 4 per cent, that had one or more quarters giving milk with 10,000 or more bacteria per cubic centimeter. The udders with pathological disturbances frequently gave count between 10,000 and 50,000 bacteria per cubic centimeter. Occasionally the milk from diseased udders had a very low count, in a number of instances less than 100 per cc.

Most of the samples of freshly drawn milk from the udders had less than 1,000 bacteria.

The agar used for this purpose contained one per cent of milk sugar.

A question has often been raised as to the significance of large numbers of bacteria in freshly drawn milk, which bacteria come from the interior of the udder. Our opinion is that the large numbers indicate some pathological condition of the udder.

2 *Methylene blue test results.* There were 396 cows, which was 22 per cent, that gave milk from one or more quarters which reduced methylene blue in less than 5½ hours. There is a strong evidence that when freshly drawn milk without external bacterial contamination, reduces methylene blue in less than five hours, the milk is abnormal and in most cases there is some pathological conditions in the udder. In a few instances milk which was decidedly gargety did not reduce in five hours.

According to a rough estimate about 75 per cent of the udders having some pathological disturbances were detected by the methylene blue test.

3 *Direct count method.* Normal milk was arbitrarily defined as milk that has less than 2,000,000 body cells per cubic centimeter and that has no detectable streptococci or staphylococci in the milk.

In only twenty samples of the milk was the presence of streptococci and staphylococci demonstrated. This is only 1.1 per cent of the cows. Five hundred seventy-six cows had one quarter or more which gave milk containing 2,000,000 or more of leucocytes.

There has been a difference of opinions as to the significance of leucocytes in milk. Our opinion based on circumstantial observations and on laboratory tests lead to the conclusion that 2,000,000 or more of leucocytes in the milk indicates some pathological condition in the udder and that such milk is abnormal and should not be used for fluid consumption.

A cow's udder is a delicate organ, subjected to hard work and it is to be expected that pathological disturbances in the udder may occur. Our study indicates that this is quite prevalent. Streptococci or staphylococci can not always be detected in the milk from affected udders. They may have come and have gone, leaving the imprints of their presence. There are probably some other causes of these pathological disturbances.

A herd that is being treated roughly is apt to have pathological udders. There is also an indication that some milking machines operated by some men cause disturbances in cow's udders.

In our strivings to bring about the production of high quality milk, the cow's udder has not received due consideration. There are too many cows that supply milk for fluid consumption which should not be used for that purpose. Milk loaded with several million of leucocytes is not "high quality milk."

Discussion

Dr. Harding: The way I understand it, you say that in one and one-tenth per cent of the cases the organisms showed on the smear, but reports I have received from tests in milk plants seem to show that only a small percentage of the samples of milk will show streptococci on smears unless incubated. I take it they were not incubated?

Professor Prucha: They were not.

Dr. Harding: You will get some on the raw milk which you will not get on the other?

Professor Prucha: Yes.

Dr. Harding: One more question—in those cases where you did find streptococci did you go back to the cow and find out whether there was any induration in the udders?

Professor Prucha: These include some cows which would be excluded on physical examination.

President Parker: Were these all hand milked cows?

Professor Prucha: No, there were some milking machines.

President Parker: Did you find any bad conditions where milking machines were used?

Professor Prucha: Yes. It is rather a delicate matter to say anything against milking machines.

President Parker: I am not saying anything against them. I believe you can get just as good results with milking machines as with hand milking, but I was wondering whether through mismanagement of the machines or anything of that kind the cows were "not contented"—put it that way.

Professor Prucha: I believe, from our records, that the milking machine may be a mischievous thing where there is udder trouble. It can be corrected if the man knows how to use it and if he knows cows, but in some cases there is no doubt the machines had something to do with it.

STREPTOCOCCI IN MILK

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Introduction

IT IS well-known that market milks, both raw and pasteurized, usually contain streptococci. These streptococci, with the exception of *S. lacticus,* come from within the cow's udder, and not from the exterior.

Numerically, they may be few or many. They vary in kind and in a general way may be regarded as bovine in nature and differentiated by certain characteristics from the human types. But the human types may also be present occasionally. It was this possibility that led the Chicago Board of Health to urge the Medical Milk Commission of the Chicago Medical Society to undertake investigational and control work on the certified milk supply of their city. This work, which has been in progress some eight years, had as its primary purpose, the detection and elimination, from the herds concerned, of cows shedding streptococci, that might be possible causes of milkborne disease.

Herds Examined

At first the herds examined, consisted of five certified milk herds near Waukesha, Wisconsin. Later, three other certified milk herds, one in Indiana, and two in Illinois, were included and more gradually and less systematically, four other herds have been examined. One was the University of Wisconsin herd, another a small herd near Madison, and the other two herds were at Fort Atkinson, Wis. These herds have varied a great deal in size, breed of cows and source and proportion of replacements. Some of the smaller herds have been maintained by the introduction of calves raised on the place, and in the others, and usually in the larger herds, replacements have been bought in. On all farms, the care and surroundings of the cows have been exceptionally good. The samples from the certified milk herds have been examined at monthly intervals. The examination of the milk from the other herds has been somewhat sporadic, but never undertaken because of mastitis or other diseases.

In regard to the size of the herds, one had about 350 cows, another slightly less than 300, two were quite small, in the neighborhood of 30; another one was about 40 cows, while the others contained from 80 to 180 cows.

Methods Used

There have been two kinds of samples taken, individual samples, and the group or composite samples.

The group samples were taken solely for the reason that it was not possible, with the facilities at hand, to test the necessary number of individual samples. The group samples were obtained by a representative of the laboratory who visited the farm, carrying the necessary number of sterile bottles. These were ordinary two-ounce vaseline bottles into which cork stoppers were fitted. Over this, a cover was tied, made up of two layers of cheesecloth, between which there was a layer of wrapping paper. This permitted the cork to be removed, handled, and replaced without the hand coming in touch with the cork itself. The cover was held in place during sterilization in a hot air oven by means of a noosed cord which was replaced by a rubber band when they were put into the cases. The carrying cases were made of insulating material such as celotex in the form of a suitcase into which two metal trays were fitted, one above the other. These trays were divided into three parts, with the center part for ice. The case held forty-eight bottles. It has been found by experience that milk samples will keep cold even in the warmest days of summer for four or five hours in such cases. Each bottle has pushed into the cork an upholstery tack on which has been painted a number so that labeling is unnecessary. The bottles are filled by taking one stream of milk from each quarter of ten cows. Usually, it is the second stream, the first being discarded. The neck band, stall or the ear tag-number is recorded for each cow of the group on a blank provided so that a record of the cows contributing to the sample in each bottle is available, one for the farm and the carbon for the laboratory. The samples from the Wisconsin farms are taken to the laboratory, directly, and plated either immediately or in case the samples arrived late in the day, they may be kept in a refrigerator and plated the next morning. The samples from the smaller farms and those at a greater distance are frequently sent through the mail. In this case, the container has a much larger proportion of ice than the carrying cases, and they are sent "Special Delivery," and usually "Special Handling," which insures the cases being kept upright and handled carefully.

These group samples are plated by introducing 1 cc. of milk into a 20 cc. water blank, made from tap water. One cc. of this dilution is placed in petri dishes to which is added a special veal agar and about 6 per cent of defibrinated horse blood.

The plates are incubated for forty-eight hours when the final examination is made. They are usually looked over at the end of twenty-four hours, and in case the dilution is insufficient, the particular sample may be replated from the milk which has been kept in the ice box. All of the hemolytic streptococci are picked into broth, incubated over night and then stained, and if the organisms are streptococci, and the culture is pure, the hemolytic titre is determined by the use of rabbit blood according to the United States Army method. Those strains having a high hemolytic titre, or, as we say, hemolyzed in the test tube, are further studied to determine whether or not the organism possesses a capsule by the India ink method. Those cultures which ferment dextrose, pH 4.9 to 5.8, lactose and salicin but not mannite and do not hydrolyze sodium hippurate are regarded as belonging to the human type. If they possess capsules, they would be *Streptococcus epidemicus,* the cause of septic sore throat; and if they do not, they would be *Streptococcus pyogenes,* the possible cause of scarlet fever. In addition to these characters, we have come to place quite a little emphasis on the type of colonies produced in the original plate, or sometimes, we replate the cultures on blood ascites agar as suggested by Pilot and Davis in order to obtain colonies for restudy. As we become more and more acquainted with the colony characteristics, we have come to feel that a considerable amount of knowledge in regard to the identity of the organism can be obtained from the colonies alone.

Kind of Streptococci

The original purpose of this work, as previously indicated, was to detect the presence of streptococci that were regarded as dangerous to human health, but as the work has progressed, we have tried to determine the identity of the entire streptococci flora of the milks examined, and for the sake of convenience in the further discussion of the entire flora, we propose to divide the streptococci studied into three great groups. Group 1 is what we call the *strongly hemolytic streptococci.* They form clear and frequently wide zones of hemolysis about the colony on the blood agar plate and hemolyze rabbit blood quickly in the test tube. They correspond to the beta hemolytic streptococci of Smith and Brown. Group 2 is also of the beta type of hemolysis, but they fail to hemolyze rabbit blood in the test tube. These we call the weakly hemolytic or *pseudo-hemolytic streptococci.* Group 3 does not produce colonies with clear zones about them, but the red blood corpuscles in a small area surrounding the colonies are changed to green, if any change is produced. Sometimes there is no visible effect on the agar. This group is referred to by different authors as *non-hemolytic, viridans, alpha, gamma,* etc.

Numerical Results

We have examined in the course of this work, 10,621 group samples, and have found beta hemolytic streptococci in 5,045, or in 47 per cent of the samples. Of the 5,045 samples, 1,459, approximately 12 per cent, were found to be strongly hemolytic streptococci. This does not, of course, represent the quantitative differentiation of these organisms in the herds since only one of the ten cows making up the sample might be shedding streptococci. We have however examined 1,825 individual samples and have found beta hemolytic streptococci in 165 of these, or in 9 per cent. Of the 165 hemolytic streptococci isolated, forty-eight hemolyze in the test tube or 2 per cent. In regard to the weakly hemolytic or pseudo-hemolytic streptococci, in the total number of samples analyzed (10,621) 3,586 of the beta hemolytic strains isolated would be classified as pseudo-hemolytic streptococci because they fail to hemolyze in the test tube. These streptococci were found therefore in 34 per cent of the samples. In the individual samples, 117 pseudo-hemolytic strains were found in a total of 1,825 samples or in approximately 6 per cent. In regard to the number of hemolytic streptococci present in the samples, it may be said that in 3,067 of the 5,045 group samples containing beta hemolytic streptococci, the number was less than 1,000. In the 1,678 samples, it was between 1,000 and 10,000; in 265 samples, the numbers were between 10,000 and 100,000. In twenty-four samples, the number was between 100,000 and 1,000,000. Eleven samples contained over 1,000,000.

Finally in regard to the non-hemolytic or alpha streptococci, as already pointed out, the typing has been much less extensive than with the hemolytic streptococci, but we have a record of 3,871 samples examined in which 1,548 or 40 per cent were found to contain alpha or non-hemolytic streptococci.

Qualitative Results

There are a number of different kinds of hemolytic streptococci that are frequently found in milk, and it seems desirable to briefly discuss the different forms or species that occur. The classification of streptococci is, as all know, a moot question since there is a great deal of difference of opinion among authorities in this group as to the relative value of different means of separating them. The problem which everyone who considers this subject has to contend with is what criteria to use and their relative value or the order in which they should be applied. It is the belief of the present authors that the action of streptococci on blood is a character of primary importance, since it not only indicates but separates between species and is readily applied, and the results obtained are quite striking. It is generally recognized that Schottmüller was the first to call attention to the action of different streptococci on blood agar plates, and he divided streptococci into the hemolytic and the non-hemolytic groups. Smith and Brown suggested for the designation of these groups, *beta* and *alpha*. Brown studied the non-hemolytic or alpha group more thoroughly and suggested other groups which he called *alpha prime, gamma* and *delta,* in addition to the alpha proper. In this paper we have not followed Brown in detail but have preferred to use as our major divisions the hemolytic and non-hemolytic groups only. We would not want to be interpreted as denying the value of these subdivisions of the non-hemolytic group, but we believe that they are criteria of minor importance.

Human Hemolytic Streptococci

Considering the hemolytic group first, we have subdivided these into the strongly hemolytic and the weakly hemolytic, although we regard this division in all probability purely artificial but useful in a practical way because it enables us to quickly eliminate a large number from further study. Under the strongly hemolytic streptococci, we make a further division into the human type and the bovine type. This differentiation is made largely on two characteristics:—one is the action on sodium hippurate and the other difference is in acid production; the bovine types hydrolyze sodium hippurate, the human forms do not, and the bovine types produce more acid from dextrose than the human type.

Under the strongly hemolytic betas of the human type, we find in milk, two species, *S. pyogenes* and *S. epidemicus.*

Streptococcus pyogenes is typically found in man, but occasionally occurs in milk. In the 12,446 examinations, we have found it eighteen times. But just what its significance is, we have not been able to determine, and in recent years, we have not found it at all. It is entirely possible that this organism may be the cause of scarlet fever. In one or two instances we have made some effort to associate it with the scarlet fever streptococci but with indifferent success. *Streptococcus epidemicus* has been found ten times in the 12,446 examinations. It has been found eighty-eight times in samples sent to the laboratory by veterinarians because of serious udder trouble in herds.

These two species differ from each other largely in the fact that the *S. epidemicus* is an encapsulated form and also that it produces the characteristic giant colonies on blood agar plates rich in serum, as pointed out by Davis and his coworkers.

This organism was first associated with milkborne epidemics of septic sore throat by Davis in 1912. The possibility of the presence of this organism in raw milk was the stimulation for this research. It is proposed to devote a special paragraph to this organism later, and we therefore pass at this point to consider the bovine types of beta hemolytic streptococci found in milk.

There are three bovine species that are quite frequently found in milk. The first and most common hemolytic streptococcus in this group is *Streptococcus mastitidis.* We have found it 654 times in the 12,446 samples or approximately 5 per cent of the samples. This species is similar in its reactions to *S. pyogenes,* on the blood agar plates and in its fermentative reactions except in the following particulars: The colonies on blood agar plates are surrounded by a narrow zone of hemolysis which is quite clear and practically free from red corpuscles, thus differing from *S. pyogenes* largely in having a narrower zone of hemolysis. It is a high acid producer usually producing a pH of 4.5 to 4.8 in dextrose broth. It ferments lactose, saccharose and salicin, but does not ferment mannite. It hydrolyzes the sodium hippurate. This organism is very evidently the cause of mastitis in cattle although it appears to be entirely absent from many herds. In reviewing a recent article by Dr. Hadley and myself, Roselle has taken exception to the use of the name of *mastitidis* for this organism. He seems to regard this organism as identical with the alpha streptococcus which we later discuss under the term *mitis.* It seems to

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us, however, perfectly clear that there are two streptococci, one a beta and the other an alpha, which are associated with mastitis, and that the difference between these two organisms is striking enough to give them separate specific standing. Whether the name *mastitidis* should be used for the beta form or the term *agalactiae*, is a matter for systematists to decide, but we prefer to retain with Bergey, the name *mastitidis* until the two organisms have been more thoroughly studied and their names established according to the bacteriological code applying to nomenclature.

Another organism that is found quite frequently is *Streptococcus infrequens.* Its colony is quite characteristic on the blood agar plate. The colony itself is very tiny, while the zone of hemolysis is large and clear. It ferments mannite as well as the other test substances mentioned above. Its action on sodium hippurate varies. As indicated above it is a common organism in the milk especially of certain herds. We have found it 573 times in the 12,446 analyses.

Another streptococcus belonging to this group is *Streptococcus asalignus.* This organism has been found 145 times in 12,446 analyses. It corresponds very closely in all its characteristics to the streptococcus found in human pathology and known as *S. anginosus.* The most striking characteristic of these organisms is their inability to ferment either mannite or salicin. The two organisms, *S. anginosus* and *S. asalignus* are differentiated by their action on sodium hippurate. *S. anginosus* does not hydrolyze sodium hippurate and therefore is grouped with the human type, while *S. asalignus* does hydrolyze sodium hippurate and falls in the bovine group. There are a few other beta streptococci that have been found a few times in milk samples as *S. equi* (4), *subacidus* (2), and *hemolyticus i* (2).

Pseudo-hemolytic Streptococci

Turning now to the weakly hemolytic or low-titre, beta streptococci, we find that these are very common in our samples, 3,703 strains having been found in the 12,446 analyses. Little detailed work has been done on this group, aside from the researches of Dr. Edith Haynes who worked in our laboratory and Cumming who worked in England on the pseudo-hemolytic streptococci isolated from the sputum in pulmonary tuberculosis. Miss Haynes studied a hundred and thirty strains of this group and found that most of them corresponded very closely to the *S. mastitidis* although there were a few that resembled *S. infrequens* and *S. asalignus.* It would seem to us that the probability is that this group has little, if any, taxinomic significance. They are in other words, weakly hemolytic strains of *S. mastitidis, S. infrequens,* and *S. asalignus,* and have been separated off from them in a perfectly arbitrary way by the application of the U. S. Army or test tube, test for hemolysis. If they are to be separated at all, they should be regarded as varieties of *S. mastitidis* and *S. infrequens* and *S. asalignus.*

Non-hemolytic Streptococci of Milk

Turning now to the non-hemolytic streptococci, it may be said that they are somewhat more common in milk than the hemolytic streptococci, but we did not pay much attention to this class of organisms at first and made no effort to type them because we had no evidence that these non-hemolytic streptococci were important in public health work. It was only when we became interested in the relation of streptococci to bovine mastitis that we began to realize the importance of this group of organisms in milk since it is the non-hemolytic streptococci that are of prime importance in this disease. We have classified these organisms by means of the same test substances that were used in the study of the beta hemolytic streptococci except that we have not used sodium hippurate, since we early found that all of this class of organisms hydrolyzed it. The classification that we have used is that of Holman. This group of organisms has been studied quite independently by human pathologists and by veterinarians. We have used the names employed in the study of human diseases and have paid little attention to either the names or the descriptions of the species found in the literature relating to mastitis. We find the following three species quite common in milk, *mitis, faecalis* and *salivarius*. We have not been able to separate these different species from one another by the means of their colonies on the blood agar plate, as we have for the hemolytic streptococci. They are differentiated, however, by their action on the same test substances that were employed in the previous groups, and so far as their reactions are concerned on these substances, *mitis* corresponds to *mastitidis, faecalis* to *infrequens* and *salivarius* to *asalignus*. All three species seem to take part in the production of chronic or subclinical mastitis, although *S. mitis* is very much more frequently associated with mastitis than the other two species. We have tested quite a few of these species, especially *S. mitis* on inulin and raffinose, and so far as these two test substances are concerned, this species may be divided into four varieties, one of which, negative to both substances and common in milk, is related to mastitis, and another, positive to both sugars, is common in the feces of cows, but we have not found it in our milk samples.

Whether we should use the name *mitis, mitior* or *agalactiae,* or mastitidis for this species, we are not in a position to say at the moment. The important thing to determine is, it seems to us, whether there is a difference between the streptococcus of this biological group which occurs in man and the form which occurs in the bovine udder and in milk. When this is done, it would seem sufficient time to ascertain what name or names might be applied according to the rule of priority.

Relation of Streptococci to Bovine Mastitis

During the last few years, we have had an opportunity in connection with our control work, to study the streptococcus content of the individual cows over a considerable period of time, in three different herds. Two of these herds, one with about sixty cows and another of 100, have failed to show, on all examinations, hemolytic streptococci, with the exception of an occasional finding of a pseudo-hemolytic streptococcus. In the other herd of something over 100 cows, fifty-one have been found to be carrying regularly, and at times, considerable numbers of *S. mastitidis,* or a pseudo-hemolytic variety. In all of the three herds, the non-hemolytic streptococci are largely *S. mitis,* and have appeared in about 60 per cent of the cows in one herd, 50 per cent in another and 6 per cent in the other.

Streptococcus epidemicus

Since *S. epidemicus* is the most important streptococcus found in milk from the standpoint of public health, it is fitting that a few more remarks should be made in regard to our experience with this organism. We have found in the certified milk herds during the eight year period during which they have been under observation, ten cows that were carrying this germ. Through the examination of samples of gargety milk, which have been sent to our laboratory either through the Department of Veterinary Science or the control laboratory of the State Department of Agriculture and Markets, a considerable number of cows carrying this germ have been discovered. This work was first done in cooperation with Professor Hadley of the Veterinary Science Department, later in cooperation with Doctors Wisnicky and Reading and Miss Gumm. Although, ninety-eight infected cows have been located in seventeen different counties in the central and southern part of the state. In the majority of instances, only a few cows in the herd were infected, but in several herds, the infected individuals constituted one-half or more of the herd, so that at times this form of mastitis constituted a very serious infection in herds.

In 1930, Edwards of the Kentucky Agricultural Experiment Station, published the fact that an organism similar to *S. epidemicus* was commonly found in mares, but that these organisms could be distinguished from those found in human epidemics of septic sore throat by means of fermentation tests with trehalose and sorbite. He later extended these studies to cultures obtained from various laboratories and made the claim that cultures of *S. epidemicus* from human sources could by this test be differentiated from those of animal origin.

Some General Statements

We believe (1) that milk, freshly drawn from the bovine udder, contains streptococci in a considerable proportion of the samples; (2) that certain herds may very occasionally contain hemolytic streptococci closely resembling, if not identical with, those causing septic sore throat and scarlet fever but that the vast majority of the beta hemolytic streptococci found in milk are either *S. mastitidis* or the pseudo-hemolytic; (3) that even more numerous than the hemolytic streptococci are the non-hemolytic streptococci, which are related to, or indicate bovine mastitis if they have any significance at all; (4) by regular examinations of the special samples of milk it is easily possible, by the methods indicated above, to give the same assurance of safety to milk that pasteurization affords. In this connection, it seems worthwhile to state when discussing the safety of milks that instead of classifying them as pasteurized and raw, it would be more correct to divide them into protected and unprotected, and under protected to include certified and pasteurized and contrast these with the ordinary raw or unprotected milk; (5) it seems practical and economical for milk producers, at least of the higher grades of milk, to look forward to the immediate future when milch cows will not only be expected to be free from the tubercle, and Bang's bacilli, but from streptococci as well.

Discussion

Dr. Frost (In response to a question): The commonest mastitis organism in our experience is the alpha type —not the beta type. However, we are convinced that we have mastitis produced by the beta hemolytic as well as the non-hemolytic alpha types and believe that it would be quite as much a mistake to classify all of the organisms causing mastitis as the alpha type as it is to classify all, as at present in the beta-hemolytic group. We feel that there are two kinds of streptococci that cause mastitis.

Dr. Breed: Certain things may be mentioned that may help in adjusting our apparently different viewpoints. Dr. Hucker and Mr. Hansen as reported this morning before the Laboratory Section of the A. P. H. A. have just completed an extensive comparison of cultures of human and bovine viridans (alpha type) streptococci. They found that there are several definite characteristics that separate the human alpha from the bovine alpha types. One of the names that has been used for human viridans organisms is *Streptococcus mitior*.

On the other hand, the streptococcus commonly found in the cow's udder has been called *Streptococcus masti-*

tidis. In Bergey's Manual this has been described as a beta hemolytic organism although this does not agree with the most authoritative reports. For this reason the new (fourth) edition of the Manual now in press will place this organism in the viridans (alpha) group. The error in the early editions of the Manual has misled many people into applying the name *Streptococcus mastitidis* to beta hemolytic organisms.

President Parker: In Jacksonville this summer we had a chocolate milk that caused sickness in the office building where it was served, within a few hours after it was drunk. I had samples of the milk and was not, for various reasons, able to follow the ultimate outcome as should have been done. There was an almost pure culture of a yellow streptococcus. One of my assistants went out to the herd and removed two cows that had udders that were diseased and there the matter ended. I suppose a score of people were made ill from drinking this milk. One of my assistants drank some of it and was just as sick as anybody else.

Dr. Brooks: It would be presumptuous of me to attempt to discuss bacteriology with a bacteriologist like Professor Frost, but this is the first opportunity I have had to incite a discussion of "streptococcus epidemicus" when Professor Frost has been present. I think maybe if I tell him the difficulty that we are having with that organism perhaps he can tell us what is the matter with us in New York State. The facts, as I understand them, are that in our laboratory in the New York State Department of Health—I believe it also is true of Dr. Park's laboratory in New York City—they have been finding an organism which seems to meet all the specifications of the "streptococcus epidemicus" in conditions other than septic sore throat—in scarlet fever, erysipelas and normal throats,—while in some of our epidemics of septic sore throat, where there was no question about the diagnosis, they have found organisms not meeting the specifications. In one instance they sent a culture of this organism to Dr. J. Howard Brown, who concluded it was not "streptococcus epidemicus." There was no question but what it was responsible for this epidemic of septic sore throat. I wonder if Dr. Frost will tell us what he thinks is wrong.

Dr. Frost: That is a very interesting question. When Dr. Brown and I started out to do this work, within a few weeks we found a cow that was infected with an organism that we could not define as *Streptococcus epidemicus.* That was the beginning, and as I pointed out, we found ninety-eight cases all together. Three of those cows were associated with epidemics. Dr. Edwards offered the suggestion that we had two varieties of *Streptococcus epidemicus,* one bovine which does not cause septic sore throat. I am not willing to follow him that far yet. Certainly in this control work in the certified herds I would not want to leave in a dairy a cow with an organism that was like *Streptococcus epidemicus.* I have had the opportunity to examine throats of people who live on farms where *Streptococcus epidemicus* was involved in mastitis in the herd, and I have found the organism there. Some of the evidence is necessarily circumstantial. When this disease is present in the cows on the farm it is likely to cause sore throat in the people on the farm. It is very difficult to investigate these things because we usually are not called in until the epidemic is well advanced or until the whole herd is infected. It is a serious condition and we can not always find the organism and we can not be sure, but I believe that where you have septic sore throat caused by milk that you ought to find that organism in the cow. We had an epidemic in Chilton, Wisconsin, where there were two hundred and fifty cases that were exactly like all other epidemics, but we went over every cow in the incriminated herds and we could not find it, but we are not sure but what that man sold some of his cows. I haven't the least idea myself that we ever have septic sore throat epidemics without having *Streptococcus epidemicus,* but we have *Streptococcus epidemicus* in a milk supply a good many times without having epidemics. Undoubtedly something else beside the organism is necessary to produce an epidemic. I have been very fortunate in securing the cooperation of the State Health Department so that I am notified now whenever an epidemic caused by *Streptococcus epidemicus* is found and so far as possible I am going to take advantage of it and make a personal visit and see what can be done. When our State Veterinary Department finds a herd with *Streptococcus epidemicus* it immediately quarantines the herd and that herd is kept in quarantine until the disease clears up, or until the cows are gotten rid of. I think there is a great deal to learn about this. I feel, on the other hand, that *Streptococcus epidemics* is not difficult to identify.

Mr. Frank: I understood Dr. Frost to say that he believes a raw milk supply properly controlled by tests, such as the examinations for epidemicus and others, would be equal in safety to a properly pasteurized milk supply. I am moved to ask how frequently it would be necessary to make the tests. It would mean careful and time-consuming examinations and probably we would have to examine every animal in a whole herd. How frequently would the examinations have to be made to achieve that degree of safety?

Dr. Frost: These herds are generally rather large and the dilution factor comes in there. I don't believe an epidemic ever occurs unless there is an enormous infection. We make the examination once a month. We do not take individual or quarter samples; we take them in groups of ten. I believe people who produce a high grade of milk should not have cows in their herd carrying hemolytic streptococci of any kind. It is relatively easy to detect this organism and I think they can be eliminated. I do not think the danger from this disease is anything like it is represented by some public health authorities. The number of deaths is very small. I don't want you to misunderstand me; I am not opposed to pasteurization. That is the only thing that can be done with market milk.

Mr. West: About two months ago in Rochester, N. Y. the doctors were sending in throat cultures in considerable number to the health office. When we found hemolytic streptococci we got samples of the milk. We found that about 13 per cent of the pasteurized milk showed hemolytic streptococci and low bacterial count and seven per cent of the raw milk showed hemolytic streptococci and low count. I just offer that for what it might be worth in this discussion.

Dr. Harding: One thing that bears considerably on this matter of epidemics spread through milk is the fact that Dr. Frost lives in one of those states where they don't have epidemics. If he lived in a state like New York or Massachusetts, or I could name a half dozen other states where epidemics for some reason or other are found, his figures today might be different. I haven't in mind the figures regarding the relative amount of disease spread through milk and other avenues. I just chance to remember that not very long ago—I think about 1922—some figures were given out for California showing that 19 per cent of the typhoid cases reported that year in California were laid to milkborne outbreaks of typhoid fever. That, of course, does not check exactly with the figures Dr. Frost gave us.

Dr. Frost: Referring to Dr. Harding's comment on the California figures, I wonder if it wasn't something like what they did in Massachusetts. They stated, I think in these words, that all epidemics which could not be traced to other sources were laid at the door of milk.

Dr. Brooks: How about the ones, because of loose epidemiological procedure, that have not been attributed to milk?

President Parker: They probably would outnumber those that have.

SOME OBSERVATIONS ON CLEANING DAIRY EQUIPMENT

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The observations that I am going to talk to you about were made in six states, Indiana, Ohio, Vermont, New Hampshire, Maine and Massachusetts, in which more or less of 20 milk plants, and 200 producing dairies were observed. The time of these observations was between June 1 and September 1.

The object of the observations was to determine the extent of the contamination caused by the contact that milk made with equipment, containers, both at the farms and at the pasteurizing plants, special attention being given to the bacteriological conditions of the equipment before and after it was washed, and just before it was used. Four methods were used to make these determinations; the equipment was rinsed with sterile water, varying amounts, depending upon the area to be covered and where chlorine was used, thyosulphite was used to dissipate the free chlorine that might be present. Sterile milk was also used as a rinse in various amounts, depending upon the area to be covered; sterilized cotton swabs were dipped into sterile milk, or sterile water, and rubbed on the equipment and smeared over the plates containing standard media, and standard media was poured over small areas of equipment, let set, and removed with a sterile spatula, placed in a petri dish, incubated in the usual way, after the method described by Hammer. It was noted in all cases, under all methods, that just after the equipment had been used for milk and at the finish of the run, all parts of the equipment were heavily seeded with bacteria. The washing of the milk handling equipment at plants consisted of rinsing with cold water, followed brushing with warm alkali solution, which at no time was the temperature above 120° F. After the washing the equipment was rinsed with cold water and permitted to dry. In some instances, where the drying needed acceleration, a fan was used to remove the moisture; this was only done to save time for the observers to make their tests, but even in this case, where chlorine was added, to the rinse, thyosulphite was used as a dissipating agent. In every case where the cleaning was what would be considered good, by organoleptic examinations, the bacterial count obtained by the various methods used was assumptively negligible.

To interpret the writer's idea of negligible in this case, the counts when a liter of water was permitted to flow down the side walls of a collar, and samples were taken at the bottom, the counts when plated in one c.c. dilution showed scattered colonies; the same condition was shown on the poured media. The conclusion drawn from these tests indicated pretty conclusively that where milk handling equipment was properly washed and rinsed with uncontaminated water it was in very good condition for its contact with milk from a bacteriological standpoint. The condition was quite different when the same technic was employed in the morning, after the equipment had been permitted to stand from 12 to 18 hours. Here, in almost every instance the equipment was heavily seeded with bacteria. In all cases the bacteriological condition of the equipment warranted some means of destroying the bacteria that were upon it before it would be sterile enough to warrant the contact with milk. The extent of contamination varied, however, depending somewhat on the conditions surrounding the equipment, and the construction of same. In damp, poorly ventilated, crowded spots the contamination seemed usually greater. Where the equipment was covered, and kept dry, the bacterial contamination was not so great. All conditions were completely controlled by a rinse or spray of chlorine solution, of varying strength from 10 ppm Av. Cl. to 50 ppm Av. Cl.

There are several dairies that are now operating on this basis, for six weeks or more; samples of the raw milk, samples of the same milk after it has been held and of the same milk after cooling, are taken every day in each of these plants, none of which show any appreciable pick-up of bacteria taken during the runs.

We found that the water supply, in too many instances was a serious, contaminating influence to the equipment. We also found that minute leaks occurred in heaters, coolers, and vats, that were not of sufficient intensity to make their presence prominent in the milk, as it was routinely handled, but showed up in many unexpected places in the technic that was used to make these determinations.

While we do not desire to make any dogmatic statements regarding these observations it seems to us that they at least indicate that it is entirely feasible, and quite possible, to satisfactorily treat for bacteriological control, all dairy equipment without the use of excessive heat in the form of very hot water and steam. One of the interesting facts observed in this was, cleaning was more easily accomplished when heat applications were not used. When we encountered water that showed high bacterial counts, and in too many cases this condition was observed, we added small amounts of chlorine, not more than five parts per million, and in many instances considerably less, to the rinse water that was used on the equipment, after washing. This was not used for the purpose of disinfection, but rather as a means of destroying germs that were in the water.

The object in bringing this to the attention of this Association is for criticism of the technic employed, and suggestions for better methods of making determinations of the bacterial condition of dairy equipment, and trust that other workers will take up the subject so that we will have a standard procedure for making tests of this character.

MECHANICAL REFRIGERATION

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DURING the past five years there has been considerable work done on the adaptability and practicability of mechanical refrigeration to the dairy farm. This work has been done because one of the factors in the production of quality in milk is a low bacterial content, since bacterial counts are indicative of the past history and future keeping quality of the milk. Bacteria-free milk does not exist and warm milk is an ideal medium for growth of numerous kinds but in cold milk bacteria grow slowly. The best fresh milk may become an unsatisfactory product if not properly cooled and we know, as milk is delivered from the average farm from day to day that about 85 per cent of the high counts is the result of the failure of prompt and proper cooling.

Proper cooling means prompt temperature reduction to a point below that of appreciable growth and that temperature is usually stated as 50° F. Such a temperature is impossible to obtain during the summer months when using water from wells on Indiana farms. Therefore, in order to reduce the temperature, ice or mechanical refrigeration must be used.

The question of comparative cost of mechanical refrigeration and ice has been well worked out by Ellenberger of the Vermont Experiment Station. He states "Little difference in cost was found with stored ice at $2.00 a ton and electricity at 5 cents per kilowatt hour. If either price varies from these figures in either direction the comparative results would be correspondingly affected." Manufactured ice here in the middle west sells for $5.00-$8.00 per ton at the plant and rural electric rates are approximately 3 cents per kilowatt hour.

About four years ago a cooperative project was undertaken by the Dairy and Agricultural Engineering Departments to study such factors as the type of storage box, the amount of current used for cooling, temperatures to which milk must be cooled to prevent bacterial growth, advisability of precooling with a surface cooler and the practicability of using mechanical agitation to hasten cooling. It is the results secured on this work that I will present to you this evening.

POWER CONSUMPTION AND TYPE OF BOX

FARM	TYPE OF BOX	MILK COOLED (POUNDS)	KW.-HR. PER 100 LBS. PER °F TEMP. REDUCTION
1	Dry	190,086	0.087
2	Dry	291,048	0.050
3	Dry	53,475	0.074
4	Wet	154,989	0.043
4 a	Wet	64,874	0.039
5	Wet	80,625	0.038
Average	Dry	534,609	0.064
Average	Wet	300,488	0.041

Careful records were kept on five dairy farms for one year, three of these farms being equipped with walk in or dry type coolers, two of which were built on the farm and one purchased assembled, and two with wet or storage-tank coolers. It can be seen from the above table that the power consumption for the dry type boxes was greater than for storage tank types. This may be due to the fact that the dry boxes were larger than the storage tanks permitting greater heat losses. Opening and closing the doors more frequently on the dry boxes would also tend toward greater power consumption, as well as difference in location in doors; also the fact must not be overlooked that in the dry type coolers the milk was stored in glass bottles, and it was necessary to cool the bottle. On the dry type boxes the milk was cooled with a surface cooler, through the upper coils of which was circulated cold water and through the lower, cold brine.

HEAT LOSSES FROM INSULATED MILK COOLING TANKS

TANK NO.	CORK SIDES	BOARD BOTTOM	THICK TOP	COEFFICIENT* OF HEAT TRANS.	BOX CONSTRUCTION
1	3	3	2	2.67	Iron
2	3	3	2	3.39	Iron-wood
3	3	3	2	3.30	Wood
4	2	2	None	4.24	Wood
5	3	3	2	2.13	Concrete
5a	3	3	None	2.30	Concrete

* BTU per 24 hours per square foot inside area per degree F. temperature difference.

Heat losses through the walls of the storage compartment are an important factor in the consumption of current by a refrigeration machine. These losses were determined for five cooling tanks. To obtain them, a known amount of water was cooled in the tanks to 32 degrees F. by means of ice, then a number of ten-gallon cans of water immersed at 95 degrees F., equal to their rated capacities. Sufficient ice was weighed into the tanks to raise the water to the desired levels in them and allowed to remain for twenty-four hours at the end of which time the remaining ice was removed and weighed. Heat losses from the boxes were computed by subtracting the amount of heat required to reduce the initial temperatures of the water in the cans and the cans themselves to their final temperatures from the heat absorbed by the ice in melting with the differences as the resulting losses.

Coefficients of heat transfer for the different boxes were computed by dividing the total heat losses in twenty-four hours by the inside areas in square feet and the results by the differences between outside and inside temperatures. The smaller the coefficient of heat transfer the less is the heat loss from the box. Differences in heat losses due to use of various amounts of insulating material is shown in these results. Box number 4, insulated with two inches of cork board had higher heat losses than those with three inches of cork board. In tank 5 where tests were run with cork board in the cover

5a and tank 4 without such insulation, higher heat losses resulted where the cork board was omitted.

BACTERIAL COUNTS OF MILK BEFORE AND AFTER STORAGE OF 12-14 HOURS
MILK PRECOOLED TO 70 DEGREES F.

No. cans	Temp. cooling medium		Bacterial counts per c c. Per cent less than 5,000	Per cent 5,000 to 10,000	Per cent 10,000 to 25,000	Per cent more than 25,000
37	35 deg. F.	Entering	45.90	21.60	18.90	13.50
		Leaving	56.70	13.50	16.20	13.50
41	45 deg. F.	Entering	63.41	24.39	12.19	0.0
		Leaving	65.85	21.95	12.19	0.0
32	55 deg. F.	Entering	65.62	25.00	9.37	0.0
		Leaving	43.75	18.75	25.00	12.50

Two electric mechanical refrigeration installations of the storage-tank type were made at the Purdue Dairy Farm one of four and the other of six 10-gallon can capacity. Thermostats were adjusted so as to maintain average temperatures of the cooling water at 35, 45, and 55 degrees F. When 35 degrees F. cooling water was used, it was found necessary to use salt in the water in order to inhibit an excessive development of ice upon the coils of the unit. The units were operated at three-fourths capacity and the studies were all made on night's milk, with a storage period of 12-14 hours. Results were expressed in terms of both units to compensate for any mechanical difference in the two commercial tanks and refrigeration units used. Ten-gallon cans were used and the water level was maintained at about 2 inches above the milk level in the cans.

The change in bacterial count of milk stored from 12 to 14 hours in cooling tanks operated at 35 and 45 degrees F. was slight. In the milk with original bacterial count of less than 5000 c.c. there was a decrease during storage, probably due to the germicidal action of the milk, for the milk was placed in the cooling tanks at the conclusion of milking.

Within individual trials it was found that when the milk was held at 35 degrees F. that, of the thirty-seven trials conducted, sixteen increased in bacterial count during storage and twenty-one decreased. Milk stored at 45 degrees F., forty-one trials were conducted of which fifteen increased in bacterial count and twenty-six decreased. Milk stored at 55 degrees F., thirty-two trials were conducted of which twenty-four increased in bacterial count during the storage period and eight decreased.

EFFECT OF TEMPERATURE ON POWER CONSUMPTION AND BACTERIAL GROWTH

Temperature	Ratio of Bacterial Increase	K W H Used
35	0.0868	0.9942
45	0.1016	0.6108
55	0.9862	0.3149

The power consumption was in nearly a straight line relationship but there is a very definite bacterial increase at 55 degrees F. The difference in cost with the milk precooled to 67 degrees F. to cool milk from 55 to 45 degrees F. was but 0.3 kilowatt hours per 100 pounds of milk. This should be emphasized to dairymen who believe they can reduce their power bills by maintaining a temperature in the cooling tank higher than 45 degrees F. The increase current cost is more than justified by the decrease in bacterial content due to sufficient cooling.

The operation of cooling tanks below 45 degrees F. for the storage of milk will depend entirely on the margin of safety desired to keep the milk below a certain temperature during shipment.

INFLUENCE OF STIRRING OF MILK

Temperature of Cooling Medium	Ratio Bacterial Increase in Milk Stirred	Not Stirred
35 degrees F.	0.039	0.221
45 degrees F.	0.116	0.241
55 degrees F.	0.323	2.249

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The question of stirring milk after it had been placed in the mechanically operated cooling tank was studied. The milk was placed in the tank at approximately 96 degrees F. and each can was stirred for one minute after being in the tank one and two hours. The above table indicates that stirring decreases bacterial count and the difference between the bacterial content of milk stirred and not stirred is greatest at 55 degrees F. The flavor of the milk was also determined and no consistent difference could be noted in favor of stirring.

DISTRIBUTION OF BACTERIAL COUNTS OF MILK PRECOOLED OVER A SURFACE COOLER TO 70 DEGREES F. COMPARED WITH MILK NOT PRECOOLED, HELD IN STORAGE 12-14 HOURS IN A MILK COOLING TANK AT 40 DEGREES F.

			Bacterial counts per c.c.			
No. trials	Milk temp. entering storage degree F.		Per cent less than 5,000	Per cent 5,000 to 10,000	Per cent 10,000 to 25,000	Per cent more than 25,000
28	Precooled to 70 deg. F.	Entering	35.72	50.00	14.28	0.0
		Leaving	17.86	21.39	35.72	25.00
28	Not precooled 96 deg. F.	Entering	35.72	50.00	14.28	0.0
		Leaving	10.72	28.58	42.86	17.86

Precooling of milk by means of a surface cooler and then placing the milk into the storage tank is common procedure on the average dairy farm. To determine the value of precooling, from the bacteriological standpoint, the following tests were made during the summer months under the same conditions as previously given.

The water in the cooling tank was maintained at approximately 40 degrees F. and the surface cooler was rinsed just prior to use with a hypochlorite solution. One half of the milk was placed directly after milking in ten-gallon cans and immersed in the cooling tank, the other half was precooled over a surface cooler. Of the milk that was surface cooled, twenty-four trials showed bacterial increases during storage and five decreases. In the milk that was not precooled, twenty-one trials showed increases and eight decreases.

Surface cooling of milk showed no bacteriological advantage in comparison to milk that was not surface cooled. No distinct advantage was secured as to flavor. The milk was judged by three judges and in seventeen trials no difference in flavor could be distinguished between the surface and the non-surface cooled milk, five trials were in favor of the non-surface cooled and six in favor of the surface cooled. The milk was of good flavor prior to cooling.

INFLUENCE OF CONDITION OF SURFACE COOLER

Condition of Cooler	Ratio Bacterial Increase	
	Surface	Not surface
Thoroughly washed and sterilized	0.9290	2.515
Washed and rinsed	5.577	2.432

In another series of trial in which surface cooling of milk was compared with non-surface cooling we procured data on the influence of the sanitary condition of the cooler. Where the cooler was thoroughly washed and sterilized by means of a sodium hypochlorite solution of 100 p.p.m. the results were much more in favor of surface cooling while the reverse was true when the surface cooler was washed and rinsed with hot water. The type of surface cooler used in all our experimental work was the tubular type.

A mechanical agitator was installed in the milk cooling tanks and the night's milk was so divided that each tank was operated at three-fourths its capacity. In order to offset any mechanical advantage the tanks were reversed at the end of each week. The experiment was conducted over a six-week period.

STUDIES ON AGITATION OF COOLING MEDIUM ONE HOUR

	BACTERIAL	
	One hour agitation	No agitation
Number of trials	13	20
Temperature of milk enter	93	94
Temperature of milk leave	43	41
Temperature of cooling medium	40	40
Trials showing increase	9	11
Average bacterial increase	1610	4570
Trials showing decrease	4	9
Average bacterial decrease	840	4600
Average of all	+770	+500

Temperatures were recorded by means of recording thermometers that were placed so that the bulb of the thermometer was in the center of the can and four inches below the milk surface. The thermometer bulb was five inches long. By this manner temperature of the milk could be secured in the center core of milk without causing any agitation within the can. Water level was held at two inches above the milk level in the cans. Lids were placed tightly on the cans. A trial consisted of three or four cans depending upon the capacity of the box. The bacterial counts are expressed as average counts but were calculated as the geometric mean.

STUDIES ON AGITATION OF COOLING MEDIUM ONE HOUR

	PHYSICAL	
	One hour agitation	No agitation
Temperature of milk enter	93	94
Temperature of milk leaving	43	41
Temperature of cooling medium	40	40
Minutes required to reach		
70 degrees F.	23 minutes	36 minutes
60 degrees F.	87 "	93 "
55 degrees F.	150 "	156 "
50 degrees F.	260 "	261 "

Judging from the geometric mean of all bacterial counts agitation of cooling medium for one hour was of no advantage and but little difference was found in the rates of cooling as measured by the recording thermometers.

STUDIES ON AGITATION OF COOLING MEDIUM, TWO HOURS

	BACTERIAL	
	Two hour agitation	No agitation
Number of trials	30	44
Temperature of milk enter	98	98
Temperature of milk leave	43	43
Temperature of cooling medium	40	40
Trials showing bacterial increase	13	24
Average bacterial increase	2000	4270
Trials showing bacterial decrease	17	20
Average bacterial decrease	8630	3410
Average of all	+4000	+800

Operation of the mechanical agitator in the milk cooling tank for two hours showed a slight bacterial advantage and the rate of cooling of the milk was slightly faster.

STUDIES ON AGITATION OF COOLING MEDIUM, TWO HOURS

PHYSICAL

	Two hours agitation	No agitation
Temperature of milk enter	98	98
Temperature of milk leave	43	43
Temperature of cooling medium	40	40
Minutes required to reach		
70 degrees F.	30 minutes	35 minutes
60 " "	73 "	106 "
55 " "	121 "	174 "
50 " "	233 "	257 "

STUDIES ON AGITATION OF COOLING MEDIUM SURFACE COOLING

BACTERIOLOGICAL

	Surface cooled	Agitation 2 hrs.
Number of trials	37	40
Temperature of milk entering	70	96
Temperature of milk leaving	42	42
Trials showing bacterial increase	12	14
Average bacterial increase	19,900	1,900
Trials showing bacterial decrease	25	26
Average bacterial decrease	9,460	10,500
Average of all	+70	+9,800

In the literature it has been suggested that mechanical agitation of the cooling medium in mechanical wet-type milk storage tanks could be substituted for surface cooling. In order to determine the validity of the statement the following experiment was conducted where one-half of the milk produced was surface cooled and then placed in a mechanical wet-type cooling tank; the other half of the milk placed in ten-gallon cans and at the conclusion of milking immersed in the tank. Considering the average bacterial count, surface cooling of milk is favored but there was a greater average increase in bacterial counts in the surface cooled milk than in the non-surface cooled milk. The bacterial counts were taken after surface cooling.

The greatest advantage in surface cooling can not be considered to be bacteriological but economical, for if one-half of the heat of milk can be removed by water, less electrical energy is required to bring the milk to the final temperature.

STUDIES ON AGITATION OF COOLING MEDIUM SURFACE COOLING

	Surface cooled	PHYSICAL Agitation two hours
Temperature of milk entering	70	96
Temperature of milk leaving	42	42
Minutes to reach		
70 degrees F.	0 minutes	84 minutes
60 " "	62 "	134 "
55 " "	118 "	185 "
50 " "	216 "	281 "

SUMMARY

1 Average current consumption for 100 pounds of milk cooled per degree F. by three dry-box type milk-cooling installations operated for one year was 0.064 kw.-hr.

2 Average current consumption for cooling 100 pounds of milk per degree F. by two storage-tank type milk-cooling installations operated for more than one year was 0.041 kw.-hr.

3 Heat losses in B.T.U. per 24 hours per square foot per degree F. temperature difference varied from 4.24 to 2.13 in five insulated milk tanks studied.

4 Heat losses are dependent upon the amount of insulating material used in the construction of the storage box.

5 Precooling of milk over a surface cooler to 70 degrees F. was found to show no significant bacterial advantage when compared with milk not surface cooled but placed immediately in the cooling tank, but did result in less use of energy by the refrigeration unit.

6 Agitation of the cooling medium in a wet storage tank by means of a mechanical agitator increased the

rate of cooling of milk not surface cooled but caused no significant difference in the bacterial count of the milk from that cooled in tanks not agitated.

7 Rate of cooling was faster with the use of a surface cooler than where milk—not surface cooled, was cooled in the tank and cooling water agitated for two hours, but there was no significant difference in bacterial counts.

Discussion

Mr. Overman: I am wondering if you have tried out any experiment using a covering on your mechanical cooling vat and then cooling the milk without the cover? I have heard it stated that the effect of the cover on cooling has been overestimated.

Professor Parfitt: The data I have there would indicate that insulated covers would be of great value. In making tests we operated without insulation and with insulation in the tank covers and the amount of current consumed was less when insulated.

Dr. Yates: I would like to ask Dr. Parfitt whether he recommends the stirring of milk while it is cooling.

Professor Parfitt: In using mechanical refrigeration there is an advantage in stirring. The objective we had was to see whether or not we could get as satisfactory results by stirring the medium that was doing the cooling of the milk so nothing would have to go into the milk and to find out if it was as satisfactory as surface cooling.

Mr. Johns: On this question of agitation of milk, I might say one company has been working during the last year on a rocker agitation mechanism where both the milk and cooling medium were agitated.

REPORT OF COMMITTEE ON COMMUNICABLE DISEASES AFFECTING MAN

J. G. HARDENBERGH, *Chairman*

THE report of your Committee this year is divided into three sections. The first includes a brief statistical summary of milkborne outbreaks in 1932 and tabulated data for the ten-year period, 1923-1932 inclusive; the second contains specific discussion of certain milkborne infections. In the third section, a brief discussion of some features of the epidemiology of disease outbreaks is included.

I

In 1932 there were reported thirty-three epidemics of disease carried by milk with 642 cases and twenty-eight deaths as listed in Table. 1. In all but two epidemics, the milk supplies involved were raw; two epidemics were attributed to pasteurized milk but in these instances investigation revealed that there were irregularities in the process indicating inadequate or incomplete pasteurization.

Table 1
MILKBORNE EPIDEMICS—1932

As Reported by State, County and City Health Officials

	Number of Epidemics	Number of Cases	Number of Deaths
Typhoid Fever	23	254	22
Septic Sore Throat	3	150	3
Scarlet Fever	6	206	3
Gastroenteritis	1	32	0
Totals	33	642	28

Table 2 is a statistical summary of milkborne epidemics of various diseases for the past ten years. In the last column is given the ratio of cases and deaths per

Table 2

SUMMARY OF MILKBORNE EPIDEMICS OF VARIOUS DISEASES
1923-1932

Year	Typhoid Fever			Septic Sore Throat			Scarlet Fever			Gastro-enteritis			Miscellaneous			Totals			Ratio of Epidemics to Cases to Deaths
	Epidemics	Cases	Deaths	Epidemics	Cases	Deaths	Epidemics	Cases	Deaths	Epidemics	Cases	Deaths	Epidemics	Cases	Deaths	Epidemics	Cases	Deaths	
1923	15	423	31	1	70	0	6	336	6	----	----	----	1 [1]	5	0	23	834	37	1: 36: 1.6
1924	35 [3]	1,065	66	1	89	0	5	265	0	2 [2]	110	1	1 [1]	23	0	44	1,552	67	1: 35: 1.5
1925	33 [4]	617	47	6	972	5	4	136	3	----	----	----	1 [1]	14	1	44	1,739	56	1: 39: 1.3
1926	51 [4]	1,209	83	6	1,518	7	5	271	3	4	342	1	2 [1]	24	0	68	3,364	94	1: 49: 1.4
1927	26 [4]	483	35	----	----	----	4	389	5	1	50	0	5 [5]	32	1	36	954	41	1: 27: 1.1
1928	26	448	48	3	1,080	49	8	369	6	3 [6]	230	17	7 [7]	69	0	47	2,196	120	1: 47: 2.5
1929	31 [2]	587	39	8	939	13	10	774	1	1 [2]	8	0	1 [8]	24	0	51	2,332	53	1: 46: 1.0
1930	30	575	41	9	1,116	7	2	42	0	5 [9]	132	8	2 [8]	103	0	48	1,968	56	1: 41: 1.2
1931	22 [3]	239	16	8	1,050	8	1	9	0	2 [10]	78	0	1 [1]	22	0	34	1,398	24	1: 41: 0.7
1932	23	254	22	3	150	3	6	206	3	1	32	0	----	----	----	33	642	28	1: 19: 0.8
Totals	292	5,900	428	45	6,984	92	51	2,797	27	19	982	27	21	316	2	428	16,979	576	
Ratio	1:	20:	1.4	1:	155:	2.0	1:	55:	0.5	1:	52:	1.5	1:	15:	0.1	1:	39:	1.3	1: 39: 1.3

[1] Diphtheria
[2] Dysentery
[3] Includes 1 epidemic of paratyphoid
[4] Includes 2 epidemics of paratyphoid
[5] Includes 2 epidemics diphtheria and 3 of Malta fever
[6] Includes 1 epidemic of dysentery—126 cases, 17 deaths
[7] Includes 2 epidemics of diphtheria and 5 of Malta fever
[8] Food poisoning
[9] Includes 1 epidemic of dysentery—64 cases, 2 deaths
[10] Includes 1 epidemic of dysentery—65 cases, 0 deaths

epidemic for the various years for all diseases and at the bottom the ratio of cases and deaths per epidemic for the various diseases based on the ten-year totals. It will be noted that the average yearly ratio for all diseases for the ten years is thirty-nine cases and 1.3 deaths per epidemic. The individual yearly ratios do not depart widely from this average, except in three instances. The ratios for the various diseases based on the ten-year totals, however, do show wide differences. Thus, typhoid shows an average of twenty cases per outbreak or just about one-half that of the average for all diseases, whereas septic sore throat shows an average of 155 cases per outbreak or four times the average. Such figures are not especially significant but they do offer one indication: in typhoid fever, the milk is nearly always infected by a human carrier *direct* and the organisms may be and probably are transferred in relatively small numbers and sometimes only intermittently to the supply; in septic sore throat, the principal infecting agency is usually a cow with an infected udder (serving as an intermediate host for human streptococci) shedding huge numbers of organisms into the supply and consequently distributing the infection in sufficient dosage to a considerable volume of milk so long as she remains infected and in the milking line.

The figures for the ten-year totals are of interest in another way, they show that typhoid fever contributes more than two-thirds of the epidemics, only one-third of the cases, but three-fourths of the deaths, whereas septic sore throat contributes only about one-tenth of the epidemics, almost half of the cases and only one-sixth of the deaths. These relationships are indicated in Table 3. From them it would appear that our milk supplies are more vulnerable to contamination with typhoid than any other infection, probably on account of its greater preva-

lence, and that protection against direct human contact is most needed in reducing outbreaks of milkborne disease.

Table 4 summarizes the types of milk supply involved in the epidemics of the past ten years, with raw milks implicated in 395 out of a total of 428 outbreaks. With certified milks showing two outbreaks and pasteurized milks fifteen, it is safe to say that the former were not properly and responsibly certified and that the latter were not adequately and efficiently pasteurized.

Table 3

PERCENTAGE CONTRIBUTION OF VARIOUS DISEASES TO TOTAL EPIDEMICS, CASES AND DEATHS BASED ON REPORTED STATISTICS FOR 10 YEARS 1923-1932

	Per cent of Total—		
Disease	Epidemics	Cases	Deaths
Typhoid Fever	68.2	34.7	74.3
Septic Sore Throat	10.5	41.1	15.9
Scarlet Fever	11.9	16.4	4.7
Gastroenteritis	4.4	5.8	4.7
Miscellaneous	4.9	1.9	0.3

Table 4

MILKBORNE EPIDEMICS—1923-1932—TYPES OF MILK SUPPLY INVOLVED

Year	Certified	Pasteurized	Raw	Not Given	Total
1923	....	2	13	8	23
1924	1	1	42	....	44
1925	....	1	43	....	44
1926	1	....	65	2	68
1927	....	....	32	4	36
1928	....	4	42	1	47
1929	....	2	48	1	51
1930	....	1	47	....	48
1931	....	2	32	....	34
1932	....	2	31	....	33
Totals	2	15	395	16	428
Per cent of Total	0.4	3.5	92.3	3.7	

In addition to the statistics cited here which have been taken from reports of the U. S. Public Health Service (1, 2), reference should also be made to the report on "Milk-Borne Disease in Massachusetts, 1930-1932" by Bigelow and Feemster (3) which most of you have probably seen. These periodic reports issued by the Massachusetts authorities are always a valuable commentary on the subject and the authors summarize the report as follows:

1 Milk-borne disease has reached an extremely low figure in Massachusetts during the last 3 years.

2 The per capita consumption of milk is apparently the same as it was in 1928. That there has not been a decrease is no doubt due to the emphasis placed upon the nutritive and protective value of milk, and also to its present low cost.

3 The per cent of communities requiring milk to be pasteurized or from tuberculosis-free cattle has almost doubled, and 84.5 per cent of the population of the state lives in communities having this regulation.

4 It is estimated that 85 per cent of the milk supply of the state is now pasteurized.

5 There has been an increase in the bacteriological examinations performed to guard the quality of milk.

(A) *Streptococcus Infections.* The significance of streptococci in milk has received the continued attention of milk hygienists and investigators. It is a question closely interwoven with bovine mastitis because, whenever milk supplies are found carrying large numbers of streptococci (other than those identified as lactic in type), investigation will reveal the presence of streptococcic mastitis in the dairy herd sources. In discussing the streptococci of milk with reference to human health, Brown (4) says:

Streptococcal bovine mastitis is very prevalent. It appears in all herds from time to time and is present most of the time in all herds of more than a few cows. The streptococci found in bovine mastitis may be hemolytic or non-hemolytic but there is no evidence that those found in most cases of mastitis are pathogenic for man.

Later on, in summing up the evidence on which may be based conclusions as to the significance of finding streptococci in connection with disease outbreaks, Brown states:

In the past epidemiologists and bacteriologists have sometimes been satisfied to find a cow with mastitis in the herd supplying the suspected milk during an epidemic. In other instances their investigations have ceased when they found a cow with mastitis due to a hemolytic streptococcus. From what has been said it should be evident that such a result is entirely without significance. In tracing the source of an epidemic the streptococcus found in the milk or udder must correspond in all respects with those found in the infected persons. This requires a detailed bacteriological study in which careful attention must be given to hemolysis, capsule production, fermentation reactions and hydrolysis of sodium hippurate. If any of these tests are omitted the result may be a mistaken identification of the streptococcus in the milk with that from the human material. It may be that serological and other tests should be added. The evidence at hand indicates that milkborne epidemics of streptococcus infection in human beings are caused not by bovine streptococci but by human strains which may become implanted into the udder of the cow. It is not a common occurrence but is sufficiently common to cause many disastrous epidemics and to demand the constant vigilance of those engaged in milk control work. Milk from cows with mastitis should not be used for human consumption and no person with a hemolytic streptococcus infection should be allowed to handle the udder of a cow.

Again, Williams (6) says with reference to handling raw milk to determine absence of hemolytic streptococci pathogenic for human beings:

In practically every well studied epidemic of septic sore throat or of scarlet fever traced to milk, the milk from at least one teat of a cow has been reported as abnormal in appearance. This abnormality, however, may be so slight (a little sediment on standing) as to escape any but close attention. It is conceivable that at the beginning of implantation no change may be demonstrable and that, on the other hand, mastitis giving an abnormal milk may be present and not cause disease in humans. Such mastitis may not be caused by hemolytic streptococci.

We may conclude from our studies on this subject that milkborne epidemics of septic sore throat and of scarlet fever may be caused respectively by one to several agglutinative types of hemolytic streptococci. When scarlet fever predominates usually the epidemic strain belongs to one of the common scarlet fever agglutinative types; when septic sore throat predominates the epidemic strain may be one or more other agglutinative types.

From all this, it is evident that the milk control official, in his epidemiological work on streptococcus infections, must proceed with caution. Whereas, on the one hand, he should not be required to fasten a specific label upon the organisms found associated with milkborne septic sore throat or scarlet fever, neither should he be satisfied with the mere finding of "hemolytic streptococci" in the milk supplies involved; at least, he should be able to say whether or not the strains found in the human cases and in the cows are identical insofar as laboratory tests will permit.

(B) *Mastitis.* In addition to the foregoing considerations of streptococcal infections and mastitis, there still remains the question of the significance of mastitis when due to organisms of purely bovine type. It goes without saying that milk from cows having mastitis, whatever the cause, is not fit for human consumption but the problem still remains to educate dairymen to the early recognition of mastitis and the exclusion of all abnormal milk. Too many dairymen still are inclined to exclude the milk only of those cows that have reached acute stages of udder disease and to keep in the milking line cows with only one-quarter affected in order to milk the other three-quarters. While the milk in early or late cases may not be essentially capable of producing human illness, yet considerable numbers of mastitis streptococci or other organisms may be added to the milk in sufficient amount as to cause outbreaks of such disease as gastroenteritis, particularly if the milk is consumed raw.

Speaking of the public health aspects of udder infection, Brooks (6) has said:

> Some feel that a few streptococci may be present normally, but it seems to me that this is an indication of the existence of latent foci of infection. If this is true, the practical question, from a public health standpoint, is "How much infection must be present before the milk becomes unsafe for human consumption?" Probably we can all agree that when there are a large number of streptococci, with or without an excessive number of leucocytes, the milk is "potentially unsafe" and should not be used.
>
> As for the significance of a few organisms, we are about in the same position as on the question as to what we should do when we find

a few hemolytic streptococci in the throat of a milk handler when there is no history of sore throat. There is a possibility of danger and yet, admittedly, it is rather remote and the probabilities are that nothing will happen. The farmer can not afford to lose a cow or the milk handler his job on the strength of a "possibility"; still we want to protect the milk consumer. I feel that until we know more about it our position in these situations should be conservative. If the milk is pasteurized it is probably safe, although we should not lose sight of the possibilty of putting pasteurized milk in bad repute if we are too ready to allow delivery to the pasteurizing plant of milk which we would not want to recommend for human consumption without pasteurization.

(C) *Undulant Fever.* The information on undulant fever as transmitted through milk and other dairy products still represents a medley of opinions. The disease is now reportable in many states and the U. S. Public Health Service lists a total of 1408 cases in 1932 in forty-five states compared with 1545 cases reported in 1931. The number of these 1408 cases attributed to milkborne infection is not given but the opinion cited last year ascribing about one-half of the cases to dairy products may be tenable. Until more definite answers can be given to some of the questions concerning undulant fever, pasteurization must be the means of protecting man from milkborne infections or in certain instances, elimination of Bang's disease from the dairy herds.

The agglutination test is a reliable means of detecting Brucella infected dairy cattle and when repeated at frequent intervals by experienced operators is believed to be a dependable method of insuring milk free from the danger of transmitting undulant fever. In this connection, work done by Cotton and his associates of the Federal Bureau of Animal Industry indicates that the blood test in competent hands gives more reliable information regarding udder infection with *Br. abortus* than does testing of the milk serum from individual quarters of the udder. Cotton also found (7) that a

blood serum titre of 1:1000 nearly always indicates udder infection; at 1:200, about 50 per cent of the animals so reacting have infected udders; at 1:100 cows rarely show infected udders unless they have recently been infected and have not reached their maximum titre.

From the reports of cases of undulant fever that are ascribed to infected milk and dairy products, it appears that many cases merit better epidemiological investigations. The mere coincidence of a given case with a raw milk supply from a herd of cattle containing reactors to the agglutination test may be strong circumstantial evidence but it is hardly sufficient evidence on which to base final judgment.

(D) *Rabies.* Practically all of the evidence with respect to the transmission of rabies through milk is negative in character. In cows exposed to rabies through the bites of rabid dogs, it is probable that the milk is not infectious until symptoms of the disease develop. Thereafter, it is unlikely that rabid cows could be milked due to their excitable condition, and this would automatically exclude virus-infected milk from the supply. In making inquiries relative to the transmission of rabies through milk, the following is a typical reply from one authority:

> Our observations with reference to the possible transmission of rabies through milk do not permit of definite deductions. It would appear, however, that it is neither common nor serious. Experimental observations are limited to one doe that developed rabies while she was nursing her young. The little rabbits remained healthy and were kept under observation for more than one year.
>
> The possibility obviously has to be conceded, but we have seen nothing in the field or in the observations mentioned above to indicate that it is of any importance in the suppression of rabies.

III

The Importance of Epidemiology in Controlling Milkborne Diseases

Your Committee believes that careful epidemiological surveys of apparently milkborne outbreaks are indispensable to the effective control of diseases transmissible through milk. If epidemiology is "the sum of what is known regarding epidemics," then it may be assumed that too little is known about some disease outbreaks. In reviewing the literature, there are found great differences in the validity of facts and evidence upon which are based conclusions as to whether given epidemics are milkborne or not. In some instances, the factual presentation is complete in all essential details; in others there is only rather scant evidence upon which to base conclusions.

Officials charged with milk control must appreciate the necessity of obtaining all the scientific facts and other pertinent data relating to communicable diseases and how to go about the important task of learning when they occur, how they occur and why, and through what vehicles they may be transmitted. Lack of such fundamental data and of the special training essential to epidemiological surveys may lead to erroneous conclusions; the result: inconvenience and unwarranted alarm to the public on the one hand and injustice to the milk industry on the other.

It is realized that not all health departments and not all milk control officials have trained or expert epidemiological service available to them. Many officials must be their own epidemiologists or "medical detectives." Only rarely is the solution of an epidemic a simple problem; often the expert is puzzled and sometimes quite unable to find the answer. Hence, it is urged that special consideration be given to the finding and reporting of facts relating to milkborne epidemics in order that our data may be basically sound and our statistics accurate. In this, the responsibility of the official for valid epidemiological surveys is evident.

Thus, Dr. Brooks, a member of the Committee, in an article on "Missed Epidemics of Septic Sore Throat" (8) and referring only to this disease, expresses the opinion that the record of milkborne epidemics probably is incomplete and some are being overlooked.

He cites figures from U. S. Public Health Service reports, including that prepared by Armstrong and Parran, published in 1927, indicating that seventy-two milkborne epidemics of septic sore throat were recorded as having occurred in the United States in a period of approximately twenty-five years up to and including 1932. Of these, 63 per cent were recorded as having occurred in two eastern states; eight states recorded only one epidemic each and thirty-two none. The record shows such epidemics to have occurred in all sections of the country, precluding the possibility of climatic conditions anywhere in the United States being such as to insure freedom from this infection.

Pointing out that New York State probably is at least as well organized as the average state for the discovery of cases and outbreaks of communicable disease, Dr. Brooks refers to experiences in that state, some of them quite recent, in which extensive milkborne epidemics of septic sore throat have not come to the attention of the State Department of Health until they have been well developed for a week or more and in one instance not until the epidemic had practically subsided.

He feels that the most probable reason for the "discrepancies" in the recorded distribution of these epidemics among the various states are either more widespread and virulent infection in some states than in others or that epidemics are being overlooked. Knowing of no evidence in support of the first and pointing to striking differences in the number of epidemics recorded in immediately adjacent states, his conclusion is in favor of the second, namely, that not all epidemics which occur are discovered and recorded. This raises a question worthy of serious consideration by milk control officials.

Conclusion

While it is the duty of this Committee to consider and report upon various phases of disease transmissible through milk, we urge that this phase of our activities as milk control officials be set in its proper relation to the milk question as a whole. Whereas every effort should be made to promote the production of milk supplies with the highest possible factor of safety, the role of milk as a potential vector of disease should not be subject to over-emphasis or distortion. There is an important question of principle involved as to how far we may properly go in arousing public opinion by confronting milk consumers with a specter of fear with respect to the safety of milk supplies. Wholesome milk is an indispensable part of our dietary and is now recognized as one of the best "protective" foods to prevent certain nutritional deficiencies. Although the transmission of any amount of disease through milk is to be guarded against, yet the contribution of milk in this respect is exceedingly small.

Vast improvements have been made and will continue to be made in the promotion of safe milk supplies based on rational methods most beneficial to the public welfare.

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HEAT RESISTANT BACTERIA IN MILK

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THE subject of heat resistant bacteria in milk has been of considerable interest for a number of years. For a time the so-called "Pin Point Colonies" which appear on agar plates were a cause of much discussion. In a great many cases this type of colony is caused by the heat resistant bacteria. At other times thermophylic organisms which grow at pasteurizing temperatures may be the cause. Thermoduric or heat resistant bacteria which withstand pasteurization but do not multiply at such temperatures are often confused with the thermophylic bacteria which do actually multiply at such high temperatures. A discussion of one without the other is difficult.

While it is probable that these thermoduric and thermophylic bacteria have no real significance from a public health point of view, it is true that they often cause bacterial plate counts too high to conform to health department requirements. It is also true that, in case of heat resistant organisms being present in large numbers, faulty methods of cleaning and sterilizing utensils are indicated. In the case of large numbers of thermophylic bacteria, long continuous runs of the pasteurizing equipment or poor cleaning are indicated.

The problem of controlling the thermoduric or heat resistant type of organism is usually one of cleanliness of utensils on the farm. It has been found in a great many investigations that milking machines are a prolific source of heat resistant as well as other bacteria. The rubber tubes, teat cups, and other parts of milking machines will, if not properly cleaned, gradually become coated with a residue of milk, which will harbor enormous numbers of bacteria, some of which will be dislodged by the milk flowing over such unclean surfaces. Milking pails, strainers, stirrers, and other utensils may also furnish their quota. Some of these organisms are often found to be of the heat resistant type. Dairies which produce milk containing large numbers of heat resistant bacteria are generally able to produce milk of a satisfactory quality after their utensils have been thoroughly cleaned and sterilized. When heat resistant bacteria are present in large numbers, it is impossible to deliver pasteurized milk with a low bacteria content. In such cases, prevention is the only cure.

For several years samples have occasionally been collected during the winter months from dairies supplying milk to plants at which milk containing heat resistant bacteria was being received. These samples were pasteurized in test tubes at 144°F. for thirty minutes, cooled, and plated on standard media. Samples from fifty milking machine dairies were taken at a time. Some of the counts after pasteurization were low (less than 1000 per c.c.), and some were high, even up to 200,000. The same experiment was made using samples from dairies where hand milking was practiced. Some of these samples also contained heat resistant bacteria, but not so many, and they were not indicated in as large a proportion of the samples as in the case of dairies using milking machines. Such results are about what would be expected when the two types of equipment are considered from the standpoint of their construction and the relative difficulty of cleaning. An attempt was made to test the effect of high temperature, short-time holding on these organisms. Small, thin-walled test tubes were used in which to heat the milk as quickly as possible by placing them in water at a temperature of 190° F. A thermometer was used to stir the sample continuously until a temperature of 160° F. was reached. They were then taken from the water bath and, after fifteen seconds, were placed in ice water. This rough approximation of high temperature, short-time pasteurization failed to kill the heat resistant organisms. This test can be much more satisfactorily done if made on one of the short-time pasteurizing installations now in use. Perhaps it has been done. It was noticed that heat resistant bacteria did not seem to be as plentiful in the summer as in the cooler months of the year. Bacteria counts on pasteurized milk from some plants were higher in winter than in summer. Samples were taken in August from some of the same dairies as those to which reference has already been made. A few typical counts will serve to illustrate the findings:

Dairy Number	August 23, 1933		August 30, 1933	
	Raw	Past	Raw	Past
1	40,000	6,800	10,000	700
2	175,000	65,000	150,000	1,400
3	45,000	20,000	18,000	200
4	1,700,000	57,000	70,000	4,100
5	660,000	10,000	1,300,000	4,400
6	850,000	16,000	145,000	18,000
7	107,000	12,000	143,000	15,000
8	200,000	4,000	475,000	18,000
9	20,000	3,200	375,000	10,000
10	2,500	1,600	90,000	2,700

These counts indicate that as a rule the sources of heat resistant bacteria are not the same from one test to the next; also, that the pre-pasteurization count cannot be taken as an indication of what to expect in the milk after it has been pasteurized. The results also show that some heat resistant bacteria were present, but not in as great numbers or in as great a proportion of the samples as in the cooler months for which figures are not given. In view of the fact that raw milk almost universally contains greater numbers of bacteria in warm

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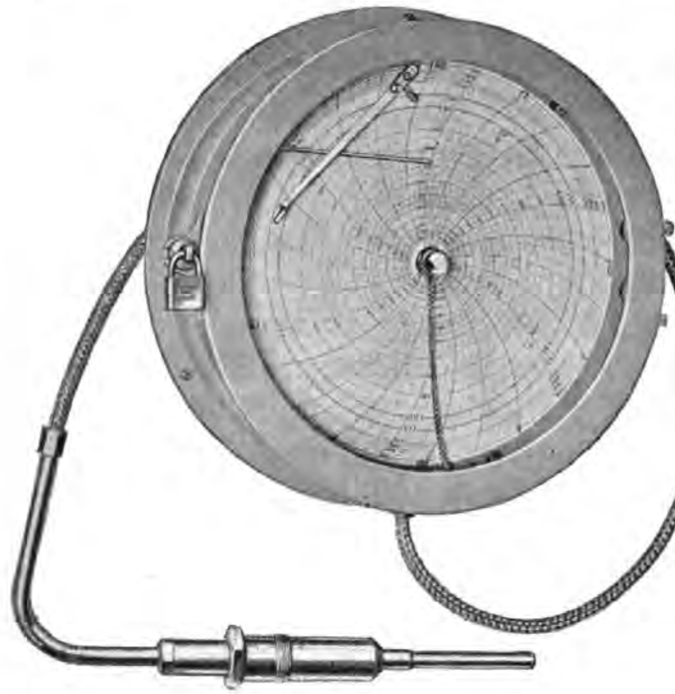

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weather, this is contrary to expectations. On the other hand, any residue of milk left in the milking machines or other utensils would cause higher counts in warm weather, and, in order to produce satisfactory milk, the utensils need to be kept cleaner in the warm weather, thus providing less opportunity for the heat resistant bacteria to develop. The fact that higher raw milk counts are prevalent in warm weather may be attributed largely to temperatures. In a paper (1) read before this Association in 1923 it was shown that when high counts in pasteurized milk were traced to individual dairies, it was possible to eliminate the high counts by a proper cleaning and sterilization of milking machines and other utensils. When the number of dairies involved was small, the problem was much easier than when a greater number were involved. Similar work during the past ten years has confirmed these findings. Mr. Ben Davies of United Dairies, Ltd., London, England, has published a bulletin entitled "The Nation's Milk Supply," (2) in which he gives the results of laboratory pasteurization of samples from a number of dairies. His results and conclusions are not the same as those given above. He finds a great number of counts higher after pasteurization than before. The differences are as much as, for instance: Before pasteurization 3,000, after 33,000; before pasteurization 12,000, after 270,000. These results he attributes to growth of thermophiles. It should be remembered that only thirty minutes elapsed during which this enormous multiplication could take place. In another series of samples he finds very low counts on pasteurized milk. These vary from zero to a few hundred colonies per c.c. For instance, one sample had a raw count of 4,000,000 and a pasteurized count of zero. Another had a raw count of 4,800,000 and a pasteurized count of 40. The difference in the pasteurizability of the two series of samples he attributes to the method of cleaning and sterilizing the utensils on the farm. When the pasteurized samples showed a low count, the utensils had been sterilized with steam or hot water. It should be stated that in Mr. Davies' work a special medium was used which gave much higher counts on both raw and pasteurized milk than the standard medium.

While in general these results are in agreement with results reported in this paper and in 1923, the reductions or increases in count on raw and pasteurized milk are much more striking. In our work no counts of zero were encountered on plates made from pasteurized milk. Large increases in count during pasteurization were not found, although some few samples did not show any reduction. The problem of controlling thermophiles or the bacteria which multiply at pasteurizing temperature is not the same as with the thermoduric organisms, which are not killed by pasteurization but do not multiply in the pasteurizer. The work reported by Mr. Davies, referred to above, indicates that great numbers of thermophiles may be present in milk as it comes from the farm. Our experience indicates that they are present in comparatively small numbers and then multiply in and on the pasteurizing equipment during the run. The development is not important during a short run, but, if the pasteurizing equipment is used continuously for several hours, the thermophiles may develop to great numbers. Some types of pasteurizing equipment are better suited to the development of thermophiles than others. It seems that the relative area of surface to which the milk is exposed has a direct influence on the development of thermophiles. This may be to some extent confirmed by examining under a microscope some of the milk solids which adhere to the surface of the pasteurizing equipment. After several hours' run enormous number of the organisms will often be found in the adhering residue. It has been found in some plants where long runs were necessary that extra holders could be used to break the run and allow each holder to be cleaned and sterilized after three to five hours' use. This has prevented the development of thermophiles to significant numbers.

Discussion

Dr Harding said in substance:

Dr. Harding: For some years I have been pointing out that the bacterial plate count was beset with a good many practical difficulties. I think Mark Twain said once that he intended to write a book in defense of the devil because anything responsible for three-fourths of the governments and all politics should have something in its favor, and I think there are still things to be said in favor of our bacterial plate count. But these presentations bring out forcibly the fact that the medium we are now using favors development of only a small part of the germ life in the milk. In this work by Mr. Davis he has evolved a very simple theory of correcting difficulties —steam and hot water treatment of utensils. He has hit upon what seems to be a very simple solution of a good many of our troubles. It looks altogether too simple to some of us, but in the absence of any data of our own on a common media, I don't think we are in a position to discuss it very much. It seems to me the one outstanding thing to be said in defense of our present medium is that, to the best of our ability, we have all been using the same thing. Now that you are, I think, all pretty much agreed this medium we are using really is not much good, perhaps it is a good time to take up the matter and see if we can not get something better.

Dr. Breed: No changes from the present standard time and temperature for the handling of agar plates have been made in the manuscript of the sixth edition of the

Standard Methods of Milk Analysis that was approved for publication by the Laboratory Section of the American Public Health Association at their business meeting last Monday morning (October 9, 1933). The preparation of future editions of this report was placed in the hands of a newly organized Committee on Standard Methods for the Examination of Dairy and Food Products.

This morning, as many of you know, a paper was presented before the Laboratory Section by Pederson and Yale,* giving sound reason for changing the temperature of incubation from 37° C to 32° C. This was followed by a paper by Bowers and Hucker * reporting on the use of yeast extract and other ingredients as a means of increasing the counts developed on standard agar. As Chairman of the new committee on Dairy and Food Products, I may say that it is the purpose of this committee to follow up the suggestions contained in these papers immediately with the very definite idea of suggesting a change in the next edition of the Milk Report in the incubation temperature to 32° C., and in the composition of the standard agar to one that will develop more colonies. It is hoped that additional comparative work can be organized this year and that the next (seventh edition) report will not be delayed more than two or three years.

Changes along these lines will make it possible to bring analytical procedures in the United States, Canada, England and Germany into very close harmony with each other.

References

1 Dotterrer, W. D.: Some Observations on High Counts in Milk Pasteurized Under Commercial Conditions. Report of International Association of Dairy and Milk Inspectors, 1923.

2 Davies, Ben: The Nation's Milk Supply. United Dairies Laboratory Department, 31 St. Petersburgh Place, London, W.2.

* Papers accepted for publication in the *American Journal of Public Health*.

MICROSCOPIC AND PLATE COUNTS ON THERMOPHILIC BACTERIA IN PASTEURIZED MILK

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Detroit, Michigan

THE recognition of the presence of thermophilic bacteria in pasteurized milk has brought up the question of the frequency with which they occur, and the best means for demonstrating their presence.

Harding and Ward (1) published the results of incubating agar plates at 145° F., as a means of demonstrating the presence of thermophilic organisms.

An investigation of the problem was made in the Laboratory of the Detroit Department of Health, and reported to this Association by Palmer and McCutcheon. (2) These writers studied the effect of incubation at 145° F., on bacterial plate counts and demonstrated the value of the method in proving the presence of thermophilic bacteria in pasteurized milk.

They also pointed out that the microscopic method yielded counts very much higher than plate counts with incubation at either 100° or 145° F.

More recently Breed (3) has recommended the use of both high temperature incubation of plates and microscopic examination of pasteurized milk be made simultaneously with standard agar plates as follows:

> The work on the presence of thermophilic bacteria in milk pasteurized by the holder process has shown that standard agar plate counts made in routine milk control work are not sufficient to show the real bacterial condition of the pasteurized milk. It is recommended therefore, that direct examinations of the milk be made simultaneously

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with the agar plate examination. When the microscope reveals large rod-shaped bacteria the probable presence of thermophilic bacteria is indicated. Additional plates made and incubated at high temperatures (55° C. (131° F.) preferably) will show whether this assumption is correct. Growth on these plates of bacteria that do not grow at 37° C. reveals the presence of obligate thermophilic bacteria. Bacteria in pasteurized milk that stain well in methylene blue are usually found to be alive. * * *

Breed restricts the use of the term thermophilic to organisms that will grow readily at 131° F., and higher temperatures. The term heat resistant is used by him to designate bacteria that show at least 90 per cent survival at 145° F., and are not able to grow readily at a temperature so high as 131° F. In this connection it should be pointed out that pasteurizing plants furnish conditions favorable for the growth of bacteria at both below and above 131° F.

Present Investigation

The primary purpose of the present investigation was to make a survey of the pasteurized milk supply of Detroit with particular reference to the microscopic appearance and approximate number of bacteria present in the product of the various milk dealers under the supervision of the Health Department. Incidental to the main object was a study of the value of certain methods for determining in routine laboratory work, the presence of thermophilic bacteria.

The survey was deemed desirable in view of the widely differing opinions about the frequency with which thermophilic bacteria occur in pasteurized milk.

The work was carried out by comparing microscopic counts with standard plate counts from the same samples, and in some cases, with counts made from plates incubated for 24 hours on an incubator shelf, the temperature of which varied from 133° to 136° F. This was determined by a study extending over many days, of the temperature of 9 points on the shelf in use.

Difco agar, dehydrated, was used for the standard plates, and one plate was made from each sample in 1:1000 dilution. A Buck colony counter was employed. The incubator used for the standard plates, showed an average variation in different spots of approximately 3 degrees, from 96.7° to 99.8° F. This variation was determined by observing on each of four days the temperature of nine points on the one shelf in use. The greatest fluctuation of temperature in one spot, was 2° F.

In making the microscopic counts, the customary practice was to make a count of well stained single bacterial cells in thirty fields, with a microscope standardized so that one bacterial cell per field represented 600,000 bacteria per c.c. When large numbers were present, a correspondingly smaller number of fields was counted. The predominating type of bacterial forms present in each smear was recorded in notes.

The samples were examined in connection with the routine work of making plate counts in the laboratory and were fairly representative of the product of forty-two dealers. The samples included quart, pint and half-pint bottles of pasteurized milk as well as table cream.

The observations were made between December 20, 1932 and February 28, 1933, when the raw milk supply was in best condition as regards refrigeration.

Types of Bacterial Forms Observed

The variety of bacterial forms observed was limited, a statement which holds true only of the winter season. Only twenty-three samples were excluded from the data on account of the presence of uncountable clumps of bacteria of various forms.

Thermophilic rods. The bacteria most frequently encountered were large rods occurring singly or in short chains. When present in excessive numbers, they formed clumps and threads.

Evidence of spore formation was rarely observed. These bacteria correspond in appearance to the thermophilic rods referred to in the publications of Breed (3) and associates at the New York Agricultural Experiment Station. Out of a total of 480 smears counted, these rods were the predominating bacterial forms present in 238 smears, or 49.6 per cent and were observed as present, but not predominating, in a larger percentage of samples. We have exact data on this point covering the first 249 smears examined. In 66 per cent of these, thermophilic rods were observed in some number, but not necessarily predominating over other forms.

The frequency of the occurrence of the thermophilic rods in the product was studied with reference to the size of the plants. The forty-two plants were listed in approximate order of size and the results of tests of the product of each plant were tabulated. In the case of the twenty-one largest plants the percentage of samples from each, in which thermophilic rods were found, varied from thirty to 100 averaging 56 per cent. In the case of the remaining twenty-one smaller plants thermophilic rods were found in 90 per cent of samples in the case of two plants, but the average for the group was 35 per cent.

Thermophilic rods were absent from smears of the product of only four very small plants represented by a total of nine samples. In four of these samples no bacteria were found in thirty fields. In the remaining five samples a count of thirty fields in each, revealed a total of ninety-two bacteria in all. This search is certainly not sufficient to establish the absence of thermophilic bacteria. No effort was made to examine a series of samples from a single plant until thermophiles were found.

Thus it may be stated that the product of practically all of the dealers marketing milk in Detroit, was found to contain thermophilic rods, intermittently.

In this connection it should be observed that thermophilic rods can not be expected to be found uniformly in the product of a plant. When we study samples taken from delivery vehicles, as in this case, it is a matter of chance whether or not the samples represent the milk likely to contain them.

Streptococci. Next in frequency of occurrence as the predominant bacterial form in smears, were small streptococci. These occurred as single diplococcus "links" or in the chains of a few such elements. Each pair of spheres was counted as a unit. Occasionally faintly stained units were observed, and these were not counted. Long chains and tangled clumps of chains such as occur in the case of pathogenic streptococci were not observed. The streptococci under consideration need not be mistaken for the lactic acid streptococci seen in pure culture starters, which latter are much larger.

Streptococci predominated in 154 smears, or 32 per cent of all smears.

Other forms. This classification includes a number of smears which did not present evidence of either thermophilic rods or streptococci predominating although in a few specimens both of these types appeared. Other organisms present in smears were Streptococcus lactis, large micrococci, together with small and large rods which differed widely in appearance from the thermophilic rods described in the foregoing.

Smears revealing the variety of bacterial forms described, totaled 25 or 5.3 per cent of all smears.

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Zero microscopic counts. No more than thirty microscopic fields were searched for bacteria. Smears in which no bacteria were found after such a search numbered sixty-three or 13.1 per cent of all smears examined.

Numerical Results

The various counts have been grouped for study on the basis of the kind of bacterial forms observed in the smears from which the microscopic counts were made and the totals appear in Table 1.

TABLE 1

NUMBERS AND TOTALS OF COUNTS BY THREE METHODS GROUPED ACCORDING TO BACTERIAL FORMS PREDOMINATING IN SMEARS

Forms Predominating	Standard Plate Counts No.	Standard Plate Counts Tot. per c.c.	133° to 136° F. Counts No.	133° to 136° F. Counts Tot. per c.c.	Microscopic Counts No.	Microscopic Counts Tot. per c.c.
Thermophilic Rods	238	34,262,300	103	33,160.000	238	1,464,954,000
Streptococci	154	8,239,000	67	1,903,000	154	250,712,000
Other Forms	25	653,000	....	....	25	6,670,000
Zero Micro. Counts	63	1,214,200	39	719,000	63	0
Totals	480	44,368,500	209	35,782,000	480	1,722,336,000

It will be observed that there were made 480 counts by both the standard plate and microscopic methods and 209 counts from plates incubated at 135° F., in all, 1169 counts. The total of the 480 standard plate counts is 44,368,500; of the 209 plates incubated at 135° F., 35,782,000 and of the 480 microscopic counts, 1,722,336,-000. The ratio between the total of all standard plate counts and the total of all microscopic counts is 1:38.8. In the 238 samples where thermophiles predominate, the corresponding ratio is 1:42.7.

The publication of the individual counts would occupy an amount of space, and incur an expense out of proportion to the number of readers who would be interested in them. Therefore we will restrict reference to individual counts, and discuss the trends revealed by the totals, which is the important matter. The detailed figures will be available for use by any student of the subject, who wishes them.

Comparison of Three Kinds of Counts Where Thermophilic Rods Predominate in Smears

There are available for comparison, 103 counts from standard agar plates, from plates incubated at approximately 135° F., and microscopic counts. The data are included in Table 2. The numbers in the column at the extreme left hand indicate the number of times each plate count occurred. The plate counts in order of increasing magnitude appear in the second column. The third column contains the factor by which the plate count totals are multiplied to equal the totals of the corresponding counts from plates incubated at 135° F. The fourth column contains the counts from plates incubated at 135° F., while the fifth column contains the microscopic counts. The sixth column contains the factor by which the total standard plate count totals are multiplied to equal the totals of the corresponding microscopic counts.

In our original table there are included columns for totals of each group of counts corresponding to the groups of plate counts. These, while a convenience in making computations, are here omitted to reduce the size of the table.

TABLE 2

MICROSCOPIC COUNTS, STANDARD PLATE COUNTS AND COUNTS FROM PLATES INCUBATED AT 133°-136° F. WHEN THERMOPHILES PREDOMINATE

(Last Three Zeros Omitted From All Counts)

Number of Counts	98° Plate Counts Per c.c.	Factor*	133°-136° F. Plate Counts Per c.c.‡	Microscopic Counts Per c.c.	Factor†
1	0	....	1	600	....
1	1	....	0	60	60.0
1	2	30.0	60	4,100	2050.0
....	3	....	140	3,600	....
....	3	....	0	96	....
....	3	....	150	10,000	....
....	3	....	150	6,700	....
....	3	....	140	2,800	....
....	3	....	13	1,200	....
....	3	....	3	126	....
8	3	25.6	20	120	1026.7
....	4	....	13	960	....
....	4	....	120	2,200	....
....	4	....	130	3,200	....
....	4	....	1	78	....
....	4	....	50	24	....
....	4	....	50	300	....
7	4	13.0	0	60	243.6
....	6	....	40	2,000	....
....	6	....	3	210	....
....	6	....	200	11,000	....
....	6	....	0	270	....
....	6	....	2	140	....
....	6	....	20	660	....
....	6	....	1	120	....
8	6	5.9	18	60	301.2
....	7	....	60	3,400	....
....	7	....	30	5,100	....
3	7	4.2	0	900	447.6
....	8	....	30	720	....
....	8	....	1	170	....
....	8	....	0	22,000	....
....	8	....	2	36	....
5	8	0.9	5	360	582.1
....	9	....	300	33,000	....
2	9	16.9	5	96	1838.6
....	10	....	2,400	25,000	....
....	10	....	280	4,700	....
3	10	89.5	5	600	1010.0
1	12	225.0	2,700	33.000	2750.0
....	14	....	25	1,800	....
....	14	....	6	78	....
....	14	....	0	2,400	....
4	14	0.7	10	2,400	119.2
....	15	....	0	60	....

* Factor by which totals of standard plate counts is multiplied to equal total of corresponding counts from plates incubated at 133° to 136° F.

† Factor by which totals of standard plate counts is multiplied to equal total of corresponding microscopic count. The totals to which the foregoing factors apply, are omitted from the table.

‡ Referred to in text as 135° incubation.

TABLE 2—(*Continued*)

MICROSCOPIC COUNTS, STANDARD PLATE COUNTS AND COUNTS FROM PLATES INCUBATED AT 133°-136° F. WHEN THERMOPHILES PREDOMINATE

(Last Three Zeros Omitted From All Counts)

Number of Counts	98° Plate Counts Per c.c.	Factor*	133°-136° F. Plate Counts Per c.c.‡	Microscopic Counts Per c.c.	Factor†
....	15	....	4	2,200	....
3	15	0.08	0	420	59.5
1	16	37.5	600	3,000	187.5
1	17	0.17	3	5,000	294.1
....	18	....	25	5,000	....
2	18	9.0	300	14,000	527.7
....	20	....	380	1,800	....
2	20	59.5	2,000	19,000	520.0
1	21	0.1	2	1,500	71.4
1	22	2.5	55	8,600	390.9
1	26	....	0	3,100	119.2
....	30	....	12	60	....
....	30	....	20	2,100	....
....	30	....	0	770	....
4	30	2.7	300	2,700	46.9
1	33	3.3	110	780	23.6
....	35	....	40	600	....
....	35	....	15	960	....
3	35	0.7	20	36	15.2
1	38	2.1	80	3,600	94.7
....	40	....	90	240	....
....	40	....	35	900	....
....	40	....	1	720	....
....	40	....	0	2,700	....
5	40	0.6	0	18	22.8
1	42	....	0	7,500	178.5
1	44	18.1	800	3,200	72.7
1	45	....	0	24	0.5
1	47	1.3	63	3,800	80.8
....	50	....	1	6,200	....
....	50	....	0	120	....
3	50	0.04	6	230	43.6
....	55	....	3	170	....
2	55	0.02	0	600	7.0
1	62	0.5	33	4,100	66.1
....	65	....	70	420	....
....	65	....	33	600	....
3	65	0.9	80	8,900	50.8
....	70	....	28	720	....
2	70	0.2	0	840	11.1
....	75	....	3	1,200	....
2	75	2.3	350	2,800	26.6
1	80	1.1	95	5,200	65.0
1	85	0.06	5	60	0.7
....	100	....	0	7,500	....
2	100	0.04	8	300	39.0
1	130	0.1	15	1,400	10.7
....	180	....	95	840	....
....	180	....	80	14,000	....
3	180	0.5	130	12,000	49.7
1	200	12.5	2,500	17,000	85.0
1	360	0.2	85	7,500	20.8
....	500	....	2	30	....
2	500	1.0	1,000	28,000	28.0
1	800	3.7	3,000	12,000	15.0
....	1,500	....	3,300	32,000	....
2	1,500	3.8	8,100	30,000	20.6
1	14,000	0.1	12,000	63,000	4.5
103	22,379	1.92	43,161	538,562	24.0

The columns headed "Factor" contain figures which are means of determining at a glance the divergence from the standard plate count, of the other two kinds of counts. When the factor is high, the corresponding counts are much higher, and when the factor is expressed as a decimal fraction, the second count is lower than the standard plate count. In considering these ratios it should be borne in mind, that Standard Methods in referring to raw milk, contains the statement that "(with the exception of the poorest grades) * * * the standard plate count will normally average one-fourth of the total number of individual bacteria present." The foregoing statement specifically excludes the poorest grades. In milk, containing large clumps of bacteria, the ratio is often greater. Robertson (4), in studying the relation between plate and microscopic counts of 264 samples of raw milk, found the factor to be greater than 10:1 in 120 cases or 45.5 per cent. In the series discussed by Robertson, twelve factors were greater than 230 and the highest was 5340.

The figures in Table 2 indicate that the total counts from plates incubated at 135° are 1.92 times the total of the standard plate counts. This higher average count at the higher temperature, according to Breed's definition, would identify as thermophiles, the bacteria responsible for the higher average.

A study of the factors indicating the ratios existing between the various standard plate count totals and the totals of corresponding high temperature plate counts, shows that there is considerable variation in ratios. Plate counts of 2,000 to 20,000 show, in most cases, a larger ratio to 135° counts than in the range of plate counts above 20,000. There are fifty-three counts below 20,000, almost exactly 50 per cent of the number of samples involved.

Thus the greatest discrepancy between the two sets of counts lies in the range of standard plate counts lying between 2,000 and 20,000.

Study of Table 2 brings out the fact that there are nineteen instances in which zero counts were obtained from plates incubated at 135° F., even though in many instances, they correspond to microscopic counts of several millions of thermophilic rods. In thirty-six other cases the 135° count is less than the standard plate count. To throw light on the problem, we have rearranged the data in Table 2 in another similar table in which 135° plate counts are arranged in order of ascending magnitude. Thus the relation of the size of 135° plate counts to the variation from the other two kinds of counts, may be studied. The table is not presented here, but comment will be made upon the trends exhibited.

The 135° counts total 43,161,000 while the corresponding microscopic counts total 538,462,000. The factor expressing the difference is 12.4. This indicates a relatively close average agreement between the results of the two methods of counting.

The nineteen zero counts correspond to standard plate counts totaling 571,000 and these correspond to microscopic counts that total 49,438,000. The factor expressing the ratio between these totals is 86.7. It appears that both standard plates and the microscopic method yielded relatively high counts in the range covered by zero 135° plate counts. Low counts with 135° incubation correspond to high factors expressing the relationship to microscopic counts. A series of six counts of 1,000 have the factor 1,314.6 to express their relationship to total of corresponding microscopic counts. Four counts of 2,000 have the factor 213.2; five of 3,000, the factor 513.7 and one of 4,000, the factor 550. Of a total of 103 counts there are thirty-five of the 135° counts under 5,000. No definite trend is exhibited by the factors until the counts exceed 300,000. In case of the thirteen highest counts from 350,000 to 12,000,000, the factors are: 8.0, 7.3, 5.0, 4.0, 28.0, 9.5, 10.4, 6.8, 12.2, 4.0, 9.6, 3.7 and 5.2. These indicate close agreement between counts from plates incubated at high temperature and microscopic counts.

It appears that counts from plates incubated at 135° F., differ widely from microscopic counts in the low range of counts below 5,000 and approach agreement with them in the high count range.

When the ratios between standard plate counts and microscopic counts in Table 2 are considered, we observe that the total of standard plate counts is to be multiplied by 24 to equal the total of corresponding microscopic counts. Here again there is discovered a marked difference in the size of the factors indicating the ratios, depending upon the size of the plate counts. The standard plate counts in the range 2,000 to 26,000 involving 56 counts show distinctly larger factors than in the range of higher plate counts. Thus the plate count of 2,000 is to be multiplied by 2050 to equal the microscopic count while the factor for the plate count of 14,000,000 is only 4.5. In this latter case, certainly the plate and microscopic counts are in substantial agreement. The facts cited, indicate here, as in the comparisons with the high temperature plate counts, that standard plate counts in the lower ranges are less reliable than the higher counts.

Comparison of Standard Plate Counts and Microscopic Counts When Thermophilic Rods Predominate

Comparisons between standard plate counts and microscopic counts alone, were made in 135 cases, in addition to those already discussed in the connection with the three count series. It is not deemed necessary to present the figures in tabular form.

The plate counts include fifty-seven groups in the range of plate counts which varies from 300 to 900,000. The series of plate counts totals 11,873,300 and the corresponding total of microscopic counts, 926,448,000. The factor expressing the divergence of these totals is 78.2. The factor for two, 2,000 plate counts is 6,750; for five 3,000 counts is 1156.5; for eight 4,000 counts is 1911.1; for two 6,000 counts is 616.6. Through the remainder of the range the factors with two exceptions are smaller and indicate no particular trend. At the extreme high end of the count series the factor for one plate count of 850,000 is 12.9 and that for two plate counts of 900,000 is 11.5. These indicate relatively close agreement between the plate and microscopic counts. Here again is evidence that low plate counts diverge much more widely from the microscopic counts than do high plate counts.

Comparison of Standard Plate Counts, Counts from Plates Incubated at 133°–136° F. and Microscopic Counts When Streptococci Predominate

There are available for comparison, counts from 67 samples made by the three methods. The counts vary from 1,000 to 1,000,000 in 36 groups of identical plate counts and 76 per cent are 50,000 or below. The standard plate counts total 3,147,000. The counts from plates incubated at 135° F. total 1,903,000. The factor expressing the relation between these totals is 0.6, which indicates that the latter counts total slightly over one-half of the standard plate counts. The factors expressing the relation between the two sets of counts, are quite consistently less than unity. In one case, the factor is 83.3, suggesting that some error in technic or observation occurred. In four instances the factors are close to unity, namely: 1.0; 2.7; 1.0; 1.7; and 1.3. In general the factors indicate that an incubation temperature of 135° F., is less favorable to the growth of the streptococci in question than the standard temperature of incubation.

The microscopic counts total 62,654,000, which is 19.9 times the total of the standard plate counts.

The factors for 15 plate counts in groups from 1,000 to 6,000 are, in order of ascending magnitude: 480.0; 149.0; 34.3; 50.0; 76.8 and 80.0. Similarly, the factors for seven plate count groups in the range from 85,000 to 1,000,000 are: 2.3; 6.6; 6.9; 2.7; 30.8; 2.0 and 4.7. Between these ranges there is little relation between the size of the plate counts and the size of the factor. These comparisons indicate that the difference between plate counts of 1,000 to 6,000 and the corresponding microscopic counts is much greater than when the plate counts range from 80,000 to 1,000,000.

In addition to the comparisons between plate and microscopic counts discussed in the foregoing, there are also available eighty-seven additional standard plate counts and their corresponding microscopic counts. These consist of forty-four groups of plate counts ranging from 1,000 to 900,000. The plate counts total 5,092,000 and the microscopic counts, 188,058,000. The factor expressing the ratio between these totals is 36.9.

Ten groups of plate counts composed of thirty-six counts ranging from 1,000 to 12,000 correspond to these factors: 240.0; 277.5; 262.8; 38.2; 158.0; 43.2; 95.0; 29.8; 5.4 and 115.8. The counts in question, number thirty-six, or 41 per cent of all. The ten highest groups of plate counts, composed of twelve counts, 96,000 to 900,000 have these corresponding factors: 31.2; 12.5; 10.7; 1.8; 3.2; 0.7; 20.7; 1.7; 1.4 and 1.3. Between these ranges, the factors vary in a way that indicates no definite trend.

Again we observe that low plate counts differ widely from the microscopic counts, and that the higher plate counts are in substantial agreement with the microscopic counts.

Zero Microscopic Counts

In sixty-three cases the microscopic count from thirty fields is zero and these counts correspond to standard plate counts which total 1,214,000. Of these counts, forty-two are 10,000 and under. Above this figure are 21 counts, the highest of which reaches 200,000.

The standard plate counts totaling 1,214,200 correspond to a total of 719,000 from plates incubated at 135° F., and among these latter there were 14 zero counts. Thus the high temperature plate counts average about half of the standard plate counts. In but three instances are the counts from high temperature incubation higher than standard plate counts and in these instances the factors expressing the differences between the counts are 2.3; 2.7 and 5.8.

Bacteria Other Than Thermophilic Rods or Streptococci Predominate

In twenty-five cases plate and microscopic counts were made from samples in which the predominating bacterial forms were other than thermophilic rods or streptococci. The plate counts total 653,000 and correspond to microscopic counts which total 6,670,000. The average correspondence between these sums is quite close, for multiplying the plate count total by 10.1 gives a figure corresponding to the total microscopic count.

Here again we note wide fluctuations in the ratio between the two counts, depending upon the size of the plate count. The four lowest plate counts, totaling 12,000, correspond to microscopic counts totaling 1,740,000. Thus the ratio of the lower plate counts to the higher microscopic counts is 1:145. The lowest plate count, 1,000, corresponds to a microscopic count of 570,000.

The three highest plate counts, 60,000; 68,000 and 200,000 have these factors: 1.8; 8.8 and 1.8. Between the counts at both extremes the factors show no significant trend.

Discussion

The wide difference from microscopic counts, of low plate counts at either temperature of incubation might be due to a variety of causes such as culture medium unsuitable for the bacterial species involved or effect of refrigeration in reducing counts. Standard plate counts of pasteurized milk are known to be profoundly affected by the length of time that the samples have been refrigerated before plating, as pointed out by Ward and Harding (5), Palmer and McCutcheon (6) and others. We have no reason to doubt that relatively long periods of refrigeration before plating greatly reduce certain 135° counts, as it unquestionably affected the standard plate counts. It would be desirable to make a series of comparisons by the three methods of counting, of milk immediately after pasteurization and after a period of twenty-four hours of refrigeration.

We have no evidence bearing on the source of the streptococci found predominating in 32 per cent of 480 samples. A study of the microscopic appearance of milk at various stages of treatment in the plants involved, should answer the question.

With the exception of thermophilic rods and streptococci, the number of other bacteria observed in smears, was limited and the number of occasions that they were found were relatively few. The work was done during the coldest season of the year. Only twenty-three smears were excluded from the series of comparisons because they contained uncountable clumps of bacteria of various kinds. Certainly most bacteria killed by pasteurization, disintegrate, and this undoubtedly reduced the variety of forms seen in smears.

Since thermophilic bacteria appear in increasingly great numbers as pasteurizing operations are continued each day, it is not to be expected that samples collected at random, as in our study, would uniformly contain them. A more rapid way to study the extent to which they occur in the product of each plant, would be to collect and test samples of the last milk pasteurized at each plant.

Our studies have revealed a considerable bacterial content of pasteurized milk at a time when the influence of poor milk producing conditions on the farms was at the minimum. This, in connection with the counts obtained, gives an indication of the extent to which plant processes affect the bacterial content of pasteurized milk.

Summary of Results

1 Direct microscopic counts of 480 samples of pasteurized milk and cream produced in Detroit during December, January and February, showed thermophilic rods in predominating numbers in 49.6 per cent of samples. They were present in lesser numbers, along with other forms of bacteria in a larger percentage of samples. In a series of 249 counts they were present either in the majority, or minority, in 66 per cent of samples.

2 Thermophilic rods were observed in the product of thirty-eight out of the forty-two milk dealers producing pasteurized milk.

3 Streptococci were found to predominate in numbers, in 32 per cent of 480 samples.

4 Bacterial forms other than thermophilic rods and streptococci predominated in 5.3 per cent of 480 samples.

5 Samples in which no bacteria were found after a search of thirty fields with a microscope adjusted to a 1:600,000 counting factor, constituted 13.1 per cent of 480 samples examined.

6 Counts from plates incubated at approximately 135° F., were less satisfactory than microscopic counts, for indicating the presence of thermophilic bacteria. The higher counts confirmed the miscroscopic counts in revealing thermophiles, but the lower counts diverged widely from them.

7 Standard plate counts whether thermophilic rods, streptococci or other bacterial forms predominated in samples, deviated widely from microscopic counts in the lower count ranges and displayed a close agreement in the case of the highest counts. In one case the three counts were in substantial agreement.

8 In the 238 samples in which thermophilic rods predominated, the ratio between the totals of the standard plate counts and the totals of the corresponding microscopic counts was 1:42.7.

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REPORT OF COMMITTEE ON MILK PLANT PRACTICE

H. A. HARDING, *Chairman*

MILK MARKETING AGREEMENTS

A STRIKINGLY new factor in the handling of milk plants is the milk marketing agreements which are being developed in the United States. These affect milk plant practice in a number of particulars.

STANDARDIZATION OF MILK

In defining the various grades of milk and of cream which shall be sold these agreements specify the fat content of each grade. This has been common practice in connection with cream but not milk. In the case of milk there has been a fairly common fat content for standard and for special milk in most cities but on the contrary the food laws in most states of the Union forbid the standardization of milk supplies.

Standardization of milk has been common commercial practice in most communities and food authorities have been familiar with this fact for many years although the practice is not recognized by existing statutes in many states.

Inasmuch as this practice now has official sanction by the Secretary of Agriculture representing the President of the United States, it would seem that consideration might well be given to the desirability of bringing state statutes into accord with these newer requirements. In this connection it might well be pointed out that the richness of the grades of milk established by the marketing agreements all seem to be distinctly above the minimum legal standards which are on the state statutes.

Milk As a Food

Another provision of the marketing agreements which will assist the milk inspection service is the provision which is commonly made for advertising the food value of milk.

In most cities the inspection service has held that part of its problem was to advise the public regarding the high food value of the milk supply which they were safeguarding. Apparently for some time this work will be carried out by the organizations which are to be financed by the dairy industry.

With the growing understanding on the part of the public of the importance of milk as food should come a greater appreciation of the part played by the inspectors in providing so fine a supply.

Milk Is Milk

The thought underlying the present trade agreements seems to be that except for variations in fat content all milk is of equal desirability. Eleven years ago this Association, by resolution, pointed out the importance of pasteurization in making milk safe. It can not view with satisfaction these milk agreements which fail to recognize the importance of pasteurization in connection with public milk supplies.

While milk as it appears on the market at present is usually of a high degree of cleanliness, we should deplore any change either in method of purchase, or of plant operation which should tend to minimize the importance of this element in milk quality.

As inspectors, our work brings home to us the marked variation in keeping quality which occurs among the milk supplies where they are delivered twice daily during the hotter months. We cannot but regret any change in purchasing arrangements which will cause this important quality of milk to be overlooked.

Quality Milk Control

During the past four years an interesting experiment in milk control has been under way at Rockford, Illinois. According to this plan the health department has supervised the quality testing of the milk as delivered to the milk plants, though the actual testing has been done by the plant force.

This is a plan according to which the health department joined with the milk producers and the milk dealers in an effort to improve the local milk supply. It has worked for four years with continued improvement of the milk supply and with the respect and confidence of all parties.

We believe this Rockford plan is worthy of careful consideration.

Metals and Flavors

Studies continue to be made of the effect of contact with various metals upon flavors developed in milk and cream.

Up to a comparatively recent date dairy apparatus has been almost exclusively from tinned copper. With the gradual removal of the tin, the copper is exposed. This process of exposure of copper has undoubtedly been accelerated in many instances by the use of chlorine.

Flavor studies indicate fairly clearly that where hot milk comes into contact with copper, the metal is dissolved—the amount dissolved being fairly proportional to the length of exposure and tending to increase with the temperature. Apparently the flavor is not due directly to the copper dissolved, but results from compounds produced gradually through the action of this copper upon the fat.

The resulting flavor is commonly referred to under a variety of names depending largely upon the intensity of the flavor produced.

Recognition of these results of the use of bare copper has led to a very marked shift from copper to other metals in the fabrication of milk plant equipment.

The item of equipment which has thus far undergone the minimum amount of change is that of the sanitary pipe, an outstanding proportion of which is still fabricated of the tinned copper.

As originally installed this sanitary pipe is tinned inside and out. However, tinning on the inside of the pipe is fairly promptly removed so that in practice, a large part of the sanitary pipes in milk plants consist of more or less bare copper.

In recognition of this problem there has appeared on the market sanitary pipe made from a variety of alloys. These alloys appear to have in common about 65 per cent copper together with, in some cases, lead and zinc. These alloys do not seem as yet to have been studied by the Agricultural Experiment Station workers but plant experiences suggest that these alloys carrying a large proportion of copper are objectionable from flavor producing standpoints.

Observations to date suggest that the alloy of nickel, chromium, and iron, commonly referred to as stainless steel, is satisfactorily resistent to hot milk so that flavors are not produced.

While experiences with aluminum are still too few to justify final conclusions, so far as they go they suggest that aluminum pipe will not produce objectionable flavors in the milk.

There is also being offered an alloy called Inconel consisting of larger proportions of nickel than that in the so-called "stainless steel." The experiences with this likewise seem to be satisfactory but is too limited to justify final conclusions.

Soft Curd Milk

During the past two years there has developed a fairly wide spread interest in the subject of milk forming in the stomach softer curds than those resulting from ordinary cow's milk. The work of Hill and others has shown that the milk from a small proportion of the cows produces a low curd tension. It has also been shown that with delicate children, the use of such milk has advantages.

It has likewise been shown that pasteurization produces a slight softening of the curd tension of milk and this curd tension can be still further reduced by homogenization at a pressure of 3000 pounds per square inch.

The selection and separate handling of a separate supply of soft curd milk necessarily involves additional expense and thus far only a few markets have manifested sufficient interest in soft curd milk to make economically possible its being offered to the consuming public.

Irradiated Milk

It has been well demonstrated for some time that milk carrying an increased amount of vitamin D can be prepared by feeding irradiated yeast to cows. More recently, apparatus has been devised utilizing the carbon arc light for the irradiation of milk, and milk so treated has been likewise found potent in preventing or curing rickets in children. Apparatus for this purpose is now available from two of the larger machinery manufacturing organizations and a third apparatus has been developed by one of the larger milk distributing companies.

The methods at present available for measuring the vitamin D content of milk are expensive. It is, accordingly, very desirable that quicker and less expensive methods of such measurement be made available.

Can Washing

Knowledge is wide spread that the fairly well washed, wet can will develop a large amount of germ life on standing.

Health officials have long insisted that in addition to being washed properly, milk cans should be dried thoroughly. This latter requirement has been difficult to enforce largely because plant workmen do not like to handle hot cans, and unless the cans are thoroughly heated in the can washing process they are rarely dried properly.

There is a growing recognition on the part of milk plants that washing solutions have little part in the actual washing of cans because of the excessive dilution factor in practically all apparatus. Accordingly, the tendency seems to be toward the use of less washing powders in can washing and the use of more abundant volumes of thoroughly hot water.

The effect of this is to heat the cans thoroughly so that insistence on dry cans has a better chance of success.

Discussion

Mr. Irwin: Dr. Harding has referred to the use of aluminum. We have several plants in Pennsylvania where aluminum is used for all purposes: tanks, pasteurizing equipment, pipes and fittings. At first we had considerable trouble with it. The fittings would not hold; the threads would turn off. The material was too soft. Other material following that became harder, so that today we have fittings that are apparently suitable for this use. Two or three different types of so-called aluminum differ greatly in their composition and in order to know what you are really using you would necessarily have to get your alloy combinations. That is difficult to do, but we can tell when aluminum is sufficiently hard to answer the purposes for milk plant equipment. We have the problem of cleaning. The softer material is more difficult to clean, and unfortunately these plants were located in various parts of the State under different water conditions. In the mining sections where we have surface water we had more trouble with the soft aluminum, but as the harder alloys came into use that difficulty disappeared and we find that we can easily clean the alloys being brought to us in milk plant construction. The cleaning of the plant day by day—regular milk plant practice—has improved so that we have cleaning compounds today that apparently do not affect the aluminum, cleaning the surface as satisfactorily as any other material for milk plant equipment.

Dr. Harding: Your committee did not go into this matter of variations and different formulæ in the aluminum, partly because it is so new and partly because the changes are not over by any means. Some of the more resisting forms of the alloy have only been out a matter of a few months and changes are evidently still under way. As I understand it the amount of material going into the alloy is surprisingly small, but its effect in hardening the aluminum is outstanding. Pure aluminum is so soft that if you would drop it on the floor it would be hopelessly marred out of shape. Some of those newer alloys are not as hard as steel but closely approximate steel, and still as I understand it this alloy is considerably less than five per cent of the material.

Chairman Johns: Some work has been done at Geneva in connection with the use of a gas flame to obtain a dry, sterile can. Possibly Dr. Breed, or some of the others working at Geneva, could tell you a little more about that.

Dr. Breed: If you can get a hot can and dry it thoroughly you have killed your bacteria better than you could ever kill it with any kind of steam sterilization. That is explained in the bulletin gotten out by our dairy department. It is a practical idea where you have gas. They have been working on electrical heating equipment to do the same thing. It really involves using moist heat because the can is heated to the point where the moisture in it becomes steam and acts to kill the bacteria. You get both the moist heat and the drying effect.

Chairman Johns: This is extremely interesting to all of us because there is probably no one thing upon which the dairy industry falls down any more than on the condition in the can at the time the farmer comes to use it. The can washer may be doing a very nice job from a bacteriological standpoint when the cans are checked immediately after coming off the can washer, but twenty-four hours later, or even a much shorter time, and it is a totally different picture.

Dr. Harding: If I may be permitted to say something which was not in the report I would like to call attention to the matter of our treatment of milk bottles. I believe there is no question but what in our present process of pasteurization the treatment which our bottles receive, in too many instances, is not up to standard. I think it is the poorest thing we are doing in connection with pasteurization. I do not want to be misunderstood. There are many plants where the treatment of milk bottles is above criticism, but there are others where it is not. The State of Pennsylvania is the only state where we have regulations which seem to completely meet the situation in requiring a little more heat treatment than perhaps is absolutely necessary. If it requires thirty minutes, as we maintain, to make milk safe, then we put it in a bottle which has been heated to a maximum of one hundred forty for two minutes, is the bottle as safe as the milk going into it? Are we not doing the thing we had in mind when we spoke about "putting new wine in old bottles"? There are bottle washers on the market that are thoroughly satisfactory. I don't want to create the impression that all the milk bottles in the country are being poorly handled. On the other hand, there are literally thousands of these milk bottle washers costing six and seven thousand dollars apiece in milk plants in the United States and Canada, where it is just physically impossible to heat those bottles enough to make them safe. You know how inspectors feel about it when the plant owners have spent six or seven thousand dollars for a machine.

Mr. Tiedeman: I might say in defense of New York State that for some time we have tried to write into our regulations just how a bottle should be sterilized. It got so complicated we decided we were on the wrong track and modified our regulations to simply say the bottle must be clean and sterilized. We got out to see whether bottles were sterilized or not, and we agree with Dr. Harding in general that they are not, but I believe we have accomplished more in two years' work getting out and testing bottles to see whether they are being properly sterilized than we would working on regulations for two or three years.

Dr. Harding: How do you test the bottles?

Mr. Tiedeman: With our Mobile Laboratories we have taken samples of bottles right off the racks, then gone to the filler and "swished" them with sterile water and then plated the water. Of course we probably would not have a perfect index but we do find plenty of bacteria that can be rinsed out of the bottle with sterile water when bottles are not properly sterilized.

Chairman Johns: I presume that in some cases those bottles are being treated with chlorine as a final rinse.

Mr. Tiedeman: Yes.

Chairman Johns: It is possible that during the time elapsing between the rinsing of the bottle and the plating of the solution of the rinse that you might have a continued germicidal action.

Mr. Tiedeman: I think it is important in that instance to remove any residual chlorine that may be present with sodium bisulphate.

Dr. Harding: We check the process of pasteurization in the plant because long and laborious studies have shown when certain heat treatment is applied to the milk we can thoroughly depend on it being a safe product. In the same way we can put temperature recording devices on bottle washing machinery and have precisely the same type of dependability regarding the safety of bottles that we have from our recording apparatus in our pasteurization regarding the safety of milk. Still, bottle washers with thermometers on them are almost as scarce as hen's teeth. We need temperature recorders on our bottle washers just as much as we do on our pasteurizers. It is one of those things we haven't begun to think seriously about yet.

Chairman Johns: I wonder if Dr. Harding is not overlooking the fact that the sterilization of milk bottles in the soaker type bottle washer is the product of not only heat but of combined heat and alkali. Dr. McCullough has done a good deal of work on this. Possibly he could give us a little information as to what would be the effect of different concentrations of alkali at different temperatures upon the killing, we'll say, of tuberculosis organisms.

Dr. McCullough: Apparently if we use two per cent of sodium bisulphate with the temperature that you will find in the average mechanical bottle washer, soaker type, we are doing about everything we can against bacteria. Unfortunately, the acid group are very resistant to alkali. They apparently are the only group of micro-organisms which are resistant to alkali.

Dr. Harding: In the first place, in bottle washers you do not have pure sodium hydroxide; it is a mixture of about forty-nine things. In the second place, you can not get one hundred forty-five and in the third place it is not exposed to that temperature for two minutes. Barring that, that sort of treatment is excellent. Now the most careful study of that sort of thing that I happen to know of was done by Dr. W. H. Park, using one of this type of apparatus. He found that with two per cent alkali the tubercle bacillus was left alive in fine shape.

Chairman Johns: I would like to have Dr. Harding give us his definite rule for sterilization in bottle washing.

Dr. Harding: May I pass the buck by asking Mr. Irwin to give us the regulation in Pennsylvania, which is the regular thing?

Mr. Irwin: The regulation requires one hundred eighty degrees. The heating of the bottle to one hundred eighty and then allowing it to cool would give sufficient time, or in the soaker type washer one hundred sixty-five degrees for three minutes or longer.

Chairman Johns: Any specifications as to alkali?

Mr. Irwin: No, believing that irrespective of the amount of sodium bisulphide or chlorine, under commercial conditions, we were not attacking the tubercle bacillus.

Dr. Brooks: I don't know anything about washing bottles, but I used to know something about the tubercle bacillus. Dr. Harding seems to be worrying particularly about bottles being infected with tubercle bacilli. I wonder, looking at it from a layman's standpoint, if there is any real danger. In the first place, it seems to me the chances of milk bottles being contaminated with tubercle bacilli are very remote; in the second place, in order to get a tubercular infection you have to have comparatively massive and repeated doses. Unless you are looking upon the tubercle bacillus as a test organism to determine the efficiency of your sterilizing procedure it is a question whether this is really a very important consideration.

Mr. Ott: I would like to ask what concentration of chlorine will kill the germ of tuberculosis in milk.

Dr. Harding: It will not do it in any strength that we can use commercially.

Mr. Yates: I think Dr. Harding has not read as much about that as he has about many other things. There is plenty of evidence in the literature that chlorine will kill the tubercle bacillus. The Institute has done considerable work on this. I think they have records that show that when you acidify your chlorine solution the tubercle bacillus will be destroyed by concentrations as low as ten parts per million after a short exposure.

Professor Prucha: I believe the problem follows very closely what Dr. Harding has stated about the practices of bottle washing. However, it seems to me we are talking about a theory that is based on something entirely different than the problem. As Dr. Brooks has indicated, we are talking about masses of tubercle bacilli in milk, something quite different from what we have in the bottle. In my own experience in taking bottles from bottle washers I have found the greater sources of contamination in the water in which the bottles were rinsed. Very seldom do we get a bottle that will show microorganisms right after they come from the soaker, even with half of one per cent caustic or alkali solution. I think we should do some studying on what we get from bottle washing. I think the infection in bottles is not as great as it is thought to be.

EFFECTIVE MILK CONTROL

HENRY C. BECKER

Chief, Bureau of Dairy Products
Chicago Board of Health

IT is not deemed necessary to stress the importance of health to this group of trained sanitarians whose life work is that of promoting and maintaining the health of our people. That motto "Health—your greatest asset" is, without question, the most significant adage of all time, for without health, life holds but little treasure.

Much has been said and done relative to the control of our milk supplies. But too much emphasis can not be stressed upon the importance of milk as related to health.

The work of the milk control officer is not merely a position, but each and every one of us has a *sacred* duty to perform. When we consider that hundreds of thousands of persons, primarily those of tender years, depend entirely upon the honesty and integrity of our work, the value of such endeavor cannot be overestimated.

The importance of our tasks is indelibly reflected in the reduction of the case and death rates of those diseases which, in past years, were too frequently milkborne, as for example, diarrhea and enteritis, typhoid fever, septic sore throat, tuberculosis and many others.

A great deal of work still remains to be done, however. We are guided in our attack of the problems which are to be solved, by the great store of knowledge that has been furnished us through the untiring efforts of investigators and research workers. These men and women are usually connected with our great universities and institutions of higher learning, and are especially trained for carrying on work of this nature.

Most of us are familiar with the vast improvement which has been made generally in our milk supplies throughout the nation. I am firm in the belief, however, that the administrative side of milk control has not kept abreast with the scientific phase of this question.

In qualifying this rather broad statement we have but to refresh our memories that it was common knowledge for many years, based upon competent scientific research, that milk from tuberculous cows was the source of a great percentage of the cases of tuberculosis, particularly in children, throughout the world. However, with these facts well known for a great number of years, it has been only within the last few years that definite steps have been taken to rid our dairy cows of tuberculosis.

Attention may be further directed to reports furnished us by the United States Public Health Service, which indicate that from thirty to fifty definite milkborne epidemics occur in this country each year.

Up to a few years ago, water ranked first as a carrier of disease. In a report recently issued by a middle western state we find that because of the efficient methods of water control placed in effect, milk now ranks first as a carrier of disease in that state.

In analyzing the vital statistics compiled by cities and states, it is believed that in numerous communities the death rates of infants are altogether too high. While we are familiar with the fact that many other factors enter into this picture, it has been our experience that pure milk is indeed of major importance in the reduction of infant mortality.

The reason for relating these facts is not to discount in the least the tremendous amount of good work that has been accomplished. It is merely to impress upon ourselves that much still remains in the administration of our duties as milk control officials.

In attending meetings of associations interested in milk supervision, it has been my observation that work mostly of a scientific nature occupies the time of the greater part of the sessions, and little is said of the actual placing into effect of such measures as are based upon the information furnished us by our scientific workers.

With this thought in mind it is my purpose to discuss briefly some of the more essential considerations of milk control from an administrative viewpoint.

From the numerous inquiries received by the Chicago Board of Health, it would appear that the milk control official is particularly interested in promulgating legislation for the control of milk supplies.

It is true that proper legislation is the foundation of milk control efforts. It is to be remembered, however, that the mere passing of a law or ordinance means but little unless, at the same time, ways and means are provided for carrying out the requirements of such legislation.

Again, in speaking of legislation, most health officers are not fully aware of their tremendous police powers in the enforcement of city milk-control ordinances, which powers may transcend, in an emergency, even that of the constitution itself. Boards of health have broad powers and, at times, may use these powers to advantage to make changes quickly and effectively.

In this connection, it may be of interest to you to learn that Chicago has made effective for sixteen years the compulsory pasteurization of all milk products, except certified milk, without an ordinance to that effect—merely by order of the Board of Health.

And again, that outstanding achievement which required Chicago's milk to be produced by healthy cows only, free from tuberculosis, under the able stewardship of Dr. Herman N. Bundesen, as commissioner of health, was successfully accomplished, even though there was and still is in the Illinois statutes a law which prohibits any city in the State from enforcing such legislation.

It is well recognized that any milk-control program, to be successful, must necessarily be controlled and under the leadership of those who will uphold a comprehensive policy without fear or favor. No program can be effective without such support.

Considerable diplomacy must be displayed in the realization of this task, but no finer monument could be built, or a greater honor bestowed upon an enforcement official than the knowledge that he has faithfully and conscientiously striven for a safe and wholesome milk supply for his people.

Every order issued and every inspection made by those who come in contact with the industry, is a reflection of the attitude of those in charge of the work. Of especial importance, also, is the necessity for all employees to be full time, well paid, well trained, honest and efficient.

This may sound highly desirable, but in the face of changing political administrations, may appear impossible to attain. In that connection, it may be of interest that under Chicago's strict Civil Service requirements, the average length of service of our field forces is fifteen years, while the youngest in point of service is seven years.

I will not recite in detail our work of routine inspection with which most of you are familiar, but will enumerate a few of the methods which we have found most effective during the past years.

Supervision, to be thorough, must cover each detail in the milk business from the cow to the doorstep. The backbone of this system of supervision must of necessity be personal inspection by field forces of each and every operation in the production, transportation, processing and distribution of the milk supply.

Pasteurization as well as milk analysis are essential, to be sure. The inspection at the source of production, however, on the farm forms the first line of defense. Proper pasteurization then acts as the second line of defense, which gives double assurance of the safety and purity of a city's milk supply.

It is true, however, that we can not have one of our representatives on the farm, or in the milk plant, at all times that milk is being produced or processed. It is for this reason that great reliance must be placed upon proper pasteurization. To do this work efficiently, a great array of mechanical devices are to be considered. In their operation, the human equation is a major factor. The more perfect mechanically the pasteurizing equipment is, the less dependent are we upon the human element for the proper functioning of such machinery.

Our efforts at the present time are being directed toward first, making the mechanical process free from any defects which may have developed because of wear over a period of years, and secondly, to make the equipment more fool-proof to eliminate the possible carelessness of the operator. We have been helped greatly in this work by our own designed potentiometer and thermocouple equipment for determining the efficiency of milk pasteurizing equipment. Defective milk pasteurizing equipment that has been detected by the use of this apparatus has been repaired or replaced.

Another essential item in the handling and processing of milk is that all such operations shall be conducted in plants which are properly constructed, located and equipped for this work. Plants that are crowded or located in basements and cellars, or other unsuitable quarters, permit of possible contamination of the milk as it is processed. In addition, a poor outward appearance of a plant reflects the attitude of the owner, causes a doubt in the user's mind as to whether or not the methods in use are in accord with the shabby appearance of the building and surroundings, and affords little incentive to keep the plant and equipment in a clean and sanitary manner.

Having in mind a plan for increasing the efficiency of the milk-handling methods, a system of photographic inspection of milk plants has been developed, which has proved to be an important measure in eliminating defects from milk plant construction, equipment and operation.

Hundreds of photographs have been taken and made into a permanent pictorial milk inspection record. In the intensive campaign conducted to eliminate poorly located or constructed plants, the owners and operators of the undesirable establishments were called before the Board of Health and confronted with a report of conditions, backed up by the actual photographs.

Pictures show actual conditions better than pages of report would be able to do. The owner or operators, confronted with such evidence, could make no effective denial that improvement was required. Time limits were given in which new plants were to be constructed or extensive alterations made. If a reinspection disclosed that the necessary changes had not been completed, at the expiration of the time limit, the plant was ordered closed. In most instances, new plants were built or alterations made, as required. In others, the owners made arrangements to have their milk pasteurized and bottled by approved plants, or in some cases, sold their business. More than forty undesirable city plants have been eliminated in this manner during the past few years.

In addition to the major changes made, there has been a definite improvement in the sanitary conditions of most plants. Photographs were taken by the inspectors of any insanitary conditions found in the plant itself,

or in its equipment and operation. Such items as dirty clothing of the workers, improper use or construction of milk-handling machinery, exposure of the milk to possible contamination, and many others were recorded, which gave the Board of Health a permanent pictorial record of the actual methods in use.

An outstanding feature of this type of inspection is the psychologic effect on the dairymen and employees. There has been a general improvement in plant maintenance and methods. The dealers explain that they wish their plants to appear at their best, if a permanent photographic record is to be maintained.

All of this work has been done without the need of special legislation of any kind. It is the result of using all means at one's disposal in educating the individual to view a problem through the eyes of the milk control official. It is by this method that the milk dealer will usually be more than willing to cooperate with the Board of Health, so that resorting to police powers in securing compliance with necessary standards will be resorted to only in isolated instances.

The Board of Health has found that by holding public board hearings for first violations, at which time the plant operator is given an opportunity to explain why compliance has not been secured, it has not been necessary to resort to drastic action in securing abatements. In addition, our field representatives remain at plants for a day or more at a time, when some particular difficulty develops, for the purpose of determining its cause, and then to instruct the dairyman in the proper operation of the plant and equipment to prevent a recurrence of such conditions.

The testing of cattle for tuberculosis in territories which supply Chicago with milk has gone ahead very rapidly during the past few years. Four of the five states from which our milk is derived are modified accredited areas, and the fifth state is expected to be accredited before the end of the year.

The administration of a program of such a magnitude would be unsuccessful without accurate records of all transactions; therefore, at the outset, a division of records of tuberculin test was established.

It has been required, at all times, that an individual herd certificate for each of the 23,000 herds producing milk and cream, for Chicago, be on file in the office of the Chicago Board of Health.

Only the official record of a federal-state cooperative tuberculin test is acceptable. A close check is kept on the expiration of tests and, if a herd is not retested within 15 days after the issuance of a notice, the milk from such herd is barred from the Chicago market until compliance and permission to resume delivery is obtained.

The routine reports of both country dairy and city milk inspectors are checked regularly with herd certificates, as a control measure to insure that (a) an official herd certificate is on file; (b) the herd certificate has not expired, and (c) the herd certificate is regular; namely, covers sufficient cattle to produce the amount of milk delivered, as well as every animal in the herd over six months of age.

The filing of such herd certificate is a prior requisite to milk shipment, and such an official record, regular in all respects, must be in the Board of Health files as long as milk products are produced for Chicago. No blanket form of certificate covering an accredited county or other area is acceptable.

With due respect to the state and federal authorities, this method of control has been found imperatively necessary to cope with the problems involving the sale, transfer and exchange of dairy cattle from otherwise unknown sources; for tracing causes and sources of excessive tuberculous infection in dairy herds (information which would otherwise be unavailable); for requiring retests of infected herds which would otherwise be undisclosed; and, in satisfying the Board of Health that bovine tuberculin testing is being done as outlined under the federal-state uniform cooperative plan.

During the past year, more than 1500 final notices were sent to milk distributors and producers before action was taken by shutting off farms for failure to retest cattle, or file official herd certificates. About one-sixth of this number were shut off upon failure to comply in time.

This system of records is not only a guarantee, but a proof as well, that the program is being conducted properly and subject to examination.

Progress made in the tuberlin testing program throughout the United States in the last ten years, or since the launching of Chicago's bovine tuberculosis eradication program, may be of interest to you.

In 1923 there were seventeen counties throughout the United States that were accredited, that is, in which the infection had been reduced to one-half of one per cent or less. Today, out of 3073 counties in the country, 1664 of these, or better than 50 per cent are accredited. This includes all of the counties in eleven states and the District of Columbia.

According to information furnished by the United States Public Health Service, 347 American cities have adopted regulations requiring the compulsory testing of cattle. From observation, however, it appears that the elimination of the disease in some sections of the country has not progressed as rapidly as the interests of public health warrant.

In conclusion, I wish to report that Chicago has not suffered a milkborne epidemic or has not had a case of communicable disease traced to our milk supply in many years.

Milk for a large city as Chicago is obtained from thousands of sources, and millions of gallons are consumed annually, handled by a vast army of individuals. You who are so familiar with the regulation of milk supplies throughout the country will appreciate that this accomplishment is not merely a matter of luck. It is the result of close application and vigorous enforcement of reasonable requirements.

I was much interested in the paper given yesterday by Dr. Hiscock, in which he stressed the value of milk as a food. He suggested that 25 per cent of the food budget should be spent for milk and urged that every available means be used to increase the consumption of milk,—the vital health food.

The work of Sherman, McCullum, Hess and others is of great value in this direction and is splendid. We as milk control officials can give them no greater support, nor can the interests of citizens be better served, than in insuring the safety, purity and wholesomeness of our milk supplies.

A few lines of adverse publicity given a milk supply by the daily press will undo years of effort in an attempt to increase our daily consumption of milk.

Discussion

Dr. Brooks: Dr. Becker referred to milkborne communicable diseases, in the past too often transmitted through milk, and I have underlined "in the past." I realized that he was talking about Chicago. After what he has told us, that all their milk other than "Certified" has been pasteurized for many years, it is quite easy to believe that they can consider milkborne communicable diseases almost a thing of the past. I believe that is also true of New York City, in my own state, where all the milk other than "Certified" is pasteurized and has been for some years. New York City has only had one milkborne outbreak recorded in seventeen years. On the other hand, in the rest of the state, which we in the State Health Department are particularly interested in, we have had one hundred four milkborne outbreaks in that same period. I don't want you to get the impression we are proud of the fact; we are not. On the other hand, it is something which we feel should be faced. I am thoroughly convinced that when it comes to prevention of the spread of communicable disease through milk, pasteurization is the one effective control measure. I believe that will hold until somebody discovers some process easier, simpler and cheaper than pasteurization for doing the same thing.

Mr. Yates: I understand that Chicago has a specific regulation that differs quite a little from those of other cities in the handling of bottles and bottle washing, and I wonder if Dr. Becker would just tell us what that is. What brings it up is the fact he stated that for a considerable number of years they haven't had any epidemics traceable to milk, and in a city of about four million people and practically all of the milk being handled within the city, it has been very interesting, in view of the discussion we had just previous.

(Dr. Becker referred the question to Mr. Krueger.)

Mr. Krueger: When the soaker type bottle washer was first used in Chicago the question came up as to just what efficiency could be expected from it. A committee was appointed to study the problem. They worked on it for weeks and they brought out a set of regulations which we have in effect today and which we think are efficient in bottle washing and sterilization of milk bottles. Some of that work has not been published. At that time they had merely the one type of bottle washer. They formulated these requirements: First, a sodium hydroxide concentration of one and six-tenths per cent, a total alkali strength of two and four-tenths per cent. A temperature of not less than one hundred twenty degrees in the soaker tank was required and immersion for not less than five minutes. We require a heat treatment of the bottle afterwards, or, as is done now in most cases, a chlorination of the final rinse of not less than thirty-five parts per million, that rinse not to be recirculated. All new machines which are brought into the Chicago market are subject, first, to examination of the blueprints by our office and then final testing before approval is given to use that machine. No rinsing is done after the sterilization treatment except with water that we are sure is free from contamination. City water is used for washing and rinsing bottles in our city plants. We consider it to be of good sanitary quality, but nevertheless ask in addition a treatment of the final rinse. We consider a bottle which has a residual count of not more than one organism per two cubic centimeters of bottle capacity as satisfactory.

REPORT OF COMMITTEE ON DAIRY AND MILK PLANT EQUIPMENT

W. D. Tiedeman, *Chairman*

IT is customary for your committee on dairy and milk plant equipment to report upon new developments. The outstanding development of the year is a so-called milk irradiator for fortifying milk with vitamin D. In this process milk is passed in a thin film before a carbon arc lamp. We understand that two milk firms in Michigan have been marketing irradiated vitamin D milk for some months. In one instance this milk is marketed at a penny per quart premium as a special milk, and in the second instance a firm, located in a smaller town, has been irradiating their entire supply without increase in the price to the consumer.

The committee also notes the increased application to pasteurizing equipment of automatically controlled hot water circulating systems.

More important than the developments of the year is the general equipment situation. There is much that might be said about the improvement in dairy and milk plant equipment during the past five years or more, both from the standpoints of sanitation and efficiency of operation. Quite naturally, some of the new developments have not proven entirely satisfactory. In developing new ideas many devices have been introduced which have been too complicated for practical use and have later been discarded. Some things that have looked good in theory have not worked out so well in practice. However, the net result has been that some of the equipment now on the market is far ahead of anything that we have had heretofore.

Notwithstanding this development milk control officials are still confronted with many problems in passing upon dairy and milk plant equipment.

Designs of leak protector valves for pasteurizers have been changed almost over night and it is necessary for inspectors to examine each new installation of a pasteurizer critically to determine what changes have been made since the last installation was approved. Leak protector grooves on inlet and outlet valves are frequently improperly placed or are too shallow to be effective when a valve is leaking freely. Steam connections have been a frequent source of annoyance. Milk will sometimes collect in the steam pipe between the valve in the steam line and the milk valve which after a day's incubation is discharged into the outlet line when steam is again turned on.

Manufacturers are almost constantly changing materials and methods of construction. A relatively cheap alloy came on the market a few years ago which was quite active electrically and caused considerable trouble with off flavors. Fortunately, it was not extensively used.

The solder ordinarily used on stainless steel appears to pit very rapidly, apparently due to electrolytic action. There appears to be danger of seams opening within a relatively short time as a result of this action. Some milk control officials feel that unless a more satisfactory solder can be developed, the soldering of stainless steel for dairy and milk plant equipment should be abandoned.

Troughs and covers for surface coolers are frequently improperly constructed. The troughs are sometimes so long that leakage from the headers will drop into the milk. Distributing troughs or pipes over coolers are not always covered.

Enclosed tubular coolers and heaters are not always constructed with the tubes so sloped as to drain, which appears to be desirable. Joints are not always designed to prevent leakage which is important. Gaskets are in some instances so installed as to make cleaning and sterilization difficult. When gaskets are necessary, the use of single service paper gaskets should be encouraged.

Bottle fillers are not always completely covered. The cement used to hold the valves in place in some enamel lined fillers will disintegrate leaving a crevice in which milk solids will collect and decompose.

Possibly due to conflicting requirements in different states, new installations of indicating and recording thermometers do not always meet local requirements.

Sanitary pipe fittings are not always of the best design. Some plugs are hollowed out on the side exposed to the milk, making cleaning difficult while others are finished flush. Methods and practices of making joints at the ends of pipes are open to considerable criticism.

Your committee believes that much could be gained if some organized group of milk control officials, preferably a committee of this organization, could confer with manufacturers of dairy and milk plant equipment and gradually develop models that will be generally acceptable. Manufacturers have invited the criticisms of individual health departments but there has been no general attempt at standardization.

The proper installation of equipment is also a matter of concern to control officials. Too frequently equipment is poorly located, is improperly connected or improperly operated, apparently due to failure of the dairyman, manufacturer and inspector to get together.

Another difficulty is presented in the practice of selling second-hand equipment which should go to the junk heap, where in most instances it most properly belongs.

It appears to the Committee that many of these difficulties can be readily eliminated.

A requirement by regulation if feasible or otherwise by common consent, that plans for new dairies or milk plants be submitted to the milk control authority for approval before construction is begun should result in better plants and better equipment. Approval should also be required for changes in buildings or equipment. Dealers should be required to demonstrate after making an installation of new equipment that such equipment can be properly operated before the installation is accepted.

Considerable progress can be made in securing better dairy and milk plant equipment if the association chooses to act upon the committee's suggestion relative to cooperative work with manufacturers. We understand that the "Standardization" and "Plant Manual Committees" of the International Association of Milk Dealers have been working on this problem with the manufacturers. We believe that cooperation with these committees is also highly desirable although the final word on matters relative to sanitation should come from representatives of this association.

MILK PRICE CONTROL IN NEW YORK STATE

Kenneth F. Fee
Director, Milk Control Board, Albany, N. Y.

DAIRY farming is the major agricultural industry of the State of New York. The 75,000 or more dairy farmers who produce milk on a commercial scale deliver approximately five and one-half billion pounds of milk to milk plants within the State annually. There are more than one million, four hundred thousand dairy cows in the State. The number of cows in the State has decreased and increased in cycles of about sixteen years duration for the past fifty years, but the number at present is not materially different from the number fifty years ago, during which time there has been a great development of the dairy industry in other states.

In round numbers, half the milk produced in New York State is used in fluid form, a quarter more in the form of cream and the remaining quarter in the form of evaporated milk, cheese, butter and other dairy products.

Anything which affects the welfare and stability of an industry of the size and importance of the New York State dairy industry can not but be of interest to the people of the State in general. When in 1931 and early 1932, therefore, there had been a rapid decline in the price paid farmers for milk, it is not surprising that the legislature took notice of the situation and appointed a special legislative committee to investigate the dairy industry of the state and report to the 1933 session.

In its preliminary report the committee listed the following "findings and conclusions":

1. The production and distribution of milk in this State is a paramount industry and affects in a large measure the health and prosperity of the people of the state. It is the duty of the state to take such measures as are necessary and reasonable to preserve this vital industry.

2. The financial situation of dairy farmers in the state is very serious and has grown increasingly critical during the period of the Committee's investigation.

3. The principal causes of the extremely low prices for milk are the unprecedented recession in business and the periodic increase in the number of dairy cows.

4. The fluid milk industry is affected by factors of instability peculiar to itself which call for special methods of control.

5. Control and regulation of the milk supply by the producers through effective cooperative organization appears to offer the best prospect for permanent stabilization of the dairy industry in the New York milk shed.

6. A State Milk Control Board with broad powers is required to deal with the present emergency in the fluid milk industry of the state.

7. Serious complications are involved in the marketing of milk produced in this state, which require careful consideration in whatever regulatory procedure is adopted.

It will be observed that the committee found that the financial situation of the dairy farmers had grown increasingly worse. The fact is that in a four year period prices received by farmers for milk had decreased 68 per cent while prices charged consumers in the New York City market had decreased from 16 cents per quart to 10 cents per quart, a decline of 37 per cent.

As a result of the work of the legislative committee and the pressure brought to bear by dairymen, a milk control law was passed by the legislature and signed by the Governor early in April 1933. As the law already has been used as the basis for similar laws in other states, a brief resume of its provisions may be of interest.

At the outset, the law states that it is enacted in the exercise of the police power of the State and for the protection of the public health and public welfare. It declares that "unhealthful, unfair, unjust, destructive, demoralizing and uneconomic trade practices have been and are now carried on" in the dairy industry, imperiling a constant supply of pure milk, and these conditions are declared to constitute a menace "to health, welfare and reasonable comfort of the inhabitants of the state."

The production, transportation, manufacture, storage, distribution and sale of milk is "declared to be a business affecting the public health and public interest." The recital continues "That the present acute economic emergency, being in part the consequence of a severe and increasing disparity between the prices of milk and other commodities, which disparity has largely destroyed the purchasing power of milk producers for industrial products, has broken down the orderly production and marketing of milk and has seriously impaired the agricultural assets supporting the credit structure of the state and its local governmental subdivisions. That the danger to the public health and welfare is immediate and impending, the necessity urgent and such as will not admit of delay in public supervision and control in accord with proper standards of production, sanitation and marketing. The foregoing statements of fact, policy and application of this article are hereby declared as a matter of legislative determination."

With this "legislative finding" as a basis, the law proceeds to set up a "Milk Control Board" composed of the Commissioner of Agriculture and Markets, the Commissioner of Health, and "the director of the Milk Control Board," the latter appointed by the Governor.

The Board is declared to be "the instrumentality of the state for the purpose of attaining the ends recited in the legislative finding, statement of policy and application" of the law and is vested with power "to supervise and regulate the entire milk industry of New York State, including the production, transportation, manufacture, storage, distribution, delivery and sale of milk and milk products in the State of New York."

The Board is authorized to investigate and regulate the entire dairy industry and is given power to subpoena milk dealers and others and to administer oaths. It is given power to adopt rules, which have the force and effect of law, and to enforce them.

The provisions of the law authorizing the fixing of prices will be of particular interest. These are as follows:

(a) The board shall ascertain by such investigations and proofs as the emergency permits, what prices for milk in the several localities and markets of the state, and under varying conditions, will best protect the milk industry in the state and insure a sufficient quantity of pure and wholesome milk to adults and minors in the state, having special regard to the health and welfare of children, and be most in the public interest. The board shall take into consideration all conditions affecting the milk industry including the amount necessary to yield a reasonable return to the producer and to the milk dealer.

(b) The board after making such investigation shall fix by official order the minimum wholesale and retail prices and may fix by official order the maximum wholesale and retail prices to be charged for milk handled within the state for fluid consumption, and wheresoever produced, including the following classes: (1) By milk dealers to consumers; (2) by milk dealers to stores either for consumption on the premises or resale to consumers; (3) by stores to consumers except for consumption on the premises where sold.

It is declared to be the intent of the legislature that "the benefits of any increase of prices received by milk dealers by virtue of the minimum price" fixed by the Board be given to producers. The law proceeds to authorize the Board to fix "the minimum prices to be paid by milk dealers to producers" and makes it unlawful to buy or sell milk "at any price less or more than such price or prices as shall be applicable to the particular transaction, and no method or device shall be lawful whereby milk is bought or sold or offered to be bought or sold at a price less or more than such price, or prices as shall be applicable to the particular transaction, whether by any discount, or rebate, or free service, or advertising allowance, or a combined price for such milk together with another commodity or commodities, or service or services, which is less or more than the aggregate of the prices for the milk and the price or prices for such other commodity or commodities, or service or services, when sold or offered for sale separately or otherwise."

Those who doubted the right of the legislature to authorize the fixing of prices did not have long to wait for a test case. A storekeeper named Leo Nebbia sold two bottles of milk for 18 cents, the minimum price established by the Milk Control Board, and with it as an inducement to its sale gave the purchaser a loaf of bread worth 5 cents. The milk dealers' organization in the city in which the storekeeper did business brought an action against him in the local court. He was found guilty of a violation of the Board's minimum price order and fined 5 dollars.

In some respects, this was an unimportant transaction, but it raised an important principle. An appeal was taken on constitutional grounds from the decision of the lower court and promptly brought to the attention of the Court of Appeals, the highest court of the State. After due deliberation that court sustained the constitutionality of the law. By this action the administration of the law was placed upon a more stable basis. The decision of the court will doubtless have an important bearing on decisions elsewhere with respect to recently enacted legislation designed to assist in the recovery from the effects of the depression.

When the Milk Control Board was brought into being on April 10, the milk business of the State was in a particularly demoralized condition. Price cutting was rampant in some of the larger city markets and had been carried on extensively for many months. The larger distributors for several years had paid producers for their milk a price based upon its utilization. That part of the milk sold in fluid form was accounted for at one price, that part of the milk sold in the form of fluid cream at a lower price and that part of the milk manufactured into dairy products at various other prices depending upon the product manufactured. Producers therefore received a price representing the proportionate amount of milk used in various forms. This price is commonly referred to as the pooled price. These larger distributors handled a smaller percentage of milk in fluid form than did many other smaller distributors. Smaller distributors therefore were able to pay slightly more than the pooled price and still purchase fluid milk at a price much lower than the price used by the larger distributors is accounting for that part of the milk which they used in fluid form. The smaller distributors, therefore, were able to secure an ample amount of milk to supply their customers with fluid milk at a price somewhat lower than the price at which the larger distributors could sell it. This was a contributing factor in price cutting which had brought the prices paid to New York State producers down to the butter and cheese prices, and in some instances even lower.

The first action of the Board was to promulgate an official order fixing minimum prices governing sales of milk by dealers to consumers and to stores. The prices first established were approximately the prevailing prices at that time and were too low to produce anything like an adequate return to farmers. Since then the price to consumers in the New York City marketing area has been raised 1 cent on two different occasions. By these two increases the price has been restored to the level which prevailed during practically all of 1932 and in general prices throughout the State have been restored to that level. At the prevailing prices, therefore, milk is still one of our cheapest foods.

The effect of the Board's actions on prices paid to farmers has been much more marked than the effect upon prices charged to consumers. The average price paid to farmers in March 1933 was approximately 96 cents for milk containing 3.5 per cent of fat delivered to country plants located 201-210 miles from New York City. The average price paid to producers for the month of August

was approximately $1.80 per hundred pounds for milk of the same fat content delivered in the same freight zone.

Specific reference to the effect of the Board's action in the case of one larger distributor may be of interest. That distributor paid producers for 3.5 per cent fat milk in the basic freight zone in August, 1931, the sum of $1.78 per hundred pounds. At that time milk was retailing in New York City at 15 cents per quart. The price paid to farmers in August, 1932, was $1.23 per hundred pounds, with milk retailing in New York City at 12 cents per quart. The price paid for August, 1933, milk was $1.91 per hundred pounds with milk retailing at 12 cents a quart in New York City. It should be said that this distributor handles a very large amount of milk in forms other than fluid milk. It will be observed, however, that while the price to consumers was the same in August, 1933, as it was in August, 1932, producers were paid 68 cents per hundred pounds more for their milk under the Board's orders in 1933.

Every milk dealer is required to submit on or before the twelfth day of the month a report showing the amount of milk handled during the preceding month and the manner in which the milk was utilized as well as the price paid to producers for the milk. Reports thus received are being carefully audited and dealers are asked to account for any discrepancies. As a result of this work, which is being supplemented by the auditing of the dealers' books and records, many thousands of dollars have been paid to producers. One distributor recently paid producers over $13,000 representing errors made in computing prices. Obviously this service is of great benefit.

Quite a large percentage of the milk produced in New York State is marketed in the state of New Jersey, adjacent to New York City. Likewise a large percentage of the milk sold in the city of New York originates in New Jersey, Pennsylvania, Vermont and other states. Recognizing the problem presented by these interstate shipments, the Legislature wrote into the law a provision forbidding the sale of milk in New York State unless producers of the milk were paid as much as they would have been paid if the milk had been purchased in New York State at prices fixed by the Milk Control Board. The need of some means of coping with out-of-state milk will be recognized. If milk dealers were able to purchase milk in other states at a price lower than that fixed by the Board to govern the purchase of milk in New York State, there would be a tendency to buy the milk elsewhere and leave New York State farmers without a market. The means designed by the Legislature to cope with this situation have thus far proved fairly effective.

In its efforts to stabilize the dairy situation and to secure a reasonably fair price to dairymen, the New York State Milk Control Board has been obliged to blaze the trail. It has been confronted with many problems, some of which are not as yet solved. If the average price paid to producers is an indication of the effectiveness of price fixing, it must be admitted that much has been accomplished. The Board is now directing its thought to a consolidation of the gains already made and is endeavoring to build up a solid foundation for future gains.

Discussion

Dr. Brooks: I have had an opportunity to see considerable of the activities of the Milk Control Board because in the absence of the Commissioner of Health, who is a member, it has been my privilege or my misfortune —whichever it may be—to act for the Commissioner of Health. I can assure you that Mr. Fee as a member and the Director of this Board has without doubt been the busiest man in New York State during the past several months. He has mentioned a few of the problems which the Board has encountered, but I can assure you he has only touched the highest places. Perhaps it will interest you to know also that another member of this Association, Sidney Leete, has been the Secretary to the Board. He also has been a very busy man. There are two things that Mr. Fee told me just before the meeting he would like to find out from you before the discussion closes. One is what other states have Milk Control Boards and whether in those states the legality or constitutionality of the milk control board idea has been tested and, if so, with what results.

Mr. W. B. Palmer: We have in New Jersey a Milk Control Board Act which was patterned after the New York State Act. There was inserted in the New Jersey Act, as in New York, a provision that nothing contained in the Act shall in any way affect the status, force or operation of any public health laws, ordinances or regulations. The fact was recognized that this is a purely economic matter and should not be confused with the sanitary supervision of milk supplies. The object of the law when it was enacted in New Jersey was to procure for the New Jersey producers the highest possible price for milk. One result has been that we have had our milk supplies degraded from A to B, although a lot of the money has been spent in the past to get them raised from B to A.

Mr. Frank: Along that same line; just a few weeks ago a health officer visited us and told us that most of the dairymen had asked him to degrade them from grade A to grade B. They told him that the grade A price that had been set, which they must require if they continued to label milk "Grade A," was fourteen cents per quart. Grade B was eleven cents per quart. They had been selling their milk at eight and nine cents a quart. They said they knew beyond a doubt if any of them attempted to get fourteen cents a quart from their milk they would simply lose their business; that the customers who had been buying milk from them would hunt somebody who would sell them milk under a grade B label, or under no label. This sort of thing indicates the possible dangers in attempting to set logical prices. I don't mean to be considered as saying that setting milk prices is wrong, but this is an illustration of the fact that setting prices which are not justified by market conditions will lead to trouble.

Mr. Chrisman: I would like to ask if there was any discrimination made in the prices with respect to sanitary quality of milk and if the prices in New York City are representative for the entire State.

Mr. Fee: The price at the present time for grade B milk in New York City is twelve cents a quart, delivered to the consumer's home; ten cents delivered to the stores, and from stores to consumers, eleven cents; that is with a differential of one cent between store price and delivered price. Then a certain group of dealers had written into the law a provision that permitted the sale of "unadvertised brands" to stores at one cent under the price fixed by the Board. As a result of that, much of the milk is sold at nine cents and can be resold by the store at ten cents. That is in the City of New York. As to upstate areas, until July 21 there was a single price in effect—minimum price—(we haven't set any maximum prices) in upstate areas which at that time was one cent under New York City price. On July 21 the price in New York City was raised from eleven to twelve cents and upstate cities of fifty thousand population or more, from ten to eleven cents. No change was made in the price to the smaller upstate cities; that remained at ten cents, except that in some instances the dealers themselves have established a higher price; and the Board has not fixed any prices applicable to communities of less than one thousand population, so that there are many small communities and much of the rural area that is not governed by any minimum price at the present time. The price in New York City at the present time is twelve cents; in larger upstate cities, eleven cents; smaller cities, minimum price is ten cents.

The question of grade has entered into the price only in the city of New York, where there is a grade A price three cents higher than Grade B price, except that milk containing more than four and two-tenths per cent butterfat must be sold at one cent higher, and special grades of milk are being sold at prices above the minimum prices.

Mr. Kelly: I would like to ask Mr. Fee if at any time since the increase in price he has any information as to the effect on consumption, either in the city or upstate.

Mr. Fee: I understand the consumption of milk in New York City was much lower in 1933 than it was a year ago, as 1932 was lower than 1931. It has fallen off about five per cent each year. Some of the distributors tell us that there has been no loss in consumption of milk as a result of Board's activities. In fact the consumption of milk in New York has been falling off for the past four years. If the consumption of milk had continued to increase at the rate which it had been increasing for many years, there would now be a demand for twenty-two per cent more milk in New York City than is being used, and for fifty-five per cent more cream, or a combined demand for approximately thirty-three per cent more than now being used. I believe the decrease is largely due to the loss in purchasing power of the consumer, and that has been particularly noticeable in the case of cream.

Dr. Leslie: In Cleveland consumption of condensed milk has increased continually through this depression.

Mr. Fee: A committee in New York State two or three years ago made an effort to find out the effect on sales of increases in prices. They found that where the price of milk was advanced one cent a quart there was practically no decrease in consumption noticeable; but with an increase in price of two cents per quart there was a falling off in consumption of about fifteen per cent.

Dr. Brooks: Are there other states that have Milk Control Boards that haven't been mentioned here?

Dr. Leslie: There is such a board in Ohio.

Mr. Fry: Connecticut has a Milk Control Board and they seem to be having the same difficulties that we have just heard from your New York Milk Control Board. They have established a license system there and have found it necessary to license everyone selling five quarts or over, because some of the smaller dealers were cutting the price so badly that with the one and two cow dairies they found it necessary to put them all on the licensing system.

Dr. Brooks: One word more on this question of relationship between the price control law and the milk sanitation. In New York State no one can sell milk under our health law and under our State and New York City sanitary codes without a permit from the local health officer. Under the Milk Control Law they must also, with certain exceptions which Mr. Fee mentioned, have licenses from the Milk Control Board. The Milk Control Board does not issue any licenses to anyone who does not have a permit from the local health officer. The effect not only of that but of the operation of the Milk Control Law generally has been in New York State to stimulate enforcement of the sanitary regulations.

REPORT OF COMMITTEE ON SANITARY CONTROL OF ICE CREAM

RALPH E. IRWIN, *Chairman*

AT OUR meeting in Detroit last year, your committee presented each member with a copy of the Sanitation Manual for Ice Cream Plants prepared by the International Association of Ice Cream Manufacturers. This manual contains a statement of purpose as follows: "A guide for ice cream manufacturers in the operation of their plants and a suggested procedure for plant managers and regulatory officials to use in inspecting ice cream plants."

Also in the Foreword it is indicated that the Sanitation Manual for Ice Cream Plants was prepared to assist ice cream plant operators to conduct their operations so as to comply with the Sanitary Regulations for Ice Cream, submitted by your committee at our annual meeting in Cleveland. This spirit of cooperation on the part of the manufacturers is highly appreciated.

One of the activities of your committee this year was a tryout of the Ice Cream Plant Appraisal Form given on pages 16-19 inclusive, of the Manual. This try-out was made by members of your committee having supervision of ice cream plant sanitation. From the reports of committee members using the Appraisal Form, we have the following comments:

1 The Ice Cream Plant Appraisal Form appears to be especially good, however, like the score card system of evaluation, it is only relative and does not give one a very definite idea as to the handling and processing of ice cream.

2 Prof. A. D. Burke, as a committee member, submitted a report prepared by C. A. Abele, Director, Division of Inspection, State Depart of Health, Montgomery, Alabama. The state of Alabama has prepared regulations governing the manufacture and sale of ice cream and similar products. So far as plant conditions are concerned, these regulations follow very closely the recommendations made in the Sani-

tation Manual for Ice Cream Plants. Mr. Abele submitted a report giving the results of the enforcement of their regulations in eighty plants located in thirty municipalities. The plants included in the report were those needing improvements. Forty-seven of the eighty plants made the improvements required and thirty-three discontinued business. Of the thirty-three discontinuing business Mr. Abele reports that only thirteen did so because they did not desire to meet the sanitary requirements for ice cream plants. The others discontinued business for economic reasons.

3 Nothing is said regarding the use of chemical cleaners. Inasmuch as chemicals are being used, at least in some plants, it might be well to have a place for them. I also note that no reference has been made to bacteriological counts or laboratories. It seems to me that both should be given recognition.

4 The Appraisal Form is, in my opinion, excellent. It is designed to assist a person inspecting a plant, indicating what to look for, and the value of parts in relation to the whole. The part played by sanitation in building up their sustaining quality is so well recognized and understood, that every worthwhile manufacturer inspects his plant just as critically as any regulatory official.

Our committee believes this Manual worthy of further study and is planning to have regulatory officials in various parts of the country use the form in an extensive way and submit further criticism.

Last year your committee submitted a resolution requesting

> "That the International Association of Dairy and Milk Inspectors request the American Public Health Association through its Committee on Standard Methods of the Latoratory Section to prepare and publish Standard Methods for the Bacteriological and Chemical Analysis of Ice Cream and its Principal Ingredients."

The Committee on Laboratory Methods acted promptly. Early this year each committee member received a copy of Proposed Standard Methods for Ice Cream Analysis. An expression of appreciation was received from Dr. R. S. Breed relative to the assistance of committee members. We were fortunate in having as a member of our committee, Prof. F. W. Fabian of Michigan State College, who is associated with Dr. Breed as a referee on standard methods for ice cream analysis.

Committee members were requested to submit criticism concerning sanitary regulations and the enforcement of such regulations in the city or state in which the committee member is located.

Mr. R. S. Craig of the City Department of Health of Baltimore, prepared a statement concerning the sanitary control of ice cream in the city of Baltimore, and also described in an interesting manner, the Baltimore system of providing locally accepted raw materials for ice cream manufacturers. Mr. Craig's report follows:

The Sanitary Control of Ice Cream in Baltimore City

Ice cream is manufactured in two types of plants in Baltimore. In the plants of the manufacturers distributing large quantities of ice cream, the ice cream mixture is pasteurized in the plant just prior to freezing, that is, with an interval of about 15 hours of ageing, at temperatures invariably below 40° F. The second type is ice cream manufactured at what is locally termed retail manufacturing plants. The latter includes manufacturers of ice cream intended for entertainment purposes and is usually excessively high in butterfat, when ice cream is considered as a balanced food.

The procedure in the larger "pasteurizing" ice cream plants is practically identical with the handling of milk in pasteurizing dairies. Since the ice cream "mix" can not come in contact with the hands or person of the operator, there is every assurance that no contamination exists throughout the procedure, even to filling larger containers and delivering to the ultimate distributor. Even small novelty containers are filled and capped by machinery, except in those instances in which no mechanical device has yet been invented for this purpose. In all larger manufacturing plants in the city, private laboratory control is in effect and there is every reason to believe that the utmost vigilance is used on the part of the manufacturer to comply with the regulations of the Health Department.

In the small retail manufacturing plants, the handling of previously pasteurized ice cream "mix" is done manually with the hazard, of course, of contamination during this process which immediately precedes freezing. A regulation has been adopted, effective July 1, 1934, requiring all ice cream plants to pasteurize the entire "mix" at the plant where the product is frozen and it is expected that this regulation will eliminate the undesirable hand contacts now inevitable in the way that ice cream is manufactured in the smaller plants.

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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 arm 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.

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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.

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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.

"When Writing Mention This Report"

Inasmuch as the larger manufacturers distribute approximately 90 per cent of the entire bulk of ice cream distributed in Baltimore, the greater emphasis in inspection, in point of numbers of weekly and monthly visits, is devoted to these plants. Upon an average of two or three visits per week are made to these ice cream plants, with a very close attention paid to pasteurization and to the handling of the mixture before and after freezing. The three-fold greater number of retail manufacturing ice cream establishments are visited three or four times monthly with an increased number of visits during the summer months. During the winter months some of these plants operate only one or two days a week, which also accounts for the lesser number of plant inspections as compared with the larger plants which throughout the year operate three or four times more frequently. Attention is focused in the case of retail manufacturers on the quality and handling of pasteurized raw materials and on the avoidance of hand contacts during preparation of the mixture prior to freezing.

All ice cream manufactured in the city of Baltimore is prepared from raw materials produced on the Baltimore milk shed, thus every ingredient in Baltimore ice cream is under Health Department control, and a vast number of samples, carefully scheduled to fully control the production of both large and small manufacturers, are collected in the course of the year. Indeed, it may be said that equal attention is paid to the sanitary quality and to the sanitary control of ice cream as with fluid milk in this city. The fact that only locally produced, locally inspected and locally pasteurized materials are used in the manufacture of ice cream, together with the maintenance of a very rigid sanitary control during manufacture, places Baltimore ice cream in a class superior to that produced in the average large city in this country.

The bacterial counts of ice cream, representing the product as sampled at the plant of the manufacturer and as delivered to the ultimate consumer, are very low. The average bacterial count of ice cream produced by the larger manufacturers for 1932 was 6,400; for the retail manufacturing group 23,000. Thus far, during 1933, the average bacterial counts have shown a considerable improvement over 1932. During July, 1933, for example, the average bacterial count of ice cream produced by the wholesale manufacturers was 8,800 (all flavors), and 5,100 for vanilla only. Samples collected from stores averaged 7,100. The sanitary score or rating of this group of larger manufacturers was 92 per cent for July. The butterfat varied between 10 per cent and 17.5 per cent approximately, with an average of about 13 per cent. In the retail manufacturing group the average bacterial count for July, 1933, for all flavors was 57,000, for vanilla only 52,000; the average plant sanitation score was, roughly, 70 per cent. The figures for July are given to illustrate the quality of the product produced during the most intensive manufacturing month in the ice cream year. During cooler months it not infrequently occurs that 85 per cent to 90 per cent of all bacterial averages of ice cream, whether from the larger group or from the smaller group, are under 10,000 bacteria per c.c.; a very large number around 1,000 or 2,000.

Samples of ice cream are collected from the larger group eight to ten times a month and from the smaller group three or four times a month; in cases where the manufacturer is having difficulty with his bacteria count (which, fortunately, rarely occurs these days), additional samples are collected for corrective purposes.

In spite of the regulation which becomes effective on July 1, 1934, requiring the pasteurization of ice cream at the plant where frozen, the Health Department has very little basis for criticism of either the sanitary quality, as disclosed by bacterial counts, or of the sanitary handling of ice cream in this city. Indeed, it may be stated without qualification, that the Health Department, in view of the splendid cooperation and support extended by the local ice cream industry, has every reason to be proud of the high quality of this product as sold in Baltimore. As related in another report in this series, it has largely been through such fine cooperation and support that Baltimore has been able to develop a milk "reservoir" which has been the means of assuring a fluid milk supply production handled and controlled under our intensive supervision during periods of severe drouth and shortage such as occurred several years ago.

Providing Locally Inspected Raw Materials for Ice Cream Manufacturers

By reason of the fact that Baltimore ice cream is composed of raw materials which are produced under local inspection and under the regulations of the Baltimore City Health Department, the sanitary quality of ice cream in Baltimore is superior to that of any other large city in this country. This claim is not made as a boast but one which endeavors to reflect credit upon the cooperation of public health conscience and business foresight of the larger ice cream manufacturers of this city.

In 1927, after a number of preliminary conferences, the Health Department established its first ice cream regulations. It is to the everlasting credit of certain prominent ice cream manufacturers that these regulations were of a high order as a collaborating effort between the Health Department and the aforementioned ice cream interests. In fact, representative members of both the larger manufacturers and the retail manufacturers sat in committee through a number of meetings until the public health objectives desired by the Health Department and the difficulties of the ice cream manufacturers had been practically reconciled.

As a part of the ice cream regulations the subject of ingredients naturally arose and when the source of raw materials was discussed it was decided by the ice cream manufacturers to enter into negotiation with local milk producers for all of their supply. In fact, the ice cream manufacturers actually paid a premium for locally inspected cream and milk and evaporated milk, and gradually abandoned western sources for raw materials as the local shed was able to increase the supply to meet the demands of ice cream manufacturers.

Contingent on the agreement between milk producers on the Baltimore shed and Baltimore ice cream manufacturers, a regulation was established requiring the usual locally inspected milk, cream and evaporated milk in the manufacture of ice cream so far as available. The interpretation of the term "available" included an adherence to a price plan previously agreed upon. The local ice cream manufacturers utilize a quantity of milk, in addition to fluid milk demands, amounting to about 5,000,000 gallons a year in the form of cream and about 1,500,000 gallons of fluid whole milk, a total of 6,500,000 gallons annually.

The interest of the Health Department in this splendid enterprise has not been solely on the improved sanitary quality of ice cream, though it will be recognized at once that the use of locally inspected raw materials of equally high sanitary quality as fluid milk at once put Baltimore ice cream in a sanitary class by itself when compared with the product of other large cities. More important, was the fact that by developing the above mentioned 6,500,000 gallon surplus for ice cream purposes, a veritable milk reservoir had been created to be drawn upon in times of shortage, such as occurred during the drouths of 1930 and 1931. When such a drouth occurs we have arranged to take care of ice cream manufacturers by issuing "emergency permits" to certain western creameries meeting a rather high sanitary standard, who may ship their product to this city only when there is a local shortage of cream. No fluid milk may be shipped; only cream and evaporated milk. Our Health Department naturally feels that the demand for fluid milk must first be served before it is used in the form of cream for ice cream manufacture. Milk in the form of cream for ice cream manufacture is included as "surplus" milk and demands a somewhat lower price for that reason. At the same time "surplus" milk is not any different in sanitary quality from what is locally termed "basic" milk, that is, fluid milk. So, when a shortage occurs, it is very easy to divert a sufficient quantity of "surplus" milk intended for ice cream manufacture, into fluid milk channels and thus to provide every infant and every other milk consumer in the city with a full quantity of fluid milk.

The great benefit that this arrangement offers to the welfare of infants will be recognized at once. To change the source of an infant's milk supply, and certainly to change it to one of inferior sanitary quality, is to invite danger. A number of years ago, before this plan was in operation, Baltimore like other large cities had to bring in fluid milk from outside sources when a local drouth occurred. This always had its malignant influence on infant welfare but since the local cream plan has been in operation, Baltimore has never had a milk shortage, even during the severe drouth during the summers of 1930 and 1931.

As stated, the greatest commendation is due the local ice cream manufacturers for the part they played in making this local reservoir possible. They do not claim that they were entirely altruistic in doing so, but the effect has been very great on infant welfare, nevertheless. This briefly, is an outline of the Baltimore plan for providing ice cream manufacturers with a supply of locally inspected products.

You will note that the report concerning the city of Baltimore deals not only with sanitary requirements but also the procedure used in securing locally produced and locally inspected materials for use in the manfacture of ice cream.

To those interested in recent legislation concerning ice cream sanitation, the committee recommends that attention be given to new laws passed in the states of New Jersey, New York and Pennsylvania, and in the municipalities of Newark, New Jersey; Philadelphia, Pennsylvania; Lower Merion Township, Pennsylvania, and Jacksonville, Florida.

REPORT OF COMMITTEE ON ORDINANCES

WILLIAM B. PALMER, *Chairman*

SINCE milk is one of the most essential foods, and since the dairy industry has been vitally affected by prevailing economic conditions much attention has been directed by governmental authorities to matters of milk production, processing, distribution and regulation. State legislatures have through special committees conducted investigations and have enacted legislation designed primarily for the economic welfare of the dairy farmer, and the establishing of state milk control boards. Similar action has been taken by the Federal Government. This trend of events has advanced even to the point, with some individuals at least, of suggesting that milk supplies be made subject to public utility regulations. The measures enacted have been predicated on the fact that unfair, unjust and demoralizing practices are carried on in the milk industry which are likely to undermine public health standards, laws and regulations, and, of course, this has direct reference to matters of economics.

Although this type of legislation grants unlimited powers to milk control boards to investigate all phases of the milk industry and empowers the boards to promulgate and enforce rules and regulations for stabilizing prices, production and supply, and declaring or establishing marketing areas, nevertheless, they have been so drafted that they shall not affect the status, force or operation of public health laws, ordinances or requirements.

All of the foregoing has caused health officials to give thought to and have a realization of the involvement of health laws and ordinances in economics. Attention is called to the fact that in practically every case where a milk control board has been established the law has designated a representative of the state department of health as a member of the board, and this certainly is evidence that the health phase of regulations must be considered not only from the standpoint of health protection of the consumer but also its relation to economics of the industry.

It is within the province of city health departments to promulgate and enforce ordinance requirements which shall have for their basis the securing of safe, wholesome and unadulterated milk supplies. It is obvious that compliance with ordinances of this type, even though they may embody only minimum regulations essential for accomplishing their purposes, entails considerable investment and continual expense to those engaged in the various phases of the dairy and milk industry. It must certainly be agreed that in order to properly conduct an industry which is as highly technical as the production, processing and handling of milk and milk products, but not always recognized as such, adequate financial returns must be obtained even before net profits are considered. Price cutting, unfair competitive and other practices, usually referred to as "chiseling," have prevailed to a more or less considerable extent, and the result has been that in some sections and the larger cities cheap milk has been available, and businesses legitimately conducted by concerns operating with adequate technical personnel, adequate technical and physical facilities have been adversely affected and the quality control work of these concerns hampered. All of these factors have had their influence in the lowering of sanitary quality from producer to consumer and the undermining of health regulations. In matters of unfair trade economic practices the health department has been without jurisdiction, but, undoubtedly, impartial enforcement of public health ordinances and laws would have deterrent effects in many instances, thus materially assisting in the maintenance of proper sanitary quality and standards.

Ordinances, Grades and Other Factors

When considering the subject of ordinances it must be borne in mind that such legislation has not been enacted in all sections of the country, but such measures have been adopted in the larger centers of population and progressive communities where public health activities have prevailed for years. People in all communities have not yet become "safe-milk-minded", or have not been informed of the necessity of such measures. In many small towns and sparsely populated areas practically no public health work is carried on as local activities except as may be absolutely demanded by state statute, which condition is, of course, due to lack of funds. Thus these districts are dependent upon the state health departments which are usually without adequate funds and personnel to conduct intensive local work, but the "county or district health plan" in those states where established is correcting this situation and affording opportunity for milk supply supervision.

In practically all states and similar jurisdictions statutes defining and regulating foods, including milk, and specifying standards of quality, production and processing, have been enacted. Consideration should be given to the point as to whether or not efficient state and local enforcement of these acts would be adequate protection for the health and welfare of the consumers. If additional provisions are deemed necessary for incorporation in local ordinances, caution should be exercised to limit such provisions to fundamental essentials.

In some localities ordinances have been enacted but, through political influences or inadequate appropriations, are not enforced. Irrespective of how meritorious an ordinance may be it is only as good as its enforcement.

Milk grading ordinances are the type which have most generally been adopted and have been in force in some cities for a number of years. The grading of milk has been held to be an effective means of attaining improved methods and conditions of production and processing, and improved sanitary quality of supplies; also a means of informing the consuming public of the character of available supplies by requiring grade designations to be printed on milk container caps, tags or labels. These ordinances define and permit from two to several grades of milk.

Some ordinances do not recognize "grades", but grade and other designations placed on products by dealers, many of which terms are meaningless, misleading and sometimes untrue, are tolerated in the administration of milk supervision.

Health departments have always advocated the liberal use of milk, and those factors which have a direct bearing on the increasing of the cost of this most essential article of diet tend to defeat the efforts made to increase the consumption of milk. In the smaller or isolated communities producer-dealers as a rule predominate in the milk business and they are not usually confronted with the very complicated systems encountered by the large distributing concerns operating in the large centers of population where extensive milk sheds are involved. In these larger districts supply and demand with surpluses and shortages in the milk production, coupled with the purchasing classifications of products according to the use to which they are put, i.e., fluid milk, fresh cream or manufacturing present a complicated problem plus ordinance requirements of numerous cities within the given district where the products are ultimately dispensed, accentuate this problem, especially since ordinances are frequently divergent in requirements, and set up milk grades which are not always uniform in their specifications. Opinion has always been that ordinances should be simplified and unified within all practical, reasonable limits.

Ordinances

As an example of the grading ordinances for milk the United States Public Health Service Milk Ordinance and Code is cited. At least in principle this ordinance is typical of milk grading ordinances.

This ordinance is approved by the Public Health Service, United States Treasury Department and the Bureau of Dairy Industry, United States Department of Agriculture, and is recommended for adoption by states and communities in order to encourage uniformity of methods of milk control practice in the United States. The United States Public Health Service has appointed a Board of Consultants, termed the Public Health Service Milk Sanitation Advisory Board, in order that it may have at its command the technical advice of a comprehensive group of experts in the various phases of the public health control of milk supplies, and in allied problems relating to the production, processing and distribution of milk. This will probably be a permanent board, although the personnel will probably change as the years elapse. The board is comprised of six State Health Department milk control officials, a representative of the Division of Market Milk Investigations, U. S. Department of Agriculture, a representative from the office of Milk Investigations, United States Public Health Service, and one representative each from the International Association of Milk Dealers, Dairy and Ice Cream Machinery and Supplies Association, and Certified Milk Producers of America, Inc.

This ordinance provides for seven grades of milk in addition to Certified milk, and its enforcement requires the grading or regrading of milk supplies every six months at least.

The ordinance is drafted in such a manner that rather complete regulations and requirements are specified for grade "A" Raw milk. The second grade is "B" Raw, which has a higher permissable bacteria count than grade "A" Raw, i.e., 200,000 per c. c. instead of 50,000 per c. c., and tight wood floors are permitted in dairy barns in place of concrete or other impervious material, and whitewashing or painting of stables is not required as for the grade "A," and likewise it is not necessary to provide partitions in the milk house to separate milk operations and cleaning of utensils, or to have a water supply piped into the milkhouse, or provide stationary wash and rinse vats and separate chlorinating compartments for utensils, or to use single service strainer filter pads, or to have covered delivery equipment of a type that will protect the milk from the sun or contamination. Grade "B" Raw milk shall be cooled to a temperature of not more than 70° F. while grade "A" Raw must be cooled to a temperature not above 50° F. Grade "C" Raw differs from grade "B" in that 1,000,000 bacteria per c. c. instead of 200,000 is permitted, and in not requiring the following; wood floors are not demanded in stables, clay being acceptable; tight ceiling is not required in stable if there is a second story above; manure removal and storage to prevent fly breeding or access thereto by cows is not demanded; utensils for handling or storage of milk or milk products do not have to be of nonabsorbent material or of construction for easy cleaning, or be in good repair with seams and joints soldered flush, and pails do not have to be of the small mouth design; milkers and milk handlers do not have to wear clean outer garments while working; milk stools do not have to be made of metal or other impervious material; milk does not have to be removed from the stables for straining or pouring into other containers; no temperature is specified to which the milk shall be cooled or delivered and it is not required that milk containers shall be mechanically filled or mechanically capped, which indicates that this product may be sold without bottling, or at least may be placed in the final container by hand operation.

Grade "D" Raw milk is raw milk which does not meet the requirements for grade "C" Raw milk, and which shall be plainly labeled "cooking purposes."

Grade "A" Pasteurized milk is grade "A" or grade "B" Raw milk which has been pasteurized, cooled and bottled in a milk plant conforming with specified items of sanitation and the average bacterial count of which at no time after pasteurization and until delivery exceeds 50,000 per cubic centimeter.

Grade "B" Pasteurized milk is grade "C" Raw milk which has been pasteurized, cooled, and bottled in a milk plant conforming with all the requirements of grade "A" Pasteurized milk.

Grade "C" Pasteurized milk is pasteurized milk which does not meet the requirements for grade "B" Pasteurized milk and which shall be plainly labelled "cooking only."

Two alternative wordings of the ordinance are offered because some communities prefer to use the grading and degrading system of improving milk quality, whereas others prefer to use exclusively the system of forbidding the sale of milk which does not comply with all items of sanitation, and instituting procedure if the violator insists in selling.

For most cities the Public Health Service recommends that the grades be limited to Grades "A" and "B" pasteurized, certified and Grade "A" raw, except during temporary periods of degrading.

In some cases it may be practicable to reduce still further the number of grades permitted to be sold to an even more desirable minimum, namely, Grades "A" Past.

and Certified. In other cases, such as communities just beginning milk sanitation work, there may be a fear of milk shortage unless the lower grades of milk are permitted to be sold for an extended period, and additional wording to meet this situation is provided.

The local enforcement of the ordinance as adopted is subject to investigation and checking by a designated official state agency.

The code is an explanatory document of each section of the ordinance and gives the public health reason for each. It is a guide for enforcement officials.

A perusal of this ordinance and code will reveal that there are some items on which unaminous opinion may not be obtained. As example; bottle caps which completely cover the pouring lip of the bottle are not required, the handling of two or more grades of milk in one plant is permitted if separate equipment and separate rooms are used, and it is specified that milk to be consumed in the form of whole milk shall be delivered to the final consumer within sixty hours of the time of pasteurization, but no public health reason is given for this last requirement, and other items.

The enforcement of this ordinance requires the services of technical personnel and technical facilities. Although the ordinance is held to be the means of securing uniformity in regulations and is stated by the United States Public Health Service to have been adopted by approximately 550 cities principally in the southern states, many items of requirements and provisions are left to the discretion of the health officer.

If it is necessary for codes to be formulated for fair practise in the dairy industry itself, it is equally important to formulate definite, uniform sanitary regulations which are effective and not unnecessarily burdensome.

Requirements commonly specified in different ordinances may be classified under three headings: namely, Safety, Palatability and Esthetics.

Under "safety" should be included all items which have a direct bearing on public health;

Under "palatability" should be included those factors which influence consumption through flavor, odor and appearance of the product;

Under "esthetics" should be included those items which relate to appearance and decency which are desirable in all food establishments, and which indirectly affect public health.

A careful study should be made of all existing ordinances to eliminate any requirements which do not come under any of the three classifications suggested. Any such regulations are unwarranted, onerous and an unnecessary burden on the dairy industry.

It is not intended to imply by the foregoing that the ordinance approved by the Federal Agricultural and Health authorities for the voluntary consideration of states and municipalities does not satisfy the above criterion of the elements which should be included in an ordinance.

Legal Phases

In order that an ordinance shall be legal it is important that same be drafted in conformity with provisions of state statutes, and this is particularly true in the matter of standards and classes of milk, designated by the ordinance as permissible.

Often the legality or constitutionality of ordinance provisions and the jurisdiction of health departments are contested before the courts. With the belief that same will be of value to control officials and the industry, the following resumé with case references prepared by Dr.

James A. Tobey, a member of this committee, is presented:

"THE TERRITORIAL JURISDICTION OF CITIES IN CONTROLLING MILK."

"It is now a well-established principle of public health law that municipal corporations may properly impose and enforce reasonable and necessary sanitary regulations with respect to dairies which are beyond their own borders, if the milk from these dairies is actually distributed within the city. The validity of such ordinances has been upheld by many courts of last resort in this country, including the United States Supreme Court.(1)

More than a quarter of a century ago the rule was laid down in a Minnesota (2) decision that a city may require inspections of dairies even if they are beyond the city limits, and similar opinions were delivered by a Virginia court in 1903,(3) a Tennessee court in 1911,(4) and a Pennsylvania court in 1912.(5) An Alabama court decided in 1914 that a license fee is not a property tax and can properly be imposed upon a person residing outside the city who sells milk in the city.(6)

Although the United States Supreme Court had held in 1902 that a state may prohibit the entry of diseased cattle or impure milk,(7) and in 1904, 1905, and 1906 had sustained as constitutional the regulation of milk supplies by municipal authorities (8) and the delegation of this power to health officials,(9) not until 1913 did a case come before it in which the question of the territorial extent of the city's powers was raised.

In the leading case of Adams v. Milwaukee, (10) it was decided by the highest court in this country that a city ordinance requiring all milk entering the city to be only from tuberculin tested cattle violated none of the provisions of the Federal Constitution, including those providing for due process of law and the equal protection of the laws for all citizens. This case also held that a violation of the ordinance justified destruction of the milk by the proper authorities. A Georgia Court has likewise held that a city may prevent unsafe milk from entering its borders. (11)

In a recent Oregon (12) case, an ordinance of the city of Portland was attacked on the ground that it conferred extra-territorial powers on the city health officer because a license was required from all dairies from which the milk supply of the city was derived, and would be granted only after certain sanitary requirements had been complied with. In upholding the validity of this ordinance, the court stated:

> "The ordinance in question, so far as it requires all persons selling milk within the city to comply with the requirements of the ordinance and to obtain a license before selling or vending milk within the city, is a reasonable police protection and a proper exercise of the police powers of the city."

This court also quoted at length from the early Minnesota decision, (2) in which it was stated that:

> "It is a matter of common knowledge that much of the milk sold in a city is produced in dairies situated outside the city limits. Any police regulations that did not provide means for insuring the wholesomeness of milk thus brought into the city for sale and consumption would furnish very inadequate protection to the lives and health of the citizens. It is also a matter of common knowledge, as well as proof in this case, that the wholesomeness of milk cannot always be determined by an examination of the milk itself. To determine whether it does or does not contain the germs of any contagious or infectious disease it is necessary to inspect the animals which produce it. This inspection is wholly voluntary on the part of the owner of the dairy or dairy herd. If he does not choose to submit to such inspection, the result merely is that he cannot obtain a license to sell milk within the city. The ordinance has no extra-territorial operation, and there has been no attempt to give it any such effect. The only subject upon which it operates is the sale of milk within the city."

Although the jurisdiction of municipalities over dairies beyond their own limits has been upheld as a valid exercise of the police power, this power must be used in a reasonable manner. Thus, a city ordinance requiring a fee of $25.00 a day for inspections of dairies more than five miles beyond the city limits, and no fees for dairies within the five-mile zone was held to be unreasonable and void by the Florida Supreme Court in 1928. (13) It is interesting to note, however, that in an action brought by a citizen of Georgia, a Federal District Court upheld in 1930, a state law of Florida requiring permits to sell milk, except from Florida owners of five cows or less who sold in their own counties. (14)

The Supreme Court of New Hampshire rendered an interesting and important decision in 1931 when it held that a city board of health could not deny a license to sell milk to a non-resident dairyman whose milk was sanitary and whose dairy complied with the requirements of the local board of health. (15)

In two noteworthy decisions in New York, (16) and in California, (17) the validity of city ordinances requiring milk for sale in the city to be pasteurized within the city limits has been upheld as a proper exercise of the police power in the interests of the public health.

The various decisions mentioned confirm the principle which has been stated elsewhere (18) that "the courts in this county continue to be liberal and progressive in upholding all reasonable regulation of such an essential food as milk. The courts seem to recognize what scientists concede, that milk is our most nearly perfect food, (19) and that the best interests of public health are maintained and promoted when the cleanliness and safety of milk are properly safeguarded.

References

1 Tobey, J. A.: Public Health Law. Williams & Wilkins, 1926.
2 State v. Nelson (1896), 66 Minn. 166,68 N.W. 1066, 61 Am. S.R. 399, 34 L.R.A. 318.
3 Norfolk v. Flynn (1903), 101 Va. 473, 44 S.E. 717,99 Am. S.R. 918, 62 L.R.A. 771.
4 State v. Davis (1911), 1 Tenn. C.C.A. 550.
5 Hill v. Fetherolf (Pa. 1912), 84 A. 677.
6 Ridgeway v. Bessemer (1914), 9 Ala. Ap. 470. 64 So. 189.
7 Reid v. Colorado (1902), 187 U.S. 137, 23 S. Ct. 92, 47 L. Ed. 108, 12 Am. Crim. Rep. 506.
8 Fischer v. St. Louis (1904), 194 U.S. 361, 24 S. Ct. 673, 48 L. Ed. 1018; St. John v. N. Y. (1906), 201 U. S. 633, 26 S. Ct. 554, 50 L. Ed. 896.
9 Lieberman v. Van De Carr (1905), 199 U. S. 552, 26 S. Ct. 144, 50 L. Ed. 305.
10 Adams v. Milwaukee (1913), 228 U.S. 572, 33 S. Ct. 610,57 L. Ed. 971.
11 Leontas v. Savannah (1927), 164 Ga. 278, 138 S.E. 154.
12 North v. Portland (1927), 123 Ore. 180, 261 P. 895.
13 Root v. Mizel (Fla. 1928), 117 So. 380.
14 Noble v. Carlton (Fla. 1930), 36 Fed. (2d) 967.
15 Whitney v. Watson (N.H. 1931), 157, A. 78.
16 Lang v. Niagara Falls (1928), 231 N.Y.S. 368.
17 Witt v. Klimm (Calif. 1929), 274 P. 1039.
18 Tobey, J. A.: Recent court decisions on milk control. U. S. Public Health Reports, Dec. 2, 1932.
19 Crumbine, S. J. and Tobey, J. A.: The Most Nearly Perfect Food. Williams & Wilkins. 1929. Also, Tobey, J. A.: Milk, The Indispensable Food. Olsen, 1933.

It has been the aim of the committee to give an impartial presentation of its assigned subject with the hope that the material submitted may be useful to those engaged in milk control work both in public departments and the industry.

Discussion

Professor Parfitt: I should like to ask Mr. Palmer whether they considered the problem which arises where a municipality has a well controlled milk supply but where people can go just outside and buy milk at a much lower price.

Mr. Palmer: The committee did not consider that, but I can tell you what happened in our own jurisdiction. Our ordinance requires that the milk be either "Certified" or pasteurized. It was attacked in court by a citizen who stated he could not secure raw milk other than "Certified." The New Jersey Supreme Court held that there was nothing to prohibit the individual from going outside of the territorial limits of the city and purchasing any milk desired and bringing it back for his own personal consumption.

Chairman Krueger: That problem prevails in practically all cities. It certainly is a live question.

AN EXTENSIVE TEST OF VARIATIONS IN BACTERIA COUNTS ON IDENTICAL MILK SAMPLES

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THE New York State Department of Health has carried on an extensive experiment in comparing 718 standard plate counts made upon eighty sets of ten identical samples of milk by seventy-eight technicians in seventy-four of the laboratories approved by the Department for the examination of milk samples and located in various parts of the State. This was followed by a comparison of the results obtained by having department technicians plate other identical samples of the milk at the same time on samples of media submitted by fifty-four of the participating laboratories.

In the first part of the experiment ten large samples of milk were prepared in milk cans in one of the department's mobile laboratories, then stationed at Geneva. Portions of each of these ten samples were transferred to eighty sets of sterile vials under carefully controlled conditions. These vials were grouped in sets of ten each and were stored immediately in ice water. Temperatures were taken from time to time in milk in additional control vials and at no time was a temperature in excess of 40° F. recorded up to the time of delivery to the various laboratories. At the time of plating, however, some samples gave temperatures as high as 48° F. in a few instances in which the samples were placed in refrigerators after receipt at the laboratory and not in ice water as requested.

The samples were distributed by automobile. Three cars left Geneva in different directions to deliver samples directly to laboratories. The fourth car took a number of samples to Albany for re-distribution. At Albany the samples were divided among five men with cars who distributed them to different groups of laboratories. The preparation of the samples were completed at 7 P.M., on May 16, 1932. The delivery of the samples was started immediately and completed within 24 hours. All laboratories plated the samples simultaneously at 2 P.M. (Eastern Standard Time) on May 18, 1932.

Our laboratory technicians plated two sets of samples immediately after the preparation of the samples was completed. Both of these sets were preserved and additional plates made at the time all laboratories plated the samples. Our men also made standard plate counts on a set of samples which had been carried over the complete circuit in one of the cars making deliveries of samples to ten other laboratories and returned to our laboratory. The results of these five series of plate counts are presented in Table 1, together with the median of all the counts that were made. They check remarkably closely and we believe can be taken to indicate that the effect of storing the samples at temperatures varying from 33° to 40° F. and carrying them around in automobiles had no effect upon the standard plate count.

The samples sent out were numbered from 1 to 10 and the laboratories were given no information as to their origin or as to the probable range within which the plate counts might be expected to fall. The instructions were simply to plate 1/100 and 1/1000 dilutions of each sample with the additional requests that if in any instance an accurate count could not be made of all colonies, an estimate of the number of colonies be made if possible and also that the letter "P" be inserted after the count if "pin-point" colonies were numerous.

The samples numbered 1, 3 and 5 were identical samples of "normal" raw milk. Sample No. 2 was raw milk which had been incubated to increase the count.

TABLE 1
STANDARD PLATE COUNTS OF "CONTROL" SAMPLES

Sample	Standard Plate Count Plated 5-17-1932 Series A	Plated 5-17-1932 Series B	Plated 5-18-1932 Series A-1	Plated 5-18-1932 Series B-1	Plated 5-18-1932 Series C	Median of counts by all laboratories
1	5,000	5,500	5,000	4,300	4,500	5,400
3	5,000	4,600	4,800	4,200	5,100	5,000
4	16,000	13,000	18,000	16,000	11,000	17,000
5	5,000	4,800	3,900	4,900	4,900	5,200
6	19,000	16,000	16,000	16,000	15,000	20,000
7	3,100	4,800	4,500	3,100	2,900	4,400
8	27,000	28,000	24,000	24,000	24,000	24,000
9	4,100	4,100	4,700	4,900	3,800	6,600
10	29,000	24,000	26,000	24,400	25,000	16,000

All counts are within the 1:5 Ratio Range.

Series A and B were plated the day following preparation of samples, 5-17-32.

Series A-1 and B-1 were plated 24 hours later i.e., on 5-18-32 at the same time that all other laboratories plated their samples. Samples were the same as Series A and B.

Series C is a series which was carried throughout trip made to deliver samples to various laboratories. This series was plated 2:30 P.M., E.S.T., 5-18-32.

All samples were plated in the same laboratory by one worker.

Samples 4, 7 and 8 were normal pasteurized milk. Samples 6 and 9 were normal raw milk. Sample 10 was milk from a cow whose milk ordinarily contained long chain streptococci.

The results of the examination of these samples are summarized in Table 2 and are presented in a mass diagram in Figure 1. If we are to expect exact mathematical agreement in counts made on identical samples of milk in different laboratories, this work clearly indicates that this cannot be obtained. There are considerable variations and we found ourselves at a loss to know which counts to accept as correct. It might be held that other things being equal the highest count obtained on any one sample represented the closest estimate of the actual number of colony producing bacteria present. We must take into consideration, however, that a standard plate count does not represent an estimate of the total

Table 2

MEDIAN COUNTS AND NUMBER AND PER CENT OF COUNTS OUTSIDE OF 1:5 RATIO RANGE FOR ALL SAMPLES

Sample No.	Description of Samples	No. of Labs. Reporting	No. of Counts Received	Median Count	Range Within which Counts are Considered Satisfactory	Within 1:5 ratio range No.	Within 1:5 ratio range %	Outside 1:5 Ratio Range: Below No.	Below %	Above No.	Above %	Total No.	Total %
1	Raw: Normal Flora	74	80	5,400	2,400 to 12,000	73	91.2	2	2.5	5	6.3	7	8.8
3	Same as Sample 1	73	80	5,000	2,200 to 11,000	73	91.2	3	3.8	4	5.0	7	8.8
5	Same as Sample 1	74	81	5,200	2,300 to 11,500	75	92.6	2	2.5	4	4.9	6	7.4
6	Raw: Normal Flora	73	80	20,000	8,900 to 44,000	68	85.0	8	10.0	4	5.0	12	15.0
9	Raw: Normal Flora	72	79	6,600	2,900 to 14,500	60	76.0	5	6.3	14	17.7	19	24.0
10	Raw from 1 cow: Long chain Streptococci	72	79	16,000	7,100 to 35,500	61	77.3	13	16.4	5	6.3	18	22.7
4	Pasteurized: Normal Flora	72	79	17,000	7,600 to 38,000	50	63.3	23	29.1	6	7.6	29	36.7
7	Pasteurized: Normal Flora	73	80	4,400	2,000 to 10,000	66	82.5	9	11.2	5	6.3	14	17.5
8	Pasteurized: Normal Flora	73	80	24,000	10,700 to 53,500	62	77.5	17	21.2	1	1.3	18	22.5
Total			718			588	81.8	82	11.5	48	6.7	130	18.2
Raw Samples			479			410	85.6	33	6.9	36	7.5	69	14.4
Pasteurized Samples			239			178	74.8	49	20.2	12	5.0	61	25.2
Total Identical Samples 1-3-5			241			221	91.7	7	2.9	13	5.4	20	8.3

number of bacteria present but an estimate of the number of bacteria in the milk capable of producing colonies on the particular kind of agar specified and under the conditions laid down in "Standard Methods of Milk Analysis." With this in view, we reached the conclusion that the median of all the counts obtained on any one sample more nearly represented the correct standard plate count for that sample.

It was also difficult to determine what departures from the median count should be considered reasonable. "Standard Methods of Milk Analysis" of the American Public Health Association contains the following statement:

> The conclusions reached by Breed and Stocking are that the margin between two plate counts made from similar samples of market milk must be as great as one to five before it becomes a practical certainty that the larger count actually represents the larger number of bacteria.

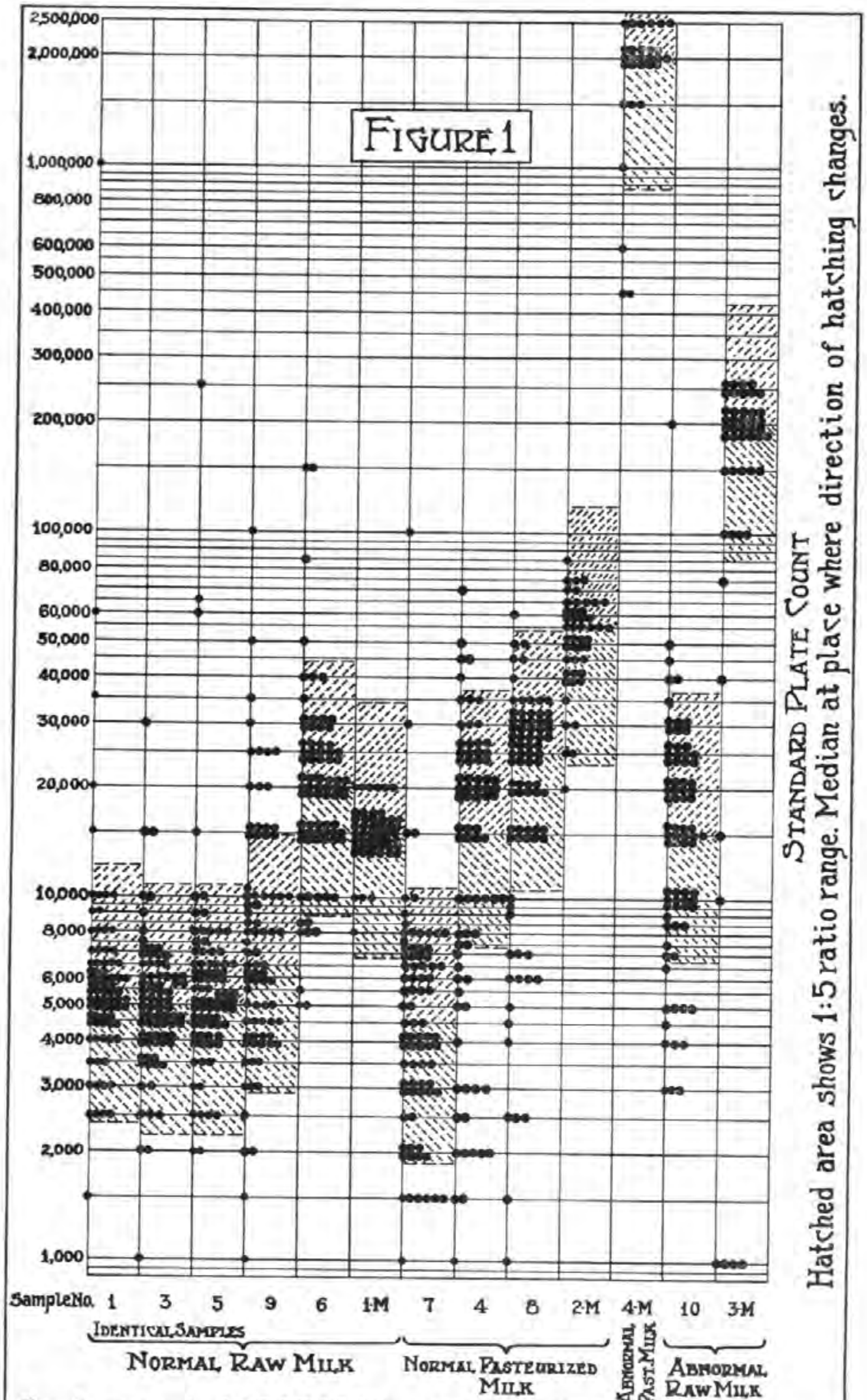
Taking the median of all counts made on any one sample of milk as the most nearly accurate for that sample and dividing a 1:5 ratio either side of this median for the purpose of this study, we have arrived at what may be considered a reasonable range within which all counts may be expected to fall. The vast majority of the counts fell within these limits as shown in Table 2 and Figure 1. Sample No. 2 was omitted from the summary for the reason that most laboratories having made only the dilutions requested were obliged to either estimate the number of colonies on the plate or report them as too numerous to count. Of the total of 718 counts made on the nine remaining samples, 588 or 81.8 per cent fell within the arbitrary 1:5 ratio range.

The results were in closest agreement in the standard plate counts made on normal raw milk. Of 241 counts made on identical samples of normal low count raw milk, namely Numbers 1, 3 and 5, 221 or 91.7 per cent fell within the 1:5 ratio range. One of the reasons for making samples 1, 3 and 5 identical was to see how this milk would be graded by the various laboratories. A special presentation of these results is given in Figure 2. The State Sanitary Code requires that the results of the standard plate counts on samples of milk collected on three different days be averaged (arithmetically) to determine the grade of the milk. The limit for Grade A milk is 30,000. Only two of the 74 laboratories would have thrown this milk out of its grade. If the grade had been "Certified" with a maximum permissible average count of 10,000 only three of the laboratories would have thrown the milk out of that grade.

There was a tendency for greater variations in the counts on pasteurized milk. Of 239 counts made on three different samples of normal low count pasteurized milk 178 or 74.8 per cent fell within the 1:5 ratio range. A possible explanation of this is that the bacteria which survive pasteurization do not grow as uniformly well in agar under conditions laid down for making standard plate counts as the bacteria which are killed by pasteurization.

Variations similar to those noted in counts made on pasteurized milk occurred in counts made on the Sample No. 10 of raw milk from a cow whose milk normally contained long chain streptococci. Of seventy-nine counts made on this sample, sixty-one or 77.3 per cent were within the 1:5 ratio range. Since many laboratories reported small or pin-point colonies on this sample we conclude that the organisms do not grow well on standard agar under standard conditions.

In an effort to eliminate more of the variables and determine, if possible, the most important single factor in the variations obtained, in making standard plate counts, this experiment was carried one step further and each of the participating laboratories was invited to send in a sample of approximately 100 c.c. of their routine agar media for milk counts. Fifty-four samples of agar were



Counts on samples 1,3,5,6,7,8,9 & 10 made in 74 different laboratories and on 1-M, 2-M, 3-M & 4-M in one laboratory on media from 47 laboratories.

received and a group of technicians plated four selected samples, three of milk and one of cream, on the same day in the state laboratory using each of these samples of media. Since all of the samples of any one dilution came out of the same dilution bottle, a number of possible variables were eliminated. After a sample was plated on each of ten different media a plate was poured using our media as a control. There were five sets of these plates poured with our media for each of the four samples. Sample No. 1 was normal raw milk. Sample No. 2 was pasteurized milk with a moderately high count. Sample No. 3 was raw milk from a cow having chronic mastitis. Samples No. 4 was pasteurized cream supposed to contain thermophilic or thermoduric organisms.

The results of the examination of these samples are given in Tables 3 and 4. The standard plate counts on control samples show maximum variations of about 12 per cent in the duplicate counts on our media for Samples 1, 2 and 4 and of 26.3 per cent on Sample 3, the pasteurized milk containing thermophiles.

Table 3

DUPLICATE PLATINGS OF SERIES OF SAMPLES USING SAME MEDIA
(Controls in Media Comparisons)

	Standard Plate Counts			
	Sample 1	Sample 2	Sample 3	Sample 4
	15,000	64,000	240,000	2,600,000
	17,000	66,000	190,000	2,275,000
	17,000	65,000	190,000	2,600,000
	17,000	67,000	190,000	2,600,000
	16,000	74,000	180,000	2,405,000
Average	16,400	67,200	198,000	2,496,000
Median	17,000	66,000	190,000	2,600,000
Greatest variation of one sample from median	2,000 or 11.8%	8,000 or 12.1%	50,000 or 26.3%	325,000 or 12.5%
Median for samples plated on all media	15,000	53,000	190,000	2,015,000

After every tenth duplicate set of plates had been poured on other media, a duplicate set was poured with media from the base laboratory. The above Standard Plate Counts are these counts.

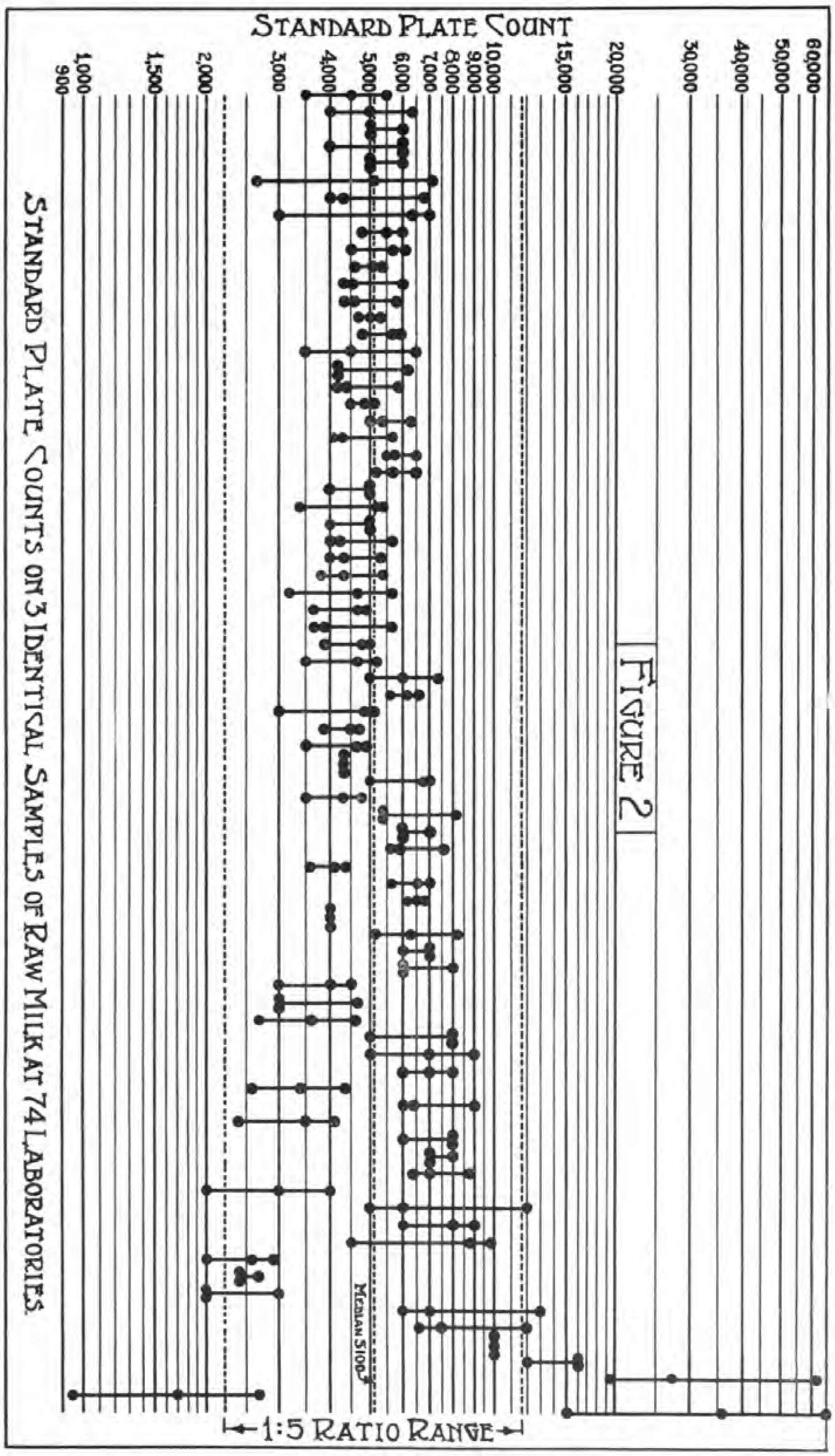

STANDARD PLATE COUNT
900
1,000
1,500
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000
15,000
20,000
30,000
40,000
50,000
60,000
FIGURE 2
MEDIAN 5100
1:5 RATIO RANGE
STANDARD PLATE COUNTS ON 3 IDENTICAL SAMPLES OF RAW MILK AT 74 LABORATORIES.

Table 4

MEDIA COMPARISON

MEDIAN COUNTS AND NUMBERS AND PERCENTAGE OF COUNTS OUTSIDE OF THE 1:5 RATIO RANGE FOR SAMPLES PLATED ON ALL MEDIA IN STATE LABORATORY

Sample No.	Description of Samples	Number of Counts	Median Standard Plate Counts	Range Within which Counts are considered Satisfactory	Number and Percentage of Reported Counts: Within 1:5 Ratio Range No.	%	Outside 1:5 Ratio Range: Below No.	%	Above No.	%	Total No.	%	Media failing to develop pin-point colonies on samples 3 and 4. No.	%
1	Raw Milk: "Normal" flora	49	15,000	6,700 to 33,500	49	100	0	0	0	0	0	0	...	.....
2	Pasteurized Milk: "Normal" flora	47	53,000	2,800 to 119,000	46	97.8	1	2.2	0	0	1	2.2	...	.....
3	Raw milk from cow with mastitis	47	190,000	85,000 to 425,000	39	83.0	8	17.0	0	0	8	17.0	6	12.8
4	Cream from preheater (thermophiles)	29	2,000,000	900,000 to 4,500,000	26	89.7	3	10.3	0	0	3	10.3	3	10.3
	Total	172			160	93.0	12	7.0	0	0	12	7.0	9	5.2

Table 4 shows that none of the standard plate counts on normal low count raw milk fell outside the 1:5 ratio range. Only 2.1 per cent of the counts on normal pasteurized milk of relatively low count fell outside this range. On raw milk from a cow with mastitis 17.0 per cent of the counts were outside the range and 10.3 per cent of the counts on pasteurized milk containing thermophiles were outside the range. On both these samples the counts outside the range were all on the low side indicating failure of the organisms to grow sufficiently to produce discernible colonies.

Within the range specified by standard methods, namely 6.2 to 7.0, the pH of the media apparently had no bearing upon the count. Six samples of media, which showed a pH above and below this range, were excluded from the summaries because they did not comply with Standard Methods.

In general, the results obtained by eliminating as many variables as possible except the media are in much closer agreement than the results of plate counts made independently by the same laboratories on identical samples of milk.

As a result of these studies, we have reached the following conclusions:

1 That standard plate counts made by different laboratories on identical samples of normal low count raw milk are in close agreement.

2 That such counts made by different laboratories on high count raw milk, on abnormal raw milk and on pasteurized milk show marked variations.

3 That the preponderance of standard plate counts falling out of range are on the low side suggesting failure of some of the bacteria to produce discernible colonies.

4 That strict adherence to Standard Methods of Milk Analysis is necessary to minimize the differences in counts made by different laboratories under present conditions.

5 That a modification of Standard Methods to provide for a media more favorable to the growth of bacteria that may be frequently found in milk and to provide an incubation temperature more favorable to such growth is desirable in the interest of uniformity.

6 That further standardization of methods is desirable.

This work was made possible through the interest of Dr. Paul B. Brooks and the cooperation of Mr. C. A.

Holmquist, Director of the Division of Sanitation, Dr. A. B. Wadsworth, Director of the Division of Laboratories and Research and of the directors and technicians of the many participating laboratories. The samples were collected and prepared for distribution by N. J. Hohl and C. H. Colvin, working in cooperation with Richard Eglinton of the city of Geneva.

Mr. W. S. Davis and Mr. Cornelius Kelly of the Division of Laboratories and Research and Dr. J. D. Brew and Mr. N. J. Hohl of the Bureau of Milk Sanitation plated the samples in the last series which were counted by Messrs. Hohl and Colvin. Mr. C. Sidney Leete did much of the work of compiling the data. Grateful acknowledgement is made for assistance rendered by the late L. M. Wachter, in securing the cooperation of the laboratories and in analyzing the data.

Discussion

Mr. Frank: I think this paper and one I heard several days ago presented before the Laboratory Session of the American Public Health Association from the Geneva Station, are the two most valuable papers I have heard in connection with laboratory work on milk in a number of years. In the Geneva paper a 32 degree incubation temperature rather than a 37 degree temperature was suggested. The range is much narrower. I wonder whether your results might not have compared more closely if that had been used. Another thing, the deviations would have been less still if the logarithmic rather than the arithmetical average had been used.

Mr. Tiedeman: In answer to Mr. Frank I would like to say that I do believe that if samples had been incubated at a temperature of thirty-two and if we could have had a media more favorable for the growth of these bacteria, the count would have been very much more uniform. Then I feel certain that the variations in temperatures of incubators were considerable; in other words, they were not all incubated at thirty-seven degrees.

IS A SINGLE GRADE OF PASTEURIZED MILK SUFFICIENT?

AFFIRMATIVE

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THE controversy between the single grade and multiple grade plan for pasteurized milk has been smoldering for some time and breaks out spasmodically each year, when milk control officials gather for discussion of their mutual problems. An analysis of our present grading systems naturally directs us to their effect on the milk industry, the inspection personnel, and the public. To the dealer and to the farmer our present grading systems, no doubt, offer a picture of necessary confusion, to the inspector one of unnecessary details, and, to the public, one of implied safety. By expanding and deflating these thoughts, to the test of scientific evidence and practical procedure, I affirm that the single grade for pasteurized milk is not only sufficient but obviously must be the true public health grade for proper public health administration. The single grade allows milk safety to proceed along on a true public health basis, and milk quality to develop on a sound marketing basis.

The Public Health Aspect

The fundamental basis for health departments to uphold any grading plan is primarily for the protection and preservation of public health. For any grading plan, to protect the public health, only accepted minimum standards for safety should be considered. Our province, as health departments, is to set up such a minimum standard to assure relative freedom from pathogenic bacteria, sediment and adulterants in order to make a product that is safe, clean, fresh and wholesome. These would depend upon actual safety factors for public health, public opinion, public interest in milk sanitation, economic factors and local practice.

Additional factors in higher grading plans concern themselves largely with the economic aspect such as, the public demand for higher restrictions, the public willingness and ability to pay for them, the dealer's demand and willingness to pay for quality milk to meet the public demand, the pride and willingness of the producer to produce better milk, and lastly the ability of the producer and dealer to pay for improvements demanded by the public with the price the public is willing to pay for its milk. Since these are largely economic factors we can obviously only justify one grade of pasteurized milk from a public health standpoint. Although health departments preempted the milk grading field early in its history, this is no excuse to permit them to wander away from this accepted health function into the field of marketing. They are not agencies to impose any more production and pasteurization requirements than are necessary for practical milk safety, nor obliged to furnish free laboratory service to the industry or to advertise milk to increase consumption unless all milk is reasonably safe.

Many quality factors, in our alphabetical grading systems, have not been recognized through our so-called health grades. To be fair to the public and the milk industry, the quality factor in milk should be placed on a sound marketing basis and not a false public health basis, unless we want to continue to harm our certified and Grade A markets when purchasing power of the public is absent. Many of our producers and dealers need little or no urging, no premium payments, or even inspection to satisfactorily comply with our regulations. In most cases a sound marketing basis has produced these results and not health departments. We can do more toward elevating our average milk quality by concentrating our efforts on the substandard milk than by expecting the public to pull it up by choosing milk of the highest grade as better and safer. Through our false conception of grading milk on a public health basis, alphabetically, we have led the dealer and public to sanctify the Grade A label based on nice distinctions having little or no public health significance. Although milk is the ultimate product consumed, it rarely is properly graded on a basis of quality except in milk contests for blue ribbons, etc. By establishing a single grade on a true public health basis of safety, we encourage the milk industry to sell milk on a sound marketing basis of quality. Our biggest contribution to public health, to the dairymen and the public, should be to set the dairy industry on the road to quality milk on a sound marketing basis. By establishing a true public health grade we can shift the attention of the milk industry to the logical method of improving milk quality through the product itself and health departments to the logical method of improving milk safety by concentrating on the subsafety milk.

The Health Office

By having only one set of regulations to consider and enforce, the health department personnel is allowed more time and effort to concentrate on our most important group, from a public health standpoint—the subsafety group. Having only one set of records to keep, paper work is reduced to a minimum and the time thus saved allows us to concentrate on inferior milk and offending dairymen, by essential reinspection. Our sampling and grading periods effect better milk control by choosing our own necessary intervals in our grading period rather

than accepting applications from the farmer or dealer at a time when he is ready and wants the grading done. Since all our safety measurements practically follow the scientific discoveries made possible by the microscope and eyes of the laboratory, we should look more to our laboratories for detecting inferior milk. With one bacteria standard we avoid time-consuming grading and announcements of high quality milks and leave our laboratories free to conduct a greater variety of tests on each milk sample with more effective results from a public health standpoint. By placing more emphasis on inferior milk and its cause, we tend to encourage development of commercial laboratories as an aid to the milk industry in a quality program. Our grading system and laboratory then become the servant of the milk control official for the benefit of the public.

Health budgets in most of our communities provide niggardly sums which must be spread over many required services in a practical way. The single grade plan gives us our best opportunity to apply these funds where they will do the greatest good for the greatest number.

The Public

By focusing all time and money on the weakest links in the complete milk chain the single, true, public health grade of pasteurized milk gives the public the most direct, economical, effective, control of milk quality for practical safety per dollar of their tax money expended. By eliminating the responsibility of health departments for grading milk above our safety minimum, we leave milk quality responsive to the public demand and to the economic status of the milk industry, as it should be.

The Milk Industry

By setting up minimum standards for safety, on a true public health basis, the single grade plan frees the dairy industry from the shackles of false health grades. We control milk safety and leave other governmental agencies and the milk industry to control milk fraud, or misbranding of special or superlative milks. By directing the thought of the milk industry to milk quality, instead of many unnecessary requirements, we relieve the milk industry of heavy financial burdens and direct the expenditure of its money on those urgent production and pasteurization needs which are hindering milk safety most. The contact of the inspector with the industry will be more satisfactory, making collusion unnecessary since the inspection decisions do not officially decide premium payments of milk. By eliminating the profit consideration from health regulation we can enter upon a broad educational field for milk quality. By working on the substandard group, where milk safety is in more danger, we eliminate unfair competition of inferior milk for the betterment of the dairy industry.

State and National Programs for Milk Control

Finally, the single grade plan for pasteurized milk simplifies our milk control programs with fewer grades to consider or confuse the milk industry, control officials and the public. A simplified single ordinance setting down minimum production and pasteurization requirements means fewer regulations which simplifies the problem of uniformity. We thereby eliminate excess detail and paper work by establishing uniform health procedure and desired result,—clean, safe milk. Any community can then adopt its own quality standard providing it establishes a minimum standard of safety along fundamental health principles as we now know them.

The single, true public health grade for pasteurized milk meets the test of the public health standard ordinance program because:

1 It provides for a maximum degree of milk safety by concentrating our time and effort on the sub-standard group.
2 It encourages greater milk consumption by enlisting a renewed dealer interest to increase consumption, on a true milk quality basis.
3 It secures the cooperation of the dairy industry, particularly because it simplifies the production and pasteurization requirements.
4 It is adaptable to small, medium, and large-sized cities because it places milk on a true public health basis, and leaves quality programs to develop on a sound marketing basis, as demanded by each community.

Our milk grading procedure, as practiced by control officials, is at the crossroads. It is up to us to decide whether we should continue the old time course of alphabetical grades of milk, on a vague public health theory that the public will solve our problem by buying the highest grade represented as the safest and best milk through a label, or, adopt a single true public health grade which more adequately protects the public health, improves milk quality, benefits the dairy industry, relieves the health office of needless detail, and gives the public more milk control service and health protection per dollar of their tax money expended. When we consider all factors in grading on a public health basis we can bring about the greatest quality of safe milk for the greatest number at the lowest cost by adopting obviously, one true public health grade for pasteurized milk.

IS A SINGLE GRADE OF PASTEURIZED MILK SUFFICIENT?

NEGATIVE

Leslie C. Frank

Sanitary Engineer in Charge, Office of Milk Investigations, U. S. Public Health Service

IN BEGINNING my discussion I wish to clear up any misunderstanding which may exist by saying that the Ordinance recommended by the federal health and agricultural agencies accommodates either the single grade or the multi-grade method. What follows is a justification of our advice to cities that while the Ordinance will be approved in either form, we believe the best results will be secured from the multi-grade form.

In order to present this problem adequately it will be necessary to discuss some of the fundamental administrative principles which underlie the design of milk ordinances. In designing a milk ordinance we must take into account whether it is intended merely to serve a single given community or whether the ordinance is intended to be used as a standard which a state or the Federal Government will recommend to many communities in order to promote a voluntary unification of milk control practice. In either case the ordinance must be designed so that it will be possible to induce the legislative body to pass it and so that its enforcement will be most likely to be thorough. But in the former case we have merely the one legislative body and the one set of local conditions to consider, whereas in the latter case the ordinance must be so designed as to be attractive to many legislative bodies and to be most easily enforceable by health officers in general.

It is obviously more difficult to design a generally applicable ordinance than to design one which must satisfy only one special set of conditions, but it is very important that we do so. I note that you have on your program for later this morning the subject "Need of Uniformity of Milk Laws and Regulations" and that the subject is to be discussed from the interstate and the intrastate points of view. I am glad that subject is to be discussed. It is very timely. Not only is uniformity desirable at all times and for many reasons, as has been emphasized for years in the publications of the Public Health Service, and by many of the members of this Association, but it is highly desirable at this time for a special reason. All over the country codes are being prepared for the dairy industry, and submitted for approval to the Federal Government. These codes have as their principal objective fair practices and fair prices. It is coming to be generally recognized that fair practices and fair prices will be much easier to establish and to enforce if the codes can be based upon uniform milk control regulations and uniform milk grades. Following is an instance of how important this is. Within the past few weeks a code has been established for a large municipal center whose milk shed extends for a radius of several hundred miles. Within this milk shed are communities governed by different types of ordinances. A few days ago the health officer of one of these communities visited the Public Health Service and stated that, to his astonishment, most of the members of the dairy industry had approached him and asked that he degrade them from Grade A to Grade B. He was dumbfounded, of course, but asked why, and the members of the dairy industry told him frankly that the new code of the milk shed within which they were located was based upon the grades defined in the milk ordinance of the large municipal center, and that if they attempted to sell their Grade A milk at the Grade A price stipulated in the code their business would be taken over by other members of the industry who would be willing to sell a lower grade of milk. Hence, they were requesting that they be permitted to label their milk with a lower grade label in order that they might be permitted to ask the lower price, and thus retain their business.

However, I shall not enlarge upon this as it only incidentally bears upon the present subject. But I do wish to make clear that at all times and now above all times it is necessary that in considering the principles of ordinance construction we must have in mind the advisability of the general nation-wide adoption by municipalities of one type of milk ordinance providing for uniform milk grades. When we consider the grades to be included in an ordinance we should therefore remember that the ordinance should be suitable for general adoption.

Now what are the requirements of such an ordinance? They are:—

(1) It should be so designed that it will not be difficult to secure its passage either by cities which are just beginning milk control work or by cities which have already made considerable progress in milk control work.

(2) It should be so designed that enforcement will be rendered as easy as possible, not only in localities in which the health officer has strong political backing, but also in localities in which the health officer's backing is perhaps a little flabby, as is only too often the case.

(3) The ordinance should be so designed that it will rapidly bring the status of milk sanitation to a high level.

Let us examine the two opposing types of milk ordinances from the standpoint of these requirements.

(1) Let us begin with the problem of the ease of securing widespread adoption. I think we will agree that if we write an ordinance which defines only one grade of raw milk and only one grade of pasteurized milk, we must define the one grade of raw milk so that it will be as safe as raw milk can practicably be made, and must define the one grade of pasteurized milk so that it will be as safe as any milk can practicably be made. Suppose such an ordinance were designed by the Federal Government and

then proposed for general adoption by all municipalities in a campaign to unify milk control methods. How many cities would adopt it? I think it is reasonable to believe that it would be most likely to be adopted by a number of such cities as had already attained a high level of milk control excellence in the past, namely the very cities which least needed a new ordinance. But it is a matter of grave doubt whether such an ordinance would be adopted by many of the towns which still have to make an earnest attack upon the milk sanitation problem, i.e., the very ones which need it most. These towns would be afraid of the sudden transition and most of them would want to pass an ordinance with less stringent requirements.

Evidence of the truth of this statement lies in the fact that there is not in existence today a single widely adopted one grade type of ordinance. A number of states have in the past realized the necessity for the unification of milk control methods and have proposed standard ordinances for their cities to adopt. Some of them have succeeded in securing fairly wide adoption of single grade ordinances, but I do not recall one in which the requirements for the single grade even nearly equal the requirements of the highest grades in such widely adopted grading ordinances as the Public Health Service Milk Ordinance. In the attempt to design a uniform ordinance nearly all states which have tried the single grade system have found it wise to make the requirements rather general and, to my mind, incomplete. This is particularly true of the single grade of pasteurized milk defined in such ordinances. Here we usually find very incomplete requirements for the raw milk which is permitted to be pasteurized.

If we turn now to the grading type of ordinance such as the Public Health Service Milk Ordinance we find an entirely different picture. State after state has been able to secure the passage of this Ordinance by the majority of its municipalities within the astonishingly short space of a few years, despite the fact that the requirements for Grade A Raw Milk and Grade A Pasteurized Milk in this Ordinance have satisfied the above mentioned criteria of excellence.

(2) Let us now consider the second requirement of the ideal milk ordinance suitable for general adoption, namely, that enforcement must be rendered as easy as possible, not only in localities in which the health officer has strong political backing, but also in localities in which the health officer's backing is not ideally strong.

How does the permit type of ordinance which defines only one grade of milk fare here? Obviously in the comparative minority of cities in which the political backing of the health officer is so strong that his revocation of a permit is never questioned, enforcement has often been satisfactory. If the offender knows that the health officer has the unquestioning support of the administration and of the local courts, the mere threat to revoke a permit will produce the desired results. But how many municipal health officers have such ideal backing? I am sorry to say that the experience of many years among many municipalities forces the answer that they are in the distinct minority. In most cases when I have asked the local health officer or inspector why a given item of sanitation was not satisfied, the answer has been that threats to revoke the permit had produced no result and the health officer was afraid that if the permit were actually revoked the revocation would not be sustained by the administration or the court.

It is easy to see why this is true. If we had to deal only with glaring offenses such as the presence in the dairy or milk plant of persons actually physically sick with a disease transmissible through milk supplies, there would be little question about support. Actually, however, most of the offenses with which we have to deal are not so self-evidently culpable. A city council and a court can easily understand the menace of a sick person handling milk, but they do not easily understand the importance of flush valves, leak protector valves, proper thermometer design and maintenance, foam heaters, thermostatic control, milk pump stops, etc. At least they do not understand them sufficiently clearly so that it is easy to convince them that because one or more of these items has not been satisfied the permit should be withdrawn and the dairy forbidden to sell milk at all. I believe that if each of you will search his own mental processes sufficiently carefully you will agree that in most cases you hesitate a long while before you actually revoke a permit because of the violation of an item of sanitation the need of which you are afraid may not be self-evident to the court. If you are an inspector and you are faced with the repeated violation of an item of sanitation by a pasteurization plant which is supplying, say 30 per cent of your city with its daily milk supply, it is easy to see that you would be much more apt to punish the plant by forcing it to display a lower grade label than by attempting to revoke its permit and take its milk off the streets altogether. In the one case you merely inform the citizens who are using the milk that, in your opinion, it is no longer up to top grade, and in the other case you are depriving the citizens of their milk supply altogether.

The truth is that most of you have seldom actually used the permit revocation device on pasteurization plants. You use it perhaps more frequently on dairy farms supplying the plant, and somewhat less frequently on retail raw milk distributors, but what most of you do in the case of a pasteurizing plant is to attempt to cajole and wheedle and threaten them into making the desired correction, but you seldom even mention the subject of permit revocation.

The case with the grading and degrading type of ordinance is different. I do not mean to say that there are not health officers and inspectors who hesitate to degrade a dairy or a plant, and who delay longer than they should in taking action. Of course there are. But it should be easy to see that if an inspector or a health officer will hesitate even to lower the grade of a plant he will all the more hesitate to revoke its permit altogether.

In this connection we have recently circularized a number of health officers who have had experience with both the permit revocation and the degrading method of enforcement and asked them to tell us frankly which they preferred. The results of the questionnaire showed that of 113 health officers who had had experience with both types of ordinance 101 stated that they preferred the degrading method of securing results.

There is one other final consideration. If you incorporate several grades of raw milk and several grades of pasteurized milk in an ordinance you not only have the advantage of being able to apply the degrading method of securing results, but you may still have the permit revocation method in reserve. The Public Health Service Milk Ordinance, for example, states that in all cases the health officer may revoke a permit after a thirty day period of degrading, and in emergencies, which he himself defines, he may revoke the permit immediately, or without first attempting to secure results by means of the degrading device. So that if we incorporate the different grades of milk in the ordinance we have all of the advantages of the single grade, permit revocation device, and the additional advantages of the degrading device into the bargain.

We come now to the final question:—Will the multiple grade method yield a sufficiently high level of milk sanitation in a reasonable period of time?

As you know, under the Public Health Service milk control plan frequent ratings are made of the status of milk sanitation in the cities which have adopted the ordinance, and I shall only say here that the results indicate beyond question that a brilliant improvement may be made in milk sanitation conditions within a period of a year or two by means of this method, and that the final results are not exceeded anywhere. An excellent example which comes instantly to mind is that of Louisville, Kentucky. Louisville's milk supply was extremely unsatisfactory until February, 1931. At that time a milk sanitation rating was made by the Public Health Service and the State Board of Health which showed that the retail raw milk rating was 51 per cent and the pasteurized milk rating 71 per cent. The Public Health Service Milk Ordinance was passed in May, 1931. Resurveys of the Louisville milk supply were made by the Kentucky State Board of Health in 1932 and 1933 with the following results:—In 1932 the retail raw milk and the pasteurized milk ratings were both found to be 83 per cent and in September, 1933, the retail raw milk was found to be 99.5 per cent and the pasteurized milk rating found to be 95.2 per cent. These survey results indicate that there is probably not a city in the United States today which has a better milk supply than Louisville.

Conclusion

To sum up, then, any milk ordinance designed for widespread adoption in an attempt to standardize the meaning of Grade A Pasteurized and Grade A Raw Milk and to afford the maximum likelihood of a high level of enforcement should incorporate more than one grade of both raw and pasteurized milk, and should give the health officer and inspector the authority to punish violations of Grade A requirements either by revoking the permit or by lowering the grade which appears on the bottle cap.

Discussion

Dr. Brooks: I am not going to enter into this discussion, because I am squarely on the fence on this proposition, but it might possibly be interesting to look behind the scenes momentarily and see just how the subject happened to be put on the program. In New York State we are just now at the crossroads, as Mr. West says, on this question of grading. Some amendments to our State sanitary code are pending. We now have two grades of pasteurized milk—A and B— and the question has come up as to whether it would be advisable to eliminate the present Grade B and retain simply Grade A pasteurized. We have an Advisory Committee which we bank on a lot. Dr. Holford and Dr. Breed are members. We also have two dairy farmers and another milk dealer on it. The Public Health Council, the body that enacts the sanitary code, has always been inclined to follow the advice of that Advisory Committee on any changes in the code. We put the question of eliminating Grade B up to this Advisory Committee and after a lot of discussion they voted against it by a divided vote. A majority of the committee felt it was better to maintain the two grades, but because in New York State the Grade B standards have gradually been raised until there is no material difference in the two grades, something needs to be done. Either we must raise our Grade A standards or eliminate Grade B. A sub-committee of the Public Health Council has considered the matter and has decided to recommend to the Council eliminating Grade B, but it is going to hold a hearing, at which Dr. Holford and the other people who don't like the idea, will have an opportunity to say what they think about it.

Mr. W. B. Palmer: We have had the grading system in operation in our communities for a number of years. The regulation establishing it became effective in 1915. Standards have been changed and the system modified until we now actually have three grades: "Certified", "Grade A Pasteurized" and "Grade B Pasteurized". Progress which has been made in the industry itself has resulted in great improvements in production and processing of milk and in the equipment of the milk plants. There have been revocations of licenses. It may be surprising to Mr. Frank to know that as an individual health officer it has been possible for me to revoke as many as eight licenses in one month and they stayed out. We now have milk supplies run in our communities by concerns that are actually supervising their supplies by their own inspection system, their own laboratory control. There has been decided improvement in the quality of milk from the standpoint of sanitation and bacterial counts. We have now reached the point where there is no essential difference between the milks that are labeled Grade A and Grade B. The only real differences are that those dairies selling their milk on a Grade A basis cool this milk to a temperature not above fifty and deliver it as late as eight o'clock every morning.

Mrs. Dugan: I want to speak, not from the standpoint of larger cities such as Rochester and the Oranges, but from the standpoint of the small city below ten thousand population. We have found that by using grading, whether it is five, six or seven or eight grades, we have been able to build up a satisfactory supply even in a very small city. We find that the supply can be taken care of without a row with the dairymen, without disrupting the health department, without scaring your county to death with a grading ordinance. I think Mr.

Frank's point is well taken about the possible political backing and that probably should be considered by those of us who have been more fortunate than some of the rest.

Dr. Holford: In the East we have had a little different experience than they have in the South, and I am glad to hear Dr. Brooks and Mr. Palmer admit that the quality of milk has been improved. I wonder if these two gentlemen, if they had a goose that was laying golden eggs—although we are off the gold standard—would be willing to kill that goose in order to enrich their pile of golden eggs immediately, or would it be better to let it live and continue to lay golden eggs? I don't believe we are ready to kill the goose. There is no question about the grading principle being based on sound facts. We have had big stick methods and we have had degrading dairies, etc. but we found the thing that brought home the bacon to the dairyman was paying him money. That counted. People in milk production realize today that in order to get a good finished product you have got to have a good raw product to begin with. Now, it is the same way in pasteurizing milk: in order to have a good finished product you have got to have a good product to start with. I am fearful that in many instances the industry does not receive credit for the part that they play in protecting milk supplies. In many instances I am sure that if it were not for the efforts put forth by the industry that the different cities would not have the quality of milk that they are receiving today.

Now another question comes up. Is there such a thing as degrees of safety? We are living today in an age of preventive methods. It is better to prevent than it is to try to cure after the disease is there. Is it not better with milk supplies to prevent foreign matter from getting into that milk than it is to try to clean it up after it gets in, or possibly say we'll make it safe and heat to fifty degrees for thirty minutes? We have the human element to contend with, and is pasteurization at all times infallible? Here is another thing we have got to consider. We can lay down our rules and regulations, but unless we have the cooperation of the producer we are not going to succeed. Now, the producer is on the job every day; we are on the job maybe once a month, maybe once a year, and do we see when we go to that dairy the normal conditions that exist at that dairy every day? I think not. So, if we have some method whereby this dairyman is receiving more money he is going to pay more attention.

One more point. One of our biggest problems is that of mastitis in dairy herds. Which one of the dairymen today is more interested in mastitis? It is the Grade A dairyman. Why? Because he feels if he puts milk into his supplies from a diseased cow he is liable to lose his premium. I am very much in favor of the grading principle and I believe if we are going to continue to improve our milk supplies we should encourage the grading of pasteurized milk.

President Parker: I'll ask Mr. Kelly to close this discussion.

Mr. Kelly: I don't think that we can blindly close our eyes and say that any one system is exactly the best under all conditions. In a somewhat long experience in dairy inspection I have found that things generally solve themselves by the "cut and try" method in particular localities. I don't mean by that a general standardization of methods and ordinances is not desirable and is not practicable. The grading system undoubtedly has many advantages, especially where it sets a premium through the dairy industry, as Dr. Holford has outlined, where this is an incentive to the dairyman to make improvements which cost him money. Too many grades to me have a serious disadvantage. First of all, from the consumer's standpoint, I think they are confusing. Second, when too many grades are in existence they must very commonly fit together, or else overlap; if that were not so your highest grade of milk would be too high to be practicable for production, or else your lowest grade is too low to be fit for consumption. There must be a distinguishing difference between grades in order that they may mean anything. I am very much in favor of the single grade in grading so far as practicable. Personally, I would like to see nothing but Certified milk and highest grade of pasteurized milk sold anywhere. Of course, we get the conditions of the small towns and rural communities, which we must care for in any nation-wide scheme of milk legislation, and it is those places in which I am particularly interested. We hear many criticisms of milk supplies and milk control in larger cities. The larger cities and large towns are pretty well protected against any serious dangers from milkborne outbreaks, but how about the little fellow out in the crossroads town? I want to see a stronger movement, either state-wide or country-wide with some common check and control that is going to protect the people, whether it be by grading system or rating system or whatever it may be.

WHAT ARE THE ESSENTIAL REQUIREMENTS FOR CLEAN, SAFE MILK FOR PASTEURIZATION?

THE HERD

VINCENT C. MOYER
Supplee-Wills-Jones Co., Philadelphia, Pa.

THERE are many factors involved relative to the essential requirements for clean, safe milk for pasteurization and the health of the herd is of utmost importance to the distributor of pasteurized milk and the health of the consuming public. Regulations have been adopted and dairy farmers have been required to meet all sorts of dairy barn and equipment requirements. Pasteurizing plants are required to meet most exacting requirements. The package in which the product is delivered must be just so—but the herd, the very source of the supply and the most important step in the whole dairy industry, is the last item to be considered. New York City and a few other boards of health are requiring physical examinations to be made of each animal in the dairy herd and checking closely to see that they are made properly. In most cases little or no attention is paid to the health of the herd, being only an item on the health score card and is checked by men not familiar with cattle diseases or the proper husbanding of cattle to prevent disease.

It is believed by some folks that pasteurization of the milk overcomes the abnormalities found in the milk from abnormal cows. Pasteurization does kill large quantities of bacteria found in milk, but some of the toxins are not susceptible to heat and chemical changes which occur in milk from abnormal cows still remain after pasteurization.

The physical examination of each individual in the dairy herd, is an added safeguard to public health in addition to pasteurization.

It has been found that herds that have not been examined, or where the owner was his own judge or where examinations were made by inexperienced men the percentage of diseased or crippled uddered cows was great and disease was on the increase. This is especially true if cattle prices are high or if beef prices are low.

Examination of cattle regularly by a qualified person, even though it be but once each year, will at least rid the herds examined of the accumulation of cows with crippled udders and other abnormal or diseased conditions which affect the milk or may affect the milk supply given by such cows.

The U. S. Department of Agriculture, B.A.I. in their T.B. eradication plan has done considerable toward ridding the herds of abnormal and diseased cattle other than tubercular animals. Our vital statistics, especially with children, show considerable improvement as a result of this work.

Every one of us here are depending directly or indirectly on the consumer's dollar for a living, and I feel sure that if the consumer knew that the milk being consumed by his family was coming from a herd in which one or more cows were affected with actinomycotic lesions, badly emaciated, chronic digestive troubles, mastitis or any other troubles with which cows may be afflicted, I am afraid that some of us would join the army of unemployed. It has been proved beyond all doubt that milk from healthy herds properly housed, fed and watered has all of the many food values claimed for it, so why allow this wonderful food to become contaminated at its very source?

Tuberculin testing and blood testing for Bang's disease is not sufficient to rid the herd of the various other troubles that cows become afflicted with. Transmissible diseases of a bacterial nature we hear about and are doing something to correct, but diseases listed as not being transmissible, causing chemical changes in milk which are very undesirable, we hear little about and know less. As an example of such chemical change I cite the herd in which there are one or more individual cows with digestive disorders. That individual cow's milk may appear normal and if mixed with the milk of eight or ten other cows not so affected, the chemical change of the milk of one cow is not noticed. The same may hold good where an entire herd may be affected with digestive disorders due to poor feeding methods and the milk from that herd mixed with that of eight or ten other normal herds, thus the ill effect of the affected milk becomes lessened to the amount of the dilution.

It is common knowledge that cows with a diarrheal condition due to bad feeding methods and sudden changes in feed or other causes will change the milk given by that cow during that period which if consumed by itself unmixed with normal milk will have a laxative effect on the consumer.

A similar effect will be produced when a cow suffering from some febrile condition, which in time causes a secondary disturbance of the digestive tract, is being treated with internal medication.

Milk from cows with conditions just mentioned may be salty, flat, cardboardy or other off flavors not removed by pasteurization and cause considerable trouble for the distributor of milk, through loss of business in addition to the possible health hazard.

Men, unfamiliar with cattle diseases and troubles, will make mistakes and condemn or recommend disposal of animals with injuries and diseases of a temporary nature, thus creating an injustice and financial loss where such loss was not called for. On the other hand, men familiar with cattle troubles will recognize the spread of disease in herds at an early stage and thus prevent losses, that would otherwise occur.

The physical examination made by a veterinarian using the standard adopted by the American Veterinary Medical Association and applied at intervals of at least once each year will eliminate a great number of cows that do not give normal milk and cleans house at least once each year. Examinations made at more frequent intervals will insure an even better supply.

A uniform method of examination and reporting of such examination should be adopted. Unless such examinations are made according to set standards coupled with good judgment the physical examination is of little use. The veterinarian doing this work should be paid for his services. Work of this type when put out to bids and given to the lowest bidder is usually of little value.

I, therefore, would recommend that a physical examination of each animal be made in every dairy herd, in accordance with the standard adopted by the American Veterinary Medical Association and a report of such examination be kept on file at the point where such milk is received.

Without healthy herds we can not expect to get normal, safe milk for pasteurization.

WHAT ARE THE ESSENTIAL REQUIREMENTS FOR CLEAN, SAFE MILK FOR PASTEURIZATION?

THE FARM

J. M. Lescure

Director, Bureau of Milk Control, Sanitary Section, Baltimore City Health Department

DAIRY FARM regulations for the production of a sanitary milk have been required by many cities throughout the country for years, but there still exists a wide diversity of opinion as to those requirements which are essential and those which are desirable.

It is very important that control officials, in drawing up rules or regulations, should give the greatest heed to the practical application of such rules or regulations. One of the chief difficulties is that many cities lay down requirements without first ascertaining whether such regulations are applicable to the local community and whether they are practical, economical, or founded upon real public health bases.

The secret of success is to insistently put before the milk producers the indisputable, unadorned principles and practices involved in the dairy farm aspects of milk sanitation. Concerning regulations, most producers have only a vague idea of what is required and few, indeed, as to why. As a custom, among large cities little effort is put forth by control officials to make milk production a simple, economical, practical and essentially understood matter.

In Baltimore it has been found that the road to success lies in educating the milk producer. The method of education is based upon two primary considerations:

(1) Written, illustrated instruction, and, (2) field demonstration at milking time. The practical advan-

tages of such a control system, from the health officer's point of view, will be obvious.

In the production of a sanitary milk, simplicity is the keynote; there are, in the first place, three very definite factors involved, namely: (1) milk producer, (2) milking methods, and (3) milking equipment. Tentatively, these are listed in order of importance.

The experience of Baltimore officials has proved that expensive or elaborate equipment is not essential to the production of sanitary milk; on the contrary, a few pieces of simple, inexpensive, but properly designed and constructed equipment are all that is necessary. Likewise, constant and rigid adherence to only a very few rules of procedure during milking is all that is required.

Every milk control official should distinguish, in his own mind, at least, between (a) that which is *DESIRABLE,* and (b) that which is *ESSENTIAL,* regarding the production of sanitary milk. Undoubtedly elaborate barns and equipment are attractive; perhaps they are desirable under certain circumstances; but sanitary milk may be produced quite as easily and certainly less expensively in modest barns and with simple equipment.

On every licensed dairy farm it is required that there shall be the following *EQUIPMENT*—

(1) A cow stable, or barn; this shall be reasonably well-lighted and ventilated, with proper stanchions, impervious flooring and drop gutters.

(2) A dairy house, equipped with tight walls and ceiling, well-lighted, well-ventilated, and adequately screened during fly season.

Only eight items of *EQUIPMENT* are required, as follows:

(1) *CHLORINE STERLIZING SOLUTION;* a home-made or proprietary preparation as elected; for the home-made solution published instructions are included in our milk-producer's bulletin.

(2) *WASH BUCKETS AND CLOTHS;* the cloths are used only for this purpose.

(3) *MILK (SHIPPING) CANS;* of specified sanitary design and of studied durable construction.

(4) *SMALL-TOP MILK PAILS;* emphatically those of seamless construction.

(5) *FLOATING DAIRY THERMOMETER;* preferably two instruments, graduated in simple degrees, with a range of from 20° to 110° Fahrenheit.

(6) *MILK CAN AND UTENSIL DRAIN RACK;* the base constructed of metal rods, and the whole entirely screened if placed outdoors. This requirement facilitates prompt and effective drying, and thus, by these simple means, the effective destruction of most bacteria.

(7) *SCRUB BRUSHES;* made of strong stiff fibre bristles.

(8) *ABUNDANT HOT WATER;* to be lavishly used for scalding rinse after the washing of utensils; and also to facilitate the rapid and effective bactericidal drying of milk producing equipment (especially metal).

MILK PRODUCERS HAVE A CHOICE OF ONE OF FIVE APPROVABLE METHODS FOR COOLING AND STORING MILK; that is, the use of:

(a) *Well Water.* Comprising a motor driven pump, a tubular surface cooler and a cork-insulated storage box. The well-water supply must be abundant; and of a temperature not over 55° F. The water may be either from a dug well or a pipe-driven one.

(b) *Spring Water.* This comprises a cooling box (preferably insulated), into which spring water flows, adequate in volume and temperature to cool the milk to 60° F. within a period of two hours of milking. Where the spring water is known to vary in either temperature or flow, the insulation of the box is required, utilizing cork or equivalent material. If ice is used to supplement or replace the spring water during warm periods, the flow of spring water is diverted around the cooling box until the latter fulfills the temperature-cooling requirements.

(c) *Ice Water.* An adequately (preferably cork) insulated cooling box of sufficient ice and water dimensions for the cooling and continuous night storage, at temperatures below 60° F. is all that is required.

(d) *Electric Refrigeration.* On the principle of the household mechanical refrigerator, and of exceptional utility and merit for the purpose, the electric dairy refrigerator has been brought to a high degree of efficiency and economy for the dual cooling and storage of milk. Special equipment for the purpose is made by several reliable manufacturers.

(e) *Direct Expansion Mechanical Refrigerator.* This type of equipment, although highly efficient and desirable, is practicable only on very large farms; in principle it is essentially the same as electrical refrigeration, except that brine solution replaces water when other than coil pipe cooling is used.

It is noteworthy that neither the milk strainer nor the stir-rod have been included in the equipment. A milk strainer, we find, detracts from the process of producing sanitary milk, a stir-rod should only be used for stirring water, not milk, during cooling. Studies made of cooling methods have shown that milk cools more quickly when the cooling water is stirred.

Our studies and experiments have likewise shown that the production of sanitary milk may be condensed into an expression of five essential fundamental rules of procedure. A series of logical, inter-related, easily followed but searchingly profound steps—covered by fully stated, explained and graphically illustrated steps in the text of our Bulletin, "Essential Requirements for Sanitary Milk Production" published in 1931 and copyrighted.

against commercial exploitation, by the Commissioner of Health at the time.

As to our method of approaching this educational program we first personally distributed the Bulletin, looking to three distinct classes of producers for understanding of the text: (1) The intelligent, educated farmers for assimilation of text, illustration and foreword; (2) the average farmer, low-school education for the text and illustrations; and (3) the rather illiterate farmer, illustrations largely for his educational knowledge. Indeed the educational value of the Bulletin lays largely in its message of written understanding in farmers' language, plus an adequately chosen pictorial appeal to those of modern scholastic training. At any event, we aimed to make fully understood without any question the following five simple rules:

Rule No. 1—BEFORE STARTING TO MILK, RINSE ALL CANS AND UTENSILS WITH STERILIZING SOLUTION. The sterilizing solution contains about 100 parts per million of a non-corrosive, sodium hypochlorite solution. Made in "stock" solution according to stated formula and prepared for "sterilizing" by adding one tea cup full to one milk bucket (3 gallons) of water.

Rule No. 2—BEFORE MILKING, CLEAN ALL COWS, WASH THE UDDERS AND TEATS, AND WIPE THE FLANKS WITH A DAMP CLOTH. The chlorine solution which remains after "sterilizing" the utensils is used for this purpose. It is one of the most important functions of the udder—and flank—sterilizing acts to really disinfect the milkers' hands.

Rule No. 3—COOL THE MILK TO 60 DEGREES OR LOWER PROMPTLY AFTER MILKING. Emphasis is placed upon *HOW COLD* the milk is gotten rather than *HOW QUICKLY* the milk is cooled.

First Aid to a Cleaner Milk Supply

De Laval Combine Milker

The De Laval Combine Milker has won universal recognition as the ideal method of producing certified or other special grades of milk. Installed in a special "milking parlor" instead of in the cows' bedroom, it milks, weighs and conveys in a single operation, enabling the milk to be kept in a completely enclosed system over the shortest and cleanest route from cow to bottle.

De Laval Magnetic Milker

Equally superior in the production of milk under ordinary farm conditions is the regular pail type De Laval Magnetic Milker, which has given to thousands of dairymen the means of producing cleaner milk at lower cost.

De Laval No-Foam Milk Clarifiers

At the milk plant, too, the De Laval No-Foam Milk Clarifier renders invaluable service in the production of cleaner milk. It not only insures a more perfect removal of sediment, but operates at full efficiency with milk at low temperatures. Hence, it is of direct value in minimizing bacterial development during processing and removes sediment before the application of heat has made it soluble or cooked its flavor into the milk.

Write for full details of these De Laval machines which can help you with your work.

The De Laval Separator Company

New York **Chicago** **San Francisco**

De Laval

It was a difficult procedure to educate producers away from the former (and erroneous) conception that the rapidity of cooling milk had a greater influence upon the ultimate sanitary quality than the *ACTUAL TEMPERATURE* attained before storage or shipment.

Most large cities in the country require a 50 degree farm, transportation, dairy plant, and delivery temperature. We here require 60 degrees, but irrespective of the regulatory allowance our results have been superior so far as sanitary quality of milk is concerned.

Rule No. 4—STORE EVENING'S MILK SO THAT IT WILL BE 60 DEGREES OR LOWER AT ALL TIMES UNTIL IT IS SHIPPED. This rule is emphasized to mean that if it is not carried out exactly to the letter, the efforts and results of Rules 1, 2 and 3 may be undone, and these efforts of no avail. The results of the emphasis placed on this Rule (No. 4) justifies the emphasis.

Rule No. 5—CLEAN ALL UTENSILS WITHOUT DELAY AS FOLLOWS:

(1) Rinse with cold water, then

(2) Scrub with stiff brush and warm alkali wash water, then

(3) Rinse and scald with boiling water, then

(4) Allow utensils to drain and dry.

The producers' efforts in a scientific or technical sense, in applying the 5th and last rule may be summarized as follows:

(1) Rinsing with cold water avoids "cooking" or coagulating the proteins so that such with butter fat particles do not tenaciously adhere to the utensil. Cold water under this rinsing operation mechanically removes not only albumin, casein and fat, but likewise the other water-soluble milk substances, also the greater number of bacteria common to normal milk.

(2) Scrubbing with warm alkali wash water mechanically removes, after chemical saponification of the butter fat and the conversion by chemical reaction of the proteins (including albuminoid material) to soluble or partially soluble alkaline albuminoid substances, through the process of emulsification, and contrasted with the almost innumerable quantities of bacteria previously found on utensils against the obvious original measurable chemical, and almost unbelievable factual, numerical evidence of removal of bacteria there is overwhelming proof of the advantage of this method of physical cleaning.

(3) After saponification by means of alkali, fat and dirt particles, are removed by scouring and scrubbing, it is a natural sequence that rinsing with hot water, known to every farmer as a solvent superior to cold, or even tepid water, should follow scrubbing and scouring (of step No. 2).

Obviously in the process of "rinsing and scalding" a vast number of bacteria upon utensils will be physically removed. The heat of "scalding" with "boiling hot" water will destroy much bacteria life. More important, we hold, as a bactericide in this specific connection, the fact of leaving the equipment in a heated state, ready for exposure to air (in the screened drain rack) which is in a state upon the average, conducive to rapid and relatively complete drying. Again the proven bactericidal advantage moisture deprivation is utilized. After such treatment and an air-drying interval averaging 12 hours or so, the use of milking utensils is preceded by the chlorine disinfection procedure according to Rule No. 1.

To summarize: The production of sanitary milk is described. It is believed to be unique as an administrative measure. No claim of originality is made; the whole is based upon a reversion to essential consideration of proven relation to the sanitary quality of milk as it is produced at the farm.

WHAT ARE THE ESSENTIAL REQUIREMENTS FOR CLEAN, SAFE MILK FOR PASTEURIZATION?

THE RECEIVING STATION

GEORGE W. GRIM

Milk Control District No. 1, Ardmore, Pa.

A PROPER milk receiving station located in the country, not far removed from the dairy farm, is an essential in assuring high quality milk for pasteurization. The principal function of the receiving station is to cool without delay, all milk as it is received to a temperature sufficiently low to inhibit bacteria growth; also to thoroughly clean and sterilize all milk cans returned to the producers. The need for carrying out both of these operations in an efficient manner is at once apparent.

Huge quantities of milk, subjected to little or no cooling at the farm, are received daily at the receiving station, where it must be cooled almost immediately to a temperature well below 50 degrees F. Satisfactory handling of this milk imposes heavy burdens upon milk cooling surfaces and upon refrigerating machinery. Milk cans must be thoroughly cleaned, sterilized and dried as fast as they are emptied in order not to delay the unloading and cooling of other milk transports as they arrive at the plant. Large quantities of water and steam must be available. The plant must be of sufficient capacity to easily handle the peak load placed upon it. It must be constructed and arranged as to meet the demands of modern sanitation. The receiving station must be well equipped for the job and operated in an efficient manner.

Milk receiving stations that fully measure up to present day requirements concerning construction, equipment, adequacy, or methods of operation are far too few.

The author concluded, following a survey of a number of milk receiving stations in Pennsylvania and other states during the past few years, that milk cooling stations in the country are probably one of the most neglected parts of the milk business; neglected both by the milk dealer and by the milk inspector. The conditions of many milk receiving stations visited furnish the evidence of neglect upon the part of the milk industry. The almost complete absence, both in the literature and in text books on milk hygiene, of any reference to milk receiving or cooling stations furnishes the evidence of neglect upon the part of the milk hygienist.

Some of the faults encountered more or less frequently during the course of investigations at milk receiving stations follow:

No laboratory control maintained over water supply. Surface water from nearby streams used in the plant, especially for cooling during winter months. Receiving station water supplies, obtained from drilled wells, frequently cross-connected with other water supplies of a questionable character. Water known to be positive for *B. coli* used without chlorination. In one instance the water supply from an artesian well owned by the plant, the town water supply and water from a sewage polluted stream were all cross-connected for emergency use in the plant.

Faulty plant waste disposal is found all too frequently. The disposal of creamery waste, especially at large creameries, presents a problem difficult of solution. These difficulties, however, should in no degree serve to excuse faults in the disposal of toilet or lavoratory waste. Unless entirely satisfactory means of waste disposal have been provided for the entire plant the inspector should insist that waste from toilets and wash stands be separated from creamery waste disposal and that a disposal system for domestic sewage of an entirely satisfactory nature be provided. Surface privies wherever found at milk receiving stations should be condemned. In their place the inspector should insist upon the installation of sanitary flush type toilets.

Faulty plumbing and drainage is a defect commonly met with. Usually floor drains in milk receiving stations are of the bell-trap type. All inlets to drain pipes should be provided with running P traps in place of unsatisfactory bell trap. It is not uncommon to find the bells removed or broken and foul smelling sewage odors from drain pipe present in the plants. The absence of adequate vents at the end of drainage pipes together with neglect in installing fresh air inlets outside the building add further to an already unsatisfactory condition. The correction of faults of this character in plant drainage should be insisted upon.

More attention to the character of construction of milk receiving stations is necessary if we are to improve the sanitation of our receiving stations. Whenever it is necessary to replace concrete or brick floors they should be pitched at a grade of $\frac{1}{4}$ inch to the foot in order to insure rapid and complete draining. The use of expansion cracks in floor construction should be discouraged. Concrete or brick floors should include a 6 inch sanitary base at junction of floor and side walls. In no instance should wood studding, door frames or other wood supports rest upon the floor.

Walls, ceilings and partitions constructed of wood have been found wholly unsatisfactory. Therefore, the use of impervious material such as cement, plaster or tile with a reasonably smooth finish and tight joints should be insisted upon. A steel trowelled sand finish is not objectionable. A finish of this character has been found quite serviceable because it seems to be particularly adaptable to ready painting under most trying circumstances.

Usually double hung windows appear to be most satisfactory. Where sky lights are installed it is best to insist that they be provided with side ventilators. Great care is necessary in selecting sky lights of a type least objectionable from the standpoint of dirt.

Smooth surfaced wood doors hung in metal frames are quite satisfactory. The lower face of wood doors may be protected by metal plate secured with screws. This type of door is to be preferred to the hollow core metal door or wood door, metal covered, because of difficulties with open seams and warping of wood within the metal covering.

Until recently there appears to have been no disposition toward a standard arrangement of rooms or equipment in milk receiving stations. Usually the plant was divided into at least three rooms; a milk handling room, a boiler room and an office. The milk handling room, commonly housed the ammonia compressor, can washer, weigh tank, receiving vat, cooler or milk storage tanks. Plants were found occasionally, where nearly seventy-five per cent of the floor area was occupied by milk handling equipment. Overcrowded conditions were not uncommon.

Conditions such as these, of course, call for correction. The remedy seems to be, first; an arrangement of the receiving station into separate rooms for various operations. The following arrangement has been suggested:—

(a) Boiler and machinery room.
(b) Milk receiving room.
(c) Can washing room.
(d) Milk cooling and processing room.
(e) Can storage room.
(f) Milk products room.
(g) Toilet and lavatory.
(h) Store room.
(i) Dressing room.
(j) Office.

Milk handling rooms in many milk receiving stations have been found deficient in natural light. A fair standard in milk plants, which has been found to assure adequate light, is to provide window glass area equivalent to twenty per cent of the square foot area of the floor of any milk handling room, exclusive of cold storage rooms.

Considerable difficulty was encountered in preventing overcrowding, particularly in plants where consolidations or rapidly increasing business demanded the installation of additional milk handling apparatus. To control the tendency toward overcrowding it was soon apparent that some standard must be adopted and placed into effect. We first set a maximum of fifty per cent of floor area of any milk handling room, not to be obstructed by milk handling equipment. In practice this standard appeared to be too liberal. To guard against overcrowding in milk handling rooms it was therefore recommended that floor area obstructed by milk handling apparatus in no case should exceed 1/3 of the square foot area of the room. It was further required that milk receiving vats or other separate milk handling apparatus be located so as not to extend beneath other apparatus. Cans, after dumping, were not to pass over weigh tanks, receiving vats or other milk handling apparatus. It was required that stationary apparatus, other than conveyors, be arranged so as to permit at least twenty inches clearance between the extreme dimensions of the apparatus and the nearest point to walls or ceiling. Coolers of the surface type are to be set so as to provide an unobstructed space for a distance of at least three feet from all points upon the milk cooling surface. In a large measure these restrictions served to prevent overcrowding.

The same lack of consideration with respect to condition of equipment in the milk receiving station was observed. The usual faults, so common in city pasteurizing plants a few years ago, were apparent. In an endeavor to secure correction we are requiring that all milk handling equipment be constructed of acceptable non-corrodible material. Such equipment shall be self-draining and in a good state of repair with interior surfaces smooth, seams flush, free from cracks, and of sanitary construction so as to be easily taken down and cleaned. Covers of acceptable type are required for all milk handling equipment. Cooler sections are to be arranged in relation to cooler troughs that condensation from headers will not run into the milk. Clearance between cooler sections to be at least 3/16 of an inch. Fillets shall be provided at all points where strips are joined to cooler tubes. All piping must be clean and constructed of an acceptable non-corrodible material easily taken down and apart and shall be kept clean, piping to be dissembled and thoroughly washed after each operation. Milk handling apparatus must not be washed upon the floor. A metal wash tank must be provided and used. The tank shall be large enough to permit the longest lengths of pipe to be properly immersed and washed. All piping must be racked between operations on acceptable sanitary rust-proof metal racks; so that the same will be protected from contamination by dust and dirt and may be easily inspected. Joints between milk piping, fittings and valves must be smooth. Piping shall be erected so as to assure self-draining. Open cracks, recesses, inside threads, dead ends, stuffing boxes and gaskets, other than single service type, must be avoided.

Recently we have been urging operators of milk receiving stations to equip with milk clarifiers or filters in order to remove dirt from the milk immediately upon its arrival at the station. Progress along this line has not been as rapid as might be desired. Only slight consideration of this matter is necessary to convince one of the wisdom of this procedure, as compared to the practice of awaiting the arrival of the milk in the city before attempting to remove the dirt. The next few years should witness a tremendous increase in the use of milk filtering or clarifying equipment at milk receiving stations throughout the country. At present little or no attempts are being made to clean milk at the milk receiving stations in the country where it is received and cooled. Developments along this line will do much in the direction of improvement in milk quality.

Before concluding the part of the discussion dealing with receiving stations it is desired to direct attention to the matter of milk receiving station records as a means of assisting the Inspector in appraising the quality and character of the milk received. Leading milk companies have compiled an array of valuable records which should in no instance be overlooked. As a rule these records consist of veterinary certificates of each herd supplying the station with milk; a sanitary report describing the important sanitary features on the farms where the milk is produced; records of contagious disease in families residing upon farms where milk is produced; records of tuberculin tests of cattle; of physical examination of cattle; records of milk receipts and shipments; temperature records of milk as received from the farm; results of sediment tests; methylene blue tests and possibly bacteria counts of individual shippers. Where records of this character are kept, a full-time force is at work. Their efforts have resulted in a continued improvement in the quality of milk received at the stations and later shipped to the city for pasteurization.

WHAT ARE THE ESSENTIAL REQUIREMENTS FOR CLEAN SAFE MILK FOR PASTEURIZATION?

THE MILK HANDLER

Verne K. Harvey

State Health Department, Indianapolis, Ind.

OTHERS have discussed the herd, the farm, and the receiving station. There remains the *milk handler*, an essential link in the procedures that insure clean, safe milk for pasteurization. Ideally, milk that is to be pasteurized and then offered to the public as a food to be consumed without further treatment should be produced under as careful hygienic technics as is the milk that is to be sold and consumed in the raw state. The milk handler is any one who comes in intimate contact with the milk, as the milker, the workman who handles the milk pails, milk cans, milk bottles or attends to the details of bottling and sterilization; the workman who delivers the milk and finally the cook, maid or other person who may handle this milk before it enters the digestive canal of the presumably healthy consumer.

Ideally, each handler of milk should have properly developed habits plus knowledge to rationalize these habits. The milker and other handlers on the farm should have deep rooted habits as to cleanliness, including clean cows, clean barns, clean milking utensils and for themselves, clean bodies, clean clothes and exceptionally clean hands. Technics of clean barns and clean cows have been discussed. The milker may keep reasonably clean by putting on a freshly laundered milking suit before milking. He should also have freshly cleaned shoes. His hair should always be covered, especially if he has been working in dusty situations. His face and hands should be scrubbed and his hands also treated with a suitable disinfectant that has been allowed to dry upon them. During and for a period before the milking, the milker should not use tobacco in any form because of several insanitary procedures that result from its use. The tobacco user more frequently touches his face and mouth with his hands and if he chews, his hands come in contact with his clothing and the tobacco. In addition, the spitting introduces an extra number of droplets into the air and this is undesirable. The milker and other handlers should understand that if it should be necessary to any call for defecation or urination they must thoroughly repeat the process of disinfecting their hands before resuming their duties. The ancient practice of spitting on the hands at milking time is prohibited now.

In order that milk handlers anywhere along the line may be relied upon as producers of sanitary milk, they must have developed such traits as carefulness, accuracy, neatness, dependability and honesty. Such traits are in fact an essential part of the equipment of a handler. Such traits compel their possessor to the conscientious practice of proper hygiene and to carry out completely the sterilization and other procedures related to safe milk.

The diseases of cattle that may be transferred to man have been discussed. The milker needs to have enough training to call attention to any signs and symptoms that may have been missed.

Milk is an excellent food for many bacteria, it may therefore carry specific organisms from the ill, the convalescent or the carrier to those who are well. In this way milk may carry typhoid, paratyphoid, dysentery, diphtheria, septic sore throat, human tuberculosis, Asiatic cholera and scarlet fever.

Hands, water or flies may carry the typhoid organism from the dejecta to the milk. Near Warsaw, Indiana, we had several cases of typhoid that were due to infection of the milk by the hands of a carrier. In Clinton we had about ten cases where the milk was no doubt infected by the use of polluted water about the dairy. There were seven cases recently in Arizona that were due to infecting the outside of the milk bottles by the hands of the delivery man.

Septic sore throat may enter the milk as droplets, from the hands or from the mechanically contaminated udders of the cow. Some think the cause of septic sore throat is streptococcus epidemicus. Roesnau claims that the organism causing garget does not cause septic sore throat but the udder of the cow may be infected mechanically by human streptococcus epidemicus and the cow become a carrier.

Ideally, every one who handles milk before it is finally consumed should have a careful examination to determine the presence of active disease or of the carrier condition. The old type examination to determine tuberculosis is not sufficient. All handlers should have the intradermal test and if this is positive they should have an x-ray. Many doctors confidently assume that every one reacts to this test and therefore it is useless. In addition, we are learning that positive reactions to very dilute solutions have positive diagnostic values. At any rate to allow prejudice to prevail to the extent that citizens go about in a false sense of security assaulting their fellows daily with tubercle germs, is neither scientific nor humanitarian.

The examination should include a careful fecal and urinary test and probably of duodenal content for typhoid bacilli. The protozoal and bacterial organisms of dysentery should be sought. Nasal and throat smears should be carefully examined for any hemolytic streptococci or diptheria organism. These examinations should be repeated each year.

In addition, no one should handle milk who is suffering with symptoms that might suggest the possibility of an acute disease developing as red and running nose, sore throat, cough, inflamed conjunctiva, fever temperature. Even if it is only an acute cold, the milker should be laid off and a substitute take his place until he is well.

Indiana protects its milk and other foods by Section 8 of the Sanitary Food Law:

No person shall work in a building, room, basement, cellar or vehicle used for the production, preparation, manufacture, storage, sale, distribution and transportation of food, who is affected with any venereal disease, smallpox, diphtheria. scarlet fever, yellow fever, tuberculosis or consumption, bubonic plague, Asiatic cholera, leprosy, trachoma, typhoid fever, epidemic dysentery, measles, mumps, German measles, whooping cough, chickenpox or any other infectious or contagious disease.

It is the duty of the State Division of Public Health to enforce the above law.

The Indiana anti-tuberculosis law makes it the duty of physicians and health officers to report all tuberculosis and the law also makes it the duty of the Division of Public Health to devise ways and means to control this disease. This is another powerful weapon to insure safe milk handlers.

Paragraph 4 under Section 1 of the Production of Milk Products, page 47, of the Red Book of Instructions to Health Authorities sets out a valuable law, which provides that each producer of milk shall provide a sanitary toilet, constructed and operated in accordance with the recommendation of the Indiana Division of Public Health. Washing facilities for employees, including running water, soap and sanitary towels shall also be provided.

The next section (Par. 5 under Section 1 of the Production of Milk Products, page 47) provides that the water supply shall meet the standards of quality of the United States Public Health Service.

Paragraph 7 provides that the milker's hands shall be clean, rinsed with a disinfectant and dried with a clean towel immediately before milking. Wet hand milking is prohibited.

Paragraph 11 provides

that no person affected with a communicable disease which may be transmitted through milk, or who is a carrier of the causative organism of such disease shall act as a milker, bottler, washer or in any other capacity in connection with the handling of milk or of any containers or utensils used in the handling, storage, bottling or delivery of milk. This provision shall also apply to any person who in any way comes in contact with a person affected with such communicable disease.

(b) Every person connected with a dairy, whose work brings him in contact with the handling or delivery of milk shall at least annually submit to a medical examination by the health officer of the state board of health, or by a licensed physician approved by the state board of health and shall submit such specimens or body discharges as are deemed necessary by the health officer or the authorized representative of the state board of health.

In conclusion the handling of milk is a technical process requiring special knowledge, skill and abilities. To sacrifice community health to economic excuses is neither scientific nor humane. To feed our neighbor filth to fatten our purse does not seem a worthy ambition. What a community wants is clean, pasteurized milk, not "cleaned" pasteurized milk.

NEED FOR UNIFORMITY IN MILK LAWS AND REGULATIONS

WITHIN THE STATE

PAUL B. BROOKS
Deputy State Health Commissioner
Albany, N. Y.

IN New York State we have a state sanitary code, Chapter III of which relates to sale of milk and cream. It is effective throughout the State, excepting in New York City, requires every person selling milk or cream (to consumers) to have a permit from the local health officer and prescribes minimum requirements. New York City was excepted because, long before the state code was first enacted, it had—as it still has—a comprehensive code of its own. Our public health law, also, authorizes local boards of health to enact local health regulations "not inconsistent" with the provisions of the state code. In the past it has been accepted as a principle that a requirement in addition to or higher than those of the state code was, in fact, "not inconsistent." It seems obviously desirable that this principle prevail at least in so far as it applies to power of the local health authorities to require pasteurization of milk not required by the state code to be pasteurized. On the other hand its application, through the addition of special requirements in local regulations, has given rise to departures from uniformity concerning which there has been considerable criticism.

As a result of cooperative effort the State and New York City milk codes are now uniform as to major requirements. However, the city still maintains some requirements not in the state code.

Within the past year, at the instigation of the writer, a committee made up of a city health officer and a city milk inspector, delegated by the State Conference of

Mayors, and of representatives of the dairy industry and of the State and New York City health departments, has been formed to study this problem of uniformity. This committee has studied the milk regulations of most of our sixty cities (all we were able to get) and, using the state code requirements as a "base line," listed the local requirements in addition to these.

These additional requirements may be tentatively separated into two general groups:—(1) Those not seriously affecting uniformity or sufficiently desirable to warrant departure from uniformity, and (2) Those either undesirable or not important enough to warrant departures from uniformity.

The committee found in the regulations of eighteen cities requirements which it tentatively put together in the class "undesirable or not sufficiently important to warrant departures from uniformity." I assume that you will be interested in knowing the sort of requirements so classified and will cite some examples; but I hope this will not divert the discussion from "the need for uniformity" to that of the judgment, if any, displayed by the committee in its selections. This list included the following requirements, the subdivision into "not sufficiently important" and "undesirable" being my own:

"Not Sufficiently Important, Etc."

(Most of those listed were in this class)

Stable painted or whitewashed twice yearly.

Horses excluded from cow stable.

Milk house walls painted or whitewashed.

No whitewash permitted. (Note the direct conflict in the two latter)

Milk house to have baseboards of concrete at least 6 inches high.

Separate room in milk house for washing utensils.
Milk house to have ventilator in roof.
Privy at least 100 feet from milk house.
Small top pails only.
Farm utensils washed before 10 A.M.
No water closet in cellar under milk-handling room of pasteurizing plant.

"UNDESIRABLE"

Milk house or room at least 100 feet from stable.
Temperature for pasteurization higher than required by state code (143° F.)
Only steam or boiling water to be used in "sterilizing" pasteurizing apparatus.
Only glass bottles (clear, uncolored glass) permitted.

These special requirements seem at times to represent the ideas of individual local milk control officers.

I might say here that the committee did not attempt to classify certain requirements which have acquired considerable vogue of late, such as those limiting the local production areas and requiring pasteurization to be done within the municipal limits. The intent of these is so obvious that we thought it better to maintain, for the time, a "hands off" attitude.

While the committee's survey has covered cities only, it is of interest that one village has set its standards for pasteurized milk so high as thus far to have entirely excluded it, which apparently was the intent.

I now come more specifically to the "need for uniformity"—the question at issue. It was the frequent repetition, publicly, of the demand for greater uniformity that led to the appointment of this committee. The declaration of the need came chiefly from representatives of the larger dairymen's cooperative organizations and distributing companies but it was often reiterated by health officials and individual farmers. The principal complaints against lack of uniformity were that it subjected producers and distributors to added expense, in meeting the special requirements of several municipalities; that at times local regulations conflicted, serving to exclude the milk of certain producers from municipalities which it otherwise might enter and that it interfered with the "free flow" of milk.

As we have studied the problem it has become apparent that there is conflict in the milk industry between the broad and general point of view, that of the larger cooperatives and distributing companies, and the local viewpoint, which is that of dairymen and small distributors whose milk is sold only in one municipality. The larger organizations, few in number, probably handle the major part of the milk supply; the smaller distributors, though handling less milk, are far more numerous. The larger organizations naturally want to be able to sell their product anywhere in the State. The local industry, on the other hand, having complied with the special local requirements (and possibly, at times having fostered them) evidently prefers to see them retained, since it tends to exclude "outsiders" and limit competition. Here again we see "a house divided against itself."

As for the health officers, where there are regulations of the type evidently designed to limit the field to the local industry (limiting production areas, requiring pasteurization within city limits, etc.) they defend them. The usual—and not illogical—argument is that funds for supervision are limited, that they can maintain close supervision over the local industry and prefer to "know where the milk comes from." At times there have been intimations that they had had little to say about the enactment of these regulations or ordinances and that they had been instigated by the local producers and dealers.

Referring to the other special requirements listed as undesirable or relatively unimportant, the committee communicated with the health officers of the eighteen cities, in effect asking their cooperation in securing their repeal. At the time of writing 11 had replied, 4 agreeing in full, 1 agreeing with one reservation, 5 making no concessions and 1 being non-committal. It appears, therefore, that there is a question, also, as to whether a majority of local milk-control officers actually want uniformity—except as applied to cities other than their own.

We in the State Department of Health must necessarily look at the matter broadly from the standpoint of the State and the industry as a whole. In the first place we believe that any requirement for which a real necessity can not be established without "stretching points" should be eliminated, whether it be in state or local regulations. Necessary requirements need no defense, but the industry has just ground for complaint if it is forced to comply with unnecessary requirements—and the public as well, since it pays the bill ultimately. No health officer should permit the sale of any milk until he is assured that it conforms to reasonable and generally accepted standards of safety and quality, and we must assume that he will be honest and use judgment in determining what constitutes such assurance. Health officers who act unfairly or arbitrarily usually have the exit pointed out to them in due time. Speaking generally, the milk handled by large organizations is at least as safe and of as good quality as that handled by small. While departures from uniformity may, at least temporarily, benefit small local groups, we believe that uniformity is in the interest both of the milk industry as a whole and of the public.

NEED FOR UNIFORMITY IN MILK LAWS AND REGULATIONS

BETWEEN STATES

J. J. REGAN
Dairymen's League Cooperative Association, Inc.
New York City

AS I AM not familiar with the conditions which exist throughout the country in respect to this particular subject, I will take as a basis for my discussion the conditions which prevail in the milk shed of the New York metropolitan district, with which I am more or less familiar. In this particular area, due to the necessarily large amounts of milk and cream shipped interstate in order to supply the great metropolitan market, lack of uniformity in state milk regulations is perhaps more noticeable, and presents a greater problem than in any other place.

For those of you who represent markets which obtain their milk supplies entirely from within one state, and for those who represent companies supplying such markets, this matter of lack of uniformity in state regulations offers no problem. For those, however, who represent markets which receive supplies from different states, and particularly for those of us who represent companies supplying different markets, in different states, it offers a real problem and one that is becoming more and more serious from year to year, due to the multiplicity of new laws and regulations being adopted both by the different states and by the various municipalities within the states.

For the sole object of making my viewpoints practical, I am not only going to take the New York Metropolitan Milk Shed as a basis, but with your indulgence, I am going to go further and take the situation in that area as it affects the particular company with which I happen to be connected. The situation as it affects this particular company is very similar to that of other large concerns operating in this area. What is commonly referred to as the metropolitan district includes New York City, Yonkers, and Westchester county on the New York side, and Newark, Jersey City, the Oranges, and adjacent suburban cities across the river on the New Jersey side. In all of this district there is a population of approximately ten and one-half million people. The inhabitants of this district are free to go from one municipality to another, but that is not the case with milk. Each municipality has its own set of regulations and no milk is allowed to be sold unless it is produced and handled in accordance with those regulations. Not all of the smaller places maintain inspection of sources of supplies, as they accept the inspection and approval of some recognized inspection agency. Most of the larger places, however, do have inspection forces and maintain regular inspection of all sources of supply. These various inspection agencies conduct inspections and maintain control independently of each other. For instance, there are many cases where different municipalities receive supplies from the same source, and in such cases, a representative of each of the different cities makes an inspection and reports to his respective health department independently of the others.

The milk and cream which supplies this metropolitan district comes principally from the five states of New York, Pennsylvania, New Jersey, and parts of Vermont and Connecticut. In this area there are approved for one or more municipalities in the metropolitan district approximately 700 production units. By production units I refer here to plants which receive milk from farms and make shipments of dairy products. At all of these approved plants milk is received at some time during the year from approximately 100,000 dairy farms.

The majority of those production units are owned and operated by a comparatively few large concerns, all of whom distribute their product in practically all of the different cities in the metropolitan district. While all of those concerns have a number of separate production units or country plants from which their supply is received, in order to effect most economic distribution they must be in a position to utilize their supply to best advantage, and in order to do this their entire supply must be considered as one single production unit.

For instance, on account of seasonal fluctuations in production and consumption, and also due to available transportation facilities, in order to effect the best utilization of the product, it is frequently necessary to shift supplies from one plant to another. Some way must be provided for taking care of the surplus. There is always some surplus and no one can tell, due to the uncontrollable factors mentioned, just how much there is going to be from week to week or from day to day. In order to take care of this surplus there must be central manufacturing plants where milk can be made into products which the market can use later. In this particular territory a great deal of the surplus goes into the manufacture of cream and powdered milk.

During a dry, warm season when there is an increase in consumption and at the same time a decrease in production, it becomes necessary at times to draw upon every available source in order to supply the market requirements. The proportionate additional requirements for the different municipalities during this season always vary, especially in this district, due to the shifting of the population to the seashore and other summer resort places.

For those reasons, in order to operate most economically, it is impossible at all times to use the output from one particular plant or any certain number of plants or production units in just one municipality and in none other. As a matter of fact, the company with which I am connected feels that in order to operate to best advantage, practically all of its 141 production units should be qualified for most of the markets in the entire district.

At present nearly all of our production units are approved for two or more different markets. The map in front of you shows the location of the different plants and the various colored circles around each show the number of markets for which they are approved. The key in the upper left, shows the particular markets corresponding to the colored circles. You will notice at once the great variety of different colors, some plants having as many as a half dozen different colored circles.

In order to show more clearly what this means, let us take just one particular plant and go more in detail. We will take, for instance, a plant located at Remsen, New York. I'll admit that this will be a rather extreme case, but still there are many situations in the territory which are similar. Around this plant there are seven different colored circles showing that in order to operate most economically it would be advantageous to have this production unit approved for seven different markets.

For instance, it would have to be approved for New York City as there are good transportation facilities to that point, and that is the regular market. As it is a manufacturing plant where cream is made and as part of this cream is used by ice cream manufacturers in New York City who distribute some ice cream across the river in Newark, it would also be necessary to secure approval by both the City of Newark and the State of New Jersey.

Most of the time the cream from this plant is shipped on trucks and as those trucks go down the Hudson Valley it would be convenient at times to supply distributing plants operating in Westchester County and across the line in Connecticut. In order to do this it would be necessary to have the approval of the Westchester County Department of Health, the New York State Department of Health, and also the State Department of Connecticut.

At times during the year it might be advantageous to sell some cream from this source in the State of Pennsylvania and in order to do this, it, of course, would have to be on the approved list for that State.

In order to meet all of the requirements of all these various inspection agencies, and thus secure permits for the different markets necessary for most advantageous distribution of the output from this plant, it would be necessary for the dairies delivering there to fulfill 35 separate conditions.

While regulations requiring most of these conditions are common to all of the different milk sanitary codes, there are many things required by one or more health departments which are not required by the others. A producer, for instance, might be complying 100 per cent with all regulations of all other departments, but if he fails to observe one of those requirements as referred to above, he is subject to exclusion.

In the course of inspections conducted by representatives of the various agencies, there would be used at least seven different plant and dairy score card forms together with numerous other forms in connection with particular items. There is not only a difference in the actual requirements appearing in those different forms, but there is always the possibility of slight variations in the interpretation of the same item or regulation by different inspectors, all of which tends to make for considerable confusion.

While I have nothing definite to recommend by way of correction of this situation which I have endeavored to describe, I believe that in connection with any effort that might be made along this line, there should be consideration given to the following, as possible major objectives.

1 The development of the area or milk shed supplying the New York metropolitan district, so far as milk sanitary regulations is concerned, as one single unit.

2 A state of close cooperation and greater uniformity in enforcement policies between health departments and other inspection agencies within the territory.

Discussion

Mr. Lang: In the last five years milk coming into Boston and cities and towns near we have worked with a great deal of zeal to comply with all the regulations, but I'll say I have absolutely lost count. I encounter in the production end the same thing—multiplicity of regulations, as Dr. Regan so vividly demonstrated. But we do have from five states—Rhode Island, Maine, New Hampshire and Vermont, and we have an effort being made now in the State Department of Agriculture of Massachusetts to license all dairies where the ultimate market is in the State of Massachusetts, through a Dairy Advisory Board, appointed by the legislature, which consists of the Attorney General of the State, Commissioner of Health and Commissioner of Agriculture, so that these regulations have been propounded on a working theory now to definitely standardize the inspections. That does not stop any municipality from adding any requirement they choose to make, but it is a step and with proper administration may secure some degree of uniformity. I don't know how long it will take to work it out, but it is constructive. The farmer is told so many different things he has lost the proper desire for the real objective, the public health objective, and that is serious, because we certainly owe a lot to the inspectors and the public health officers' efforts.

Mr. Jennings: I would just like to mention the fact that a few years ago I was with the State of Arizona and we had all but two incorporated towns under the same milk regulations, before the last one came in, which was Phoenix. Capitol towns are quite frequently a little bit Bolshevik; think they are sufficient in themselves and they do not want to come in on the uniform program. Some of the other towns in certain sections needed milk and Phoenix wanted to furnish some, but they couldn't, and some of the other towns got it and finally Phoenix came in, and as many as six markets were supplied from the Phoenix area under the same regulations.

Dr. Regan: In order to avoid any misunderstanding as to my viewpoint, I want to say that I don't think there is any standard ordinance that can be adopted on a nation-wide basis, but I do think there can be a lot of uniformity affected within areas not nation-wide but confined to certain areas where milk finds a market around particular metropolitan areas like we have in the New York district.

Dr. Brooks: I heartily agree with what Mr. Frank said a while ago about uniformity as far as uniformity is practicable. He has developed a standard ordinance which I am not criticizing at all, but which we do not feel would apply to our conditions in New York State. I don't want to get into a discussion of the standard milk ordinance; we have been over that a good many times, but I recall that our Committee on Ordinances, which has in the past given some study to the question of uniformity, came to the conclusion that it was not practicable to have one ordinance that was adapted to all conditions in the different parts of the United States. It seems to me that the committee might well concentrate on the question of the possibility of securing a greater degree of uniformity in general principles and fundamental standards and make a report along that line at the next meeting.

Mr. Frank: The Public Health Service has appointed an Advisory Board which is composed of six representatives of the state boards of health, the federal health and agricultural departments, and three organizations from the industry. The standard ordinance is subject to change on a two-thirds vote of that committee.

Dr. Leslie: I would like to say a word for the consumer. The consumer is going to wonder why it is that in one place the milk house, according to regulations, must be within ten feet of the barn and not over twenty; in other places it must be one hundred feet from the barn, and so on. I think there should be a real reason back of any regulation. I believe if we don't settle this problem the consumers are going to settle it for us, and we may not like the way they settle it.

President Parker: Last year in Florida this question of ordinances was up for discussion and I made the statement that if we didn't get down to common sense and establish some uniformity some day some of our modern ordinances would be brought into court and if they were it would be just too bad. I don't believe the courts will sustain a lot of this stuff that we have written into ordinances, all with the best intent. It is a serious situation. If you get into court it is my firm belief milk inspection is going to get a terrible bump and we had better clean it up ourselves rather than let the courts do it.

Mr. West: This started out as a debate and will probably end as a debate, but I agree with Dr. Regan wholeheartedly in the confession of lack of uniformity. I also agree with Mr. Frank that we have got to bury our petty differences and get down to some practical procedure. Don't know whether I brought out in my paper or not but I think we have got to get our ideas, as Mr. Parker suggests, down to what is actually fundamental for milk safety and separate the milk quality factor from our standard health programs and put them on a sound basis. You take New York City paying millions of dollars for Grade A premiums based on bacterial counts on the theory the public was going to buy a safe grade of milk. They have set the price on butter fat and bought the milk on that basis, so it has become necessary for the dairymen to degrade themselves to B milk, and what I suggest is that these economic factors have nothing to do with safety. I feel our money is better spent by having a single grade and focusing our attention on the fifteen or twenty per cent substandards. As Dr. Harding has said, eighty per cent up to standard is a good batting average. With limited funds, the way I see it we ought to get down to the milk, beginning with the cow, carrying right through to milk handlers and those that have the most to do with the milk.

Dr. Regan: I would like to correct one other possible impression that might have been gained from my paper. When I talk about uniformity I don't mean uniformity as far as grading is concerned. I don't want anybody to get the impression that I am for one grade of pasteurized milk. I am not. I am for two grades of pasteurized milk. I think a group like this that stands as the highest court on questions of regulations on milk sanitation would be making a backward step if they were to recommend discontinuing a system that has accomplished a great deal in the past.

REPORT OF COMMITTEE ON DAIRY FARM METHODS

Thomas J. Strauch, *Chairman*

UNDER the strenuous competition existing in most milk markets, milk distributors depend upon the quality of their milk for the sale of their products. With the demand for a higher quality milk, the milk producer faces the problem of improving the quality of milk at the source of production—the farm. Progressive milk distributors are demanding a higher quality product from their shippers and are penalizing those who do not ship them milk free from odors and which shows poor keeping quality.

We all now admit that the final quality of dairy products depend to a great extent upon their quality at their source. Your committee therefore recommends certain practices which must be followed in order to produce milk of a high quality on the farm.

The essential requirements for the production of milk of a high quality, in the opinion of your committee, are as follows:

The utensils must receive proper care. All utensils should be rinsed immediately after use in cold water, then scrubbed with brush and warm water, to which a good dairy cleanser has been added. The utensils should then be thoroughly treated with steam, boiling water or an efficient chemical germicide; and after drying, should be kept in a clean place. Sterilization does not take the place of cleanliness.

Milk must be free of flavor defects and odors caused by material consumed by the cows. It is necessary to keep cows out of pastures containing garlic or weeds likely to taint milk. If this is impossible, the cows should be taken from these pastures from seven to ten hours before milking time and fed some kind of dry feed. Poorly ventilated and unclean stables furnish a source of bad milk odors.

Milk should not be used from cows that are not clean, from cows that are not healthy and free of tuberculosis, from cows milked too near calving time, or from cows with diseased quarters. Only smoothly finished utensils should be used. Rusty utensils will taint the milk they hold.

Other things being equal, the keeping quality of milk depends upon its temperature. Milk should be promptly cooled to a temperature below that of appreciable bacterial growth. It has been found from experience that the most suitable temperature from the standpoint of bacterial growth is 45 degrees F., or lower. Your committee therefore recommends that milk should be immediately cooled at the farm to a temperature of 45 degrees F., or lower, and stored at a low temperature. There should be an accurate thermometer on all farms.

REPORT OF COMMITTEE ON METHODS OF IMPROVING MILK SUPPLIES IN SMALL COMMUNITIES

C. A. Abele, *Chairman*

DISCUSSION of the importance of milk control in small communities as a public health measure constitutes mere repetition of an oft-declared fact. Nevertheless, despite the repeated presentation by the U. S. Public Health Service and the American Child Health Association, of evidence of higher milkborne disease rates in the smaller communities of this country, there has been apparent in recent years no appreciable tendency toward the extension of quality and safety control of public milk supplies to such communities. A number of reasons—excuses might be a more appropriate term—are usually advanced to account for this situation. The fundamental reason, rarely acknowledged, is no doubt the inertia of uninformed public opinion. If this surmise be correct, public health authorities are, in the last analysis, at least partially responsible for the continued relatively high morbidity rates of milkborne diseases among these population groups.

This phase of the problem, and a solution therefor, were, however, rather fully discussed in the first report of this Committee (1932). That report also enumerated some of the failings of such milk control activities as are being conducted in some small communities, and urged that any municipality contemplating improvement of its milk supply obtain the assistance of one of the qualified organizations or agencies, such as the State Department of Health, or a national official or voluntary public health organization, in the conduct of a survey to ascertain the actual status of quality of the community supply, so that accurate data essential to the molding of intelligent public opinion may be available.

Realizing, however, that the members of this Association need no evangelizing concerning the desirability of and need for milk control in small communities (under 10,000), but that they are, instead, interested in the practical phases of such milk control activities as are in effect; and recognizing the fact that the fiscal affairs of most municipalities have in the last few years come to constitute the paramount issue in the consideration of milk control activities, your Committee this year decided to seek information concerning the manner in which milk control activities are still being maintained in communities of this magnitude, so that it may be available to those members of the Association who face similar problems.

A careful consideration of the subject will doubtless convince rational observers that communities of less than 10,000 population can not really afford to employ trained full-time personnel for milk control alone. In 1930, according to a survey conducted by Municipal Administration Service, the maximum expenditure for municipal milk control in a representative group of medium-sized and large cities scattered throughout this country was 34 cents per capita per annum, and the average was under 20 cents. These figures have doubtlessly been reduced during 1933. Nevertheless, even under present salary scales—the cost of travel having been reduced but slightly, if at all—the cost of full-time milk control by trained personnel can hardly be less than 20 cents per capita per annum in cities of 10,000, and is increased in inverse proportion to the population in the smaller cities. As long as members of the Police and Fire Departments work long shifts for small salaries it is difficult to justify a demand for the payment of salaries such as full-time trained dairy-inspectors feel entitled to. The justification of comparatively large appropriations for full-time milk control is made still more difficult by the fact that an energetic inspector, after the initial campaign, would probably find that his necessary activities did not fully occupy his whole time.

With the intent, therefore, of learning what methods and practices are being followed, rather than of recommending procedure, this year's Committee has undertaken its assignment.

Data has been gathered by personal correspondence and from information directly available to committee members, because information obtained by generally circulated questionnaires is so frequently incomplete and sometimes misleading. Detailed information has been obtained concerning 64 communities of less than 10,000, in which milk control activities are being conducted. This does not constitute a sufficiently large sample of milk control activities to warrant generalizations from the data obtained; but these municipalities are situated in six states, from the Pacific Coast to the Appalachians, and from the Lakes to the Gulf, and certain facts stand out prominently.

In none of the communities from which data were obtained is a full-time inspector employed solely for milk control. Milk control personnel includes a public health nurse, a city engineer, a waterworks superintendent, several meat inspectors, numbers of sanitary officers of county health departments, and some health officers, in addition to a number of part-time inspectors, including practicing veterinarians. It is to be noted that wherever (among these 64 cities) milk control is not combined with other principal functions of city officials, or included among the activities of a health department, part-time personnel is employed.

It is not possible, on the basis of the meager data available, to arrive at any conclusions as to the relative effectiveness of (1) control activities conducted by municipal officials, (2) of health department personnel, and (3) of part-time personnel. The personal equation is probably the most important factor in such a question, although the nature of the primary function of officials to whom milk control is also delegated materially affects both the time and the interest devoted to the latter activity. The duties of health officers, for instance, are so numerous, so varied, and frequently of such an emergency nature, that a program of routine milk control procedure can not be maintained without frequent disruption, and most health officers would no doubt welcome an opportunity to delegate this activity to some member of their staffs. Generally speaking, appointment of a practicing veterinarian as part-time dairy and milk inspector does not result in completely impersonal milk control, although this generality must also be qualified by consideration of the personal equation. The choice between part-time inspection by a practicing veterinarian and a total lack of inspection, usually results in acceptance of the former, in the hope of subsequent rectification. Your Committee favors the employment of veterinarians as full-time dairy inspectors, but disapproves their appointment as part-time inspectors.

In several of the states in the East, groups of small neighboring communities have combined and cooperated in the employment of milk control officials and the establishment of laboratory service. This appears to be the most logical solution of the problem, particularly when the communities are so close together that certain of the milk supplies are common to two or more of the communities. The most frequently encountered practical difficulty faced in such arrangements is their possible disruption by changes in the political complexion of municipal administrations. For details concerning such amalgamations of milk control activities in New York

State, see the Report of the New York State Department of Health, for 1932.

As has been reported at a previous meeting,* milk control in fourteen of the Alabama communities under 10,000 is largely supported by meat-inspection fees, the meat inspector, always a graduate veterinarian, also being dairy inspector, and in every case being subject to the direction of the health officer. In one county five communities, by cooperation, obtain the services of one inspector. In other cases, cities separated by as much as 25 miles, and in adjoining counties, employ the same inspector, who serves them on alternate days.

The costs of these meat and dairy inspection services, over and above meat inspection receipts, are borne by the municipalities, or partially absorbed by the health department. In two communities, 25 miles apart, served by the same inspector, the meat inspection revenues produced balances between $115 and $165 in each city during the past year, after paying the inspector's salary and expenses, janitor services at the slaughter-house, and the expressage on milk-sample shipments to the State Laboratory, fifty miles distant. In other cities and groups of cities the meat inspection revenues failed by $300 to $800 to meet the cost of the double service. It is quite significant that only two such full-time meat and dairy inspection services have been discontinued, and that in these cases the cities have simply discontinued paying a fixed salary, and have placed the service on a fee basis, for part-time service. This action, of course, has not increased the effectiveness of milk control.

A means of financing milk control activities which is sometimes suggested and discussed, but the practice of which appears to be of somewhat limited distribution, is the assessment of at least part of the cost of inspec-

* Coordinating Municipal Meat and Dairy Inspection in Alabama Communities, by H. J. Thrasher, Eighteenth Annual Report (1929) of the International Association of Dairy and Milk Inspectors.

tion and laboratory examinations upon the milk industry. This procedure is still a controversial subject in most sections of this country because of the principles involved. The existence of numbers of inconsistencies in the administration of inspection services by municipalities must be admitted. Except for the payment of flat-rate privilege licenses, groceries, restaurants, soda fountains, etc., are rarely required to pay directly for inspection services. On the contrary, meat inspection is usually financed by the collection of a fee for every carcass or part inspected. There is, therefore, precedent for both proponents and opponents of a direct tax or fee for dairy inspection.

The manner of levying such direct taxes, and their amounts, vary considerably among the few examples studied, and are also matters of controversy. Cost of transportation and time consumed are the principal variables in the cost of dairy inspection in any particular locality. Unless thorough examinations of the cows are routinely made, the numbers of cows being milked, or the total volume of milk being sold, are not significant factors in inspection cost, and do not constitute logical bases for fixing inspection taxes or fees. On the contrary, if any benefits accrue to the industry as a result of milk control—as control advocates universally claim—these benefits may properly be assumed to be proportional to the sizes of the individual businesses affected. It is obvious that it is administratively simpler to base tax levies upon the number of cows being milked, or the volume of milk sold, than upon the distance traveled by the inspector or the time spent in making inspections, and this is the practice most frequently followed.

Several California municipalities—under and over 10,000—levy an inspection tax upon each gallon of milk produced and sold. The assessments vary from 1/4 cent on production and 1/4 cent on distribution, to 1 cent on raw and ½ cent on pasteurized milk sold. In Oregon the tendency in taxation appears to be to base assessments upon the numbers of cows milked, the usual levy being about $1.00 per cow per year.

The difference in returns from these two types of levies is quite striking. Even at only ¼ cent per gallon tax, each cow of a producer would have to produce only 400 gallons annually to yield an equivalent of the $1.00 head tax on cows.

It is also rather obvious that the assessment against each gallon of milk sold in a community of 2500 must be quite excessive to yield, let us say, $100 per month for the financing of milk control. Market milk consumption in communities of this size is considerably below the average for all urban communities; but, assuming it to approximate 2/3 pint per capita per day, we might count upon a daily volume of sales of approximately 200 gallons. An assessment of 1 2/3 cents per gallon would be necessary to yield $100 per month. In larger communities a far smaller assessment would yield ample funds for inspection service.

In some communities the cost of laboratory examination of milk samples is paid by the producers or distributors, as the case may be.

To summarize:

1 This study, incomplete as it has been, has brought to light the fact that some communities have discontinued milk control activities or allowed them to lapse, but that a majority of the communities under 10,000 are still continuing milk control activities in spite of reduced revenues.

2 Employment of full-time personnel, solely for milk control, is rare. Inspection activity is usually made a function of personnel primarily engaged in some other service, or is made a function of the health department,

to be conducted as the health officer is able or sees fit.

3 Milk control is financed in various ways:

(a) by appropriation from the City Treasury,

(b) as an activity of the health department, with or without earmarked appropriation,

(c) by combination with meat inspection,

(d) by cooperation of two or more communities,

(e) by direct taxation of the dairy industry, or

(f) by a combination of any two or more of these methods.

4 No attempt has been made to determine average salaries paid inspectors, nor to draw any conclusions as general trends from the data gathered, because the sample is deemed to be too small.

REPORT OF COMMITTEE ON LABORATORY METHODS

George E. Bolling, *Chairman*

Your Committee desires to report a trial of the comparative merits of two media in plate counts of ice cream.

The media employed were nutrient agar as prescribed for plate counts of milk and the same agar with the addition of 1 per cent saccharose.

Eight members of the Committee reported upon their work which is summarized in the table; as all did not report results with different dilutions of samples, such figures are omitted.

At least, one previous investigator, using plain nutrient agar, found wide disparity in the counts based on different dilutions of the same sample, the higher dilutions showing no colonies when the results on lower dilutions would indicate several hundred to be expected. This was not confirmed by those of this Committee who reported results on different dilutions.

Most of the members felt that the use of saccharose agar yielded larger colonies and fewer pin-points and some reported better agreement between counts obtained on different dilutions of the same sample.

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.

SUMMARY OF RESULTS ON COMPARISON OF MEDIA IN PLATE COUNTS OF ICE CREAM

Laboratory	Collaborator	Number of Samples	Average of Plate Counts		Per cent Higher Count with Saccharose Agar	Percentage of Plates giving Higher Count	
			Standard Agar	Saccharose Agar		Standard Agar	Saccharose Agar
Albany	A. H. Robertson	10	61,370	87,970	43	—	100
Baltimore	J. H. Shrader	15	14,880	14,957	.5	47	53
Brockton	G. E. Bolling	30	109,422	145,448	33	44	56
Cleveland	H. O. Way	5	178,000	280,000	57	20	80
Hartford	F. L. Mickle	75	600,000	613,644	2	43	57
Jacksonville	H. N. Parker	19	113,571	172,105	52	42	58
Ottawa	C. K. Johns	50	307,123	395,216	28	22	78
Somerville	H. E. Bowman	24	81,629	121,850	49	29	71