ELEVENTH ANNUAL REPORT

OF THE

International Association of Dairy and Milk Inspectors

INCLUDING PAPERS READ AT THE ANNUAL CONVENTION IN ST. PAUL, MINN. OCTOBER 9 - 10 - 11, 1922

COMPILED BY
IVAN C. WELD, Secretary-Treasurer
1120 CONNECTICUT AVENUE
WASHINGTON, D. C.

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"One single idea may have greater weight than the labor of all the men, animals and engines for a century."

COMPILED BY
IVAN C. WELD, Secretary-Treasurer
1120 CONNECTICUT AVENUE
WASHINGTON, D. C.

Price Two Dollars

International Association of Dairy and Milk Inspectors

CONSTITUTION AND BY-LAWS

CONSTITUTION

ADOPTED OCTOBER 16, 1911

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

The membership of this Association shall be composed of men who now are or who have been actively engaged in dairy or milk inspection. Any person who now is or who has been so engaged may make application to the Secretary-Treasurer and if application is accepted by the Membership Committee, said applicant may become a member of the Association 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, who 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 at any Annual Meeting by a two-thirds vote of the entire membership of the Association. 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 of such proposed amendments. All members voting on such proposed amendments shall register their vote with the Secretary-Treasurer on blanks provided by the Association before the date of 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

*Adopted October 29, 1915.

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.

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Those who advertise with us are clearly in sympathy with the work of our Association. We are materially benefited by their patronage, and therefore our members and readers should correspond with them FIRST and mention this publication when in need of supplies.

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Second Vice-President, J. B. HOLLINGSWORTH
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Third Vice-President, J. E. EARNSHAW..Kansas City, Mo.
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Auditors:

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Loomis, Frank J.	Inspector of Milk and Meat	Watertown, N. Y.

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Phipps, W. H.	Supervisor of Production, Missouri Dairy Company	Kansas City, Mo.
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Price, Wm. H.	With Detroit Creamery Co.	Detroit, Mich.
Rasmussen, Fred	State Commissioner of Agriculture	Harrisburg, Pa.
Redfield, Harry W.	Food & Drug Laboratory, U. S. Dept. of Agriculture	New York, N. Y.
Roadhouse, C. L.	Professor of Dairy Industry, University of California	Davis, Cal.
Robinson, Herbert S.	Dairy Inspector, Health Department	Boston, Mass.
Robertson, Fred L.	Milk Inspector and Chemist, Health Dept.	Springfield, Mass.
Russell, Alfred M.	Agent, Board of Health and Inspector of Provisions	P. O. Box 56, W. Newton, Mass.

Schletty, Peter	Dairy & Milk Inspector, Dairy & Milk Department	361 O. Thoroughfare, St. Paul, Minn.
Schofield, Earl F.	Milk and Food Inspector	Greenwich, Conn.
Seaman, Carl O.	Milk Inspector	Manchester, N. H.
Sharwell, Samuel G.	Chief Dairy and Food Inspector	Newark, N. J.
Shoultz, W. A.	Director of Food Div., Board of Health	Manitoba, Canada
Shrader, J. H.	Director, Bureau of Chemistry & Food, Baltimore City Health Department	311 Courtland St. Baltimore, Md.
Smisek, M. J.	Milk and Dairy Inspector	St. Paul, Minn.
Smith, Clarence E.	Commissioner of Health	Greenville, S. C.
Smith, Russell S.	Market Milk Specialist, Dairy Div. U. S. Dept. of Agriculture	Washington, D. C.
Spoon, J. P.	Milk and Meat Inspector	Burlington, N. C.
States, M. V.	Milk Inspector	2804 Sixth St., Detroit, Mich.
Stahl, C. L.	Dairy Director of Virginia, State Dairy & Food Division	Richmond, Va.
Stevenson, A. F.	With The Borden Co., Mfg. Dept.	New York, N. Y.
Strauch, Thomas J.	Chief Dairy Inspector, Bureau of Health	Richmond, Va.
Strickland, F. N.	Executive Secretary, Chemist, Board of Food & Drug Commissioners	Providence, R. I.
Sunball, H. P.	Milk Inspector, Detroit Board of Health	Detroit, Mich.
Supplee, G. C.	Director of Research Laboratory, The Dry Milk Co.	Adams, N. Y.
Talbot, A. E.	Dairy Specialist	Kansas City, Mo.
Taylor, George B.	Bacteriologist, Chestnut Farms Dairy	Washington, D. C.
Thomson, James E.	Chief, of Div. of Milk Inspection, Dept. of Health	New York, N. Y.
Thompson, O. P.	State Dairy Inspector	Waterloo, Iowa
Tolland, Alex. R.	Dairy Inspector, Health Department	Boston, Mass.
Trickey, Chas.	Chief Dairy and Food Inspector	Highland Park, Mich.
Vance, Sarah H.	Director, Bureau of Foods, Drugs and Hotels, State Board of Health	Louisville, Ky.
Vener, Benjamin	With Tait Brothers	Springfield, Mass.
Wallis, Wm. H.	Milk Collector, City Annex	Somerville, Mass.
Walmsley, F. D.	Vice-President, Borden's Farm Products Co., Inc.	Chicago, Ill.
Ward, Henry A.	General Manager, Wellington City Council Milk Department	Wellington City, New Zealand

Ward, Willard E.	Agent, Board of Health For Milk and Food Inspection.	Brookline, Mass.
Warner, W. J.	State Milk Inspector	Andover, Conn.
Washburn, R. M.	Director of Laboratories, International Dry Milk Co.	Minneapolis, Minn.
Weaver, Geo. P.	City Milk Inspector	632 Ave D, Detroit, Mich.
Weld, Ivan C.	Investigator for Chestnut Farms Dairy	Washington, D. C.
Walsh, H. W.	Milk Inspector	5368 Seminole Ave. Detroit, Mich.
Whittaker, H. A.	Director, Div. of Sanitation, Minnesota Board of Health.	Minneapolis, Minn.
White, J. T.	Milk Inspector	1130 Seward Ave., Detroit, Mich.
Wines, E. H.	Dairy Inspector	105 Stevens Ave., Highland Park, Mich.
Wing, Chas. W.	City Veterinarian & Assistant Health Officer	Room 613, City Hall, Oakland, Cal.
Yates, J. W.	Farm Dairy Inspector	Kansas City, Mo.
Young, Dr. Hulbert.	Manager, Walker-Gordon Laboratory	Baltimore, Md.

HONORARY MEMBERS

Evans, Wm. A.	Editor, Health Dept., Chicago Tribune	Chicago, Ill.
Pearson, Raymond A.	Pres. Iowa State College	Ames, Iowa
Woodward, Wm. C.	American Medical Assn. Bureau Legal Medicine & Legislation	535 N. Dearborn St., Chicago, Ill.

Eleventh Annual Convention

HOTEL ST. PAUL

ST. PAUL, MINNESOTA

MONDAY, OCTOBER 9, 1922

FIRST SESSION

The Eleventh Annual Convention of the International Association of Dairy and Milk Inspectors was called to order by President H. E. Bowman, of Somerville, Mass., at 11 o'clock.

President Bowman introduced Honorable Chris Heen, State Dairy Commissioner of Minnesota, who welcomed the Association to the city of St. Paul and to the state of Minnesota. Mr. George E. Bolling, First Vice-President of the Association, responded to the address of welcome. In closing, Vice-President Bolling presented President Bowman, who delivered the presidential address.

The report of the Committee on Transportation and Marketing of Milk and Milk Products was received.

SECOND SESSION

The afternoon session was called to order by President Bowman at 2.15. Dr. H. A. Harding presented a paper on "The Effect of Steam on the Germ Life in Milk Cans."

Mr. C. E. Clement, Dairy Division, U. S. Department of Agriculture, read a paper, "The Relation of the Milk Inspector to the Milk Plant Manager."

Prof. C. L. Roadhouse, Chairman, reported for the Committee on Serving Milk in Schools. It was voted by the Association that the recommendations of the Committee on

Serving Milk in Schools be referred to the Executive Committee.

A paper prepared by Mr Ira V. Hiscock, "Administrative Standards for the Control of City Milk Supplies," in Mr. Hiscock's absence was read by Mr. Holt, of Connecticut.

Dr. Durgin, of the U. S. Department of Commerce, addressed the Association.

THIRD SESSION

The evening session of the convention was called to order by President Bowman at 8.15.

Dr. Julius Hortvet, Chief Chemist, Minnesota State Dairy and Food Commission, addressed the Association on the subject, "The Composition of Milk." Dr. Hortvet explained and illustrated the use of the cryoscope for determining the freezing point of milk.

Mr. Greene, secretary of the California Dairy Council, addressed the Association briefly.

Prof. H. E. Van Norman, President of the World's Dairy Congress and President of the National Dairy Association, addressed the convention on the subject of "The World's Dairy Congress."

TUESDAY, OCTOBER 10

FOURTH SESSION

On Tuesday morning, October 10, the convention was called to order by President Bowman at 10 o'clock. The first paper presented was by V. J. Ashbaugh and Dr. G. C. Supplee, of the Research Laboratory of the Dry Milk Company, Adams, N. Y., and had for its subject "Constructive Policies and Methods for Milk Improvement."

"The Efficiency of Milk Plant Machinery" was the subject of a paper contributed by Carl O. Seaman, of Manchester, N. H. In Mr. Seaman's absence the paper was presented by Mr. Hartnett, of Holyoke.

The report of the Committee on Pasteurization of Milk and Cream was presented by its chairman, Dr. William H. Price, of Detroit.

FIFTH SESSION

The afternoon session was called to order by President Bowman at 2 o'clock. Dr. J. A. Kiernan, Chief, Tuberculosis Eradication Division, U. S. Department of Agriculture, addressed the Association on "The Extent of Tuberculosis in Live Stock in the United States and Progress in Its Suppression."

Mr. Russell S. Smith, Market Milk Specialist, U. S. Department of Agriculture, Chairman, presented the report of the Committee on City Milk Contests.

The report of the Committee on Bovine Diseases—Their Relation to the Milk Supply and to the Public Health, was presented by Dr. G. H. Grapp, Chairman.

A paper entitled "Transportation and Handling of Milk" was presented by Dr. C. Bricault, of Haverhill, Mass.

In the absence of Dr. Hulbert Young, of Baltimore, the paper prepared by him on the subject, "The Fat Content of Mother's Milk," was read by Prof. J. A. Gamble.

Mr. C. H. Kilbourne, of New York, read a paper, "The Relation of Temperature to Cream Layer in Pasteurized Milk."

SIXTH SESSION

The evening session was called to order at 8.15 by President Bowman. Dr. F. D. Walmsley, Vice-President, Borden's Farm Products Co.. Chicago, read a paper on the subject, "Dairy Control."

Mr. C. A. Thomas, secretary to His Honor Mayor Nelson, of St. Paul, addressed the Association briefly.

Mr. A. Gordan Raymond, of the United Dairies, Ltd., London, England, addressed the Association.

President Bowman then introduced Mr. Ernest A. Evans, Member of the Royal Sanitary Institute, and Member of the Royal Institute of Public Health, London, England, who presented a paper.

The report of the Committee on Dairy Methods, by Prof. T. J. McInerney, Cornell University, Ithaca, N. Y., was read by Mr. Estes.

Wednesday, October 11

SEVENTH SESSION

The morning session was called to order by President Bowman at 10 o'clock. Dr. Fred Evans, of Sioux Falls, S. D., addressed the Association regarding bovine diseases.

Prof. C. L. Roadhouse, of Davis, Cal., read a paper on "The Structure and Equipment of Milk Plants."

A report was received from the Committee on Food Value of Milk and Milk Products and was presented by Mr. O. M. Camburn, Director, Division of Dairying and Animal Husbandry, Massachusetts State Department of Agriculture.

EIGHTH SESSION

The afternoon session was called to order by President Bowman at 2.15.

A paper on the subject, "Results of Further Investigations of Remade Milk and Milk Powder," prepared by Mr. O. L. Evenson, of the U. S. Bureau of Chemistry, in Mr. Evenson's absence was read by Mr. Howard Estes.

Dr. O. P. Thompson, of Waterloo, Iowa, read a paper describing market milk conditions in Iowa.

The report of the Committee on Bacterial Analysis of Milk and Milk Products was presented by its chairman, Mr. George E. Bolling, of Brockton.

Prof. W. P. B. Lockwood presented a report of the Committee on Marketing Milk and Milk Products.

A paper by Mr. Benjamin Vener, of Springfield, Mass.,

"Ice Cream and the Health Officer," in Mr. Vener's absence was read by Mr. Chilson, of Detroit.

The report of the Membership Committee, prepared by its chairman, Prof. James O. Jordan, of Boston, Mass., was received and read by the Secretary.

BUSINESS SESSION

At the business meeting of the Association, brief verbal reports were made by the President and Vice-Presidents. The auditors reported they had examined the accounts of the Secretary-Treasurer, which they had found to be correct. The report of the auditors was adopted, as was also the report of the Secretary-Treasurer.

The Association then proceeded to elect officers for the coming year, and the following were elected:

President, George E. Bolling, Brockton, Mass.

Frist Vice-President, J. B. Hollingsworth, Ottawa, Canada.

Second Vice-President, J. E. Earnshaw, Kansas City, Mo.

Third Vice-President, T. J. Strauch, Richmond, Va.

Secretary-Treasurer, Ivan C. Weld, Washington, D. C.

Auditors, Thomas Holt, Hartford, Conn,; Thomas F. Flanagan, Hartford, Conn.

Invitations for our next annual convention were received from various cities, organizations and officials and read for the information of the members.

The Committee on Resolutions reported, and the following resolutions were adopted:

1. WHEREAS, This Association has profited and been greatly benefited by the contributions to its program of men not included in its membership; be it

Resolved, That the International Association of Dairy and Milk Inspectors in annual convention assembled extends its appreciation and thanks to the following:

Dr. J. A. Kiernan,
Dr. Julius Hortvet,
Prof. H. E. Van Norman,
Mr. V. J. Ashbaugh,
Dr. William A. Durgin,
Mr. A. Gordan Raymond,
Mr. Ernest A. Evans.

2. WHEREAS, This Association has enjoyed the courtesies extended by the Minnesota State Dairy Commission; be it

Resolved, That the appreciation and thanks of the International Association of Dairy and Milk Inspectors be extended to the Honorable Chris Heen and members of his staff.

3. *Resolved,* That the appreciation and thanks of the International Association of Dairy and Milk Inspectors be extended to Prof. James O. Jordan, whose efforts as chairman of the Membership Committee during the past year resulted in the addition of 65 new members to the Association, thereby greatly extending its influence.

As no other business was presented for its consideration, the convention finally adjourned.

ADDRESS OF WELCOME

HONORABLE CHRIS HEEN, *State Dairy Commissioner of Minnesota.*

It is with a keen sense of appreciation of the honor that has been conferred upon me that I appear before you this morning to welcome to our capital city as well as to our state a body of men engaged in the highly important service that you, in your several capacities, are rendering the consumers of our land in the matter of protecting their health, in consistently and continuously endeavoring to bring the milk supply of your several communities under such reasonable control as will make it possible for you to say, as you would all like to say: "You can use of the milk supplied by the producers and distributors of this municipality without the slightest fear of any of it being otherwise than the best." I am wondering whether even you, yourselves, realize the great value to the consumer of the work that has been done by you and others engaged in similar activities in educating the producer to the necessity of care and cleanliness in his own operations as well as the certainty that his herds are free from communicable diseases.

It must seem to the most of you as it does to the speaker that it has been but a comparatively short time since there came that understanding of the necessity for these conditions to the mind of even the discriminating consumer. In the old days milk was just milk, there apparently not being much inclination on the part of either the producer or consumer to discriminate so long as too much sediment —whatever that may mean—was not present in the bottom of the container. But what a change has come over our people! The demand for clean milk has greatly increased. Material progress has been made, as we all realize, thanks

to faithful work on your part, and with a continuance of such service we hope, we know, that the time is rapidly approaching when the consumer will take into account the bacterial condition as well as the location of the "cream line" in their daily milk supply.

But it is not for me to take up a discussion of matters that will have your thoughtful consideration while in session here with us. One has but to take a casual glance at your program to realize that it is replete with papers and addresses that cannot fail to be educational and constructive; that the days of your stay with us will be full of good thoughts and experiences that you can and will carry home with you and which will make your work increasingly useful to your people.

I know, too, that it is not at all necessary for me to attempt to emphasize the importance of the position that Minnesota occupies in the dairy world. The volume of creamery butter produced here as well as the quality of it, alone has put Minnesota in the forefront. However, I feel that I may say, and without any seeming immodesty, that we have also been usefully active in the work in which you gentlemen are engaged, and I know that this meeting here in our midst can be of no greater benefit to any of you than to those of our force who are engaged in this work and who will mingle with you during your deliberations. Perhaps this is a selfish attitude on our part, but we should all get all we can out of these meetings, then put that information into active and valuable use in the days and months to follow.

Until within comparatively recent years, very little thought or attention was given to the great importance and necessity of milk in the human diet. But thanks to all the agencies now enlisted in what are known as "Milk Campaigns," a keener and more general interest is now manifest in milk as a food, actually as a food, just simply acknowledging the existence of one of nature's laws, inas-

much as the earthly existence of each and all of us began with milk as the only food; and as we who have suffered life's physical ills began to return to physical normalcy, the first and only food the good doctor or nurse would allow was milk—and then a little more milk. Should we not have learned from experience that it is the greatest and most valuable food of all, and learned a long time ago to safeguard its source as well as its distribution.

Laws have been enacted and agencies have been established for the enforcement of laws, the purpose of which is to prevent, if possible, the adulteration of some relatively unimportant food products. Now, since our lawmakers have come to recognize the importance of the best food available to mankind, it is up to you and to me and to others charged with supervision of distribution as well as production of milk and milk products to do our very best to fill the niche in which we have been placed; to carry on the work with which we have been charged in such a manner and with such earnestness and enthusiasm as will make it possible that the humblest of our citizen consumers, the poorest child of the poorest parent, may not only know the value of, but be supplied with, enough of this most highly necessary of all foods for mankind.

In conclusion, permit me to say that if it were possible for me to have the last word, rather than the first to be uttered at these sessions, I should feel impelled to say: Let's all return to our several homes and to our respective duties more than ever convinced of the importance of securing an abundant supply of clean, healthful milk—milk that has been produced and handled under such circumstances and conditions as one would wish surrounding the production and distribution of the most important and the most delicate of all food products.

"Progress is promoted by the exchange of knowledge."

RESPONSE TO ADDRESS OF WELCOME

VICE-PRESIDENT GEO. E. BOLLING,
Brockton, Mass.

After hearing Mr. Heen's words of cordial welcome to St. Paul and to Minnesota, any of us far Easterners who may have entertained misgivings as to the advisability of venturing so far in the West, farther than ever before, are reassured. All of us, Easterners, mid-Westerners and Westerners, appreciate his welcome and are glad to attend a convention held coincidently as to time and place with the National Dairy Show.

To paraphrase Kipling a bit, there is neither East nor West when milk and dairy inspectors meet in convention, as we do here. One man's problems are those of the fellow in the next chair, though their respective homes may be thousands of miles apart; an interchange of experiences and ideas cannot help being mutually beneficial. The inspiration of meeting in a state where the dairy interests are so extensive as in Minnesota, and with the National Dairy Show, is very great. Producers and inspectors are, I believe, getting to have the same end in view, the marketing of clean and safe milk, and as the problems are studied by all parties there will be a better mutual understanding and appreciation of each other's viewpoint.

Without cow's milk, one-half of the babies born in the United States would not live six months, which fact means much to both producer and inspector. Our aim is to give these infants, as well as adults, a safe milk and to incidentally help the producer sell more of such milk has received the stamp of our approval.

This convention is sure to be of benefit to us all, and on behalf of the Association I thank Mr. Heen for his words of welcome and assure him they are deeply appreciated.

"I care not what position a man may be in, you can measure his usefulness to humanity by the service he renders the community in which he resides."

PRESIDENTIAL ADDRESS

H. E. BOWMAN, Somerville, Mass.

For the eleventh consecutive year the members of the International Association of Dairy and Milk Inspectors are gathered to discuss important subjects pertaining to what has become the science of milk inspection.

The object of our being, as set forth by the constitution, is primarily to develop uniform and efficient methods of dairy and milk inspection, and to place the same in the hands of competent officials.

Uniformity of laws and regulations is much to be desired, but competence in the administration of the laws governing this branch of public health work is second in importance to no other phase of this subject.

Courtesy, with a full understanding of the pitfalls which beset the producer, the common carrier, the milk plant operator and the distributor, means success for the official whose duty it is to maintain a constant supply of wholesome, safe, pure milk. Personally I plead guilty to the charge of being a crank on the subject of safety.

On the subject of legislation and regulation I wish to urge at this time that *simplicity* be the key note of all who formulate new regulations, to the end that two or more men may enforce the same regulation in the same manner and with similar results. Much confusion has resulted from a multiplicity of complicated laws and regulations in the past, and it should be the business of organizations such as our own to see that score cards and regulatory measures are so worded that a condition either exists or does not exist, thereby enabling many men to work and obtain similar results with similar regulations.

There is one subject in this connection I feel is worthy of much more consideration than is given it. Last year in one of the papers, the point was brought to your atten-

tion without exciting much comment. In Massachusetts we have a section of our general laws which provides that a license may be issued to a milk dealer if he is a *suitable person.* This matter I believe merits the consideration of all who are entrusted with the licensing of milk dealers.

Certainly the time has passed when *anyone* may engage in a business requiring the utmost attention to detail, and which demands a thorough knowledge of sanitary methods. Furthermore, men who consider the inspector a pest and who do not consider ordinary cleanliness either of person or premises an asset and a necessity, should not be included in the class of suitable persons.

The advent of the process of pasteurization, with the attendant pipes, pumps, and other apparatus, makes it imperative that a place be given on milk plant score cards to this apparatus, with adequate points for its proper installation, not forgetting the important positive temperature control both for the pasteurizer and the cooler.

The importance of our work should never be underestimated. Familiarity often breeds contempt, and if one performs too much routine or travels too long in a rut, he is apt to lose sight of the object to be obtained, and our work becomes commonplace.

On the other hand, the inspector who takes pride in his work, tries out new methods and attends meetings such as these, will be stimulated to help in solving the problems with which each of us is sure to be confronted from time to time. Then work will cease to be routine and commonplace, and the result will be something of lasting good. Milk and dairy inspectors throughout the whole country are benefited particularly when we are able to "broadcast" the accomplishment of our Association by means of our published reports.

Thanks to the untiring efforts of one of our past presidents, the membership of our Association has increased to a greater extent than in any year previous. Prof. James O. Jordan has, with his characteristic energy, steered to a suc-

cessful ending the activities of the Membership Committee for 1922 and I am proud to state that 65 new members have been added to the roll during this period, making our membership a total of 165, of whom three are honorary members. A successful organization requires funds and new blood, and due to the activities of Professor Jordan and his committee we have both.

Last year in New York City I was impressed with the constant attendance and unfailing interest displayed at each session of our convention. From the opening until the closing the attendance was remarkable. The same faces were noticed and new faces appeared at each session, despite the fact that one of the largest and strongest associations in this country, interested in health subjects, was holding its meetings in the same city and at the same time. This is as it should be, and I wish to urge the continuance of this practice, that your officers may feel sure of your continued support and that all may be benefited by the program prepared. The surest antidote for radicalism is the interchange of ideas, a tolerance for the other fellow's opinion; and no matter how sure you may be that your methods are best, one is certain to carry added information and a more workable program back to his home town after a convention of our Association.

I purposely make this address short. Our program is very complete and interesting, and I cannot enlarge upon the various topics of interest without perhaps encroaching upon the subject matter of the papers to come. I do, however, wish to thank you for the honor of serving you as your presiding officer for this year. By constant attendance and by taking an active part in each session, you will do much to further the interests of this association and the officers will feel well repaid for the preparation of the program which is to follow.

"Acquire not only learning but the habit of learning."

REPORT OF COMMITTEE ON BOVINE DISEASES THEIR RELATION TO THE MILK SUPPLY AND TO THE PUBLIC HEALTH

DR. G. H. GRAPP, *Chairman*

The study and investigation of bovine tuberculosis as a public health question was stimulated by the activity of those who questioned the statements of the late Dr. Robert Koch that the danger to man from bovine tuberculosis was negligible. Observations made since that time have established more firmly than ever that the transmission of the bovine type of tuberculosis to man is not uncommon and that at least ten per cent (Park) of the deaths from tuberculosis in children under five years of age are the result of infection of bovine origin.

The guarding of public health against such sources of infection becomes a public duty and justifies this association and its members in using every honorable means in order that there may be a more general recognition of this question from a public health standpoint.

Too frequently do we hear of representatives of health departments and members of the medical profession making statements that the danger of transmission of bovine tuberculosis to the human family is negligible, and more or less indifference to this problem on the part of some of the public health officials is still noticeable.

As the source of bovine infection to the human family is largely confined to the milk, milk products and meats, a supervision of the production, handling and distribution of these products constitutes an important public health service, and no organized effort or campaign for the control and suppression of human tuberculosis is logical that does not include measures to control bovine tuberculosis. Large sums of money are expended annually to care for individuals with

tuberculosis and larger sums will have to be appropriated for many years to come unless measures are adopted to prevent the infection of new individuals. Certain scientists, health service organizations and dealers in milk and milk products attempt to solve the problem by pasteurization. If pasteurization under rigid regulatory inspection forces could be universally applied, no doubt it would be effective. But it is impossible to obtain that kind of pasteurization except in a few of the larger cities where the inspection service is rigid and complete. The larger percentage of our population living on farms and in the smaller communities continues to use raw milk and milk products.

Proper pasteurization has not, nor is it likely to become general, nor will it solve the control and elimination of the bovine source of infection to the human family.

The members of this Association should interest themselves in educational campaigns explaining the relation of animal tuberculosis to the public health. Even if it is not our duty primarily to do educational work pertaining to public health, we should be in a position to furnish health authorities with such information as will assist and stimulate them to reach the public through educational institutions, the public press, medical colleges, bulletins and other channels. For these reasons and with the above object in view, your committee submits a résumé of certain literature on the transmissibility of bovine tuberculosis to the human family.

RÉSUMÉ OF LITERATURE ON THE TRANSMISSIBILITY OF BOVINE TUBERCULOSIS TO THE HUMAN FAMILY

1. Park and Krumweide.

These investigators examined 487 cases of tuberculosis to determine the type of bacillus and recorded 1,033 cases found in the literature, making a total of 1,520 cases. Nine hundred and fifty-five were adults over 16 years of age, 177 were children from 5 to 16 years of age, and 368 were children under 5 years. The bovine type of the bacillus was

found present in 35 per cent of the children from 5 to 16 years of age, and in 26 per cent under 5 years. Both the human and bovine types were found in 11 additional cases examined. Examinations made at a foundling asylum on nine cases in children under six years of age, who were fed on cow's milk, showed five, or over 50 per cent, to be infected with the bovine type. The bovine type was found to be present in 12.5 per cent of the fatal cases of tuberculosis in children under 5 years of age in New York City.

2. In a later article, as a result of studies of 1,042 cases, Dr. W. H. Park's conclusions are:

"As the result of a large series of cases reported by ourselves and others, it has been shown:

"(1) That children are especially infected and the point of entry is the alimentary tract.

"(2) That cervical adenitis and abdominal tuberculosis are the most frequent types of infection.

"(3) That generalized tuberculosis due to bovine tuberculosis is less frequent.

"(4) That bone and joint tuberculosis is most commonly of the human type.

"(5) That the meninges are less commonly affected by the bovine than by the human type.

"(6) That the infection of adults by bovine bacilli is very frequent.

"(7) That pulmonary tuberculosis due to bacilli of the bovine type is rare."

Park concludes as follows:

"A careful study of all the factors leads us to estimate that about 10 per cent of all deaths caused by tuberculosis in children under five years of age is due to bovine infection when the milk is not pasteurized."

3. Dr. A. Phillip Mitchell, of Edinburgh.

Reports examination of 72 cases of cervical gland tuberculosis in the Children's Hospital in Edinburgh, and found tubercle bacilli of the bovine type in 65 cases, or 90 per cent.

(Cattle in the vicinity of Edinburgh are very highly infected with tuberculosis.)

4. British Royal Commission.

This commission announced in 1911, the following:

"There can be no doubt that a considerable portion of tuberculosis affecting children is of the bovine type, most particularly that which affects primarily the abdominal organs and the cervical glands." Of 108 cases of tuberculosis examined by this commission, the bovine type was present in 24, or 22 per cent, of the cases.

5. British Royal Commission. Second Interim Report.

Conclusion. "We may briefly sum up the bearings of the result at which we have already arrived, as follows:

"There can be no doubt but that in a certain number of cases the tuberculosis occurring in the human subject, especially in children, is the direct result of the introduction of the bacillus of bovine tuberculosis into the human body; and there also can be no doubt that in the majority at least of these cases the bacillus is introduced through cows' milk containing bovine tubercle bacilli, is clearly a cause of tuberculosis and of fatal tuberculosis in man.

"Of the sixty cases of human tuberculosis investigated by us, 14 of the viruses belonged to Group 1, that is to say, contained the bovine bacillus. If instead of taking all these sixty cases, we confine ourselves to cases of tuberculosis in which the bacilli were apparently introduced into the body by way of the alimentary canal, the proportion of Group 1 becomes very much larger. Of the total sixty cases investigated by us, 28 possessed clinical histories indicating that in them the bacillus was introduced through the alimentary canal. Of these, 13 belong to Group 1. Of the nine cases in which the cervical glands were studied by us, three, and of the 19 cases in which the lesions of abdominal tuberculosis were studied by us, ten, belong to Group 1.

"These facts indicate that a very large proportion of

tuberculosis contracted by ingestion is due to tubercle bacilli of bovine source. A very considerable amount of disease and loss of life, especially among the young, must be attributed to the consumption of cows' milk containing tubercle bacilli. The presence of tubercle bacilli in cows' milk can be detected, though with some difficulty, if the proper means be adopted, and such milk ought never to be used as food. There is far less difficulty in recognizing clinically that a cow is distinctly suffering from tuberculosis, in which case she may be yielding tuberculous milk. The milk coming from such cow ought not to form part of human food, and, indeed, ought not to be used as food at all. Our results clearly point to the necessity of measures more stringent than those at present enforced being taken to prevent the sale or the consumption of such milk."

6. British Royal Commission. Excerpt from Third Interim Report.

"Tuberculosis involving the udder is comparatively common in cows, and in such cases their milk always contains tubercle bacilli and is, therefore, dangerous for human beings consuming it. It was, however, undecided what is the danger, if any, attaching to the milk of tuberculous cows in which the udder presents no evidence of the disease. We, therefore, took the opportunity of making a number of observations and experiments bearing on this point.

"The experiments were made with the milk of cows which had contracted the disease in the natural way. In natural tuberculosis in the cow, cases which show such obvious symptoms of the disease as emaciation and cough should be considered separately from the cases in which there are no such signs and in which the disease is to be recognized during life only by means of the injection of tuberculin. None of the cows investigated showed any signs of disease of the udder during life, and in all, after slaughtering, the udder was carefully examined for tuberculous lesions and tubercle

bacilli. No tuberculosis was found except in one cow in which one quarter of the udder showed four small nodules. These could not possibly have been detected during life.

"We found that the milk of the cows obviously suffering from tuberculosis (see appendix; cows B., C., and F.) contained tubercle bacilli whether the milk was obtained in the ordinary way or was withdrawn from the teat by means of a sterilized cathetor. The presence of tubercle bacilli in the milk of cows clinically recognizable as tuberculous confirms the opinion we expressed in our Second Interim Report that the milk of such cows must be considered dangerous for human beings.

"The experiments which we have carried out with regard to the infectivity of the feces of tuberculous cows were dictated by knowledge of the fact that dirt of various kinds from cows and the cow-sheds is almost constantly present in milk as it reaches the consumer. Cows suffering from extensive tuberculosis of the lungs must discharge considerable numbers of bacilli from the air passages in the act of coughing and some of the bacilli thus expelled may find their way into the milk. But our experiments indicate that the excrement of cows obviously suffering from tuberculosis of the lungs or alimentary canal must be regarded as much more dangerous than the matter discharged from the mouth or nostrils. We have found that even in the case of cows with slight tuberculous lesions, tubercle bacilli in small numbers are discharged in the feces, while as regards cows clinically tuberculous, our experiments show that the feces contain large numbers of living and virulent tubercle bacilli."

7. Eastwood and Griffith, of Great Britain.

In 261 cases of bone and joint disease examined by these men, they report tubercle bacilli of the bovine type in 55, or 21.1 per cent of the cases. The percentage of bovine cases was as follows: all ages, 21.1 per cent; under 10 years, 29 per cent; and over 10 years, 9.4 per cent. The material in all these cases was removed from an infected bone or joint

or from an abscess in the neighborhood of such a lesion. The cases were taken without restriction of age, locality, or other circumstances.

8. Dr. Frazier, of Edinburgh.

Of 70 cases of bone and joint tuberculosis examined, 50 or 60 per cent showed the bovine type of the tubercle bacillus. He reports that in the greater number of cases the history indicated that the infection was due to cow's milk.

9. Dr. Richard E. Smith, Massachusetts Anti-Tuberculosis League, Boston, Mass.

"In general, tuberculosis of bovine origin represents about 25 per cent of all cases of tuberculosis in children under five years of age. In certain types of the disease it is very much more. It is estimated that in New York City, between six and ten per cent of the children that die in the hospitals each year of tuberculosis die of bovine tuberculosis.

"The percentage of cases of bone tuberculosis which are due to bovine infection varies very markedly according to the age of the patient. Taking a series of cases, in 67 cases that were investigated, 70 per cent were of bovine origin, and at least 78 per cent under four years, so that beginning with all the cases at one year, going up to the children at 12 years of age, it ranges from 100 to 60 per cent. Taking 72 consecutive cases of gland tuberculosis which were operated on, 90 per cent were due to the bovine organism. Of these 72 cases, 36 were under five years of age, and all but three of the 36 were of bovine origin.

"The real hope of eliminating bovine tuberculosis rests in prevention, not in treatment, and it ought to be possible to entirely eliminate bovine tuberculosis. It comes almost exclusively from milk and its products, from milk and cream and butter, ice cream and cheese. The percentage of bovine active, virulent tubercle bacilli in market butter is quite large."

10. Dr. Delphine.

"Taking all evidence into consideration, it is possible to say without fear of exaggeration that not less than 25 per

cent of the children under five years of age which are suffering from tuberculosis were infected primarily by the bovine type of the tubercle bacillus. This rate is much lower than one based on probabilities would be."

11. Ching Yik Wang, Edinburgh.

"The material for this study was obtained from the Royal Hospital for sick children and the Royal Infirmary, Edinburgh, and consisted of post mortem material from twenty children, ranging from one to fifteen years of age. When the investigations of previous workers are included, the bacteriological examinations of 281 cases of various clinical forms of tuberculosis in Edinburgh resulted in the isolation of the bovine tubercle bacilli in 78.4 per cent of cases under the age of five years; in 70.3 per cent between five and sixteen; and in 7.8 per cent over the age of sixteen years. Abdominal tuberculosis and tubercular meningitis are together responsible for about 90 per cent of the summed mortality from tuberculosis in children under one year, and about 75 per cent in children between one and five years. The material from nine children dead from these two diseases were examined bacteriologically, and from six the bovine type of tubercle bacillus was isolated.

"From the prophylactic point of view, any measure resorted to in combating the disease should be directed not only aginst the human spread of infection, but also, and more particularly in the case of children, against the bovine source of infection. It should be stated that the material used in the investigations was from children of the poorer classes. The results, therefore, should not be held strictly applicable to the community in general or as representing the conditions prevailing in other localities where the environment may be widely different."

13. Special Milk Board, Massachusetts State Board of Health.

It is agreed upon by all leading authorities that at least from 5 to 7 per cent of all tuberculosis in human beings is

definitely and directly of bovine origin, and the possibility of the true percentage being still higher cannot be denied."

14. N. Novick.

"It was thought worth while to ascertain, having material at hand, whether the percentage of incidence of bovine infection in tuberculous meningitis is appreciable, greater perhaps than is commonly accepted; whether the bovine type of virus has a special predilection for the meninges.

"Park and Krumweide, in their study of bovine and human infection of tuberculosis in man, a study which included about one thousand cases of all forms of tuberculosis, found fifteen per cent of bovine infection in tuberculous meningitis. Rosenau, analyzing 1,040 cases, including those studied by Park and Krumweide, by the English and German Commission, and some cases collected from literature, came to the following figures:

16 years and over . . .	686 cases	9 bovine	1.3 per cent
Between 5 and 16 years .	132 cases	33 bovine	25.0 per cent
Under 5 years	120 cases	59 bovine	49.0 per cent

"Rosenau states that 'almost half the number of cases tabulated above were studied by the research laboratory and were unselected.' This is important to note. The striking feature of these figures is the alarming percentage of bovine infection in children under 5 years (49 per cent). In adults the percentage is very small—almost insignificant. Undoubtedly, it is due to milk entering as the chief element in the diet of children and serving as the probable path of transmission of tubercular disease, and the fact that the bovine bacilli are much more virulent in the young."

15. Edward R. Baldwin and Leroy U. Gardner, in an article, "Reinfection in Tuberculosis, Experimental Arrested Tuberculosis and Subsequent Infections," state:

"To sum up our study of this problem, we believe that the lesson to be learned and applied is that, hand in hand with efforts to safeguard the young from infection, more atten-

tion should be paid to safeguarding both young and old from disease. Without stricter dairy hygiene, the supply of dangerously infected young people will be kept up; without earlier diagnosis, education, and favorable conditions of life for the prospective victims, clinical tuberculosis will continue at an irreducible minimum."

16. Allen K. Krause, in an article, "The Prevention of Tuberculosis, based on the Relation of Childhood Infection to Tuberculosis in Adult Life," states:

"Yet, that childhood infections are prolific breeders of adult tuberculosis, cannot be denied. Anyone who comes in contact with many adult consumptives needs no better evidence of this fact than good and thorough histories, which he has pieced together after adroit cross-examination of his patients. Scores of these will satisify every requirement laid down by the most uncompromising proponent of the puerile genesis of adult disease, and physical examination as it brings to light anatomic evidence of hidden, always silent and never suspected residua, will not infrequently clinch post history."

17. A. Stanley Griffith.

Reports 1,068 cases of tuberculosis of all ages in the human family in which 20.7 per cent were of bovine origin. 37.55 per cent in children under 5 years of age; 29.45 per cent in children from 5 to 10 years; 14.66 per cent in children from 10 to 16 years; and 6.25 per cent of cases 16 years and upward were of bovine origin.

18. Dr. W. A. Evans, Chicago, in a paper entitled "Why Health Departments are Interested in the Eradication of Bovine Tuberculosis," read before the tuberculosis eradication conference, Chicago, Ill., November, 1921, states:

"There were 1,096,436 deaths from all causes in the registration area in 1919. Of these, the total number of deaths from all tuberculosis was 106,985, and the total number of deaths of children under five from all tuberculosis was

5,830. The estimate of Park is that in 1919, 583 children under five years of age died of tuberculosis due to bovine tubercle bacilli in the registration area. This is an estimate only of deaths due to tuberculosis in children under five.

"The theory of Von Bering as to the cause of tuberculosis in adults is now decidedly in the ascendant. It is that much, if not most of the clinical tuberculosis of adult life is the result of infection which has lain dormant for more than a decade, is developed into a clinical disease by some period of stress. This theory magnified the importance of infection in childhood, and incidently of infections with bovine bacilli. There have been no adequate studies to determine the possibility that a bovine bacillus infection in childhood may result in the excretion of bacilli conforming to the human type in adult life. In fact, the typing of bacilli excreted by adults having tuberculosis has been wholly inadequate."

19. "The bovine bacillus is responsible for tuberculosis in children. Every case of tuberculosis in the human subject due to bovine bacilli must be charged to intimate contact, in most cases through the ingestion of contaminated dairy products produced by tuberculous cattle."

20. Fishberg says:

"While it is difficult to say how much tuberculosis is of bovine origin and how much of human origin, yet pathologists who have studied the question carefully now agree that about eleven-twelfths of all tuberculosis in man is caused by human bacilli and about one-twelfth by bovine bacilli; and that bovine infection as it occurs, predominates in childhood, while human infection, although accountable for a large percentage of disease during childhood, is accountable for nearly all disease of adult life. In this connection the following table from the Imperial German Board of Health is interesting. It presents an analysis of 1,400 investigated cases.

	Total Number Investigated Cases	Type		Percentage of All Cases Due to Bovine Type	
		Human	Bovine	In Adults	In Children
Tuberculosis of the lungs..	811	807	5	0.66	0
Tuberculosis of the bones and joints	99	95	5	0.66	4.3
Meningeal tuberculosis	33	30	3	0	10.34
Generalized tuberculosis ..	178	147	33	2.5	23.18
Tuberculosis of the cervical glands	167	120	47	5.8	40.7
Tuberculosis of the mesenteric glands	112	78	35	12.10	51.0
Totals.....	1,400	1,277	128		

"The studies of Eastwood and Griffith are very interesting in that they have made a special study of the type of infection in bone and joint tuberculosis. Basing their classification upon cultural characteristics and the virulence of the bacilli as shown upon rabbits, they examined a total of 261 cases and found the human type of bacilli in 196, bovine in 55, and a bacillus which they were unable to classify in 10 cases.

"I desire to emphasize in this connection, the fact that the bovine type of bacillus disappears very rapidly from clinical tuberculosis after the tenth year, indicating that the bovine bacillus produces infection only during early child life; or that it probably changes its characteristics with growth upon human soil for many years, and assumes the characteristics of the human bacillus. We must recognize the fact that our methods of determining the difference between bovine and human infection are not absolutely reliable; yet we cannot help noting that the results obtained by different observers agree fairly well. It is also suggestive that all find little bovine infection in adult life.

"These same writers have made a study of the types of bacilli occurring in the genito-urinary tract and I will quote their summary: 'Seventeen cases were examined, the disease affecting the genital organs in nine instances (seven testicles, one salpinx, one prostate) and the urinary tract in eight. The bacilli obtained were of "human" type in fourteen cases and "bovine" type in three. The three "bovine" cases were

affections of the kidney in persons aged, respectively, 25, 19 and 20 years.'

"Griffith further reports an analysis of results obtained from the investigations of sputum of 212 patients suffering from pulmonary tuberculosis in England and Scotland, with the following results: isolated the standard human type of bacilli in 205; the standard bovine type in 3; and an atypical human type in 4 of the cases. In discussing this question, Griffith says: 'In this country therefore, pulmonary tuberculosis which has arrived at the ulcerative stage is but very rarely referable to tubercle bacilli of bovine type.' While such apportionment of bovine and human infection in man seems to be fairly well accepted, yet it comes in conflict with other pathological ideas which seem to be fairly established. We are taught today that clinical tuberculosis in adult life is largely an extension from an infection which takes place in early child life (Romer). If this is true, and our knowledge of the disease supports the theory, what is there to hinder this metastatic infection in later life from being of either bovine or human origin; and, according to the data quoted above, why is not adult tuberculosis more largely of bovine type, unless mutation of type takes place? Children unquestionably take in both types of bacilli and are infected by same; and as yet we do not know that the resulting infections differ to any great extent, or even at all, in their subsequent pathological change or clinical course."

21. Dr. Louis Cabbett, Lecturer in Pathology at Cambridge University.

"These remarks introduce the question whether the bovine type of tuberculosis is more or less virulent for man than the human type. At first sight it might seem, from the fact that the bovine bacillus is only found in a small proportion of fatal cases of human tuberculosis—cases confined, moreover, to very young children whose susceptibility might be supposed to be greatest—that the bovine type of bacillus is for man of considerably lower virulence than the human.

But is this really the case? A. S. Griffith thinks that it is not. It might be suggested that if comparative inoculations were made, the bovine type would prove a little more virulent for the human being, as for the monkey or the guinea pig. It has been pointed out that it is easier to infect by the aerial route than by the alimentary route; that the human type of tubercle bacilli has a practical monoply of this easier route, while the bovine type has no chance of infecting except by the more difficult route of the alimentary canal; consequently the bovine type succeeds, as a rule, only in young children, when susceptibility is high and milk, the chief carrier of bovine bacilli, is taken in large quantities.. I think this line of argument is worthy of serious consideration.

"The fact that bovine tubercle bacilli are so frequent in mesenteric glands and are so rare in the lungs is in opposition to Calmett's view that pulmonary tuberculosis is commonly caused by tubercle bacilli absorbed through the intestinal mucous membrane, and carried by the ducts and veins to the right side of the heart, and so to the lungs. If this were the common channel of infection, we should expect to find the same proportion of bovine infections in pulmonary as in abdominal tuberculosis. Lastly, the fact that bovine tubercle bacilli have frequently been found in abdominal cervical tuberculosis (that is, in cases arising from infection through some part of the alimentary canal) and seldom in the lungs, is easily explained on the ground that human tubercle bacilli alone are sprayed into the air, therefore alone have a chance of entering the lungs directly, while bovine tubercle bacilli, being limited to food substances, can only infect man through the alimentary canal. The inhalation theory of the origin of pulmonary tuberculosis thus receives strong support.

"In cases of lupus, it is, at first sight, surprising to find so high a proportion of bovine infection as 50 per cent. Lupus usually arises on the face and to a lesser extent, on the buttocks, to which the tubercle bacilli

may be considered to have access after passing through the alimentary canal. It may therefore be considered that usually, when it is not secondary to ulceration of a caseous gland, it is caused by direct application of tubercle bacilli to the skin. Now, bovine bacilli in milk and tubercle bacilli of human type which, whether dry or moist, get into the air from consumptive patients, have, probably, about an equal chance of getting to the skin of the face in numbers sufficient to cause infection. Hence it is that the proportion of infection with one type of mammalian tubercle bacillus is about equal to that of the other. The percentage of total mortality from all kinds of tuberculosis caused by the bovine tubercle bacillus in England and Wales in the year 1919 was 6.5, and therefore was to infection coming from the cow, and probably in the immense majority of cases through milk."

In conclusion I desire to express my appreciation to Dr. C. E. Cotton, of St. Paul, Minn., for his assistance in the preparation of this report.

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"Knowledge is not power until it is used to do something."

REPORT OF COMMITTEE ON TRANSPORTATION OF MILK AND MILK PRODUCTS

DR. C. W. EDDY, *Chairman.*

This report should be considered as a supplement to previous reports of similar committees, some of which cover the subject quite fully.

No evidence is at hand that would indicate that milk products other than fluid market milk and cream are handled in an objectionable manner. This seems to be due to the fact that such strict supervision of fluid milk is required on the part of food authorities that transportation of other dairy products is largely overlooked. It is the belief of your chairman that the transportation of cream intended for churning deserves the attention of future committees on transportation. What effect upon public health this lack of care may have would be difficult to determine, but the commercial losses from this neglect must be enormous.

Transportation by means of trucks is rapidly increasing in every section, made possible by the rapid construction of hard surfaced roads. In the territory under the observation of the chairman, on January 1, 1921, fifty per cent of the milk was brought into the city by trucks. Today, September 28, 1922, sixty-seven per cent of the milk comes to the city by trucks.

Refrigeration is impracticable in this method of transportation, which necessitates greater care upon the part of the producer and distributor. Truck transportation will eventually become the almost universal method wherever trucks can be used. The plan has much to commend it commercially, as it transports the milk directly from the producer or gathering station to the premises of the distributor.

Transportation by means of glass-lined tank trucks,

trailers or railroad tanks has increased somewhat. It is limited in the case of trucks and trailers by road laws limiting weights. This is a satisfactory and sanitary method wherever it is commercially practicable.

Transportation by means of refrigerated or heated cars is ideal in theory, but in practice appears to offer serious opportunities for abuse. This is true in case of interstate shipments, and from information at hand much of the criticism should be directed to the Interstate Commerce Commission, who are directly in authority. Regulations covering refrigeration and heating should provide specific temperature provisions. The regulation at present merely provides for refrigeration in summer and heating of cars in winter, a regulation entirely too vague to be of value.

In this connection it is suggested that a definite temperature requirement should be provided, that cars be adequately iced when atmospheric temperature exceeds 50° F. and by adequate icing, that enough ice be provided to keep the milk at or below a temperature of 55° F. during transportation, and that cars be heated to prevent milk from freezing whenever the atmospheric temperature is below 32° F. It is suggested that our organization call this to the attention of the Interstate Commerce Commission, and urgently request that they take immediate steps to make effective such a regulation.

Local transportation problems can best be handled by the authorities in each location. If we can accomplish any reforms along the lines of interstate shipments, we will accomplish a worth-while task.

DISCUSSION

Prof. Roadhouse, California: In the San Francisco section milk is hauled for a greater distance for producers who previously delivered their milk to cheese factories. Their milk is cooled to 38° F., put in glass-lined tanks, and taken

to market 130 miles distant. Two trucks are used, each with a trailer, and both truck and trailer are fitted with glass-lined tanks with a capacity of 1,500 gallons each. The success of this plan is dependent upon the milk being delivered promptly by producers twice daily to central receiving stations, where it is cooled immediately and just previous to starting on its journey to the city.

Mr. Holt, Connecticut: We have had producers leave our Connecticut market for the New York market because we require that the milk be cooled within one hour after milking.

Mr. Kilbourne, New York: When farmers cool their milk within one hour, they must use an open or other cooling apparatus. The average farmer does not keep his cooler clean or sterile and milk is therefore somewhat contaminated in cooling.

Mr. Strauch, Richmond: Some of our producers milk at 5 A.M. and 1 P.M., and deliver milk twice daily, with low bacteria counts.

"Science does not help unless it is applied."

EFFECT OF STEAMING ON THE GERM LIFE IN MILK CANS

H. A. HARDING, *Dairy Research Division, Frederick C. Mathews Company*
Detroit, Mich.

Steam is almost universally relied upon for controlling germ life in milk cans. Accordingly any one who dares to suggest that steam is not a satisfactory agent for this purpose is certain to receive considerable criticism.

If, on the other hand, one turns to the bacteriological studies of the milk cans, as they are delivered to the milk producer, one finds that in a large percentage of cans there are found many millions of bacteria.

At least during the warmer portions of the year the morning milk delivered at receiving stations, so promptly as to exclude the possibility of bacterial growth, ordinarily has a germ count of from 50,000 per cubic centimeter up and a study of the sources from which the milk receives this germ life shows that more than 80 per cent comes from the milk cans.

A physical examination of the washed cans shows that a few of the cans have not been properly washed, particularly in the region just below the neck, and a study of the germ content of the milk put into such cans usually shows such milk to be grossly seeded with germ life. However, the great proportion of the milk cans as they reach the milk producer are clean, and it is these clean cans which are adding from 30,000 to 100,000 per cubic centimeter to the germ count of the fresh milk.

This may seem like a rather startling arraignment of present milk can conditions, but if you will go carefully over the available technical data and supplement it with a little study of your own, practically all of you will find

that it applies with disagreeable exactness to your own local conditions.

Since practically all of these milk cans have been steamed, the questions naturally arise: What is wrong with the present treatment of the cans, and how may they be properly treated?

Observations of the methods employed in handling milk cans usually shows that after the cans have been thoroughly washed they are exposed to flowing steam over a steam jet during three to five seconds.

The results of an extended study of the influence of jet steaming upon the germ life in milk cans is given in a recent number of the Journal of Dairy Science.* Time does not permit an extended review of this study. It is sufficient for the present purpose to note that the effect on germ life from steaming milk cans over steam jets depends primarily upon the volume of steam passed into the can.

The volume of steam passing out of a steam jet depends upon the size of the jet opening. The size jet in most common use is one-quarter inch.

Again, the amount of steam passing per second through a quarter inch jet opening depends upon the steam pressure at the jet opening. In actual practice this pressure varies considerably. When this pressure amounts to 20 pounds per square inch it strongly tends to lift the can and higher pressures are not practicable. In most cases the actual steam pressure, not in the boiler but at the steam jet, is less than 20 pounds.

At a pressure of 20 pounds a jet opening of one-quarter inch will deliver 0.6292 cubic feet of steam per second. Accordingly the can which is being steamed from three to five seconds cannot be receiving more than from 1.9 to 3.2 cubic feet of steam, and if the pressure at the jet is

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*Harding, H. A., Prucha, M. J., Weeter, H. M., and Chambers, W. H. Effect of steaming on the germ life in milk cans. J. of Dairy Sci. 5:282-290. 1922.

less than 20 pounds it will be receiving correspondingly less.

The relation of the volume of steam applied to the amount of germ life remaining in the can was found to be as follows: "The volume inclosed by an 8-gallon can is practically 1 cubic foot. When the volume of steam blown into a can was equal to 2 cubic feet, the destruction of germ life became apparent. When the volume of steam amounted to approximately 5 cubic feet the average bacterial count of the can after steaming was such that if the can had been filled with milk the bacterial count of the milk would have been increased less than 1,000 per cubic centimeter. When the volume of steam was increased to about 9 cubic feet, the corresponding effect of the can on the milk was reduced to less than 100 per cubic centimeter. When the volume of steam was increased to 11 cubic feet per can, the average contamination of the milk was reduced below 10 per cubic centimeter."†

Considering the volume of steam blown into milk cans under ordinary conditions, in the light of these measured effects of the action of steam upon germ life, it is seen that the amount of steam blown into a can in three seconds is just about sufficient to produce enough reduction in the germ life in the can so that the reduction will show on careful measurement of the germ life. When the steaming is continued for five seconds enough germ life remains in the can so that if filled with milk the germ count of the milk would be raised many thousand per cubic centimeter. In fact, in order to reduce the contamination from the freshly steamed milk cans to 100 per cubic centimeter, it is necessary to steam the cans over a quarter-inch jet at 20 pounds pressure for at least fifteen seconds, or three times the present maximum exposure.

Every milk inspector knows that any change in milk plant

†Quoted from above mentioned paper.

operations which calls for a steam treatment of three times the present duration likewise calls for important changes in plant machinery.

It should be remembered also that these freshly steamed milk cans are not immediately available to the milk producer. An interval of eight to twenty hours will elapse before milk is put into them.

There is now in practically every milk plant some provision for drying the steamed milk cans. However, it is only in very rare cases that the cans actually become dry. As a result the germ life which has only been moderately reduced during the washing and steaming process develops in the interval before use so as to regularly produce the seeding of the milk which was noted at the beginning of this discussion.

In order to make the present process efficient the steaming should be continued three to five times as long as at present and the drying of the cans should be made effective.

In actual practice it will be found that increasing the length of the steaming period will increase the present difficulty in drying the cans. This comes about from the fact that in practically all cases the place where the cans are dried is immediately adjoining the place where the cans are steamed. During the steaming of the cans steam is forced out of the cans and passes over the drying compartment, where the air is thereby rendered too moist to rapidly dry the cans.

Since the correction of the present faulty process of handling cans involves both a marked extension of the steaming period and likewise an increased efficiency in the drying process, and since the increased efficiency of the steaming process naturally leads to a decreased efficiency of the drying process, it is only natural to look for another and better treatment for milk cans.

It has been shown in the above mentioned study that practically the same destruction of germ life in the cans

results from steaming the cans over a jet at 20 pounds pressure for fifteen seconds or from rinsing each can with two quarts of boiling water.

In the commercial treatment of milk bottles the earlier use of steam has almost entirely given place to the application of hot water, and accordingly the replacement of steam by boiling water in the treatment of milk cans naturally suggests itself. The use of hot water on the milk cans easily meets both of the difficulties which arise from the use of steam. It is obviously a simple matter to provide for the introduction of more than two quarts of water within the time available and at the same time such copious use of water will not interfere with the later drying of the cans.

A number of commercial machines are now available which are fitted for the hot water rather than the steam treatment of milk cans. Understanding the reason for this change in the accepted method of handling milk cans, the milk inspector can hasten the day when the highly undesirable seeding of the milk with a large number of germs from the milk cans is largely cut off.

It should be clearly understood that in the preparation of milk cans which are to receive milk after a lapse of a considerable interval the dryness of the cans is of much greater importance than their treatment with either steam or hot water. The fact that the use of hot water removes the germ life without interfering with the drying process is the best reason for using it in place of steam.

DISCUSSION

Prof. Roadhouse, California: The steaming of cans is altogether of too short duration. We find cans in some plants are afterwards treated with hot air. Too much steaming of cans, unless steam is confined, is injurious to buildings where steaming takes place. Cans should be

steamed freely until they are hot and then kept hot for a long enough time. Too much steam is usually wasted.

Mr. Doterrer, Chicago: Some washing machines rinse cans with water at 180° F. before steaming. Sterilizing cans over a steel plate, which prevents air entering the cans, will be found more effective. Less steam will be used and less steam will be wasted.

Prof. Stocking, Ithaca: How does efficient rinsing with boiling water compare with efficient steaming?

Dr. Harding: We have to keep cans moving in every plant. The time used for steaming is regulated by necessity of moving cans out of the way. Steaming over jets can be worked out by having jets arranged in rows, but the steam not used is wasted. Economy alone will drive us to use boiling water rather than steam. We will get better results from drying than from careless steaming. The boiling water treatment, properly applied, will insure good results.

"Truth itself is of no particular advantage except as it is used."

MUNICIPAL AND FACTORY MILK INSPECTION

JOHN GAUB, Aspinwall, Pa.

The inspection of milk for manufacturing differs in many respects from that followed in municipal control, in that special tests are necessary to determine the sanitary, the chemical and physical condition of the milk.

Generally, milk is graded from a bacterial standpoint in connection with its fat and solid contents. The general purpose is to detect dirty milk and that likely to transmit disease. On the other hand, some manufacturers go a little further and determine the coagulability—whether the coagulation is caused by bacteria, or by the constituents of the milk.

In general the bacterial content of the milk for manufacturing is determined by the microscope—direct count—which gives results usually ten times higher than the plate count and in addition gives information as to the kinds of bacteria and their sources. Milk for condensing should not be too easily coagulated and yet should permit sterilization without browning too much. It should not coagulate with less heat than that necessary to kill the spores of bacteria. Hence it is possible to reject milk for condensing which to all intents and purposes would be satisfactory for municipal purposes; and many times milk having undergone bacterial action or other abnormality which would condemn it for municipal purposes would be accepted for condensing.

In brief it may be said that coagulation in milk is brought about by the reaction of the various inorganic salts on the casein and albumen, especially when heated. This important factor depends on the herd from which the milk is obtained, since some cows give milk containing a large amount of inorganic salts, while with others the contrary

is true. Diseases of the milk tract, underfeeding and poor health due to improper rationing may cause much trouble. On the other hand, colustrum and pre-colustrum milk will cause much abnormality, while bacteria producing acid and digesting protein are another cause of abnormality.

METHODS OF TESTING MILK

The methods for testing milk usually employed for both municipal and factory purposes are well known. However, there are some facts that might be pointed out wherein the manufacturer is a little more sensitive than the municipality.

The usual titration for acidity with standard alkali and phenolphthalein gives the amount of acid present but does not tell the source. By this method we get the amount of alkali needed for neutralizing all acid present, acid salts and some extra alkali for bringing the milk to the degree of alkilinity as shown by the indicator. Normal milk direct from the cow shows 0.15 per cent lactic acid, although no free acid is present; hence any figure above is considered free acid. However, this apparent acidity varies with the seasons and the animal. Hence the usual titration with phenolphthalein gives the total acidity of the milk and its relation to the sterilizability of the same.

On the other hand, the test of Baker and Van Slyke, known as the Brom-Cresol-Purple test, show the free acid and its source. This method in brief consists in adding to 3.5 c.c. of milk a drop of a saturated aqueous solution of Brom-Cresol-Purple and noting the color. Milk from diseased udders is easily detected by the blue color, while normal milk shows a lavender and sour milk shows a green color.

Another very important test is that of heating the milk for a certain period and noting the results. This method as devised by Grindrod is as follows:

Heat 2.5 c.c. of milk in a test tube to a temperature of

278° F., using the last ten minutes to reach 278° F.; then maintain that temperature for twenty minutes and use an additional ten minutes for lowering to temperature of boiling water. This test can be made in an autoclave or pilot sterilizer and can be used in connection with pasteurized milk.

The alcohol test for coagulability is no doubt familiar to all of us. Now if we combine this test with the Brom-Cresol-Purple test we get very good results as to acidity and its cause. However, it has been pointed out by several workers that the alcohol test coagulates normal milk in winter, due undoubtedly to the abnormal composition of the milk. On the other hand, when the cattle have grass in the spring and summer the test is very reliable.

FERMENTATION-REDUCTASE TEST

This test is a combination of the fermentation and reductase tests. The reductase test, as is well known, determines the relative number of bacteria in the milk, depending on the enzyme (reductase) present which is produced by bacteria. The fermentation test after six hours' incubation shows the kind of bacteria, whether protein digesting or acid forming. Now when the two tests are combined, i.e., when to 15 to 20 c.c. of milk has been added three or four drops of a 2 per cent solution of methylene-blue, and the tubes covered so as to be protected, and placed in an incubator and observed hourly after the first hour and for the first six hours, then every six hours, we get results indicating not only kinds of bacteria but also the relative number of bacteria present.

For example, if the milk decolorized the blue within one hour a large number of bacteria must have been present and probably would sour very soon; while if more than six hours are needed to decolorize the blue the indication is that a moderate number of bacteria are present. Now if the sample showed coagulation in six hours and had a lac-

tic acid odor, the milk contained undoubtedly a large number of acid forming bacteria, and should digestion of the curd set in after six hours the indication is that protein digesting bacteria are present. Now should the coagulum be digested after twelve hours, protein digesting bacteria are present in excessive amounts. On the other hand, if no coagulum is seen after thirty hours, the indication is that a preservative has been used.

Pasteurized milk cannot be reliably tested by this method. However, in some cases it is possible to determine the condition of the milk as to spore-forming bacteria rather than the relative number of bacteria.

MICROSCOPIC EXAMINATION OF MILK AND SOME OF ITS INTERPRETATIONS

This method was originated by Dr. Breed at the New York Experiment Station and consists of spreading on a slide 0.01 c.c. of milk, distributing it over an area of a square centimeter, allowing it to dry slowly, dissolving the fat by ether or xylene, fixing the slide with alcohol and staining with methylene blue, then observing it under the microscope. For approximate work the writer has used a glass rod drawn out to a point, thus delivering small drops of which the number should be weighed in order to deliver ten milligrams of milk. Then prepare the slides with the standardized rod, spreading evenly over the area of one square centimeter and proceeding as method requires.

In order to become acquainted with the various kinds of bacteria and their characteristics it is advisable to examine the fermentation tests, of which it is possible to get five kinds. Under the microscope it will be seen that souring is due to a diplococcus, while a larger diplococcus causes proteolytic action. However, there are some of the latter two organisms that are difficult to distinguish. On the other hand, when the bacterial count is fairly high, say about fifteen million, and the bacteria are scattered, the

milk received an infection and did not deteriorate much after receiving it. Now if the bacteria are in clumps, the milk received a smaller infection which grew during shipping, indicating undisturbed growth; while if the infection were scattered the milk was shaken or very little growth followed after the infection entered.

Should most of the bacteria be of one kind, the indications are that dirty containers or utensils or dirty milking machines were used, while if the bacteria are of various kinds dust of some sort entered.

Leucocytes

As is well known, the question of leucocytes is a troublesome one to all inspectors. No definite number of leucocytes can be specified as indicating abnormal milk. However, it can be said that in normal milk leucocytes appear usually as single-celled bodies, while in milk from inflamed, injured or irritated udders polynuclear leucocytes are found.

When leucocytes are found in clusters, disease is indicated. Should a streptococcus be associated with them, it is an indication of infectious mastitis. It is possible to identify the organism infrequently, but when found present it is a sure sign of the disease. Other diseases are not so easily found and identified. Where disease of the udder is indicated, it is needless to say the cow should be immediately placed in quarantine and preventive measures taken to protect other animals from infection.

Detection of pasteurized milk

Milk that has been pasteurized presents difficulties in detecting bacteria and leucocytes under the microscope. On the other hand, this kind of milk does not give the reductase and fermentation tests. However, if the milk was abnormal and was pasteurized, the alcohol test would show coagulation, as would also the heat test. Should the bac-

teria be abnormally high in the milk before pasteurization, the spore count will also be high.

Usually the only way to detect pasteurized abnormal milk is to run a control at the same time on a milk known to be practically free from bacteria and perfect in other respects. The normal milk should be pasteurized and then incubated with the doubtful sample. The sample of known purity will spoil, due to proteolytic bacteria, generally, but the time necessary will be longer than that of the unknown sample. Sometimes milks are observed that spoil rapidly and yet show very few bacteria other than spores, thus indicating that the milk had been heated at some time during its preparation. On the other hand, it is possible many times to detect pasteurized milk by comparing plates and the numbers of bacteria with the microscopic count, in which case if the plate count is higher than the microscopic count, pasteurization is indicated.

In brief, it may be said that there is no one single test that may alone be used to grade milk properly. Methods must be used separately and jointly in order to give correct information regarding the condition of the milk. In order to determine the quality of milk for manufacturing or for municipal purposes, systematic routine tests should be used.

"Saying well causes a laugh, doing well causes silence."

THE RELATION OF THE MILK INSPECTOR TO THE MILK PLANT MANAGER

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The relations between milk inspectors and milk dealers have undergone a considerable change in the last few years. In the old days the chief functions of the milk inspector seemed to be to prosecute the dealer for selling adulterated milk or milk not up to the standard, or to stop producers from shipping because their dairies did not come up to certain standards. Under such conditions the dealer naturally looked upon the inspector as a nuisance and a necessary evil. During the last few years there has been a much better feeling between them, both on account of the improvements that the dealer has been able to make and because of the better understanding of the functions of the milk inspector.

Since the advent of pasteurization and the greater quantity of milk handled in city milk plants, the duties of the inspector have changed to a considerable degree. Instead of spending most of his time at the dairy farms and in taking samples of milk from delivery vehicles, a considerable portion of his time is now spent at the city plants. The growth of our large cities has pushed the dairy farms farther and farther away, and the inspection of each individual dairy two or three times a year, as was often the custom a few years ago, is now almost a physical impossibility for many city health departments with the inspection force that is allowed them. It is now a more common practice to inspect the milk as it arrives in the city and to follow this up by inspection of certain dairies which are especially in need of it and to supplement this inspection

with inspections at the city plant. In this way the relations between the inspector and dealer have become much closer and they have come to know each other better.

Just as the dairy inspector should know something about the practical side of dairying to be able to talk intelligently with the producer, it is also important that he should have some knowledge about the operation of city milk plants, as much of his time is now taken up with inspections at this point. Most large cities have special men for milk plant inspection.

In order to get results the inspector must have the confidence and cooperation of the milk plant manager or superintendent, and if he is to gain this confidence he must have some understanding of the operation of the plant and of the problems of the dealers. He has the opportunity of visiting many plants and can often offer helpful suggestions as to the arrangement of equipment, etc. In many cases when the inspector is well versed in milk plant equipment and operation the dealer will come to him for suggestions when he contemplates installing a new pasteurizer or other new equipment.

It is the duty of the inspector as well as his privilege to take advantage of this opportunity to be of practical assistance to the dealer. He should keep himself posted on all the latest developments in milk plant equipment and operation. He should know something of the advantages and disadvantages of the various types of pasteurizers and other equipment.

Besides the information the inspector is able to obtain from visiting various plants, attending fairs, dairy shows, etc., he should obtain all the latest publications on the subject. Such publications are often issued by the various State experiment stations and by the U. S. Department of Agriculture. Various bulletins are issued by the U. S. Department of Agriculture, and there is also issued by the Dairy Division of the Department a monthly "Milk

Plant Letter." This letter is in circular form and is sent to most of the leading milk dealers in the country and to any others who desire it. It contains information of practical interest to the milk plant operator, as a result of studies made by the Dairy Division. The tables below are taken from the last two numbers of this letter.

TABLE NO. 1—MAN HOURS USED IN WASHING BOTTLES AT TWO MILK PLANTS OF APPROXIMATELY EQUAL CAPACITY

	Plant No. 1	*Plant No. 2*
Number of bottles washed	32,500	30,000
Number of automatic machines used	1	1
Number of hand machines used for washing very dirty bottles	1	1
Number of men used with automatic machines	6	3.5
Hours	7	6.5
Man hours with automatic machines	42	22.8
Man hours on hand machines for dirty bottles	24	8
Total man hours	66	30.8
Bottles washed per man hour	492	974

TABLE NO. 2—MAN HOURS USED IN BOTTLING MILK AT TWO PLANTS OF APPROXIMATELY EQUAL CAPACITY.

	Plant No. 1	*Plant No. 2*
Number of bottles filled and capped	26,000	27,000
Number of filling and capping machines used	3	3
Number of men	9	6
Hours	7	6.5
Man hours	63	39
Bottles filled and capped per man hour	413	692

A glance at these two tables shows that the labor cost of washing bottles and filling them was much greater at Plant No. 1. Only 492 bottles were washed per man hour at this plant while 974 were washed per man hour at Plant No. 2. Table No. 2 shows that 692 bottles were filled per man hour at Plant No. 2 as compared with only 413 at Plant No. 1.

In Plant No. 1, the bottles on the receiving platform are placed on a conveyor which takes them to the basement where they are washed.

After being washed, the bottles are carried on another conveyor up to the second story floor, where they are removed from the conveyor and stacked. When the bottles are cool, they are removed from the stacks and placed on more conveyors which take them to the fillers. After being filled and capped the cases are sent on conveyors down to the milk storage room on the ground floor of the plant.

At Plant No. 2, the bottles are washed and filled on the ground floor, and pass in a continuous movement from the receiving platform through the washing and filling machinery to the milk storage room. In this plant, at the end of the washing machine, there is a system for cooling the bottles after they are washed. This is accomplished by a series of tanks containing water of constantly lower temperatures. The cooling water is pumped from these tanks to distributing tanks, from which it falls in fine sprays over the outside of the bottles, thus cooling them.

While the fillers used at these two plants were not made by the same manufacturer, they were of the automatic type at both plants. Previous studies made of these machines have shown that the number of bottles filled and capped per man hour is practically the same under similar conditions.

The principal reason for the saving in man hours at Plant No. 2 as compared with Plant No. 1 was that at No. 2 the bottles passed in a continuous movement through the machinery, while at No. 1 the bottles go to three different floors in their passage from the receiving platform to the milk storage room. The dirty bottles that were washed by hand at Plant No. 1 were also washed in the basement, and had to be transferred to other floors as in the case of bottles washed by automatic machine. The continuous movement of the bottles was greatly expedited at Plant No. 2 by the cooling arrangement for the

bottles after they were washed. On account of this system no men were required to stack the bottles or to take them down from the stacks. The floor space used was also much greater at Plant No. 1.

The data given in these tables is an example of helpful information which an inspector should be able to give regarding the arrangement of milk plant equipment. It is, of course, to the interest of the dealer to have his machinery so arranged as to get the best results with a minimum expenditure for labor. If the inspector is able to better understand these problems and to offer helpful suggestions when the opportunity arises, there will be better cooperation between the inspector and the dealer and better results for all concerned.

"The object of human life, and the purpose of all its endowments, talents and discoveries, is not enjoyment, but achievement."

THE CRYOSCOPIC EXAMINATION OF MILK

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Without attempting a definition or a discussion of details, it is necessary only to direct attention to the fact that normal cow's milk exhibits great variations in general composition. The lacteal secretion obtained by the complete milking of healthy cows yields on analysis results which show a range of variations given by Lythgoe in the following table:

I—COMPOSITION OF MILK

	Extreme Limits. Per cent.	Usual Limits. Per cent.	Herd Milk. Per cent.
Total solids	10.0–17.0	10.5–16.0	11.8–15.0
Fat	2.2– 9.0	2.8– 7.0	3.2– 6.0
Solids not fat	7.5–11.0	7.7–10.0	8.0– 9.5
Milk sugar	4.0– 6.0	4.2– 5.5	4.3– 5.3
Protein	2.1– 8.5	2.5– 4.5	2.5– 4.0
Ash	0.6– 0.9	0.7– 0.8	0.7– 0.8

The table shows that milk fat is the most variable of the constituents; protein ranks next in variability; then next in order are the mineral constituents covered by the term "ash." It will be observed that lactose or milk sugar may be rated as practically a constant ingredient. Other constituents, both soluble and insoluble, are present in milk, notable among which is citric acid present in amounts ranging from approximately 0.1 to 0.2 per cent. The result obtained by subtracting fat from total solids, in other words, the fat-free-solids, yields a value which is more constant than any other constituent excepting milk sugar. These general variations in the composition of milk, chiefly as regards the content of fat and fat-free-solids, are well illustrated also in the following table which includes results of analyses compiled by Brown and Ekroth covering approximately two hundred thousand (200,000) samples of English and American milks which were believed to be genuine:

II—TWO HUNDRED THOUSAND (200,000) GENUINE MILKS, ENGLISH AND AMERICAN

(Table by Brown and Ekroth.)

Fat		Solids Not Fat	
Extremes.	Average	Extremes.	Average.
2.85–3.30	3.00	7.75–8.35	8.05
2.95–3.60	3.25	8.05–8.65	8.30
3.15–3.95	3.50	8.20–8.90	8.55
3.50–4.65	4.00	8.55–9.25	8.90
3.90–4.50	4.50	8.85–9.50	9.20
4.20–6.25	5.00	9.05–9.65	9.35
4.50–?	5.50	9.20–9.80	9.50
4.75–?	6.00	9.30–9.90	9.60

Also, in like manner, the same relationships and range in composition are given in the following table compiled by Lythgoe as a result of analyses of somewhat over six thousand (6,000) samples of milk collected by the Massachusetts State Department of Health:

III—SIX THOUSAND AND FORTY-FOUR (6,044) MASS. MILKS

(Analyses by Lythgoe.)

Number of Samples.	Fat.	Solids not Fat. Extremes.	
4	2.75	7.25	7.65
39	2.83	7.67	8.07
165	3.09	7.91	8.31
1,566	3.28	8.22	8.62
1,867	3.47	8.53	8.97
1,061	4.08	8.92	9.12
479	4.47	9.03	9.42
182	4.82	9.18	9.58
81	5.24	9.26	9.66
29	5.72	9.28	9.68
10	6.03	9.47	9.87

In judging the purity or quality of a sample of milk it is inevitable that emphasis will be placed largely upon the content of milk fat and fat-free-solids. Determination of these ingredients involves methods which are comparatively elementary, such as the well-known tests for specific gravity and fat. Clearly enough, however, it is not possible in the large majority of cases to safely judge a sample of milk by the information obtained from the amount of total solids and the content of fat. As already stated, the fat-free-solids figure is a somewhat more reliable criterion, and the percentage of milk sugar, the least variable ingredient, serves a more useful purpose, but there are difficulties attending

the determination of this latter ingredient as a routine method of analysis. It has been observed as a result of examination of tables already submitted that great possibilities exist for adjusting milk to certain required standards as regards fat and total solids. These results can be accomplished very conveniently by means of the well-known methods of partial skimming, blending whole milk with skimmed milk, or by adding cream. These methods, commonly referred to as "standardizing," are illustrated by means of the following simple figures which fairly approximate actual conditions:

IV—MILK "STANDARDIZED" BY PARTIAL SKIMMING

	Fat.	Solids Not Fat.
Normal milk containing	4.0	9.10
Standardized milk containing	3.5	9.10
Compared with normal milk containing	3.5	8.60
Normal milk containing	5.0	9.50
Standardized milk containing	4.0	9.50
Compared with normal milk containing	4.0	9.10

V—MILK REDUCED IN FAT BY ADDING SKIMMED MILK

(Added skimmed milk 20 per cent. Solids not fat same as 3.9 per cent fat milk.)

Normal milk containing	3.9	8.80
Resulting milk containing	3.1	8.80
Compared with normal milk containing	3.1	8.30

It is apparent from these two tables that the addition of skimmed milk effects no appreciable change as regards the content of solids-not-fat while at the same time a very substantial reduction takes place in the content of fat. In other words, the value for milk fat may be very materially altered while the fat-free-solids will remain practically undisturbed. Somewhat the reverse effect is brought about when cream is added to a sample of whole milk. In this case, milk having a low content of fat and fat-free-solids will be improved only in respect to fat with no substantial improvement in solids, as shown in the following table:

VI—MILK "STANDARDIZED" BY ADDING CREAM

	Fat.	Solids Not Fat.
Normal milk containing	3.5	8.60
Standardized milk containing	5.0	8.60
Compared with normal milk containing	5.0	9..50

A further illustration of standardizing is afforded by the common practice of adding water in addition to skimmed milk or by adding water alone. Obviously, by this method, there will occur not only a reduction in milk fat but also in the solids-not-fat. The following two tables will illustrate very clearly, taking actual samples as a basis, in the first case, the result of adding a definite proportion of water to a high-test milk, and in the second, the result of adding a definite proportion each of skimmed milk and water:

VII—MILK "STANDARDIZED" BY ADDING WATER

(Added water, 12.5 per cent.)

	Fat.	Solids Not Fat.
Normal milk containing	4.0	9.10
Standardized milk containing	3.5	8.00
Compared with normal milk containing	3.5	8.60

VIII—MILK REDUCED IN FAT BY ADDING SKIMMED MILK AND WATER

(Added skimmed milk, 15 per cent; added water, 8 per cent.)

	Fat.	Solids Not Fat.
Normal milk containing	3.9	8.80
Resulting milk containing	3.1	8.20
Compared with normal milk containing	3.1	8.30

It will be seen that partial skimming or addition of skimmed milk tends to shift the sample into the group of milks having abnormally high fat-free-solids. The addition of cream has directly the opposite tendency, in other words, to shift the sample into the groups of milk having abnormally high fat in relation to fat-free-solids. The addition of water has a double effect tending to reduce both fat and solids, with results rather more observable in the reduction of solids-not-fat. By a combination of the two practices, adding skimmed milk together with water, it is

possible for the manipulator to produce an article more nearly resembling the composition of average normal milk.

Certain general rules for judging the genuineness of market milk have been in vogue during many years past and these may be summed up somewhat as follows:

Skimming raises the specific gravity and lowers the fat and total solids; addition of water lowers the specific gravity, the fats and total solids; the double practice of skimming and watering decreases all values but lowers the fat more in proportion than the solids-not-fat Milk is watered when the specific gravity falls below 1.028 and the percentage of fat and solids-not-fat are low; milk is skimmed when the specific gravity is high (generally above 1.034) and when the percentage of solids-not-fat is abnormally high. Such generalizations are only of a rule-of-the-thumb kind and have served a comparatively limited purpose in the past. Every food control laboratory has nevertheless exerted its best abilities in a greater or less degree toward the problen of controlling the compositions of market milk. In addition to the usual routine determinations which include specific gravity at standard temperature of 60° F., fat, total solids, and solids-not-fat by difference, a valuable method has been developed during the past 20 years based on the examination of the milk serum. The refractometric examination of the serum has gained considerable prestige and had been adopted as a standard method in many localities. It will be observed that results obtained by the serum examination, in addition to the determination of ash, are dependent chiefly upon the content of milk sugar. Various other chemical or physico-chemical methods have been investigated but for the most part have not been found reliable in practice. The problem confronting the analyst has consisted in the discovery of some principle on which could be developed a method whereby the addition of water to milk can be reliably determined within reasonable limits of experimental error. The discovery made by Beckmann in 1894 that cow's

milk has a constant or only slightly variable freezing-point is in harmony with the results of investigations on a great variety of natural gland secretions, such as pancreatic juice, bile, etc. It is interesting to note that, owing to the fact that there is a close relationship between the osmotic pressure of the blood and the osmotic pressure exerted by the gland secretion, there follows a correspondingly close relationship among the freezing-points of these various fluids.

The following is illustrative of some results which have been reported in various publications relative to the freezing-points of a number of animal gland secretions including cow's milk:

Gland Secretions	Freezing Points −0° C.
Bile	0.560
Gastric Juice	0.550
Pancreatic Juice	0.470
Cow's Milk (general range)	0.540 to 0.560

It was anticipated and proven by early investigators that fairly definite limits for the osmotic pressure of milk and the consequent freezing-point results may reasonably be expected. Later investigations have confirmed and strengthened these conclusions and the resulting practical reliability of the freezing-point determination as a means of detecting added water. The freezing-point of a fluid as well as its osmotic pressure is dependent wholly upon its soluble constituents. In a natural secretion such as milk the water-soluble ingredients are chiefly milk sugar, and mineral salts. Variations in these constitutents will naturally cause corresponding changes in freezing-points. The general character of milk looked at from this standpoint is well illustrated in the following tables:

IX—CONSTITUENTS OF MILK—COLLOID CHEMICAL CLASSIFICATION

Crystalloid dispersion	Salts (such as NaCl, etc.) Sugar (lactose)
Colloidal dispersion	casein—an unstable or irreversible colloid lactalbumin—a stable or reversible colloid

In suspension—milk fat.

X—OSMOTIC PRESSURE OF AVERAGE MILK

Constituents	Percentage	Osmotic Pressure (Atmospheres)	
Lactose	4.7	3.03	0,250°
Alkali Chlorides { Cl ions / Na or K ions }	0.1	1.33	0.110°
Other salts and ions		2.42	0.200°
Totals		6.78	0.560°

The content of milk fat does not affect the freezing-point and the same is substantially true regarding the casein salts and any other insoluble constituents. The slightly soluble albumenoids may have a correspondingly slight effect. The chief variations, however, are due to the content of lactose. Among conclusions reached by recent investigators are the following published in 1917 by the Bureau of Chemistry, U. S. Department of Agriculture:

"The freezing-point figure of milk is the most constant one yet obtained and the safest basis upon which to draw conclusions as to the presence or absence of added water."

"The presence of water added to fresh milk in excess of 5 per cent can be detected with certainty by the freezing-point measurement." Attention is also called to the fact that tests should be applied only on normal or reasonably fresh milk owing to the fact that a marked increase in acidity counteracts a rise in the freezing-point and may conceal the presence of a substantial amount of added water.

Attention has often been called to the technical difficulties incident to the carrying out of a freezing-point determination as a routine method. Also the time element has been an obstacle and the hope has been expressed that a device might be developed which will render the method practical and at the same time very materially shorten the time, especially when a large number of samples are to be tested. For the purpose of overcoming these difficulties and also having in mind the necessary requirements regarding reliability and accuracy, a new model freezing-point apparatus was devised during the winter of 1918-1919.

Many preliminary trials were carried out on samples collected in nearby localities. The apparatus was further developed and perfected and in the meantime numerous tests were applied to authentic samples for the purpose of establishing the natural variations in freezing-point in mixed milk from herds as well as in milk taken from individual cows. It was deemed highly necessary that the investigation be conducted in this manner in order to prepare a proper foundation for the application of the method to samples taken in the open market. Results obtained during the years 1919, 1920, 1921, on authentic samples are shown in the following table:

XI—RANGE IN FREEZING POINT DEPRESSIONS FOR NORMAL MILK

	Sp. Gr.	Fat.	S-N-F	Freezing Point Depression. —0 °C.
Individual Cows				
Minnesota State Dairy and Food Department.				
1919-1920 (60 samples)				
Maximum	1.0350	7.30	10.15	0.562
Minimum	1.0262	2.20	7.37	0.534
Average	1.0319	3.94	8.90	0.547
1921 (17 samples)				
Maximum	1.0330	4.9	9.25	0.560
Minimum	1.0281	2.4	8.02	0.540
Average	1.0311	3.4	8.67	0.547
Libby, McNeil and Libby, Morrison, Ill.				
1921 (27 samples)				
Maximum	1.0380	6.3	10.26	0.563
Minimum	1.0256	0.9	7.20	0.532
Average	1.0313	3.9	8.62	0.546
Connecticut Agricultural Experiment Station, New Haven.				
1921 (75 samples)				
Maximum	1.0343	6.8	9.63	0.566
Minimum	1.0271	2.7	8.17	0.530
Average	1.0313	4.0	8.64	0.543
Herds				
Minnesota State Dairy and Food Department.				
1919-1920 (15 samples)				
Maximum	1.0330	5.50	9.27	0.562
Minimum	1.0305	3.10	8.48	0.545
Average	1.0319	4.15	8.95	0.551

	Sp. Gr.	Fat.	S-N-F	Freezing Point Depression. —0 °C.
Libby, McNeil and Libby, Morrison, Ill.				
1921 (37 samples)				
Maximum	1.0336	5.4	9.30	0.553
Minimum	1.0285	2.7	7.98	0.530
Average	1.0312	3.7	8.45	0.542
Connecticut Agricultural Experiment Station, New Haven.				
1921 (9 samples)				
Maximum	1.0317	4.1	8.77	0.560
Minimum	1.0305	3.3	8.38	0.535
Average	1.0311	3.6	8.50	0.544
SUMMARY OF ALL RESULTS				
Individual Cows				
(180 samples)				
Maximum	1.0380	7.3	10.26	0.566
Minimum	1.0256	0.9	7.20	0.539
Average	1.0315	3.8	8.7	0.545
(61 samples)				
Herds				
Maximum	1.0336	5.5	9.30	0.562
Minimum	1.0285	2.7	7.96	0.530
Average	1.0313	3.8	8.58	0.544

Preliminary trials were also conducted on mixtures containing known proportions of added water. The following tabulation includes results obtained by the application of tests made on a series of mixtures prepared for the purpose:

Freezing-point —0° C.	Water Added Per cent	Freezing-point —0° C.	Water Found Per cent
0.550	4.5	0.524	4.7
0.549	17.6	0.450	18.2
0.540	3.5	0.532	3.3
0.540	6.5	0.512	6.9
0.551	10.0	0.494	10.2
0.545	8.0	0.509	7.5
0.550	11.0	0.490	10.9
0.545	5.0	0.521	5.2

Having completed the necessary preliminary investigations, thereby placing the cryoscopic test on a reliable basis as a routine method for the examination of market milk, the work begun early in 1919 was continued so as to include not only actual retail samples but to a large extent also samples obtained from producers. In connection with this

work carried out in the Minnesota Dairy and Food Laboratory, collaborative studies were made of the cryoscopic method with the assistance of other laboratories in various parts of the country. A comparison was made between results obtained on specially prepared mixtures containing known proportions of added water by means of customary methods heretofore applied and results obtained by the cryoscopic examination. Inspection of the tables on page 82 will afford many instructive data illustrative of the relative merits and different methods of examination under known conditions.

Owing to the observed natural variations in freezing-points of genuine market milks obtained from healthy individual cows and herds it has been found desirable to adopt a reasonable tolerance in passing judgment on market samples. The tolerance figure decided upon is 3 per cent, which is manifestly very liberal owing to the fact that the highest freezing-point results have been obtained on milks from individual cows, while on the other hand, the observed range in the case of milks from herds is much narrower and includes no results as high as those obtained on samples taken from individuals. In reality, a 2 per cent tolerance figure would be more nearly in accordance with actual conditions.

In actual routine practice, therefore, all samples of market milks which as a result of freezing-point tests show a calculated added water figure lower than 3 per cent are reported as passed. Samples testing from 3 per cent to 5 per cent are reported as watered and a warning is issued to the dealer or producer. Prosecutions are instituted on samples testing 5 per cent and higher. The result of this practical mode of procedure has been very beneficial during the past three years. It has been possible to trace out the origin of the low-watered samples and correct irregularities which otherwise would never have been revealed which were contributory to various aggravated forms of adulteration. Fines and workhouse sentences have been imposed in

XII—PURE BRED JERSEY HERD, 7 COWS.

Water Added %	Sp. Gr. at 15.6° C.	Fat %	S.N.F. %	Immersion Refractometer Readings at 20° C.		Acetic Serum Ash		Cryoscopic Determinations		
				Acetic Serum	Copper Serum	Gm. in 100 cc.	Added Water Indicated	Freezing Points —0° C.	Added Water % (T—T′) 100 / T	Added Water % (0.550—T′) 100 / 0.550
None	1.0344	5.25	9.65	46.40	39.51	.8172	None	0.554	None	None
5	1.0329	5.00	9.23	44.36	38.32	.7672	"	0.525	5.32	4.54
7	1.0324	4.90	9.08	43.68	38.00	....	"	0.512	7.57	6.82
9	1.0317	4.83	8.89	43.21	....	.7452	"	0.502	9.47	8.73
11	1.0312	4.65	8.73	42.40	37.38	.7332	"	0.489	11.81	11.09
13	1.0304	4.60	8.52	41.62	36.80	.7208	"	0.475	14.34	13.64
15	1.0296	4.50	8.30	40.98	36.43	.7184	"	0.466	15.93	15.27

XIII—HOLSTEIN HERD, 7 COWS.

Water Added %	Sp. Gr. at 15.6° C.	Fat %	S.N.F. %	Immersion Refractometer Readings at 20° C.		Acetic Serum Ash		Cryoscopic Determinations		
				Acetic Serum	Copper Serum	Gm. in 100 cc.	Added Water Indicated	Freezing Points —0° C.	Added Water % (T—T′) 100 / T	Added Water % (0.550—T′) 100 / 0.550
None	1.0320	3.07	8.61	42.22	38.45	.7374	None	.550	None	None
5	1.0305	2.90	8.21	40.92	37.39	.7248	"	.520	5.45	5.45
7	1.0300	2.85	8.07	40.30	36.78	.7160	"	.508	7.45	7.54
9	1.0294	2.78	7.91	40.00	36.30	.7073	"	.500	9.09	9.18
11	1.0288	2.75	7.75	39.25	35.78	.6946	Prob.	.488	11.19	11.27
13	1.0281	2.70	7.56	38.61	35.41	.6832	Pres.	.476	13.27	13.36
15	1.0275	2.65	7.41	38.00	35.09	....	"	.466	15.19	15.27

numerous instances as a result of prosecutions based on samples testing in many instances under 10 per cent of added water, until at the present time the markets are practically freed from the demoralizing practices incidental to the indiscriminate watering of milk. Associated with the cryoscopic tests there have also been carried out the usual determinations, including refractometric readings on prepared serums and ash determinations. Such complete analyses are not called for in the great majority of samples but are applied to all samples which in one way or another give rise to suspicion that they may have been tampered with. These various methods of testing milk are found to be valu-

XIV—MARKET MILKS TESTED FOR ADDED WATER

No. of Milk	Sp. Gr. 60° F	Fat %	S-N-F %	Immersion Refractometer at 20° C.		Acetic Serum Ash Gm. 100 cc.	Added Water Ind.	Cryoscopic Examination	
				Acetic Serum	Copper Serum			Freez. Point —0° C.	Added Water %
6720	1.0294	3.4	8.17	40.00	36.51	....	None	—0.530	3.64
6725	1.0300	8.5	8.34	40.23	37.37	....	"	—0.546	...
6793	1.0286	3.5	7.99	39.36	36.50	0.7548	"	—0.546	...
6902	1.0302	3.6	8.40	40.98	....	0.7380	"	—0.516	6.18
6904	1.0302	4.0	8.49	41.66	....	0.7556	"	—0.536	...
6955	1.0298	3.9	8.38	39.66	36.25	0.7130	"	—0.498	9.45
6963	1.0276	3.8	7.81	38.02	35.00	0.6012	Pres.	—0.466	15.27
6983	1.0292	4.3	8.31	40.35	37.00	0.7348	None	—0.533	3.09
7012	1.0296	3.5	8.25	39.38	36.18	0.7264	"	—0.535	...
7153	1.0281	3.5	7.87	38.80	35.78	0.6800	Pres.	—0.504	8.39
7361	1.0319	3.7	8.23	39.00	36.08	0.6788	Prob.	—0.483	12.18
7376	1.0293	3.9	8.25	38.25	35.10	0.6672	Pres.	—0.459	16.54
7377	1.0290	4.1	8.02	36.13	34.62	0.6142	"	—0.430	21.82
7378	1.0301	4.2	8.51	40.08	36.39	0.7316	None	—0.497	9.64
7406	1.0309	3.5	8.75	39.30	36.00	0.6768	Prob.	—0.494	10.18
7428	1.0305	3.5	8.48	40.24	36.49	0.7400	None	—0.510	7.27
7606	1.0303	2.7	8.26	39.07	35.72	0.6816	Pres.	—0.505	8.18
7678	1.0310	3.8	8.65	42.52	38.42	0.7320	None	—0.537	....
7885	1.0284	2.9	7.83	39.00	36.00	0.6860	Prob.	—0.493	10.36
7928	1.0275	3.9	7.80	38.24	35.68	0.5972	Pres.	—0.468	14.91
7930	1.0290	2.8	7.95	39.00	36.08	0.6668	Prob.	—0.477	13.27
8036	1.0306	3.4	8.47	39.42	36.46	....	None	—0.495	10.00
8030	1.0311	3.7	8.66	40.38	37.00	....	None	—0.501	8.91
8071	1.0304	4.2	8.58	39.70	36.00	0.7280	None	—0.462	16.00
8111	1.0303	3.7	8.47	40.82	37.52	0.6872	Prob.	—0.514	6.54
8114	1.0311	3.3	8.58	40.79	37.36	0.6872	"	—0.520	5.45
8130	1.0299	3.7	8.36	40.28	37.38	0.6716	"	—0.490	10.91
8232	1.0308	3.4	8.53	39.17	36.68	0.7128	None	—0.508	7.64
8284	1.0288	4.1	8.16	38.90	35.80	0.7272	Prob.	—0.512	6.91

able as a means of obtaining corroborative information and thus affording ample evidence whenever necessary in court proceedings. Limitations of the customary methods have already been pointed out, but nevertheless results obtained by these methods are in many cases found to be useful. The table on page 83 includes a number of samples subjected to complete analyses during the past eighteen months and each case will afford instructive figures for examination and comparison.

The conclusions drawn from the specific gravity, fat, fat-free-solids, and serum examination results are based on limits adopted by the Association of Official Agricultural Chemists. The results reported on the basis of the cryoscopic tests are given in accordance with the rules already stated and of course do not include any figures for added water which turn out by calculation to be under the liberal allowance of 3 per cent. Chief interest has, of course, been centered upon our efforts to improve the character of milk delivered to the consumer; in fact, this has been the single object in view. Often it has been necessary to apply inspection methods in tracing back suspicious samples to producers in outlying territories and much valuable cooperative work has been carried on with the distributing plants located in the cities. A gradual and, at times, a rapid improvement has taken place, especially since the winter months of 1919-20, until at the present time the actual proportion of market milk samples found to be watered has been reduced to a small figure well below 5 per cent. The following tabulation includes all market samples which have been subjected to tests beginning in February, 1919, and ending at the close of the present month. The tabulation will be instructive as affording an illustration of the improvements which are attainable by the application of the plan of handling market milks which has been developed in the Minnesota Dairy and Food Laboratory in recent years:

XV—MARKET MILKS

	Number of Samples	FAT: Samples below 3.25%	FAT: Percent of samples below 3.25%	FAT: Average Fat %	Total Solids	Samples containing added water: Total No.	Samples containing added water: Percent
1919 (Beginning Feb. 1)							
Totals . . .	976	135				285	
Averages . .			13.8	3.54	12.19		29.34
1920							
Totals . . .	1,168	161				176	
Averages . .			13.75	3.61	12.53		13.88
1921							
Totals . . .	1,115	113				59	
Averages . .			8.64	3.71	12.68		5.16
1922 (Ending Nov. 1)							
Totals . . .	751	74				23	
Averages . .			8.51	3..78	12 79		4.1

"Happy the man who studying Nature's laws
Through known effects can trace the secret cause."

ADDRESS

PROF. H. E. VAN NORMAN, *President,*
World's Dairy Congress Association.

It is a great pleasure for me to address the men whose duty it is to safeguard the milk supplies of our cities. The high quality of milk which the cities receive is largely due to the modern system of municipal milk inspection and to the painstaking work of the municipal milk inspectors. The quality of municipal milk inspection has greatly advanced since the day when any political heeler out of a job could be appointed a milk inspector. The modern inspector is expected to understand the technique of milk handling well enough to serve as an instructor and aid to the producer. He performs his task in a spirit of helpfulness, to assist the farmer in caring rightly for his product and not to make a display of his authority like the oldtime inspector.

Because you come constantly in contact with the perplexing problems of milk production and transportation, I feel you will be peculiarly interested in the preparation of the program of the World's Dairy Congress, which is to be held in the United States next October.

The World's Dairy Congress was conceived in the spirit of give and take, in the spirit of willingness to exchange the newer knowledge internationally that has appeared in the last few years. It was conceived in the realization that progress is always in advance of the printed record and that, if we are to learn the newest developments in any or many branches among the multiplicity of activities which relate to the breeding of the dairy cow and the manufacture and distribution of her products for the use of man, we must bring together for personal reports

those progressive, constructive men and women who have done the new things.

Unsolved, perplexing problems confront many branches of the dairy science and industry. Progress in the solution of these questions can be made by discussion and the exchange of ideas among those who are seeking to solve them. But we must limit our discussions. The Program Committee is therefore confining itself to those questions which are of importance to several or all nations and particularly interest the following groups of individuals:

I. Research and Education.
   For teachers, investigators, engineers, officials and other technical men interested in the solution of dairy problems.

II. Industry and Economics.
   For men engaged in the business of milk production, manufacture, exportation, importation, storage and distribution of dairy products and equipment.

III. Regulation and Control.
   For national, state, municipal and private officials concerned with standards, sanitation and disease control.

IV. National Health.
   For health and nutrition workers, philanthropists, welfare workers and students of the influence of diet on the health and vigor of the nation.

Those who know important questions which should be discussed or of recent accomplishments which should be presented will help the Program Committee by informing it of their suggestions immediately. Many doers hide their accomplishments under the mantle of modesty. You must help the Program Committee uncover them. That is the imperative immediate task. The following are a few of the questions that have been suggested for each of the

program departments. They represent either results accomplished or the desire for information.

Under I.—Research and Education.

The role of inorganic salts in the nutrition of the dairy cow.

Efficiency of the cow as a converter of roughage into human food.

The type of cow making the largest production.

Physical, chemical and biological criteria for judging dry milk.

Types of containers and vehicles for transportation of products.

Cause and control of contagious abortion.

College and graduate courses in dairying.

Utilization of by-products.

Under II—Industry and Economics.

The education of the producer as to the value of a better product as a means of increasing sales.

The essential factors in obtaining high production.

The utilization of dairy wastes.

The use of dry milk in ice cream, etc.

Cooperative associations.

The standardization of dairy equipment.

International influences affecting the price changes of various dairy products.

Under III—Regulation and Control.

Where shall the line be drawn between national, provincial, and municipal inspection?

What methods of regulation have been most successful?

What principles underlie the development of a code of sanitary laws?

The definition of pasteurization by law.

International nomenclature for cheese brands.

Methods of grading milk for manufacturing purposes.

The control of foot and mouth disease.
Methods of eradicating tuberculosis.
Under IV—National Health.
Nutritive value of milk.
Nutritive value of dry milk.
Relative nutritive values of pasteurized and raw milk.
The menace of the traffic in vegetable oils.
The use of milk powders in public health work.
How shall we teach the public the value of milk?

Will you immediately communicate with the committee suggestions peculiar to your individual interests?

"An opportunity which presents itself must not be lost."

ADMINISTRATIVE STANDARDS FOR THE CONTROL OF CITY MILK SUPPLIES*

IRA V. HISCOCK, *Assistant Professor of Public Health, Yale University School of Medicine,*
New Haven, Conn.

A recent survey of health department activities in 1920 indicates that some measure of control of the sanitary quality of the milk supply is exercised by all American cities of 100,000 population and over; but it is surprising to find that pasteurization is not yet general except in the larger cities, and that only 31 out of the 83 cities studied have a grading system. Systematic supervision is most highly developed in the larger cities which draw from wider areas for their supplies.

The supervision of milk supplies is generally carried on in the larger cities as a part of the work of the division of foods, while in the smaller cities (less than 140,000 population) it is handled by the health officer himself or by a subordinate directly responsible to him. The plan of organization best suited to an individual city obviously depends upon local conditions; the essential consideration is that efficient control be exercised by public health authorities.

This is a period of standardization and we must have standards for improvement in technique as well as for the guarantee of satisfactory products. The collection of these data on the present status of milk inspection in our larger cities furnishes valuable information as to personnel, expenditures and other factors concerned in milk supervision and suggests the basic needs for control of milk supplies in the near future.

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*The writer desires to express his obligation to the Committee on Municipal Health Department Practice of the American Public Health Association for permission to use data presented in this paper.

The licensing of milk dealers is fundamental for the successful control of the milk problem and this practice is nearly universal. The farms are also licensed in over a third of the cities studied, but this procedure is of secondary importance inasmuch as the farms can be indirectly controlled through the milk dealers. Prosecutions in the large cities are usually conducted by the city attorney on complaint of the health department. Most cities, however, now endeavor to reduce these prosecutions to a minimum, while several cities handle the question through the health department entirely and withdraw the license or permit in preference to making a definite fine.

The usual practice appears to be to employ between one and two inspectors per 100,000 population for the supervision of sanitary conditions at farms and dairies. Such a personnel should make possible the inspection of each farm once or twice a year. It is believed by the writer that farm inspections should be more frequent than twice a year although it is realized that this opinion is not universally held. The quality of milk produced depends upon the care exercised on the farm and a competent milk inspector is in a position to render an important educational service at the dairy.

The standard score cards of the U. S. Department of Agriculture are generally used for the purpose of recording the results of farm inspections. Baltimore, Pittsburgh, Washington, Jersey City and the cities of New York State use a modified score card. Fall River, Omaha and New Haven use special forms and Youngstown uses the Ohio State University score card.

For the supervision of the health of the dairy cattle one veterinarian on full time is usually provided for a population of from 300,000 to 600,000. Four cities of over 250,000 population did not, in 1920, employ veterinarians, while of the cities of less than 250,000 population, about half the departments report veterinarians on their inspection staff.

In some instances, veterinarians give a part of their time to milk inspection work and the rest to some other form of inspection service such as that of meat. This seems to be a good arrangement for the smaller cities because it enables them to have a full time veterinarian in the department, which is a distinct advantage over part time service.

The importance of temperature standards is well recognized by the members of this association. Temperature regulations are usually enforced at farms, in transit, at milk depots and on delivery wagons. The limits set generally vary from 50° to 55° F. and are lowest at milk depots (in 65 per cent of the cities 50° F. and under) and on delivery wagons (in 60 per cent of the cities 50° F. and under). Chicago and some of the California cities have a standard at the milk depots of 45° F., or even lower in the case of Los Angeles.

The most important single factor in milk supervision is a well-equipped laboratory and, as stated by the National Commission on Milk Standards, this is the "key to the solution of the problem of the proper use of grade labels." An efficient laboratory can make a large number of tests at a low cost and can thereby maintain constant supervision over the milk distributed in a given community. A city which is unable to maintain a milk laboratory can easily arrange with some other community or the State laboratory to handle this work. Laboratory control is exercised in practically all the large cities and from 130 to 140 samples (chemical and bacteriological) per 100,000 population on the average, are examined in a year. These samples are most frequently collected at the milk depots and on delivery wagons; rarely from farms and in transit.

A system of grading based on dairy scores and bacterial counts is the basis of efficient control of the milk supply. Although there may be health officers and milk inspectors who are not yet convinced of the value of milk grades, a large proportion of our leading health officials, including the

National Commission on Milk Standards, consider "It is feasible for small communities as well as large communities to adopt a grading system and to secure its benefits."*

It is surprising and disappointing to find that only 31 of the 83 cities studied report the use of a grading system, and among these 31 there is little uniformity as to requirements. The adoption of such standard systems of grading milk as have been suggested by the Commission on Milk Standards would seem to be one of the most urgent steps to be taken in this field in the future. Regulations either state or local, as those in New York State, should provide for appropriate tags or labels for the containers of the various grades of milk sold.

After the introduction of a grading system, the pasteurization of all milk below the generally accepted standard of Grade A Raw should be secured. In at least 10 of the 12 cities of over 500,000 population,† all milk except that from tuberculin-tested cattle must be pasteurized. As nearly as can be ascertained, about 95 per cent of the milk supply of these cities is thus treated. The individual reports show that 9 out of the 12 cities of this group pasteurize 95 per cent or more of their total milk supply. Of 13 cities having a population of 250,000 to 500,000, only 5 (Milwaukee, Newark, Cincinnati, Jersey City and Seattle) require the pasteurization of all milk not from tuberculin-tested cattle. Four of these cities report 95% or more of their total supply as pasteurized. Of the 58 cities of less than 250,000 population studied, pasteurization is required in less than half (23) and only 5 or about 9 per cent of the cities pasteurize 95 per cent or more of their total supply.

Since pasteurization offers the only safeguard for milk not produced under ideal conditions and from tuberculin-tested herds, and is the only absolute guarantee against dis-

*Public Health Reports, Vol. 32, No. 7, February 16, 1917, p. 5.

†For a more detailed discussion of this subject, see A. J. P. H. Vol. XII, No. 7, 1922, p. 577.

ease even in high-grade milk, it is urgently needed that official regulations be made to conform with modern knowledge more closely than is the case at present. Furthermore, pasteurization should be carefully defined and should be coupled with intelligent inspection at the source and competent supervision at the milk plant to insure protection. Only a few of our cities studied (about 12) have systems of this kind at the present time.

The tuberculin testing of all cattle producing milk which is sold raw is an important regulation which is apparently enforced in less than half of the cities studied in the survey previously mentioned. In Kansas City, Mo., St. Paul, Houston, Kansas City, Kan., Duluth, Spokane and San Diego, 90 per cent or more of the cattle are reported tested. Tuberculin testing may be carried on either by the state, or by private or local veterinarians, or by both. Philadelphia, Los Angeles, San Francisco, Milwaukee and several of the smaller cities depend largely upon state officials, but in case of the large cities under study veterinarians are more commonly employed for this work.

The medical inspection of milk handlers is ostensibly carried out in 17 of the 83 cities surveyed, but here, as elsewhere, the completeness of enforcement leaves much to be desired. It is believed that all handlers of milk to be sold raw as well as all handlers of milk after pasteurization should be given regular medical examination.

The production of a small amount of very high grade raw milk under the supervision of such bodies as medical milk commissions in cooperation with health departments is highly desirable and it is found that over half of the cities of 100,000 population and over have the benefit of milk commissions. An average of about 500 quarts per day per 100,000 population of certified milk is produced in 45 cities receiving certified milk, as compared with the total milk supply of about 33,000 quarts per 100,000 population.

It is difficult to ascertain the expenditures for milk control since in many instances this work is carried on under some other division, such as that of foods or laboratories, and the financial data are not separable. The average amount of money spent by 26 of these large cities presenting complete data on the subject is a little over $.04 per capita, varying from $.01 to $.13. The majority of these 26 cities benefit from systematic milk supervision and it is believed that the figure $.05 per capita would provide for effective milk supervision in most of our cities.

In conclusion, it must be recognized that the regulations, personnel and appropriations of many of our large cities are still inadequate for effective milk control. Standards and milk ordinances are exceedingly helpful but lose their value if they are not supported. Pasteurization should be urged more strongly than ever and systems of grading milk supplies should be more widely developed to safeguard our most essential food.

DISCUSSION

Mr. Archibald, Minneapolis: How rigidly are the requirements enforced?

Mr. Holt, Connecticut: Requirements not enforced are worse than none at all. We require cooling to 55° and have rejected thousands of quarts of milk because of insufficient cooling. We are going slowly but surely. Condemned milk is sometimes cooled to a lower temperature and put back into the supply on the next morning. Milk dealers are cooperating with us much better than formerly.

Dr. Harding, Detroit: We know that it is desirable that milk should be cooled as much and as quickly as possible. Morning's milk to be delivered in from one to three hours after milking will be frequently injured by an attempt to cool on the part of some farmers.

Mr. Holt: Under ideal conditions milk may go from

one to three hours if it is then cooled properly. If received at points not provided with cooling equipment after three hours, it cannot be cooled previous to going on its journey to the cities where it may not be received for several hours.

"Leadership consists of seeing right, thinking right and acting right."

CONSTRUCTIVE POLICIES AND METHODS FOR MILK IMPROVEMENT

V. J. Ashbaugh and G. C. Supplee

The Research Laboratory of The Dry Milk Company,

Adams, New York

Progressive manufacturers of various dairy products are becoming more and more aware of the advantages of obtaining a high grade of raw material. This is no less true of manufacturers who conserve milk by dessication. It is well known that the quality of the raw material is usually reflected in the general quality of the finished product, and a closer study of the problems involved in drying milk proves that this product is no exception to the rule. Although members of your Association are primarily interested in the production of milk destined for consumption in liquid form, the system of milk improvement herein described, while inaugurated by a company manufacturing dessicated milk products, may also be applicable under conditions in which the majority of you are particularly concerned.

The problem of milk improvement to the manufacturer having several factories, each receiving a different supply of raw material, becomes somewhat complicated. His first step should be the formulation of certain definite policies and then gradually determine what methods are most practical and valuable for securing and maintaining a satisfactory supply. The manufacturer formulating policies regarding milk improvement recognizes that the quality of milk depends largely on existing conditions at the source of supply, that is, on the farm. He should further recognize that the correction of these conditions can be accomplished permanently and within a reasonable

length of time by a plan which provides for a certain amount of cooperative work with the producer, which, however, must be carried on in such a way that it will not bring about unfriendly relationship between himself and the patron, but rather, create a better understanding and appreciation of each other's problems. He should also realize that to intelligently aid his patrons in delivering a high quality of milk he must have at hand all possible information concerning the milk delivered by each. A practical system of milk improvement which embodies these broad considerations may be divided into three parts: the field work, the weigh stand inspection work and the laboratory work.

It has been found practical to have at each factory a man whose entire time is devoted to the matter of milk improvement, and whose work is so arranged that he may assume much of both field work and the milk inspection work on the weigh stand. The qualifications of this combination field man and milk inspector are important; besides being thoroughly familiar with the sanitary principles underlying good milk production and being a capable judge of milk he must possess tact and personality which will win the good will and confidence of the producers. The success of the whole system depends largely on the field man's ability to create in the minds of the producers a desire to produce at all times a high quality of milk.

The weigh stand inspection serves to furnish full information concerning the quality of milk received, but what is still more important, it designates particular defects which guide and direct activities in the field. The physical examination of the milk is for apparent common defects and is made to a greater or less degree on all receiving platforms. Each can of milk is examined in a rapid and practical manner by noting the odor, color and physical condition for the purpose of detecting bad taints or odors, sour milk, bloody milk, a curdled condition or visible dirt. The

temperature of all night's milk should be taken when by feeling of the cans it is suspected to be above a certain standard commonly recognized in that locality.

Closely related to the daily routine physical examination of the milk is the detection of small amounts of visible dirt by a regular application of the sediment test. Besides indicating the amount of insoluble dirt present, the discs when returned to the patrons serve as a bit of concrete evidence emphasizing defective producing methods. The greatest value of this test has been found to be derived by its systematic application. A sediment test should be made on each patron's milk at least once a month and the discs returned on the card for that purpose with the relative degree of cleanliness indicated. In addition to this regular monthly test the milk of all patrons who deliver milk of an unsatisfactory grade should be retested three or four times during the following week for more up-to-date information regarding that milk.

The judicious application of the acid test has been found valuable in detecting developed acidity which might otherwise have passed unnoticed. In fixing a suitable acidity standard, the season, and possibly the breed of the cattle in the particular locality should be considered. Provision should be made for those cases where the milk of the herd has a high apparent acidity. The use of the acid test, while valuable for excluding milk with an abnormal amount of developed acid, is probably not justified for constant use except for the most rigid control purposes.

Since the bacterial content of milk is of basic importance in determining milk quality, a properly taken representative sample should be obtained from each patron's milk at least once a month for examination by the Breed microscopic method. This method is particularly suitable for such examinations because the samples can be rapidly graded into at least three classes on the basis of relative counts. The results of these examinations, which may or may not be

used as a basis for excluding milk, are valuable in furnishing information not otherwise obtainable and in facilitating the field work. This information very frequently points out certain faults in the production and handling on the farm. In addition to the regular monthly examination, the milk from those patrons, which contains excessive numbers should be re-sampled three to five times during the remainder of the month in order that the field man may have up-to-date information upon which to base his activities in giving assistance to individual patrons. The routine bacteriological examination of patrons' milk by the microscopic method implies that the meager equipment necessary is available and that it is conducted by a person with ample training to properly perform the work. If the milk from several stations is to be examined it is undoubtedly more economical to have the prepared smears sent to a central laboratory for counting and grading, thereby avoiding unnecessary duplication of equipment.

The essential features of this system of milk improvement provide, first, for the securing of information relative to defects in each patron's milk; and second, they provide for cooperative measures to correct the conditions causing them, the basic purpose being to accomplish a gradual but permanent improvement in the supply by intelligent field work based on weigh stand and laboratory findings. Illustrative examples of the working of this principle follow:

The farmer whose milk was classed as unsatisfactory by the regular monthly sediment test does not always respond to the suggestion set forth by the returned dirty sediment disc as shown by subsequent re-tests taken within short intervals. A rejection of his milk would be a more emphatic notice and recourse is sometimes made to this procedure. If, however, there has been indication of slight improvement or desire to eliminate the dirt from his milk, a personal visit is made to the farm where sufficient time is spent with the patron pointing out in a tactful manner

the probable causes of difficulty, and frequently rendering material assistance by exemplary means. In dealing with cases where milk with a high bacterial content has been delivered consistently for a period of time, it is assumed that the patron needs help. In determining the cause of various defects in milk, probably none is as difficult for the producer to locate as those conditions which are frequently responsible for a high bacterial count. The average producer can hardly be expected to locate the trouble alone. His knowledge of bacteria and conditions favorable to their growth is usually limited and a thorough examination of all conditions attending production at his farm, particularly utensils, milking machines, etc., by both the farmer and the field man usually reveals something of more significance than would be detected by the farmer alone. The very nature of the conditions responsible for high bacteria counts are such that weigh stand threats or milk rejections alone cannot replace the right kind of field work in insuring either a temporary or permanent improvement.

While a good proportion of the field work is spent on specific conditions such as those just mentioned, there are, however, other activities which properly belong in this category and which have materially assisted patrons in producing a better quality of milk. Various cooling devices, strainers, cotton, etc., have been sold at cost. Aid has been given in procuring an adequate ice supply; ice has been sold to patrons whose supply has been exhausted; hypochlorite solution has been prepared and sold at a very low cost to those patrons using milking machines; white-wash pumps have been kept for use among the patrons and lime and other supplies have been bought in large quantities and dispensed at a cost covering the material only. Physical examination of the cattle in those localities where such is required has been done by the Company's veterinarian for a nominal sum. These and other services not only aid in se-

curing a better milk supply but they tend to create a general feeling of good-will among the patrons.

To what extent producers may be expected to respond to this policy for improvement of the milk supply in any particular territory depends somewhat upon local conditions. Where such a system has been employed it has been found that the quality of the supply has been improved in every instance. Perhaps the most significant single index for measuring the general quality of milk is its bacterial content, and figures showing the relative number of patrons delivering a satisfactory milk to several factories should indicate the average rate of improvement. This rate of improvement has varied in different localities depending upon the general quality of the supply when the work was begun, and upon the natural advantages which some territories possess, such as cold springs or a cheap ice supply, which are factors making possible production of better milk at only a slightly increased cost.

The following comparisons represent the improvement obtained during a three-year period. The figures are derived from the monthly bacteria counts and represent the average proportion of Grade I milk delivered during the first year the improvement policy was in effect, and the Grade I milk delivered during the third year of the existence of this policy. By "Grade I milk" is meant that milk showing the most satisfactory bacterial content, the limits for this grade having been the same throughout the entire period. The quality of milk in this class is equal to, if not better than the average quality used for city consumption, using municipal standards as a basis for comparison.

At one factory where the general supply was good at the beginning as represented by the fact that 86 per cent of the deliveries were in the Grade I class, three years of improvement work only raised the Grade I deliveries to 92 per cent. The other extreme is represented by the improve-

ment record of a factory whose supply at the beginning was of only average quality. Here the Grade I deliveries was increased from 37 per cent during the first year to 74 per cent during the third year. The average improvement obtained from the several territories taken together shows 21 per cent more deliveries in the Grade I class during the third year than was shown during the first year.

It is not to be assumed that field work directed to specific conditions on the farm, or in rendering other services which the manufacturer may be in a position to furnish, will guarantee that all milk delivered will be up to the standards which have been established. Since the average manufacturer is obviously dependent to a certain extent upon his patrons, he naturally avoids as much as possible any condition which will tend to create the dissatisfaction which commonly accompanies milk rejection. It usually happens, however, that some defects are present which justify rejections. It has been the experience of those familiar with milk improvement work that there must be a policy of milk rejection adopted which is based on definite standards, these standards having been established on the basis of the present quality of the supply and bearing a certain relationship to the rate of improvement in the particular territory concerned. It has been found that the greatest possible benefit both as a control feature and as a disciplinary measure is derived from a rejection policy which operates consistently. Such a policy has been found to operate with a minimum of friction when accompanied by a liberal educational policy as outlined herein. The records from those factories where milk was rejected in connection with this system of milk improvement shows that the amount rejected during a period of one year varied from .021 per cent to 1.25 per cent, the average for all factories being .077 per cent. The chief cause of rejection was high temperature, although about 40 per cent of the total rejected was for common defects such as high acid, taints, odors and sediment or dirt.

Regardless of where the responsibility of milk improvement properly belongs, there are indications that no extensive campaign for better milk is to be launched or maintained entirely by the volition of the producers alone; nor is there satisfactory evidence that milk buyers can expect to obtain a permanent improvement of their supply by the lever of milk rejection only or through the milk inspectors, whose duties often confine them to purely inspection work. Without question there has been much accomplished by these methods, but it would seem logical for the milk buyers, who form the connecting link between the official control agencies and the producers, to give favorable consideration to any policy which would embody purely control measures and fundamental educational work, the objective of which is the permanent improvement and maintenance of the quality of the milk with which they are particularly concerned.

"Truth is so important and of so delicate a nature that every possible precaution should be employed to exterminate its violation."

THE EFFICIENCY OF MILK PLANT MACHINERY

CARL O. SEAMAN, Manchester, N. H.

From the standpoint of a milk inspector this question is not an economic one. When we inspect a milk plant it does not concern us so much if the operators are wasteful of coal, or the arrangement of apparatus makes it necessary to have extra help, as these questions are outside of our province, although these and other similar conditions must be remedied to bring a plant up to its highest possible efficiency.

The majority of milk plant managers do not know just what results they are getting, nor do they have a laboratory or knowledge of chemistry and bacteriology to make a systematic investigation. It behooves us milk inspectors to help them, because by educating them to improve their product we benefit the whole community.

What good is accomplished if we make periodical counts of bacteria in milk and do not follow up the high ones, find the cause and have the trouble corrected?

A milk can that has been properly scrubbed, sterilized and dried can be stoppered up tight and remain free from odors indefinitely. We cannot expect to receive a wholesome, sweet and good flavored milk from the producer, when he is provided with bad smelling, contaminated containers. What could be more discouraging to a milk producer who prides himself for his neatness, who follows every rule, than to receive from the city milk plant dirty cans teeming with bacteria and be told by the plant management that said cans had been washed and sterilized and were ready to ship his milk in.

In my efforts to improve the milk supply in our city, I call at a milk plant and inform the owner or manager that I am going to make some efficiency tests, so that he as well

as myself may know what results he is securing. Invariably he is anxious to have this information for his own benefit. I go prepared to follow the milk through all apparatus used, taking samples for bacteria counts of the raw milk at the weigh can, mixing vat, clarifier or filter, and from the pasteurizer vat before heating. Then following up the process, samples are secured after the milk has been held the usual time, then samples are taken from the cooler, bottle filler and finally from the filled bottles.

The temperature of milk is observed as it is received at plant, again in the pasteurizing vat after heating and holding, and also after passing over the cooling system. We also check for accuracy the recording thermometers. If the holding tank system is used, the period of holding is noted.

Other samples are taken at intervals of one-fourth to one-half hour, from holder tank outlet, cooler and bottle filler, until we have three or four sets of samples. These samples have been secured without stopping any machinery in a plant, nor would I advise interfering at such a time with the usual methods employed.

Washed and steamed cans and bottles are also examined, the usual methods being used for this purpose.

Some of the troubles and defects detected are as follows:

The recording and other thermometers are frequently found several degrees inaccurate.

Holding tanks not functioning properly, due to faulty construction or some essential part being left out, so the milk takes the path of least resistance and passes through in less than 30 minutes.

Cooler not large enough to sufficiently cool milk below 50° F.

The use of strainer cloths, washed and sterilized only every other day, and strainer cloths left in water after rinsing and never sterilized.

The washing and sterilizing of cans without scrubbing.

The washing of cans not first rinsed.

Attempting to sterilize bottles and cans with insufficient steam.

Rinse water jets with insufficient water pressure to reach bottom of cans.

The use of washing solution badly contaminated with milk, litter and dirt.

The piling of can covers in the washing machine so that the inside surfaces were not washed or sterilized.

The rinsing of bottles with cold water, and insufficient steaming of utensils.

Careless methods of cleansing receiving tanks, mixing vats, pipes, milk pumps, heaters, cooling coils, bottle fillers, etc., are detected and numerous other defects and bad practices are brought to my attention and to the attention of the milk plant operator.

Improved apparatus is sometimes installed after my reports are rendered. The flavor of milk is frequently improved and bacteria counts usually lowered as a result of our efforts.

DISCUSSION

Dr. Harding, Detroit: In one instance the first milk over the cooler contained 1,000,000 bacteria per cubic centimeter. The last milk over the same cooler contained only 20,000 per cubic centimeter. In collecting samples we may get either kind. Vats, pipe lines and coolers should be thoroughly scalded previous to use. Most contamination comes from cans or apparatus used.

Mr. Bowman: Any well-regulated inspection force will visit a plant and try to find the cause of high counts. Action should rarely be taken except as the result of several high counts indicating that carelessness is common.

"Perfection is acquired by doing common things uncommonly well."

REPORT OF THE COMMITTEE ON PASTEURIZATION OF MILK AND CREAM

DR. WILLIAM H. PRICE, *Chairman*

Pasteurization is one of the pillars of the dairy industry. Pasteurization is a process, or a series of processes, which have proved to be essential to the maintenance and promotion of the public health. Its influence in safeguarding milk, in increasing available supplies of milk, on the physical and chemical and bacterial characters of milk, and on the food values contained in milk has been investigated and voluminously reported. Those matters may be considered to have been determined, so far as importance to food control officials is concerned. Pasteurization affords a powerful weapon for combating communicable diseases, infantile diarrhea, nutritional disorders, and diseases of unbalanced diet. Extension of the process of pasteurization is in the interest of the public health. Standardization of the process would be of advantage.

About 1860, Louis Pasteur studied the "diseases" of wine, and later of beer, and found that temperatures lower than boiling—130-140° F.— held for a few minutes were sufficient to prevent fermentation due to bacterial action, without impairing the palatability of the juices themselves. Jacobi in New York and Soxhlet in Munich reported favorably on the heating of cow's milk as a means of safeguarding the lives and health of artifically fed infants and other milk consumers. Flugge, Koeppen, and the American Pediatric Society reported adversely. The medical profession was divided in opinion regarding the process. The thermal death points of various pathogenic organisms in milk were investigated and reported on by different observers. Denmark, in 1898, required the heating to 176° F. of all milk intended for feeding calves. A few milk handling con-

cerns began to employ flash pasteurization, sometimes clandestinely. An ever-increasing number of reports of milk-borne epidemics attracted attention to the possibility of their control by heating milk in volume to temperatures lower than boiling. Park and Holt, after extensive investigations in New York, reported that the general practice among the tenement population of heating milk was undoubtedly a large factor in lessening infant mortality. Public health officials began to recognize the value of pasteurization of general milk supplies as a means of combating communicable disease transmission and infantile diarrheas. The uncertainties of the flash method in practical operation and the high temperatures it required to insure safety, which temperatures disturbed the cream layer and the relative proportions of the various types of bacteria remaining after pasteurization, suggested heating to lower temperatures and holding thereat for longer periods—the holding pasteurization which has developed into the present accepted practice.

TEMPERATURE AND TIME OF HOLDING

Smith in 1899 and Russel and Hastings in 1900 reported the destruction of pathogenic organisms in milk when heated to 140° F., and held thereat for 20 minutes. Rosenau confirmed their findings in 1908, and reported the killing of the bacteria which caused tuberculosis, typhoid, diphtheria, and of other pathogenic organisms which might be associated with milk, when heated to a temperature of 140° F. and held thereat for a period of 20 minutes. At the same time he recommended increasing the temperature to 145° F., and the time of holding to 30 minutes, to provide a margin of safety against lapses below the necessary temperature and time, under working conditions with the equipment then available. With the exception of a single item, or the interpretation thereof, Rosenau's conclusions and recommendations have been found practicable for

application under working conditions and acceptable to all interests concerned in the pasteurization of milk.

Where pasteurization by the holding process prevailed, milk-borne epidemics ceased, infant mortality was reduced, larger supplies of safe milk were made available at lower cost than would otherwise be possible, the process was amenable to supervision and control; and these considerations naturally received the approval of health authorities who, almost without exception, exert their influence toward extension of the process of pasteurization by the holding method. Dairy machinery manufacturers are able to furnish heating, holding, and automatic temperature control and recording equipment which meet the recommendations, with the following exception: It is not possible for heating equipment to deliver large volumes of milk at exactly a given degree of temperature, and a leeway of not to exceed 3° F. must be allowed the heating and temperature control equipment, under practical working conditions. The progressive dairy industry voluntarily adopted the system, at least to the extent that met the approval of their customers, for the same reasons which actuated the approval of the public health authorities. The milk-consuming public welcomed the system, *provided,* that in the process of pasteurization the cream layer was not shortened, the taste of the milk was not affected, and the proportions of the bacterial flora remaining after pasteurization were not altered. If the cream layer was impaired, if a cooked taste was imparted to the milk, or if the pasteurized milk finally putrified instead of souring, then the public condemned such pasteurization and demanded raw milk, or milk heated to a lower temperature, or held for a shorter time; and this attitude prevailed regardless of repeated epidemics following the trail of raw milk routes, or of the alleged greater safety imparted by the higher temperatures, or of assurances that the normal character of the milk had not been altered. To the public, short cream layer means skimmed milk, and putrid milk

means that a preservative has been added; and both of these are resented not only as evidences of adulteration but also as affronts to the intelligence of the consumer.

One clearcut issue of contention remains to mar the harmony otherwise prevailing among those interested in extending the practice of milk pasteurization. It is contended by some that a temperature never lower than 145° F., held not less than 30 minutes, is necessary to secure destruction of all pathogenic organisms that may be contained in milk, and that it is practicable, by appropriate equipment and methods of processing, to employ that temperature for the stated time without imparting objectionable taste to the milk and without reduction in cream layer from that which would be obtained by holding for the same length of time at a lower temperature, namely, 142-145° F., never lower than 142° F. It is the contention of others that no evidence is available even remotely tending to show that a minimum temperature of 145° F. will effect any greater safety in milk than will approximately 145° F., never permitted to fall below 142° F., the period of holding being 30 minutes in both cases; that a minimum of 145° F. necessarily involves variations in temperature to as high as 148° F.; that these higher temperatures seriously reduce the cream layer; and that the consuming public resent this decrease in cream layer, so forcibly as to demand raw milk in preference, or milk pasteurized at lower temperature, thus making the higher temperature pasteurized milk unmerchantable, and delaying the introduction of or handicapping pasteurized milk or leading to evasions of regulations requiring pasteurization at a minimum temperature of 145°. F.

It is of the utmost importance that a correct conclusion be arrived at regarding this issue, to the end that safety may be insured, and that at the same time, no superfluous restrictions may retard the introduction and use of the essential process of pasteurization. The participants in this controversy are not divided according to professional or busi-

ness interests; health officials and milk dealers are included in each school. Both health authorities and milk dealers are interested in increasing consumption of safe milk—which means pasteurized milk. Opposition of the public is sufficient to defeat that purpose. There is no conceivable reason why milk should not be heated to the higher temperatures except the reason of effective opposition by the public. The committee has no knowledge of data leading to the conclusion that milk pasteurized at a minimum temperature of 145° F. is in any respect safer than milk pasteurized at approximately 145° F., never lower than 142° F. A number of the committee have had original observation of impairment of cream layer by temperatures exceeding 145° F., carefully controlled, and held positively for a period of 30 minutes. A majority of the committee are of the opinion that the public interest will be better served by rigid enforcement of adequate standards rather than by the adoption of excessive restrictions "made to be violated." Therefore a majority of your committee concur in the following

DEFINITION OF PASTEURIZATION

Pasteurization is a process by which every portion of the milk so treated is heated to a temperature of approximately 145° F., never lower than 142° F., held thereat for not less than 30 minutes, and then cooled to a temperature of 45° F. or lower. The degree and time of heating, holding, and cooling should invariably be recorded by a tested automatic device, the records of which should be dated daily and should be checked at regular intervals by the health authorities. Immediately after pasteurization, and at the place thereof, the milk should be filled into the final containers and stored at a temperature lower than 50° F. until delivered to consumers. Repasteurization is unnecessary, objectionable, and should be prohibited. Deviation from the processes stated above should disqualify

resulting products, so far as city milk supplies are concerned, from being termed pasteurized.

A division of opinion regarding the foregoing temperature requirement occurs among members of the committee. There are eleven members of the committee.

From one member no reply was received.

One member believes that further investigation is desirable before final judgment is rendered on this subject.

Two members believe that a minimum temperature of 145° F. should be recommended.

Seven members approve the temperature stated in the foregoing definition, namely: Approximately 145° F., never less than 142° F.

The members are unanimous that a holding period of 30 minutes should be recognized.

INFLUENCE OF PASTEURIZATION IN CONTROLLING DISEASE TRANSMISSION

The efficiency of pasteurization in controlling transmission of communicable diseases through the medium of milk supplies is a matter of common knowledge; but that common knowledge is not acted upon to the extent to which the efficiency of properly supervised pasteurization warrants. In smaller places there often seems to be a tendency to hold aloof from pasteurization, and to attempt to substitute alternatives of less efficiency for it. The result is a recurring series of raw-milk-borne epidemics each year, and the past year has been no exception. The first reported milk-borne epidemic occurred in England about the middle of the past century; and reports of milk-borne outbreaks of typhoid, diphtheria, scarlet fever, and septic sore throat increased as attention of physicians was attracted to this possible source of transmission and as mixed milk supplies increased in number and volume. These reports reached maximum in number about 1904-1907, just previous to the introduction of pasteurization; and they faded

away with remarkable rapidity thereafter, wherever pasteurization was generally employed. During the past year the committee's attention has been called to numerous milk-borne epidemics, in various parts of the country, all transmitted through raw milk. Space permits a review of only three of these epidemics.

One of these epidemics occurred in Hillsdale, Michigan, and is reported in the November 26, 1921, issue, *Journal American Medical Association,* by Dr. Richard M. Olin, Commissioner of Health of Michigan. Following are some extracts from Dr. Olin's report:

"As usual ignorance and carelessness laid the stage for the typhoid fever outbreak in Hillsdale, Michigan, during the fall of 1920, which developed into an epidemic, with eighty-three cases and eight deaths before it was controlled." "C. S., Jr., a son of the distributor, was confined to his bed after September 19th, with what was clinically diagnosed as typhoid fever. C. S., the distributor, complained of not feeling well during the interval from September 25th to October 5th. He continued, however, bottling the milk and handling the supplies." "Sale and distribution of milk from the S premises was prohibited by the Michigan department of health. A meeting of the Hillsdale city council was called—and an ordinance requiring that all milk sold in Hillsdale be pasteurized, and means be provided for free immunization against typhoid fever was passed at this meeting on advice of officials of the Michigan department of health." By November 9, fifty-one cases of sickness clinically diagnosed as typhoid had been reported to the local health officer. State medical inspectors visited the home of each of the sick and made careful inquiry concerning the different sources of food and drink. Aside from one patient, all of the patients had used milk from this one distributor. "Of a total of about 400 families furnished milk by the distributor—forty-five families were invaded by the disease. Information proved con-

clusively that the epidemic originated from the milk supply (which was raw), which had been contaminated at the bottling station."

An epidemic of septic sore throat in Portland, Oregon, in March and April, 1922, was traced to an infected raw milk supply, and was successfully combatted by pasteurization. Following are extracts from a report of that epidemic:

"This epidemic was first brought to the attention of the Health Department on Monday, March 27th, last. The first cases arose three days previously, and all the cases except contacts arose during the period from March 24th to the 30th. Several clinicians observed that the severe cases were most of them along the route of one dairy, and this fact was later proven by the Health Bureau.

"Almost immediately upon first information reaching the Health Office, this dealer was placed under the supervision of the Milk Division and two inspectors were placed in charge. The milk from this time on up to the present has been pasteurized.

"It was found that about 1,500 people used the milk, and among these about 475 cases of septic sore throat were found, of which about 130 were severe, 170 moderate, and 175 mild. There were 20 deaths—the ages of these ranging from 10 months up to 79 years.

"The conclusion reached is that the epidemic arose from the drinking of raw milk from one dairy in which two cows were infected with hemolytic streptococcus, probably resulting from infection of these two cows' udders by a milker who had hemolytic streptococcus sore throat of mild grade. All deaths except one were on this dairy route. The elimination of the infected cows and pasteurization of the milk from the herd resulted in immediately checking the epidemic so that no new cases appeared after the first few days. It will probably require some weeks yet, and possibly

months, before this dairy can be released from heating the milk, and every cow will be cultured at least twice."

The third epidemic is referred to in an editorial entitled "Relative Security Afforded by Bacterial Control of Milk Supplies and by Milk Pasteurization," published in the June 17, 1922, issue of the *Journal of the American Medical Association*. The entire editorial follows:

"A particularly instructive milk-borne epidemic of typhoid has recently been reported from the post laboratory at Fort McPherson, Georgia. Although a large number of cases was not involved, and although the mode of contamination of the milk presents no especially novel features, the accessory circumstances are highly illuminating.

"The main milk supply for the post of Fort McPherson was obtained at the time of this outbreak from a single large dairy. Pasteurization of the milk was carried out in Atlanta according to methods specified by the post laboratory. This pasteurized supply had been in use for a period of more than three years, during which time no sign of illness was traced to it. In the summer of 1921, a number of families connected with the fort discontinued the use of the pasteurized milk and purchased milk from a number of small milk dealers, the chief reasons apparently being objections to the taste of the pasteurized milk and the fact that the pasteurized milk had to be sent for while the other was delivered at the door. The small milk dealers found that they could dispose of their milk more readily if they could exhibit a laboratory report, and accordingly submitted samples of the milk to the laboratory about twice each week. In October, 1921, typhoid fever appeared in the family of one of the dealers delivering unpasteurized milk, and the use of this contaminated milk led to the occurrence of nine cases of typhoid among the consumers.

"It is highly interesting that the bacterial examination of the milk samples, both pasteurized and unpasteurized, was conducted in the post laboratory during the summer and

autumn of 1921 covering the period of infectivity of the raw milk. The results show that the colony count of the milk supplied by the small dealers was very low, averaging between 2,000 and 5,000 per cubic centimeter, even during the summer months. This was somewhat lower than the count obtained from the pasteurized milk supply, which averaged about 10,000.

"This is probably the first instance on record in which, during a period of typhoid infection, routine bacterial examinations have been made of pasteurized and unpasteurized milk samples, at a time when both kinds of milk were being supplied to a small and fully controlled body of consumers. Although the epidemiological study shows convincingly the presence of typhoid bacilli in the raw milk during the period of observation, the colony count seemingly gave no indication of danger. The pasteurized milk, on the other hand, which gave a somewhat higher colony count than the dangerously contaminated raw milk, was demonstrably not a source of typhoid.

"Although it is often stated that the bacterial count is the best single index we have of the general sanitary character of milk, it is plain that important exceptions must be made. A relatively fresh raw milk of low bacterial content may be dangerously contaminated with typhoid bacilli, while a pasteurized milk with larger total numbers of bacteria may contain no disease-producing bacteria and be quite safe for use. The clearly described outbreak at Fort McPherson emphasizes once more the importance of sanitary control of the dairy and its surroundings, and especially of medical inspection of milk handlers and their families, and also affords a convincing instance of the advantage of pasteurization.

"The history of this outbreak shows, further, the protective value of typhoid vaccination. Among seventy-six persons protected by anti-typhoid inoculation there was only one case of typhoid, while among eighty-four not protected

there were eight cases. Both groups were living under fairly similar conditions, and appear to have been equally exposed."

An editorial entitled "Why Does the Tuberculosis Death Rate Fall so Rapidly?" appeared in the July 22, 1922, issue of the *Journal of the American Medical Association.* Most of this editorial is devoted to a consideration of the human, and more important, type of infection; but the following extract refers to the bovine type of infection and to the influence of pasteurization thereon:

"Emerson holds that it is possible to see the effect of improving milk supplies by pasteurization, for since this has been enforced in New York, there has been a notable change in the rate of reduction of the non-pulmonary forms of tuberculosis in that city. In 1914 the rate was 27, in 1921 it was 14 per hundred thousand. That much of the lymphatic, bone and joint tuberculosis has been of bovine origin is admitted, and as a specific instance of the change since the general pasteurization of 98 per cent of all our city milk supply, instead of finding 64 per cent of a series of 100 cases of tuberculous adenitis to be of bovine origin, as was the case in 1912-1913, only 16 per cent of a series from the same hospital source was found to be of bovine origin in 1917 by Dr. W. H. Park. Whether or not adult pulmonary tuberculosis has been affected by the tubercle bacillus content of milk, the reduction of milk-borne bovine lymphatic tuberculosis of children is an accomplishment of great and lasting importance."

RELATIVE IMPORTANCE, TO HUMANS, OF HUMAN AND BOVINE TUBERCULOSIS INFECTION

During the past year, as previously, there has been confusion in the minds of some persons regarding the relative incidence of and mortality from tuberculosis of human and of bovine origin, and the relative efficiency of tuberculin testing and pasteurization in combatting that part of tuber-

culosis which is of bovine origin. The human type of tuberculosis, which includes the pulmonary, is not a factor in this latter consideration, because there are no data which direct suspicion toward milk as a transmitting agent of the human type of the disease.

Regarding the former consideration—the relative incidence of and mortality from tuberculosis of human and bovine origin—the committee believes that the best evidence available is that contained in a paper entitled "The Rôle of the Bovine Type of Tubercle Bacillus in Human Tuberculosis," read by Dr. Charles Krumwiede before the Eighth Annual Convention of this Association. Tables were included in Dr. Krumwiede's paper and from them he drew the following conclusions regarding the incidence of and mortality from bovine tuberculosis to be expected in humans with an unpasteurized milk supply from average non-tuberculin-tested herds:

"A study of this table (included in the Eighth Annual Report) shows that bovine infection is a nearly negligible factor in the tuberculosis of adult life. Nor is it a factor in the causation of pulmonary tuberculosis, or 'consumption,' which causes the vast majority of deaths from tuberculosis in man and which, because of the infectious sputum, is responsible for the transfer of the disease from man to man.

"In children, however, bovine tuberculosis is a decided factor, especially under five years of age. * * *"

"If we consider the total deaths from tuberculosis of children under five years of age, the total fatalities due to bovine infection are not high as compared with the total fatalities for all ages from tuberculosis. The annual fatalities in New York City average somewhat below 10,000. The average annual deaths under five years of age are between eight and nine hundred. The total annual fatalities, therefore, from bovine infection would be only eighty or ninety.

"Regarding the tubercle bacilli of the bovine type changing

to the human type, I do not believe the types change. * * * In one known instance, twenty years after infection of a human by the bovine type of organism the germ was still of the bovine type."

The conclusion of this observer is that something less than one per cent of human deaths from tuberculosis are due to infections from bovine sources, when none of the milk is pasteurized and none of the animals furnishing the milk is tuberculin tested; and that the bovine type does not change into the human type during a long period of residence in the human body. These conclusions differ widely from the theories promulgated by some agencies who assume a much higher percentage to be due to the bovine type. The conclusions of Park and Krumwiede are of the utmost importance when planning measures for the control of human tuberculosis; and this is especially true because of the high standing of the authors, the representative number of investigations from which the conclusions were drawn, the fact that theirs is the only investigation on this subject that has been conducted on a large scale in this country, and that their conclusions correlate well with similar investigations conducted abroad.

After considering the relative importance of bovine tuberculosis in humans and the indispensable character of milk as a food, the committee concludes that tuberculin testing, and even pasteurization, are of secondary importance to the maintenance of abundant supplies of milk. The problem remaining, namely, what procedure is best calculated surely and quickly to control the one per cent of human tuberculosis of bovine type which does exist when none of the milk is pasteurized and none of the animals are tuberculin tested, suggests inquiry regarding the relative efficiency of pasteurization and of tuberculin testing as agents for this control. Because tuberculin testing is not certain of removing all reactors, deals with a multitude of units—dairy farm managers, is time consuming in its accomplishment, involves

long intervals between tests, and is handicapped by a scarcity of competent operators; and because pasteurization is certain in destroying all of the infection, is applicable every day to every portion of exceedingly large volumes of milk, deals with only a comparatively small number of units—milk plant managers, and is easily supervised and controlled, the committee concludes that pasteurization is the surest and quickest method of eliminating that portion, one per cent, of human tuberculosis which traces its origin to bovine sources. In addition to the tuberculosis factor, this conclusion is supplemented by the certainty that pasteurization is also a preventive of transmission of typhoid, scarlet fever, diphtheria, and septic sore throat through the medium of milk supplies; while tuberculin testing offers nothing whatever with respect to these latter considerations.

Having in mind the above conclusions, the committee deprecates the tendency of some health promoting agencies to write into milk ordinances provisions that permit tuberculin testing as an alternative to pasteurization. Tuberculin testing is exceedingly valuable to the dairy industry, but its inferiority to pasteurization in safeguarding milk supplies should not be confused by health promoting agencies.

One member of the committee dissents from the above conclusions.

EFFECT OF PASTEURIZATION ON THE FOOD VALUES CONTAINED IN MILK

Park and Holt, in New York in 1902-1903, observed the feeding of alternate groups of children on raw and on heated milk and arrived at conclusions favorable to heated milk. Weld, in Washington in 1912, reported the feeding of alternate groups of children on raw and on pasteurized milk with results slightly favoring pasteurized milk. No data are available tending to show that the protein, carbohydrate, fat, or mineral constituents of milk are adversely affected by pasteurization, so far as their nutritive values

are concerned. The data available regarding the effect of pasteurization on the vitamins contained in milk are so voluminous as to preclude possibility of abstracting them into this report. However, the committee believes that milk control officials are warranted in proceeding on the following conclusions, with respect to pasteurization and the vitamins, when regulating milk supplies.

(a) Fat soluble A is relatively stable at much higher temperatures, applied for much longer periods, than are employed in held pasteurization. Held pasteurization, therefore, has no appreciable adverse influence on the fat soluble A content of milk.

(b) Water soluble B is relatively stable at much higher temperatures, applied for much longer periods of time, than are employed in held pasteurization. Held pasteurization, therefore, has no appreciable adverse influence on the water soluble B content of milk.

(c) There is evidence to warrant the conclusion that water soluble C is adversely affected by heat, and by storage; and that even freshly drawn raw milk, and even mother's milk, is a relatively poor source of water soluble C. The obvious conclusion is that the diet should be supplemented by appropriate amounts of C bearing food, as may easily be done by the addition of a few spoonfuls of orange or tomato juice.

PASTEURIZATION AS AN IDEAL IN MILK SUPPLIES

The committee deprecates the tendency of some authors, even some who heartily endorse pasteurization, to refer to pasteurization as "not the ideal, but only an expedient." Probably the ideal in milk control is the direct transferance of milk from the gland of the healthy mother to the mouth of her nursing young; but this is not the officially contemplated control. The tendency of some authors to refer to pasteurized milk as second to "pure raw" milk is doubtless a survival from the days when pasteurization was uncertain.

No data are available to warrant such expressions and it is desirable that they be culled from the text and reference books. So long as "carriers," "mild missed," "incubating," "suppressed," and "convalescent" types of communicable disease exist, pasteurization is an ideal safeguard for any milk.

One member of the committee dissents from the above conclusion.

VARIATIONS FROM PROVED PROCEDURES IN PASTEURIZATION

The committee deprecates the tendency of some health promoting agencies to adopt variations from proved procedures in pasteurization, and to write such variations into milk ordinances. Following is the definition of pasteurization contained in a bulletin entitled, "A Guide for Formulating a Milk Ordinance," prepared by State officials for use by local health authorities: "Pasteurized milk is milk which has been heated to and held for thirty minutes at a temperature of approximately 145°F., never less than 142°F., and then promptly cooled to a temperature of 50°F. or lower; or *milk treated for the destruction of bacteria contained therein by such other method as may be approved by the health officer or board of health.*"

The accepted procedures of pasteurization are definite and practicable and should be adhered to until better procedures have been proved to exist.

PRESENT PROCEDURES OF PASTEURIZATION

The committee recommends that only the holding type of pasteurization be considered standard and permissible. Temperature of pasteurization has been fully discussed in a previous section of this report. Clement, page 206, Eighth Annual Report; Kilbourne, page 216, Eighth Annual Report; Clement, Chairman, page 215, Ninth Annual Report; and Kilbourne, Chairman, page 149, Tenth Annual Report; have reported exhaustively to this Associa-

tion regarding standard procedures of pasteurization, including safeguards therefor and the recording of data. The conclusions of those authors are endorsed by the present committee. A brief, and inadequate summary of their conclusions follows:

The construction of the building and the equipment should be such that they are capable of safely and efficiently treating milk and cream, so that all dangerous bacteria shall be destroyed without impairing its chemical and nutritive properties, and without needlessly decreasing the cream layer.

The operation of the apparatus should be so automatically controlled that the results of which the apparatus is capable shall be secured with the least chance of failure.

There should be certainty that the men who are in personal control of the operation of the plant are efficient; in order that the *mechanical possibilities* and the *automatic controls* shall be efficiently directed.

Only good milk should be used.

The equipment should be simple, and easily cleaned and sterilized.

All pipes and pumps should be of sanitary construction.

Ample steam boiler capacity is essential.

All the milk must be heated uniformly.

The holding process must be actual and accurate. Continuous flow holders should be checked often by an approved process for accuracy, and automatically controlled compartment holders should be tested frequently to insure that the valves operate accurately and that there is no leakage.

There should be accurate automatic control of the rate of flow of milk through the apparatus.

Automatic temparature control is essential for all continuous pasteurizers.

Temperature recorders, which are tested frequently for accuracy, are essential for all pasteurizers.

There should be a minimum of unnecessary agitation of the milk, and foam in the holder should be avoided.

Leaky valves in the apparatus should be eliminated.

The milk should be heated reasonably quickly, and after holding should be cooled quickly to 45°F., or lower.

A cooler of ample capacity is essential.

The milk should be stored, after pasteurization, at a temperature of 50°F., or lower, until delivered.

All milk handling apparatus should be thoroughly washed, rinsed, and sterilized.

Special attention should be given to the first and the last milk through the pasteurizer, to insure that proper heat for the proper time is applied at those periods.

It is important that the piping and the pump used for withdrawing pasteurized milk shall not have been contaminated by raw milk.

There should be a minimum of the human element in the operation of pasteurizing equipment.

DISCUSSION

Dr. Whittaker, St. Paul: The Minnesota State Board of Health some years ago secured a definition of pasteurization from the U. S. Department of Agriculture, and later the U. S. Public Health Service gave us about the same definition. With that information, 145°F. for not less than 30 minutes was adopted as a regulation of our State Board of Health. The enforcement of this regulation in those cities where applied has not resulted in any harmful effects. We do not feel that the requirements are at all detrimental to the milk industry. I would like to see further work along these lines. I would like to see settled once and for all the requirement for pasteurization. We find everything from 140°F. to 145°F., for periods ranging from 20 to 30 minutes. I am not ready to favor lowering our temperatures for pasteurization.

Dr. Harding, Detroit: All this difference of opinion is natural, but regrettable. All favor proper work and results. So far as I know, there is a consensus of opinion that

a temperature of 145° for 15 minutes has always killed tubercle bacilli. We want a margin of safety as great as may be practicable. While 15 minutes may be enough, we accept 30 as a margin of safety. New York City requires a pasteurizing temperature of not less than 142° for 35 to 40 minutes. The effect of temperature on creaming power of milk had not been fully measured.

At about 143° the effect of heat on cream line becomes measurable, being slightly reduced at 144°. The temperature of 145° reduces the cream line about 10 per cent, as compared with the same milk heated to 142°. At 148°, 40 per cent of the cream does not appear in the cream layer. So at 146 to 147-148, there is a reduction in cream line that interferes with commerce. As yet I personally know of but one plant that is actually pasteurizing at 145° for 30 minutes.

Mr. Kilbourne, New York: Pathogenic organisms heated for 15 minutes are actually destroyed. I recently observed 143° on a temperature recorder, while the actual temperature of the milk was only 138°. Another recording instrument showed 143°, while the milk was actually heated to only 138 to 140°. Similar discrepancies in temperature were observed in other plants. The speed of the pump may differ and with increasing speed the heating power may be lowered. My feeling is that these very conditions suggest that the efforts of this body should be for accurately controlled apparatus used under present rules and regulations.

Mr. Whittaker, St. Paul: In a paper published in our Tenth Annual Report there are communications from official sources approving 145° for 30 minutes. To allow sufficient margin of safety they prefer 145° for not less than 30 minutes. I am interested in the health side of this question.

Mr. Archibald, Minneapolis: Dr. Harding's remarks might lead us to conclude that the authorities quoted by

him were more definite than they actually are. The report would be understood by those here, but it would be accepted by milk dealers as a signal for lower temperature.

Mr. Taylor: The term "pasteurization" has been variously defined. Most plants are pasteurizing under 145°. All thermometers should be checked and recording instruments checked about once a week.

At 145° under certain conditions as good a cream line can be obtained as in the original raw milk. If the heating medium used is not at too high a temperature, we can get as good a cream line as would be observed in the same milk unheated. Most scientists say 145° for not less than 30 minutes. We as an organization of inspectors should stick to that temperature and be satisfied with a cream line as good as that in the raw milk.

Dr. Harding, Detroit: Do you mean sharpness of line of demarcation or volume of cream? It should be clearly understood what is meant. Various sizes of bottles account for some difference. I am willing to accept 142° as a minimum, 145° as a maximum.

Mr. Taylor: I referred both to sharpness of cream line and to volume of cream.

Mr. Whittaker, St. Paul: I have here a copy of our Tenth Annual Report. On page 270 I find included in one of the papers the following communication from Dr Theobald Smith:

THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH
DEPARTMENT OF ANIMAL PATHOLOGY
Princeton, N. J.

February 28, 1921.

I have your letter of February 26, asking my opinion of the regulation of the U. S. Department of Agriculture concerning the pasteurization of milk. My opinion, subject to further thorough experimentation on the tubercle bacillus

in commercially operated plants, is that a temperature of 145° F. for not less than 30 minutes allows a slight margin of safety which should be maintained under commercial conditions. If further experimentation, as stated above, should actually show that this is a larger margin of safety than is needed, then I think it would be time enough to change the figures.

Very truly yours,
(Signed) THEOBALD SMITH,
Director.

Dr. Price: I do not know of any data covering the work done by the U. S. Public Health Service on which it bases an opinion favoring 145° as the temperature for pasteurizing milk. I realize that sentiment differs.

"The gem is polished by friction, man by affliction."

THE FAT CONTENT OF MOTHERS' MILK

DR. HULBERT YOUNG, *Manager,* Walker-Gordon Laboratory, Baltimore, Md.

Quite a number of specimens of mothers' milk have been submitted to our laboratory for analysis by the physicians of Baltimore. I am not able to give any definite numerical table of the reasons assigned for wanting these analytical results, but our impressions are that they are usually one of three: that the baby is not doing as well as could be expected, and the quantity being apparently normal and sufficient, it is desired to know if the milk is particularly rich or particularly poor; that the quantity is not ample for the baby's needs and supplemental feedings are to be prepared or the baby is to be weaned altogether; that although the baby is progressing nicely and the quantity seems ample, it is desired to know whether the milk composition suggests any possibility of disrupting existing favorable conditions.

Practically all reports of analyses of mothers' milk that have come to our attention suggest that, to quote Judson and Gittings, "if we draw up a table representing the most reliable series of analyses of mothers' milk we find that the variations are not very great, and that the figures all approximate to a general average."

Others state that the fat content varies, but leave the impression that the average given may be taken as a fair working basis. The largest number of analyses which we have seen reviewed has been 140 and the smallest, 18.

Our general impression is that the average fat content found in the specimens examined in our laboratory would probably agree with the published averages in the main. Notwithstanding this, we seem to have found a much wider divergence than we have found recorded.

A review of our records shows that 460 specimens have

been submitted and examined within the past few years and that the fat content ranged from less than 1 per cent to over 10 per cent. The second striking point in our results is that almost equal numbers of specimens were found within each half of one per cent of fat in those specimens containing from 1 to 5 per cent fat. The complete table is as follows:

0.0 to	1.0	per	cent	fat	15	specimens	or	3.3	per	cent	of	total number
1.0 to	1.5	"	"	"	28	"	"	6.2	"	"	"	" "
1.5 to	2.0	"	"	"	46	"	"	10.0	"	"	"	" "
2.0 to	2.5	"	"	"	72	"	"	15.8	"	"	"	" "
2.5 to	3.0	"	"	"	47	"	"	10.1	"	"	"	" "
3.0 to	3.5	"	"	"	57	"	"	12.5	"	"	"	" "
3.5 to	4.0	"	"	"	58	"	"	12.7	"	"	"	" "
4.0 to	4.5	"	"	"	50	"	"	10.8	"	"	"	" "
4.5 to	5.0	"	"	"	31	"	"	6.7	"	"	"	" "
5.0 to	6.0	"	"	"	25	"	"	5.3	"	"	"	" "
6.0 to	7.0	"	"	"	15	"	"	3.2	"	"	"	" "
7.0 to	8.0	"	"	"	10	"	"	2.2	"	"	"	" "
8.0 to	9.0	"	"	"	2	"	"	.4	"	"	"	" "
9.0 to	10.0	"	"	"	2	"	"	.4	"	"	"	" "
10.0 to	11.0	"	"	"	2	"	"	.4	"	"	"	" "

Richmond states the average fat content to be 3.3 per cent. Heineman gives it as 3.78 per cent, and our average is 3.2 per cent.

All of the specimens submitted were, of course, collected under the direction of physicians interested. Many may, however, have been collected wholly from the first of the flow, from the middle, or from the last portion, instead of being a portion of either the entire pumping or of equal quantities of the first, middle or last portions. We do not know and have no means of finding out, should we have the temerity to endeavor so to do, as to the manner of their collection, save where information is requested or volunteered. One of the physicians for whom specimens were examined is a pediatrician of national if not international reputation, and it occurred to us that the specimens submitted under his direction should certainly show contrary results if the general manner of collection had been faulty.

A comparison of the analyses of the 59 specimens submitted from him, however, showed practically identically

the same range of fat content and approximately the same relative number of specimens in each half of one per cent fat between 1 per cent and 5 per cent as did the total number mentioned and listed above. We believe it fair to assume, therefore, that although there may have been faulty methods employed in the collection of some of the specimens, the general practice must have been above reproach.

CONCLUSIONS

First. The appearance of a specimen of human milk is a very poor index as to its actual fat content as determined by the Babcock test.

Second. There seems to be a much wider range in the fat content of human milk than has been generally reported.

Third. Any single source of supply or specimen may conform or may vary widely from the average fat content of like sources or specimens.

DISCUSSION

Mr. Taylor, Washington, D. C.: In listening to this paper I was interested to note the wide variations which occur. In this connection I looked up some of my own records of analyses made several years ago, and submit them in the form of a table.

The analyst usually does not know the history of such cases nor just why the physician submitted the samples. A history of each case would make the records here very interesting.

It must be assumed that the physician submitting breast milk for analysis did so because some symptoms in the child or in the mother indicated that there was something wrong with the product. As a rule the child is not thriving, consequently an analysis was made to determine whether the milk was normal. Another thing of great importance is to know whether the mother is secreting enough milk for the child.

BREAST MILK ANALYSES

Fat	Solids	Lactose	Proteid (by difference)	Ash
2.10%	10.76%	6.09%	2.29%	.28%
2.80	11.20	5.80	2.38	.22
1.60	11.65	6.20	3.60	.25
2.00	10.52	6.45	1.81	.26
1.25	9.86	6.42	2.01	.18
3.00	11.54	6.00	2.40	.24
3.00	12.52	6.38	2.86	.28
1.30	9.68	5.72	2.22	.44
2.90	11.95	6.30	2.42	.33
4.80	13.40	6.51	1.89	.20
5.80	14.99	5.94	3.09	.16
1.00	8.59	5.38	1.87	.34
4.30	12.27	6.98	.78	.21
1.98	10.74	6.70	1.86	.20
4.20	12.68	6.60	1.72	.16
3.50	12.03	5.80	2.52	.21
Lowest 1.00%	Lowest 8.59%	Lowest 5.38%	Lowest .78%	Lowest .16%
Highest 5.80%	Highest 14.99%	Highest 6.98%	Highest 3.60%	Highest .44%
Average 2.85%	Average 11.53%	Average 6.20%	Average 2.23%	Average .25%

In these analyses it is shown that there is a wide variation in the percentage constituents of mothers' milk; but as to which samples are normal it is difficult to say. We know also that the composition of breast milk varies according to the age of the child, and that must be taken into consideration in determining a normal milk.

In the examples given it is thought that only a small percentage represent a normal milk from a healthy normal mother whose child is thriving on the product.

"Oh, Mirth and Innocence! Oh, Milk and Water! Ye happy mixtures of more happy days!"

TRANSPORTATION OF MILK IN METAL TANKS*

RUSSELL S. SMITH, *Market Milk Specialist,* Dairy Division, U. S. Department of Agriculture, Washington, D. C.

Metal tanks for the transportation of oil, turpentine, syrups and other liquids by rail and motor truck have been in successful use for many years. The use of similar tanks for the transportation of milk seems to be a comparatively new development. The development has no doubt been slow because of the perishable nature of milk, necessitating refrigeration, and the reluctance of the trade to adopt methods which had been untried on a commercial scale.

Transportation tanks, mounted on railway cars, on electric cars, and on motor trucks have been observed by the writer during their actual operation, and the purpose of this article is to elaborate on these observations and on the experiences of transportation tank owners, rather than to compare the relative merits or demerits of different types of equipment. In February, 1922, approximately 13 milk transportation tanks were in use on railway cars or on electric cars, and 68 on motor trucks or trailers.

TANKS MOUNTED ON RAILWAY FLAT CARS

In 1907, three glass-enamel insulated metal transportation tanks having a capacity of 3,120 gallons each were installed by two milk companies in Boston, Mass. This is thought to have been the first time tanks were used in the transportation of milk by rail. Two of these tanks were used continuously for five years. The other tank, owned by another company, has been in continuous use

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until the present time, averaging one round trip of 280 miles every fifth day between a country shipping station and the city plant. Because the tanks were insulated and were filled to full capacity there was only a slight change in temperature of milk during transit. Unloading was facilitated by having the car run alongside the city plants. When empty the tanks were rinsed and then steamed under pressure at the city plants and again before filling at the country cooling stations.

In 1920, two 2,875-gallon glass-enamel metal tanks were installed on two flat cars for the transportation of condensed milk a distance of 20 miles between a country condensery and a city plant. These tanks were placed at one end of the flat car to allow for a later installation of another similar tank on the same car. These tanks were constructed with double walls so that either air or a refrigerating medium could occupy the four-inch space between walls. This system would provide insulation or refrigeration for the product and thus allow for storage at the destination or for transportation over a longer distance. Unloading was facilitated by having the cars run alongside both the country condensery and the city plant.

An installation was recently made of six metal tanks in three refrigerator-type railway box cars, built for that purpose. Two tanks were securely braced one at each end of each car, and the space near the center of the cars was used for the pumping machinery. Each tank held 2540 gallons, thus making possible a shipment of 5,080 gallons of milk in one car, a distance of 106 miles from the country shipping station to the city railroad terminal. As the city milk plant was about 1-4 of a mile from the city terminal, a tank mounted on a horse-drawn wagon was utilized for conveying the milk across town, five round trips being made for this purpose each night after the tank car arrived.

TANK MOUNTED ON ELECTRIC CAR

One 3,500-gallon glass-enamel metal tank, mounted on an electric car and completely inclosed, is in daily use over a distance of 26 miles between a cooling station and a manufacturing plant. This tank is not insulated but is protected from the sun's rays by being inclosed. For loading and unloading the car is switched alongside both the cooling station and the plant. The tank is never loaded to capacity and is used for but one round trip daily, remaining at the car barn when not in use.

TANKS MOUNTED ON MOTOR TRUCKS

Metal tanks mounted on motor trucks or trailers, for the transportation of milk, are a more recent development. Their use has no doubt been influenced by the development of motor transportation and better roads, which make possible the establishment of receiving stations near milk-producing territory which hitherto has been inaccessible by rail. Metal tanks mounted on motor trucks for transporting milk were first used in California about the year 1912. Since that time the number has increased until in March, 1922, approximately 75 had been purchased for this purpose; but because of some difficulties seven of these were not in use at the time of this investigation.

Three kinds of material have been used in constructing metal tanks, viz.: copper, tinned copper and steel. Copper tanks are made of three sheet-copper plates riveted at the top and at the ends. The tanks are smooth and polished inside and painted gray outside. Some are covered with insulating material covered with heavy canvas which also has been painted. Tinned copper tanks are made of plates riveted or soldered together; and steel tanks are made of three sheet-steel plates with all joints welded together. Steel tanks used for transporting milk are coated inside with glass enamel which becomes fused with the steel

during the manufacturing process. The resulting smooth surface, with its possibility of easy cleaning, has met with favor in the milk industry.

It has been mentioned that of the total number of tanks purchased, seven were not being used, and some of the reasons for this have been noted as follows:

1. The haul between cooling station and condensery had to be made over rough, hilly roads with frequent steep embankments which made safe driving difficult.

2. Twice a week, coal was hauled from the condensery to the cooling station on the milk-hauling truck. If a tank were mounted on the truck the coal could not be transported.

3. The milk plant did not have a chassis of suitable weight for the tank. The intention, however, was to secure one later.

EXPERIENCES OF USERS

Inquiries made relative to the installation, operation and experiences of owners of 36 transportation tanks have revealed points which may be of interest. As the instances were quite different, some of those which bring out various phases of the subject are cited in detail.

(1) An 865-gallon tank was mounted on a four-ton truck. It hauled the full tank of milk for condensing, a distance of 8 miles over a dirt road between a country receiving station and the condensery. Two trips were made daily, the first beginning at 6.30 A.M. and the second ending at 2.30 P.M., when the day's work for the one man employed on the truck also ended. There was a platform around the tank which allowed a number of cans of cream to be carried. When unloading this tank quite a little time was wasted in getting the truck into the exact position so that a receiving pipe could be attached. The receiving pipe was a 3-inch tin drain-pipe 12 feet

long, soldered to a threaded-end piece of iron pipe. The pipe extended through a small opening in the wall to a receiving vat inside the plant. The tank was nearly filled with milk and there was a delay of 16 minutes before the tank could be emptied because no empty vat was available. It took only 12 minutes to empty the tank after the outlet valve was opened. This outlet valve on the tank was of special design and it seemed to be especially adapted for transportation tanks. Some dust was found in the tank outlet pipe before the coupling was made to the pipe leading to the plant. In such a case the dust should always be completely removed before the milk passes through. The temperature at the top of the milk in the tank was 63° and at the bottom 62°. When the tank was empty, the truck was driven to one side of the milk plant and tap water run in until it was about one-third full. This water was hauled part way back to the country filling point, then the valve was opened and the country road sprinkled. This seemed to be one way of making good use of the rinse water, as the road was extremely dusty.

The driver of the chain-drive truck was attempting to shift gears while climbing a hill and the change could not be made because of the shifting of the liquid. A setback occurred which made a strain sufficient to break one of the driving chains. The truck backed over the side of the road into a ditch and could not be moved until the milk, which had spoiled in the meantime, had been drained from the tank.

On one occasion the engine went wrong and the truck with the tank full of milk had to remain in the sun until 6 P.M. When the truck arrived at the plant it was found that all excepting about 12 inches of milk at the top was sweet. The top layer had soured.

(2) Two 525-gallon tanks were mounted on two 2-ton

trucks. Each hauled milk for condensing, twice a day, a distance of 12 miles over a dirt road between two receiving stations and the condensery. One man was employed on each truck. Ten minutes were required in emptying one 525-gallon tank which was full. Filling it one-third full with tap water took five minutes. This was the only washing prior to its return trip to be refilled with milk. The temperature of the milk was 63° F. One of these 525-gallon tanks had been in daily service for about eight years. It had been battered severely and had been soldered in five places. The manhole opening on this tank was raised about 8 inches above the top of the tank and it was poorly attached. On the other tanks the opening was lower and the general construction was better, which no doubt made them more serviceable.

The plant also received considerable milk from farmers delivering direct to the plant. This milk is hauled by private route collectors. One two-horse double-decked wagon hauled 50 ten-gallon cans of milk and made but one trip a day. A truck tank was not used on this route because of the many individual shippers contributing to the load. The milk received in cans in this manner was pasteurized and bottled for local trade.

(3) A 1,025-gallon tank was mounted on a five-ton truck. It made two or three trips a day over a dirt and macadam road, hauling milk from two receiving stations to the city plant 9 miles away. One man was employed on the truck, and the day ended at 11 A.M. for both the man and the truck. A platform around the tank made room for 34 cans in addition to the milk in the tank. The tank had a two-inch cork insulation and had two manholes in the top. Originally there was a partition in the center of the tank, but the shifting of the liquid had broken this and the metal of the tank had started to spread. The tank was braced on the outside by a metal

band at each end; these bands were not attached to the tank but served to hold it in position. When the tank was returned to the manufacturer, six metal tee bands were soldered to the tank for bracing. The tank was again placed in service for a three-year period which the manufacturers recommend before again overhauling the tanks and insulating material.

(4) A 950-gallon transportation tank was mounted on a 3-ton truck. The truck made one trip daily from one of the company's cooling stations 22 miles away to the city plant and return. There was no platform around the tank and no further use was made of the truck after it returned to the cooling station. A small motor truck went from the city plant to the cooling station each morning to transport in cans the milk which was left over after the large transportation tank was filled. The milk went into the transportation tank from the cooler through a one-inch pipe and it took about an hour to fill the tank. This tank was not insulated but was lettered and painted yellow with black trimmings and was very attractive for advertising purposes. Because of the low temperature of the milk, about 45° F., moisture gathered on the outside of the tank and when dust collected it was difficult to keep the tank clean. One man was employed on the truck and he took great pride in keeping it neat and clean. He worked at the cooling station during the afternoon when there was not enough milk to warrant a second trip. With the exception of about four miles the entire trip of 22 miles was on a macadam road. In riding on the truck it was noticed that there was considerable strain on the engine when gears were shifted, that the tank bulged considerably, and that the truck skidded slightly when going around a curve at a good speed, all due, no doubt, to the shifting of the liquid in the tank. The tank was fastened to the truck body by two steel bands; these were

not quite tight and a slight wearing effect was noticed where the bands were in contact with the tank.

The tank was about three-fourths full on this observation trip. The temperature of the milk at the start was 50° F. and at the end of the 22-mile trip it was 55° F. The time of the trip was 1 hour, 18 minutes. The air temperature was 78° F. Because of other trucks being unloaded at the city plant the truck with the tank had to wait 17 minutes before being driven into a position for unloading. It took three men 15 minutes to make the proper pipe connection with a 1½-inch pipe; one man was stirring the milk through the top manhole during this time and also during the 15 minutes required for gravity flow before the tank became empty. The tank was then rinsed with cold and next with hot water. This took about 10 minutes, after which it started on its return to the cooling station.

It became possible to note a comparison of time between receiving milk in cans and washing and returning cans to a motor truck which was just ahead of the tank truck, and the time of emptying and cleaning the tank.

The truck carried 75 cans of milk, some of which were 5-gallon cans. The entire load was about 400 gallons. Because of a very efficient system of receiving, weighing, and recording milk, the entire load was taken care of by four men in 15 minutes. The empty cans were placed in the near-by can washer and steamer and were back on the truck 5 minutes after the milk had been received. The entire operation was accomplished in about 20 minutes, or in about the same time required to drain the tank, containing 800 gallons of milk, and then wash the tank inside and outside before its return.

The following table shows the time of the trip and the temperature of the milk at the start and at the end, on

five days when both forenoon and afternoon trips were made. The tank was not quite full. The mean average air temperature for the period was 74° F.

TABLE I—TEMPERATURE CHANGES AND TIME FOR TRIPS WITH MILK TANK.

Air temperature *Degrees F.*	Temperature of milk at start *Degrees F.*	Temperature of milk at end *Degrees F.*	Increase in temperature of milk *Degrees F.*	Trip started	Trip ended	Time for trip *Hrs.*	*Min.*
86	45	53	8	9.45	11.15	1	30
84	47	55	8	2.45	4.00	1	15
82	44	49	5	10.05	11.15	1	10
84	45	52	7	2.45	4.00	1	15
78	45	51	6	9.45	11.05	1	20
81	46	57	11	2.00	3.15	1	15
78	45	52	7	9.50	11.20	1	30
84	48	58	10	2.30	4.00	1	30
76	45	51	6	10.05	11.20	1	15
79	47	57	10	3.15	4.30	1	15

It will be noted that the rise in temperature in the afternoon was greater than in the forenoon. It must also be noted that the tank was not full; the quantity varied from 600 to 800 gallons, while the capacity of the tank was 950 gallons.

(5) An owner having in daily use two metal transportation tanks had one 1,025-gallon tank operating over a distance of 37 miles between a country cooling station and the city plant, making one trip a day. The road was macadam for the entire distance. Table II is a temperature record and time for the trip on five days. The mean average air temperature for this period was 65° F. The tank was full.

(6) A 2,000-gallon metal tank was operated for a distance of 30 miles between a country cooling station and a city plant, making one trip a day. The road was macadam for the entire distance. The tank was mounted on a 5-ton truck and was insulated with about 2 inches of cork which was covered with a close-fitting canvas cover painted white.

TABLE II—TEMPERATURE CHANGES AND TIME FOR TRIPS WITH MILK TANK.

Air temperature *Degrees F.*	Temperature of milk at start *Degrees F.*	Temperature of milk at end of trip *Degrees F.*	Increase in temperature of milk *Degrees F.*	Trip started *A.M.*	Trip ended *P.M.*	Time for trip *Hrs.*	*Min.*
78	42	46	4	11.05	2.30	3	25
74	46	48	2	10.00	1.45	3	45
67	43	49	6	10.10	1.45	3	35
77	46	52	6	9.50	1.25	3	35
54	49	50	11	10.00	1.20	3	20
59	40	46	6	10.05	2.45	4	40

The tank was filled full each trip to lessen the chance for churning. The average mean air temperature for this period was 66° F. The following time and temperature changes were recorded:

TABLE III—TEMPERATURE CHANGES AND TIME FOR TRIPS WITH MILK TANK.

Air temperature *Degrees F.*	Temperature of milk at start *Degrees F.*	Temperature of milk at end *Degrees F.*	Increase in temperature of milk *Degrees F.*	Trip started *A.M.*	Trip ended *P.M.*	Time for trip *Hrs.*	*Min.*
71	52	54	2	10.05	12.20	2	15
64	53	54	1	10.30	1.05	2	35
68	44	46	2	10.40	1.20	2	40
75	44	46	2	10.00	1.00	3	0
72	52	54	2	9.50	12.20	2	30
63	44	46	2	10.00	12.30	2	30
73	50	52	2	10.20	1.10	2	50
76	56	58	2	9.50	12.30	2	40

It was possible to secure a rough comparison between the time of emptying the tank at the city plant and that of receiving the milk hauled in cans. It has been repeatedly observed that a truck having milk in cans arrived and left at about the same time as the truck tank. The truck with cans carried from 80 to 100 ten-gallon cans of milk. The cans were emptied, washed, sterilized, and returned while the tank was being emptied through a 1½-inch pipe. The milk was drained from the tank by gravity into a receiving vat inside the plant, and was then pumped to

a higher level in the plant where it was pasteurized and bottled as whole milk.

(7) An owner had in daily use a 1,000-gallon metal tank for transporting milk from the country receiving station five miles away to his creamery and condensery where the milk was condensed or separated for butter making. There was a 2-inch insulation of cork over which there was a metal jacket which formed the outside of the tank. The tank was bolted to a frame with skids and when not in use it rested on a platform outside the company garage. A 3½ ton truck with regular general-service body was used for transporting the tank. For loading the tank upon the truck body, the truck was backed into the proper position and then the driver (usually alone) used iron rollers and a rope tackle to move the tank and slide it into position. The skids were then bolted to the truck body. At the end of the trip the reverse operation placed the tank back on the platform until the following day, thus releasing the truck for other duties. The platform and skids for the tank were decided upon after consideration of some plans for leaving the tank suspended from a pulley and rope tackle during the time it was not in use. The owner was very much pleased with the results gained by using the transportation tank in the present manner. It took one man 20 minutes to load the tank upon the truck body.

It required from 45 minutes to 1 hour to fill the tank by pumping in the milk as it was received from patrons, and from 15 to 20 minutes for it to be emptied by gravity into the receiving vat at the creamery. In cleaning the tank, the driver rinsed it out with cold and then hot water. Previous to starting for the milk the tank was rinsed with cold water. A greasy film was noticed on the inside of the tank, and in the outlet pipe at the rear end there was an accumulation of scum with some dirty rinse water. This showed that regular scrubbing and thorough steaming of

the tank had not been practiced, as it should be if the tanks are to be used at all.

The temperature changes were limited to from 2 to 5 degrees in all kinds of weather, and as the milk was not to be sold as whole milk no particular attention had been paid to cleanliness. Aside from the fact that no milk had been received in a sour condition, the principal saving was in the cost of cans and the labor of washing them.

The removal of the tank from the truck, thus releasing the truck for other uses, is the striking feature of this installation. The loading device was rather crude, but the principle seems to be proper; and it could no doubt be applied to many transportation tanks and so release trucks for other useful purposes.

(8) An owner of two 830-gallon transportation tanks had them in daily use. One of the tanks was mounted on a 5-ton motor truck and the other was on a trailer drawn by the truck. This was the first installation of transportation tanks by the manufacturers of this particular make. Their representatives have since put in several changes because of their observations on this installation. The first change recommended was that the heavy lid with its many separate clamps should be displaced by an aluminum lid with fewer clamps, all controlled by a center wheel, and then finally it was decided to have the lid hinged.

Another change was made when the springs on the trailer were too greatly affected by the weight of the tank. Extra leaves were supplied to the springs and the trailer was shortened about a foot. With this change no further trouble was encountered from this source. The hitch between trailer and truck had been a matter of concern because of the weight of the load on the trailer and the experience gained when the trailer once broke away with the tank full and ran over the roadside, finally landing in an up end position. Later in the day, after the trip had been made to the creamery with the other full tank, the trailer had to be

drained before it could be recovered. The present hitch was made with a double bolted lock, and a chain hitch is also used as an additional precaution.

A feature of the attachment to the truck was the wooden cradle with its end braces for the tank. At all points of contact there was a layer of rubber one inch thick and 4 inches wide. This served as a shock absorber, and its use on other installations will be recommended by the tank manufacturers. These transportation tanks were used for hauling skim milk from the company's creamery to its condensery, a distance of nine miles. Two trips a day were made. the second trip ending at the condensery about 2 P.M., this completing the day's work for the truck and driver. The time in transit was about 1 hour and 20 minutes over a rather rough dirt road. The truck had a platform around the tank which allowed 37 cans to be carried. Upon its arrival the skim milk was stored over night in an insulated tank where it was agitated but not refrigerated. In the morning it was made into sweetened condensed skim milk. The time required for emptying each tank by gravity was 15 minutes. When the tanks were empty, the driver entered each with a brush and a rubber hose and thoroughly cleaned them inside. He scrubbed the tank inside and outside twice a week, taking much pride in its appearance.

On one occasion the engine went wrong and the tanks full of skim milk were delayed for a long enough period in the sun to spoil the milk. On one other occasion a delay, because of motor trouble, caused the truck with full tank to arrive at the condensery as late as 5 P.M. The milk was worked up but it was nearly spoiled. Skim milk is hauled in summer, and sour cream in winter.

The following table shows temperature changes in the skim milk during transit under different air temperatures, when the tanks were full and half full:

TABLE 4—TEMPERATURE CHANGES AND TIME FOR TRIPS WITH TANKS FULL AND HALF FULL.

Maximum air temperature	Temperature of milk at start	Temperature of milk at end of trip	Increase in temperature	Time for trip	
Degrees F.	*Degrees F.*	*Degrees F.*	*Degrees F.*	*Hours*	*Minutes*
		Full tank			
75	65	66	1.	1	27
75	63	63.5	0.5	1	10
75	61	62	1.	1	10
81	72.5	73	0.5	1	3
81	61	63	2.	1	15
		Trailer tank half full			
76	66	68	2.	1	27
75	62	65	3.	1	10
81	61	66	5.	1	15

CONCLUSIONS

Tanks on Railway Cars

Metal tanks mounted on railway flat cars for transportation of whole milk and partially condensed milk are in successful daily use. This method of transportation of milk seems to be the best adapted to full tank shipments between a country shipping station or condensery located adjacent to a railroad siding, and a city milk plant or condensery also located adjacent to a railroad siding. When the rail shipment ends at the city railroad terminal, additional facilities have to be provided for transporting milk to the city plant, and the problem then becomes more complex.

Change in the temperature of milk during transportation in metal tanks mounted on railway or electric cars is influenced by the volume of milk, its temperature, the temperature of the outside air, the temperature of the metal tank, and the time in transit. The change can be reduced to the minimum by covering the tanks with insulating material, by inclosing the tank so as to avoid the sun's rays, by properly cooling the milk, by filling the tank full, and by avoiding delays in transit.

Shipments of milk, poured into the tank from the far-

mers' cans at different railway or electric stations along the route, have not as yet demonstrated a desirable method.

Tanks on Trucks

Metal tanks mounted on motor trucks, trailers and horse drawn vehicles for transportation of whole and skim milk are in successful daily use. This method of transportation of milk seems to be best adapted to full-tank shipments between milk receiving stations and condenseries or city milk plants, connected by good roads which are without many steep grades. It has not as yet been demonstrated that tanks on motor trucks are desirable for milk-collecting routes where the milk from the farmers' cans is poured into the tanks for transportation to the condensery or city milk plant.

Change of temperature of milk during transportation in metal tanks mounted on motor trucks, trailers, or horse drawn vehicles is influenced by the same factors, and may be reduced by the same precautions, as with tanks mounted on railroad cars.

The prevailing method of cleaning the tanks seemed to consist of flushing them out with cold and hot water. Only one instance of scrubbing the interior with a brush was noted; this occurred twice each week.

The outlet pipes varied in size, and this influenced the time required for emptying the tanks. The ideal method would be an extra large outlet pipe which would allow a gravity flow of the milk into an empty receiving vat in the plant.

While the cover or lid of the tank opening was at first removable and quite heavy, great improvement has been effected by having it made lighter, hung on swivel and spring hinges in some cases, and in some other cases fastened with a center wheel or one-screw clamp.

Another important improvement has been to reinforce the tank with tee iron bands, six or eight in number, soldered

to the tank, instead of having only two flat bands which were not attached.

The mistake of ordering tanks so large that their full-load weight is in excess of what is suitable for the chassis calls attention to the fact that truck owners should be careful about overloading when installing transportation tanks for milk. Aside from danger of violating the laws in some States relative to overloading motor trucks, there would no doubt be some danger of breakdowns or engine trouble.

The lack of economy when the tank is fastened to the motor truck so that the truck can be used for no other purpose is illustrated by the case in which an owner used the entire outfit for only one trip daily between his country receiving station and his city plant; and even then had to use a smaller truck to bring in the excess milk.

Economical use was made of a tank where it was so arranged that it could be put on and off the truck body at will, and was removed every day at the end of the trip, leaving the truck to be used for other service. Installations already made can in some cases be altered to adapt them to this principle.

Special attention should be given to cooling the milk to a low temperature before it enters the transportation tank, as the condition of the milk when it arrives at its destination depends largely upon its condition and temperature at the starting point.

Proper cleaning and sterilization of transportation tanks after each shipment is essential.

"Cost is the father and compensation is the mother of progress."

DAIRY CONTROL

FRED D. WALMSLEY

Vice-President, Borden's Farm Products Company of Illinois

As a general rule, milk reaches the consuming centers through two distinct routes, namely, the direct can shipper and the receiving station in the country where the milk is processed for the consumer and shipped in cans or bottles. In this discussion, we will be confined to farms coming under the latter heading, as ordinarily this plan proves more satisfactory.

First, from a direct shipper's standpoint, if there is a condition which makes the milk unfit for consumption in a fluid state, it is generally too late to make use of it in any other channel. The receiving station plan makes possible a more rapid correction of the causes for unsalable milk.

The hygienic quality of milk depends very largely on conditions existing at the dairy farm; therefore, a thorough knowledge of these conditions and the personal habits of the dairyman is essential if the inspection is to be of very much value.

Without doubt, the dairy score card system is the oldest and most reliable single agency in obtaining improved dairy conditions. It brings together the representative of health bodies and the dairyman and makes possible a better understanding of the other's problems. Like any measuring device, it tends to record in systematic form the results of the producer's efforts.

Unfortunately, many forms of dairy score cards are in use. We feel that a more uniform, essential score card could be adapted to the needs of most of the milk producing territories, and thereby increase the dairyman's interest in

the production of better products. A uniform score card for sections where two or more large milk producing centers join is especially desirable.

Change of prices for dairy products ofttimes causes a migration of dairymen from one market to another. Such differences in price are very likely to raise the question as to what are really essentials for the production of milk of satisfactory quality.

The word "sold" is used very frequently in the commerce world. Dairy control, to be efficient, must be "sold" to a dairyman to the end that he will lend his best efforts to produce a satisfactory and salable product.

In the very beginning of the fluid milk industry, all milk was produced near the consumer, and delivered to the consumer fresh from the cow and within a couple of hours of milking. As time elapsed and the centers of population enlarged, the producing sections were further removed from the consumer, thereby destroying all personal contact and necessitating municipal rather than personal control.

The practicability of transporting milk by railroad had long been established, but as some of the milk in warm weather was found to sour quickly, the use of ice became necessary.

The measuring of fat in milk made possible milk standards and aided materially in preventing adulteration and in determining the value of milk as a food.

Fluid milk prices were made enough higher than butter and cheese prices to produce a revenue sufficient to create an interest in the building of larger and more sanitary barns, milk houses and ice houses.

Following this period of pioneer work came the printed score card, which provided a numerical value to each phase of milk production. Thus, the good barns, milk houses, cement floors, noted today, are a natural consequence of the active work in scoring dairy farms.

The effect of certain germ life on the character of the

milk has received and continues to receive attention and has made clearer the essentials for satisfactory milk production. The infectious nature of bovine tuberculosis was established and the healthy dairy cow is destined to replace all others. As there are a number of conditions which may affect milk even before it leaves the cow's udder, the cow should receive a very thorough physical examination by a competent and interested veterinarian, and no animal which shows evidence of a contagious or infectious disease should remain with the milking herd.

Healthy cows should have a comfortable, clean stable with plenty of fresh air and water, and no spoiled food should be allowed to become part of the herd's rations. The attendant should be habitually of clean habits and himself and his family free from contagious disease. The vessels which receive the cow's production should be of bright tin, well constructed and in good repair. Heat applied to the utensils after the washing operation is important, and the mere fact that the pails or cans are not sufficiently washed and scalded may be the means of spoiling milk.

Milk rooms vary much in construction and distance from the barn. A milk room far enough from the stable to be free from stable odors, yet close enough to permit the dairyman to use it regularly, is most satisfactory.

With the increasing knowledge of the effect of bacteria in milk, steps should be taken to prevent as far as possible the entrance of germ life into milk. Maximum bacterial limits for milk call for increased interest in preventing all forms of contamination and the laboratory becomes an adjunct to the score card in a thorough dairy control system. The dairyman must have a knowledge of bacteria, how they grow and multiply and what they do, for unless he understands conditions permitting bacteria to multiply and their effect in milk, he will not be able so easily to prevent and control contamination. A number of the larger distributors of fluid milk have, through the installation of labora-

tories, brought this story to the dairyman and given him the knowledge that is so necessary.

With the direct microscopic method there are some advantages, probably the most important of which is the short time required after taking a sample before the results can be obtained and corrections made where necessary. This method will quickly differentiate between the dairyman who habitually endeavors to take the best possible care of his milk and the one who is generally slack in his methods. If a field man, by laboratory means, can educate a dairyman to the point where he will recognize that he has produced a milk of high bacteria content, and can demonstrate to that dairyman's satisfaction where the point of contamination is, he will have accomplished a great work and bettered the milk supply considerably. Such results are generally accomplished by the aid of the standard plate method of counting, as results are more accurate and the dairyman may be better satisfied with the old established method.

Some producers do not seem to have the understanding or touch necessary to produce milk of satisfactory quality. A field man visiting such a farm finds everything apparently in good shape, but he takes samples from utensils and various places and also of the milk as it leaves the individual udders. After the samples are analyzed, it may be found that one-quarter of an udder was responsible for the trouble, the cans may not have been properly sterilized, or the utensils, such as pails and strainers, were not properly cared for. The results of such laboratory examinations are taken to the farm and measures for their correction are immediately taken.

The laboratory in this way actually keeps a watchful eye on the quality of the milk. For instance, it has been found that high bacterial content in night's milk is as a rule due to lack of proper and efficient cooling, while high counts in morning's milk are generally the result of improper washing and sterilizing of utensils. High counts in both morning's

and night's milk can be generally attributed to the individual udder, unclean milking, or a lack of sterilized utensils, especially during the summer when milking machines are used and not cared for.

One of the great benefits of inspection of dairies is the contact inaugurated between health bodies or distributors and the individual farmer. With the assistance of the laboratory, this phase of the work is doubly valuable as it brings the different factors more often into conference and a better exchange of ideas and better understanding of the problems involved.

Successful dairy inspection tends to prevent contamination of milk. Aside from its composition, quality in milk is practically a question of dairy control. We note from many quarters the dangerous thought that pasteurization of the milk alone is sufficient. We should not regard this operation as capable of making a poor product good, but rather of protecting the quality already established and insuring absolute safety.

"Fortunate is he whom the dangers of others have rendered cautious."

THE RELATION OF TEMPERATURE TO CREAM LAYER IN PASTEURIZED MILK

CHAS. H. KILBOURNE

New York City

It so happens that I am a member of your Committee on the Pasteurization of Milk and this committee in its report is taking a quite positive stand as to the temperature which shall be considered as standard for the pasteurization of milk. One of my objects in presenting this paper is that I wish to give some reasons why I think this body should approve the report.

We know the principal reason why public authorities are insistent that milk shall be pasteurized is because this process destroys or renders harmless any bacteria in milk which are considered to be dangerous to man. By this means the milk dealer is able to avoid loss from sour milk. The public at large does not *care,* because as a rule it does not *know.* The public, however, does know when the taste of the milk is not agreeable, and also knows when the cream layer on the milk bottle seems to be narrow or invisible. People may then think they are being deprived of the proper amount of cream.

I have made an effort to determine in some degree the extent to which the cream layer is affected by the different degrees of heat applied for different periods, and I wish to present my observations to you. This may seem useless labor in view of the extensive work of Prof. Harding and others last year, but every additional fact serves either to strengthen conclusions already formed, or else to break them down.

My work has been carried on at plants equipped with standard apparatus, supplied by various manufacturers. My

object has been to find what actual results are obtained in the ordinary course of milk handling. I have also made some experiments to find the results when the milk is heated in bottles and held for varying periods of time. This latter test gives us some idea of the effects which are secured when factors other than heat and holding time are absent.

In 1914 I made a series of tests which were at the time published, and were later embodied in a book. These tests, which were made in eight different plants where different types of apparatus were in use, showed that at no place did the milk which had been heated show a greater volume of cream than was secured on milk which was raw, or unpasteurized. In most cases, especially at the higher temperatures and for the longer holding times, the volume of the cream was very materially less than in the raw milk. In some few instances, however, the amount of cream on the heated milk was the same as on the raw article. Some surprising results were found, as, for instance: In milk which was held for 50 minutes at 145°, the volume of cream was equal to that on the raw milk. Again, milk which was heated to 143° and held for 30 minutes had but 10 per cent of cream, as compared with 13.5 per cent on the raw milk, and this when other conditions surrounding the process were apparently very favorable. These facts seem to indicate that there are various factors affecting the creaming of the milk other than the temperature and the holding time.

The tests which I have made more recently confirm the impression that there are other important influences which affect the creaming. Without burdening you with the full details of the work done, I will say that I have carried on the work at five plants having different forms of equipment, and while the number of individual tests is not large, the results are, I think, interesting and briefly are as follows:

At one plant where a tubular heater and a continuous flow type holder was in use, milk which left the holder at 140°, after being held for about 30 minutes, showed

11 per cent of cream, as compared with 17 per cent of cream in the raw milk. Later, in the same apparatus, milk which left the holder at 145° had 12 per cent, and in another test, 14 per cent of cream.

At another plant having a similar equipment, milk leaving the holder at 145° and held for 30 minutes showed 8 per cent of cream, which was the same as was observed in the raw milk.

At a third plant where the heating and holding was done in a vat, the temperature of the milk was 143°, the holding time was 40 minutes, the cream shown was 14 per cent, while the raw milk had 17 per cent. Other samples pasteurized at 143° showed a cream layer of 16 per cent. In both instances there was an apparent reduction of the volume of cream in the pasteurized milk.

At another plant the heating was effected by still another form of tubular heater, and a flow type holder similar to that used at the first plant mentioned. The holder was said to fill in 30 minutes. This would mean the actual holding time was somewhat less than 30 minutes, since there is always a certain amount of mixing of the milk in this form of holder. At this plant the milk left the holder at 143°. The volume of cream in this milk was 11 per cent, and nearly the same as in the raw product. Another sample of raw milk at the same plant had 13.5 per cent and there was in the pasteurized milk 12.5 per cent of cream.

At the fifth plant, the milk was heated in a tubular heater and held in a series of seven tanks which were surrounded with hot water. In this apparatus the milk left the heater at 137°. During the holding of the milk in one of the tanks, the temperature of the water surrounding the milk was high enough to raise the milk temperature to 140°, at which point it left the tank after being held exactly 30 minutes. In another of the tanks, the incoming milk had a temperature of 140° and the outgoing milk 142°. The raw milk had a cream layer

of 10 per cent while the pasteurized milk from the first tank had 15 per cent, and in the second, 16 per cent of cream. This seems to be abnormal, and I am unable to explain it. The raw milk was well mixed and was that which was flowing from large storage tanks in which the mixing was well done. The pasteurized milk was taken from the top of the holding tanks in which the milk had not been stirred during the holding period. It was claimed, however, that the cream did not rise on the hot milk. In order to counteract any possible cream separation, my samples were taken with a dipper with which I stirred the milk before sampling it. Unfortunately the amount of butterfat was not ascertained.

When we consider the uncertain effects produced on the cream layer and possibly on the taste of the milk which is treated at the higher temperatures, it seems to me there are dangers which would confront the adoption of minimum temperatures higher than 142°. I think the possible benefits do not equal these dangers. It is granted that greater reductions in bacteria content result when milk is held at high temperatures for long periods of time. But in seeking for low counts are we not, perhaps, getting away from the main object for which pasteurization is done? It is not our main object to secure low counts, but rather to make sure that all so-called disease producing bacteria if present are killed. The principle reason why authorities have required pasteurization of milk is because epidemics of typhoid, septic sore throat, etc., seemed to follow the use of unpasteurized milk. So far as I know, there is no evidence that any such epidemics have followed the use of mlik which has been so treated, except when it has been shown that the milk was reinfected after treatment. The possibility that some of the so-called pathogenic bacteria may escape destruction when the minimum temperature is 142° can, I think, be remedied when we secure more accurate control of temperature, holding time, milk flow, and steam

pressure. I am impelled to think that the matters which call for special attention are to secure more accurate control of these features before we attempt to increase the standard pasteurizing temperature.

I am, therefore, strongly in favor of requiring the heating and holding of milk at a minimum temperature of 142° for no less than 30 minutes.

DISCUSSION

Mr. Smith: How were temperatures taken?

Mr. Kilbourne: All temperatures were taken by me with my own accurate thermometer. All cream measurements were made after the milk had stood for about four hours.

Mr. Archibald, Minneapolis: We made readings of cream volume after about 20 hours, or at the time when the consumers received the milk. Twenty-three out of thirty reported satisfactory cream lines. Only four reported less. Most all agreed that the cream volume was equal to the cream volume in the same milk in a raw condition. One plant pasteurizing milk at 145° for 30 minutes is not having any difficulty with the cream layer. It may be a little more difficult proposition at some of the larger plants.

"Yet the deepest truths are best read between the lines, and, for the most part, refuse to be written."

TRANSPORTATION AND HANDLING OF MILK

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The subject of milk handling has been so well presented in former papers that there remains but little to be added. However, faulty refrigeration or the total lack of ice "en route" is the reason for much monetary loss to all concerned, especially to the consumer. There has not been sufficient emphasis laid on this, the main source of trouble. As long as the railroad authorities assume the attitude of carelessness toward milk dealers by neglecting to furnish ice in milk cars during the summer months, it is beyond the control of dealers to apply a remedy. The only alternative is for the producer to cool his milk in a thorough manner as soon as possible after milking and keep it cold until shipped. This will partly overcome the loss from souring in transit.

Milk cooled down to 45 degrees F. soon after milking and held at this low temperature until delivered to the railroad station or truck will arrive at destination within a reasonable time in good condition. I am able to state that milk so handled, shipped with other milk, reached the dealer eight hours after shipment in good condition.

Other conditions must also be regulated. Cans must be clean and handled with care and not left exposed to the sun and dust. Intelligent cooperation with the producer will encourage him to act favorably on the suggestions made by the inspector in these as well as other matters and for the benefit of all interested parties.

"The life of a pioneer is not an easy one."

REPORT OF COMMITTEE ON SERVING MILK IN SCHOOLS

DR. C. L. ROADHOUSE, *Chairman*

The Committee on Serving Milk in Schools was appointed to study the methods used in the care of milk served in schools in the various cities in this country, with the view to preparing recommendations that might be followed by school authorities.

The committee appointed this year was composed of 35 members. Letters were sent to each member requesting a report from his district. Reports were received from 39 cities in this country and one from Canada, indicating that milk is served generally in schools throughout America. In most cities the serving of milk has been started in the past year or two and reports show a rapid increase in the number of new cities and schools.

SUMMARY OF REPORTS RECEIVED

A summary of the forty cities reported indicates the serving of milk to graded schools in forty cities and to high schools in one city. Six cities used pasteurized milk, fifteen used raw milk, one raw milk from accredited herds, and eighteen failed to specify the kind of milk served. In nine of the cities the milk was served from bottles by means of straws, nine used straws or drank direct from the bottle, five drank from the bottle direct, five drank from the bottle or poured the milk into cups furnished by the pupils, and four used straws or cups furnished by pupils.

In eleven cities milk was served only to children below average weight, and in twenty-nine cities it was served to children underweight and to others that would take it. The price paid for milk varied from three cents to four cents per half pint. In one city it was served at 10.30 A.M. and

2.30 P.M. All others served it in the morning only.

When children were not financially able to pay for the milk, funds were secured from organizations to pay for the milk used by under-nourished children. The following organizations in various cities supplied funds: Parent-Teachers' Associations, Dairy Council, School Nutrition Committee, Masonic and Elk Lodges, Junior Red Cross, Council of Jewish Women and Consumers' League.

In Buffalo one-third of all children in schools were served milk. The bottle caps are wiped with a paper napkin before serving. Yakima, Washington, sold 103,708 half pints to pupils and donated 22,388 half pints during the year. In Friday Harbor, Washington, the milk is served by high school girls; in Marshall, Missouri, it is served by girls of the seventh grade who wear white aprons and caps; in St. Louis it is served by volunteer women workers of the Red Cross; and in Winnipeg it is served under the supervision of a nurse, furnished by the dairy supplying the milk. Springfield, Massachusetts, reports the monthly sampling and examination of the milk.

Recommendations for Serving Milk in the Schools

1. *Quality of Milk.* Emphasis is placed upon the desirability of securing milk of the highest sanitary quality. Dairy farms with healthy cattle and facilities for cooling milk and sterilizing dairy utensils and milk distributers with facilities for thoroughly cooling milk and efficient sterilization of equipment should be given the preference in purchasing milk.

2. *Delivery.* Since the milk distributor has facilities at his plant for keeping milk in good condition it should not be delivered to the school until just before the time of serving. Milk delivered in metal-lined cases and covered with ice may be held at the school without deterioration. Milk carried to school by children should be placed in sterile milk bottles.

Where it is impossible to secure delivery of milk just before serving or in refrigerator cases the school should provide refrigerator boxes for keeping milk cold.

3. *Method of Serving Milk.* Milk should be served from the original container by means of straws purchased in sanitary paper wrappers. Bottles of milk should be inverted to distribute the cream before removing cap, and the cap removed at time of serving. The straws may be inserted through a small opening in the cap to prevent spillage of milk.

4. *Sampling.* Samples of milk should be collected regularly by the Department of Health and examinations made for sanitary quality and adulteration. Even though samples of milk from the same supply are collected elsewhere, there is an educational value in taking samples at the school and it would tend to discourage the serving of "left-over" milk, which might be practiced by uninformed teachers.

Marked benefits have been recorded from the serving of milk to school children in different cities, where it is used alone or with graham crackers or a sandwich. A description of such benefits by a teacher of the seventh grade of the Powell School of Washington, D. C., will serve as an example, and is as follows:

"In my seventh grade class of last year, I found the use of milk at the half past ten recess very beneficial, both physically and mentally. My class of thirty-seven pupils began taking one-half pint of milk the latter part of December. The posture test taken on February 23rd showed a rating of 55.8 per cent. On March 27th, when another test was made, the rating had increased to 64.7 per cent. On May 1st, a third test showed a rating of 77.7 per cent. I feel that this rapid improvement was due in a great measure to the nourishment the children derived from the milk. Their power of concentration and attention to their studies also improved."

If the quality of milk is satisfactory, too much cannot be said in support of its use in schools.

DISCUSSION

Dr. Shoultz, Winnipeg: Increased weight and mental efficiency has resulted from the use of milk in schools. One half pint of milk, with the straw and biscuit, furnished for 3 7/12 cents, permits the creation of a small fund for indigent children.

Mr. Chilson, Detroit: We have been feeding milk to school children for some years. The Health Department secured an appropriation of $2,000 to correct poor nutrition. Certain children received one half pint of milk and two graham crackers. Seventy-five per cent of the children in the schools paid for their milk.

Prof. Roadhouse, California: In most places school children go to a separate room to receive the milk. We have not dwelt on details in the serving of milk. The use of milk in the schools has become a nation-wide movement during the past year or two. We should publish our recommendations on this subject.

"Health and understanding are the two great blessings of life."

REPORT OF COMMITTEE ON DAIRY METHODS

PROF. T. J. MCINERNEY, *Chairman*

One authority on milk production states that no greater field of usefulness exists than that of producing milk for human consumption. Those engaged in the production of milk carry responsibilities regarding which the public should be informed, because when milk is carelessly produced or carelessly handled much damage to the health of a community may result.

CARE OF CATTLE

First of all in the production of clean milk it is necessary to have healthy cows. If cows are diseased, their milk may contain disease-producing bacteria or be otherwise unfit for use. Special attention should be given to the condition of the udder, and any milk that appears slimy, ropy, watery, colored or otherwise abnormal, should be discarded. A skilled veterinarian may do much to determine the general health of a cow by giving her a thorough physical examination.

In New York State since 1916, all cows producing Grade A or B milk must pass an annual physical examination by a competent veterinarian.

Probably the tuberculin test is one of the best methods we have for detecting tuberculosis in cattle. Cows should be tested for tuberculosis at least once a year by a capable veterinarian, and if disease is found, the test should be made twice a year. Dr. Moore recommends that if on the first test 50 per cent or more of the cattle react, that the entire herd be slaughtered, the reason being that if so many react the first time, there will be many reactors on the following tests and it will be better in the end if the herd is slaughtered at once and the place thoroughly disinfected.

CLEANLINESS OF BUILDINGS AND SURROUNDINGS

High ground, sloping toward the south or the east, is desirable for a barnyard, for a slope in either of these directions protects animals from the prevailing winter winds. Pig pens, outhouses, piles of manure, and the like, left standing in the barnyard, may be sources of contamination.

The construction of the stable may be of less importance than careful methods in the production of clean milk, but it should be such as to lighten the labor necessary for keeping the stable and its equipment clean. The most common defect in dairy stables is lack of cleanliness. The interior of the barn should be so constructed that dirt, cobwebs, and the like cannot easily collect. The stable floor and the gutter should be made of some material, such as cement, that will not absorb moisture, but is easy to clean and disinfect in case of necessity. A swing stanchion is more comfortable for a cow than a rigid one, and it should be so constructed that it does not collect dirt. The length of the stalls should be such that the cows can stand comfortably and the droppings fall into the gutter.

One of the first requirements of a sanitary cow stable is good light. This is necessary in order that the work may be properly done and that the general health of the animals may be good. A good coat of whitewash applied to the interior of the stable at least twice a year is a very inexpensive and efficient method of keeping it light and clean; a bright, clean stable is a great incentive to the production of clean milk. Sunlight is one of our greatest natural disinfectants and the stable should have plenty of window space so that the sunlight can enter. If light is lacking in the underground side of a basement stable, a window may be cut in the floor above.

Good ventilation, as well as plenty of sunlight, is necessary for the health of the animals. Every dairy stable should have some system of ventilation to keep the air fresh and pure and the cows comfortable and unexposed to

injurious draughts. Poor ventilation usually means poor sanitary conditions. One good method of ventilation is the King System, but this will not work well unless the building is tight. Simple, direct openings are very effective, but they are likely to make a direct draught, especially if they are exactly opposite each other. The cloth curtain system has two advantages in that it is inexpensive and the curtains can be easily replaced when they become dirty, but the main disadvantages are that this system may collect dust and may not be suitable for cold climates.

DAIRY UTENSILS

There are at least four different dairy utensils that are used by all dairymen: the milk pail, the strainer, the cooler and the milk can. Of course we cannot forget the milking machine, which to a certain extent may be mentioned in connection with the milk pail. The strainer (minus the cheese cloth or absorbent cotton) may be dispensed with in some cases.

MILK PAILS

There are two general types of milk pails on the market: the large open top and the small-top or partially covered pail. The former with its large open top may collect dust or dirt that falls from the body of the animal during the process of milking and from a sanitary standpoint is not to be desired. I am glad to state that the small-top or covered pail is now very generally used where a high grade of milk is produced. When the small-top pail was first put on the market, a great many milkers objected to it, stating that the opening was not large enough in which to milk conveniently. But after using this style of pail for some time, a milker does not want to change to the old style. When the amount of fine dust and dirt that collects on the cover of this style of pail is noted, and one realizes that it is this style of pail that prevents this dirt from falling into the

milk, no one wants to use the open-top pail. I once heard a prominent dairyman state that he had yet to find a dairyman who once having used the small-top milk pail, returned to the large open-top pail.

A good milk pail should not be too high and neither should it be too broad. It should be of such a size that it can be held conveniently between the knees and pass under the cow where it can be easily milked into.

The pail should be made of good material that will stand the wear and tear of the ordinary dairy. The pail should have no open seams because such places cannot be satisfactorily cleaned and they provide a breeding place for bacteria. Open seams should be filled with solder.

Pails should be so constructed that they can be easily washed. In choosing a milk pail we should select one that is neither too broad nor too high, made of good material, no open seams, a small or covered top and so constructed that it can be easily cleaned.

STRAINERS

The purpose of straining milk is to remove any insoluble dirt. Bacteria counts were made on a series of samples of milk before straining, and again on those same samples of milk after passing through the strainer. The average counts for this experiment are as follows:

Bacteria per c. c. before straining 11,400

Bacteria per c. c. after straining 10,150

Although a lower count was found in the strained milk, still the difference was very small. It also proves beyond a doubt that you cannot remove all or any great portion of the bacteria from milk by the process of straining. There are three kinds of strainers commonly sold on the market. The wire strainers are good because they can be easily washed, but when used alone they are not as effective in removing dirt as are the other types. Cloth strainers are effective in removing dirt but they are rather hard to

clean and soon become a breeding place for bacteria. Some dairy companies have forbidden the use of the cloth strainer for the above reason. Absorbent cotton used in connection with a wire strainer is probably one of the most effective means we have in removing sediment from milk. This, of course, is more expensive because the absorbent cotton cannot be used a second time. From a sanitary standpoint this strainer is to be desired. In using absorbent cotton as a strainer, care must be taken or holes will appear. Then the milk will pass through without being strained.

Some years ago it was proposed that the milk should be milked directly into strainers. Experiments show that milking directly on to any dirt collected on the strainer increases the germ content of the milk. The explanation for this is that milking directly on to a strainer washes the germs off the dirt and these germs pass directly through the strainer into the milk. Another objection to this method of straining is that the milk when it beats on the dirt so collected on the strainer tends to dissolve this dirt directly into the milk, which makes matters worse, since the dirt in this soluble form cannot be removed by any process of straining. We must remember that straining does not remove all contamination from milk and we should produce milk in such a way as to prevent dirt from getting into the milk and then the matter of straining is not so important.

MILK CANS

The milk can which is most common in use is known as the forty-quart can. There are at least three styles or types of cans, the main difference being in the shape of the cover. The three styles are called the New York top, the Philadelphia top, and the Boston top. Each style has its advantages, but the one most commonly used is the Philadelphia style of top.

The main requirement of a milk can is that it be durable. Probably no other dairy utensil receives as rough treatment

as the milk can. As in the case of milk pails all seams should be filled with solder. Rusty cans are liable to give a metallic flavor to the milk. All covers should fit tightly so as to prevent milk from slopping and so that dirt will be kept out.

COOLERS AND AERATORS

A milk cooler is a necessary evil. We know that every utensil with which milk comes in contact tends to increase the bacterial content of the milk. The object of a milk cooler is to cool the milk without bringing the milk itself in contact with the refrigerating material. The refrigerating material should also be kept in motion. If ice and water are used for cooling milk in a conical cooler, the ice and water should be stirred; otherwise, the warm milk coming in contact with the cooler will raise the temperature of the water near the surface of the cooler and as a result the milk will not get the benefit of the ice. By the use of a stirrer, the ice and water inside the cooler will have a uniform temperature. In this way the milk gets the benefit of the refrigerating substances.

If a cooler made up of coils is used for cooling purposes, the refrigerating material should enter at the bottom and flow out at the top. The reason for this is that the warm milk will pass over that part of the cooler containing the warmest liquid first and as the milk passes down over the cooler it is coming in contact with a colder surface until at the bottom it passes over the coldest surface. There should be as few cracks or crevices as possible in a cooler and it should be so constructed that it can be easily cleaned. The cooler by all means should be in a place where it is protected from dust.

COOLING OF MILK

"No matter what the intensity of the sun's rays may be, the temperature of snow and ice can never rise above 32° F."

If I were asked to state what was the most important factor in the handling of milk and its products, I would answer temperature. Temperature is defined as "the degree of sensible heat or cold." In the dairy industry we use high temperatures (140° F. and above) to destroy bacteria and low temperatures (below 50° F.) to retard bacterial growth. It is the temperature between these two points that we must avoid because the average temperature between these points (about 100° F.) is the most favorable for germ growth. Let me quote from Farmers' Bulletin 976, U. S. Department of Agriculture.

"When drawn from the cow, milk has a temperature a little above 90° F., a temperature at which bacteria grow very rapidly. The effect of temperature upon the development of bacteria is well illustrated by two samples of milk, one of which had 280,000 and the other 16,400 bacteria per cubic centimeter at the beginning. Each sample was divided into four parts, and the eight parts were set away at certain temperatures to determine what length of time would elapse before the milk soured. The high bacteria sample set at a temperature of 100° F. soured in twelve hours, while the low bacteria sample at the same temperature kept sweet 36 hours. When kept at 40° F. the high bacteria sample soured in 180 hours, while the low bacteria sample soured in 396 hours. The high bacteria sample represented milk of ordinary quality, while that containing the smaller number was representative of milk of a higher quality. The effect of low temperature in checking bacterial growth and multiplication is very evident."

A TYPICAL CASE OF NOT PROPERLY COOLING

A few weeks ago the writer secured a sample of milk from a prominent dairy. The bacteria count was high and the indications were that the high count was due to dirty utensils. The dairy was ordered to clean up, but after three or four days the count was still high. A milking

machine was used at this dairy. Thinking that the contamination may have been caused by not taking proper care of the milking machine, hand milking was recommended. The first day after hand milking was practiced the count was low, but the very next day the count was high again. It was decided then that the high count was not due to the milking machine. The manager was much worried because he had done everything he thought he ought to do to get a low bacteria count and besides he was milking the herd by hand.

The writer called the manager on the phone and asked the manager to come to the laboratory and take certain equipment to the dairy so as to locate the trouble. We arrived at the dairy at 2.30 P.M. and from all appearances everything seemed to be all right. The morning's milk, which was milked at about 5 A.M., was in a tank of water and a large cake of ice and a few small pieces of ice were in the tank. The temperature of the milk in the center of the can was taken and it was 56° F., and this was nearly ten hours after the milk had been drawn from the cows. The manager admitted the can of milk was placed in the tank of ice and water without being stirred. All the milk in the center of the can remained at a high temperature for several hours and this was verified by the high bacteria count of a sample of milk taken from this can. The contents of the can was stirred and the temperature was again recorded. This time it was 44° F., while that of the water in the tank was 42° F. This shows that the milk near the walls of the can had cooled to practically the same temperature as the water, but the milk in the center of the can remained high for a long time and was thus favorable for bacterial growth. A thorough bacteriological examination of all utensils with which the milk came in contact failed to reveal any other source of contamination. A thermometer was left with the dairyman and he was instructed to stir the milk about four times during the first hour after

milking and to record the temperature. In about 1 1-2 hours the milk was cooled below 50° F. This practice has been followed since and the milk continues to show bacteria counts less than 10,000 per c.c.

Better results can be obtained from a given amount of ice by keeping plenty of ice in the tank and thus keeping a low temperature in the tank, rather than allowing the temperature of the water in the tank to get high and then have to use a great deal of ice to cool the water in the tank before placing the milk therein.

The process of cooling should begin by having the water in the tank properly cooled before placing the cans of milk in the tank. It is important that a certain efficiency be secured from the ice and water used. The general rule is that a tank holding a little more than four gallons of water for each gallon of milk is more efficient than a larger one when the milk is cooled directly in the tank. If the milk has been partially cooled before placing it in the tank, say to about 60° F., about 2 pounds of ice will be required to hold each gallon of milk below 50° F., while if the milk has not been cooled before being placed in the tank, about 4 pounds of ice are required to cool each gallon of the warm milk below 50° F.

CONCLUSION

In concluding this report, I could use no better expression than that used by Mr. Montgomery Farling, of Ithaca, N. Y., who on completion of 35 years as a milk producer and distributor in Ithaca, gave the following reason for his success in producing high grade milk:

"I soon became convinced that dependence upon mere artificial devices for undoing wrong procedures, in the absence of proper care, was futile, and this led me to simple methods and great carefulness."

"Do the right thing, at the right time, in the right way. Do some things better than they were ever done before. Work for the love of the work. Anticipate requirements."

ICE CREAM AND THE HEALTH OFFICER

BENJAMIN VENER, Springfield, Mass.

The health officer is beginning to talk "ice cream." Can he be of assistance in correcting or improving the quality of ice cream? Should he sidestep this problem? Does he know enough about the bacteriology of ice cream and its ingredients? Let us meet these questions, for progress in bacteriology and for the good of the industry concerned.

During the last decade ice cream has been gradually developing, changing from the novelty holiday rendition, from the age when we used to enjoy going to a party because some kind soul had money enough to buy ice cream for the crowd, to the stage where we carry streaks down our coat fronts as insignia of our last ice cream cone. In other words, ice cream today is a food, a necessity, a distinct part of the staff of life that helps us live and enjoy life. A food necessity requires measures of safety for its purity and wholesomeness and the health officer is a pioneer who undertakes measures that will enhance the purity and sanitary condition of ice cream in his section.

The year of 1851, when Jacob Fussel saw the need of creating a market for his surplus cream and milk and turned to the manufacture of ice cream on a factory scale, can be said to mark the beginning of this great dairy industry. He was the father of the commercial ice cream business. The great development came with the year 1910, when ice cream gallonage amounted to one hundred million gallons. The figures will show that this industry has reached the enormous output approaching three hundred million gallons of commercial ice cream during the year 1922.

Using the figures of 1921, when 275,000,000 gallons were made, wholesaling at an average price of $1.25 per gallon, the value of this commodity was worth $350,000,000, or about 60 per cent of the total value of all other dairy products. This business required an investment of

at least $150,000,000. Practically half the value of the production, or one hundred and fifty millions of dollars, are tied up in machinery, buildings, delivery outfits, cabinets, ice making systems, tools, etc. These statistics are given only to bring out the fact that the ice cream business is an industry that must be seriously considered in order to accomplish the most good for all concerned.

If we review some of the more important products that go into the manufacture of ice cream we come to the conclusion that all ingredients are of a nature that calls forth our bacteriological knowledge for its study and for the safety of the finished product. Milk and its products comprise practically the entire mix or stock from which ice cream is made, and from a bacteriological standpoint are the most important, and emphasis must be placed on these ingredients from an inspection standpoint. Herein lies the health officer's duty. The larger plants are aware of this fact and demand the best quality of milk ingredients.

Sugar, the sweetening of the mix, when kept dry and clean, is not a source high bacteria counts. Extracts, because of the high alcoholic content, can be said to be usually free from bacteria. Gelatin has always been a matter of much controversy and debate. When purchased from reputable houses and made under the newer sanitary conditions, it can be obtained nearly bacteria free and absolutely pure and wholesome. Even if we take a gelatin, for example, of 1,000,000 bacteria to a gram, and if 3½ oz. are used to 10 gallons of ice cream, the bacteria added to the ice cream due to the gelatin would increase the bacterial content of the finished ice cream by only 5,000 per gram. We can therefore disregard the bacterial increase due to gelatin of a high grade, as most of these better gelatins have low bacterial counts.

If we review the research work relating to bacteria in ice cream, we learn two striking facts: first, that there has not been much work done along these lines; second, that the

counts we do find are usually high. The investigators proved beyond doubt that these samples, picked up at random in our large cities, had a high bacterial count.

Most of the ice cream made in those days was good ice cream and made from high grade materials. But this ice cream was home-made ice cream, or ice cream produced in shops to be sold in most cases directly to the consumer. Those of us who have made ice cream in the home, or who have made ice cream to sell years ago, know that aged cream or sour cream made the nicest, the smoothest and in every case a very delicious ice cream. The old ice cream maker stuck to his rule of thumb knowledge and usually used a sour or high bacterial cream.

Now we did have, just what the investigator found, a food delicacy hard to beat from a home-made ice cream viewpoint, but with a very high bacterial count. And the scientists of those days painted this fact across their publications and spread their ciphers across their tables of bacterial counts. We are just beginning to follow up this work, with better facilities, newer and modern plants, and favored with the newer knowledge in the art of ice cream making. And what is most important of all, the ice cream industry is ready to meet this bacteriological problem with time and money and is only waiting word as to how to proceed from this organization or similar scientific bodies so as to be able to pass all requirements for a perfect food.

The health officer can act for the common good if he will only stress upon the fact that quality ice cream can be made, bacteriologically low, as well as that of a high food and vitamine content. From our experiments we have found that prolonged ageing of the mix gave us the greatest counts. And we found that this could be entirely eliminated and a perfectly good ice cream can be made with a low bacterial content. An ice cream that would meet the strict requirements laid down by the expert ice cream maker in regard to body, texture, flavor and smoothness. Ice cream of a

low bacteria count can be made, providing the stock or mix from which it is to be made be scientifically pasteurized and held at 40° and frozen within a period of 72 hours. This low count ice cream can be obtained, providing ice cream making is taken out of insanitary cellars and dark, damp back room kitchens, where but few, if any, of the principles of sanitation are emphasized. Ice cream manufacturers should be placed under restrictions as stringent as those pertaining to the handling of milk.

It is the duty of this organization, composed of its many health officers, sanitarians, and food officials, to bring out some standard method for bacterial determination of ice cream. A method for the determination of the purity of the ingredients that go into the manufacture of ice cream, such as cream, gelatin, fruits, extracts, etc. Also to determine whether it is possible to have commercial ice cream of a low bacterial content, and to determine what the sanitary importance of organisms may be when found in ice cream at the low temperature at which it is held. Let us keep our scientific investigations concerned with those practical problems that are a distinct part of the processes of ice cream manufacture.

Ice cream of a high food content can and should be made with a low bacterial count. Ice cream can be made with a bacterial count not exceeding the standard of milk and cream in the section in which it is made. Can we prove these assertions? The ice cream industry welcomes your verdict along these lines.

DISCUSSION.

Miss Vance: We find when the ice cream mix is properly made as low as 10,000 bacteria per cubic centimeter and no B. Coli are found. Some pasteurized ice cream has higher counts than the raw product. Manufacturers are now anxious to have us make a standard.

"The sciences have bitter roots, but their fruits are sweet."

REMARKS REGARDING BOVINE DISEASES

DR. FRED EVANS, *City Veterinarian,*
Sioux Falls, S. D.

We are always ambitious to do the important thing—things that seem great and look great in the eyes of the public. We are too prone to overlook other things of vast importance, although seemingly small.

Of the diseases that should receive more attention and that too frequently are overlooked, I mention actinomycosis. This disease we find has quite a general distribution. We find it from time to time in the dairy cow. We hear of cases of epidemic septic sore throat and bowel trouble in children and we cannot ascertain the source. Perhaps if we would look more closely for this disease in our dairy herds we would find a reason for some of these seemingly mysterious conditions.

A case came under my notice a few years ago, of a tenant who was prevailed upon by the land owner to take his family cow out to the farm and dry her off and let her run in the pasture until she freshened again.

The tenant called my attention to the cow's condition and asked me to examine her on the day following her arrival at the farm. I examined the cow and discovered her udder to be in bad condition. I advised the man to dry her up immediately and keep her away from the rest of his herd, and that he try to persuade the owner to take her to the packing house to be slaughtered. Half of her udder was badly infected with actinomycosis. I tried to scare the tenant so that he would not milk her, but a few days later the owner appeared on the place and persuaded him to keep the cow, stating that he had kept this cow for several years for a family cow with no bad results. He could not see how harm could possibly come from milk-

ing her, and to my disappointment the tenant took the owner's advice and continued to milk her.

The case was forgotten for a period of four or five months, when a telephone call came from the tenant asking me to call. I went to the house and asked what was wanted. "Nick is sick, come in." "Well," said I, "now what's the trouble? Have you had a doctor?" "No, but we have had Nick in town to two doctors, and as neither seemed to know what was the trouble, we thought we would call you to see what you thought best to do." I went in to see Nick, and found his throat swollen so badly that he could not swallow, neither could he lie down; he was forced to remain in a sitting position all the time. While examining his neck I found characteristic yellow nodules of actinomycosis. I told his mother to take Nick to a doctor as soon as possible, which she did and we succeeded in saving Nick's life. This case suggested to me the probability that we have actinomycosis where we do not suspect it.

We find it a very common disease in the udders of swine; and especially in the pure blooded registered sows, which are kept for several years for raising pigs, do we find gland after gland infected with actinomycosis.

I am thoroughly convinced that a great many of the udder lesions in our dairy herds that we are prone to call unimportant abscesses or tubercular lesions are in reality actinomycosis.

Another disease that is considered altogether too lightly is garget, or mammitis, especially when it assumes the infectious type. In the last few years we had an outbreak in a dairy that was supplying raw milk in the city. There were numerous cases of bowel trouble among the children, especially among the users of milk from this dairy. An investigation brought out the fact that this dairy had been affected with infectious garget for some time until nearly half of

the herd was infected. The herd was separated into two groups. Milkers from the infected division could not go near the healthy cows or assist in caring for them in any manner. The disease responded to treatment and the trouble shortly disappeared. The children made a simultaneous recovery.

I would remind you in connection with this case, also with the case of actinomycosis infection of the udder, that the danger could be overcome by proper pasteurization of the milk.

Much has been accomplished by way of tuberculosis eradication. Much remains to be done. The active steps taken by the U. S. Department of Agriculture to eradicate this disease will be presented by another during this convention.

We still have inefficient testing by the careless operator to contend with. A case recently came to my notice of two cows that had been tested for tuberculosis every year for five consecutive years. Upon applying a combination test these two cows were found to be pronounced reactors and upon post mortem proved to be generalized cases.

In our western states we have generally no laws to compel testing for tuberculosis and destruction of reactors. Many herds made up of a high percentage of reactors are supplying milk for city consumption. Such milk could be rendered safe by proper pasteurization.

We should exercise more care in selection of milk dealers, as well as milk producers. When a man applies for a license, although he may have complied with all the requirements of the city in which he proposes to sell his milk, a thorough inspection of his premises and his methods of handling his product should be made before such license is granted.

Too often a man will come into the health office seeking a license to distribute milk, all dressed up for the occa-

sion. Again we have a man come in in overalls. Fine clothes do not make fine men, and some fine men are not fine dairymen.

We cannot be too careful in selecting the person we are going to permit to be a distributor of a food that is so important and so generally used as milk. I would like to make a stronger plea than ever has been made for proper dairy inspection, for the eradication of all disease among dairy cattle, and finally for the proper pasteurization of all milk for each city of any considerable size.

"Ignorance of truth is the cause of all misery."

STRUCTURE AND EQUIPMENT OF THE MODERN MILK PLANT

DR. C. L. ROADHOUSE, *Professor of Dairy Industry,*
University of California, Davis, Cal.

Changes in types of construction and ideas concerning sanitation have taken place so rapidly in the past decade that the milk plant operator looking forward to a new structure or additions to his present building should give this subject a great deal of thought.

It is possible for a well arranged plant to effect great economies in labor, while a poorly planned building may become a continual source of expense because of the additional labor required to operate it. Most dairy establishments outgrow their quarters after a few years as a result of the normal increase in business, and the greatest fault in the constructing of most dairy plants is that sufficient space has not been provided, or that plans were not made with a view to additions to the building to take care of future expansion. When preparing plans for new dairy plants they should be drawn in such a way that additions or the building on of another floor may be easily possible to take care of fifty to one hundred per cent increase in business. Such additions may never be made, but if the plan is prepared with this in view it may save the expense of a complete new building.

Anyone contemplating building a new milk plant will do well to visit the up-to-date plants in our cities and study their construction, layout of rooms and equipment. If it is impossible to visit other plants, plans and specifications sometimes can be obtained from those who have constructed new buildings.

LOCATION OF MILK PLANT

The plant should be located where the raw material can be easily secured and where manufactured goods can reach the consumer with the shortest haul. A well built plant for retail business should be on a main thoroughfare because of the convenience to the public as well as for the advertising advantage. On the other hand, a poorly built plant might better be located where it will not be seen. A milk plant opposite a park is well situated from an advertising standpoint, and there would be a greater freedom from dust in such a location.

GETTING MILK INTO THE PLANT

There are two principal systems of handling milk: the older system of raising the milk on elevators and passing it through the various pieces of equipment in the plant by gravity as it passes from the receiving vat to the pasteurizer, from there to the other equipment, finally reaching the bottling machine, which is on the lower floor level; or it may be pumped to the higher level and then passed through various equipment by gravity. Since pumps and piping can now be secured of sanitary construction for milk handling, the saving in labor in pumping milk as compared to elevating it in cans favors the pumping method. Such equipment, to be satisfactory, of course, must be easily cleanable and properly cleaned and sterilized each time it is used.

Although we accept the pumping of raw milk through proper equipment as a satisfactory procedure, at this time, I believe, all sanitarians would agree that it would be inadvisable to pump milk after it has been pasteurized. If it should become desirable to elevate pasteurized milk, it should be done either in cans or by drawing the milk through sanitary piping by means of vacuum. Some of the modern glass enamel equipment with tightly fitting manhole covers make it possible to accomplish this.

TYPE OF BUILDING*

The type of milk plant to be constructed will depend upon local conditions and the type of machinery to be used. It may be one, two or three stories high, but labor requirements usually increase with the height of the building.

An important point in building from the standpoint of economy in labor is to plan so a man will remain on one floor rather than go from one floor to another in carrying on his regular work.

MATERIALS FOR CONSTRUCTION

Reinforced concrete is looked upon as being the most satisfactory and durable construction for a dairy building; in most locations it is also more expensive. Hollow tile construction with reinforced concrete frame is very satisfactory for dairy buildings where such building materials are available. The hollow tile may be covered with a cement finish when desired, and if this is done it has the appearance of a concrete structure.

Selected brick with a cement finish inside makes a very satisfactory dairy building, and cement blocks may be used where the materials for making them are easily available.

Wood structures are not satisfactory as permanent buildings for handling dairy products because of their rapid deterioration, especially where water and milk come in contact with the wood.

INSIDE WALLS AND CEILING

All inside walls and ceilings of dairy buildings should have a smooth, easily cleaned surface that is durable and waterproof. Cement is very satisfactory as an interior finish, but walls should be treated with waterproof and steamproof paint such as factory white enamel or rice

*Reference is made to Bul. No. 849, Dairy Division, U. S. Dept. of Agr.

white paint. A painted surface gradually changes color when kept moist and white paint is not durable in manufacturing rooms where steam is abundant unless they are well ventilated through the ceiling.

Rooms that are lined with smooth lumber should have the cement foundations for all walls built up to a height of three or four feet above the floor, or to the base of the windows. Enameled brick, tile, enameled cement and cement plaster are the most satisfactory materials for the inside walls. The ceiling should be twelve to fourteen feet high and covered preferably with hard cement over galvanized metal lath.

FLOORS

Concrete floors with a waterproof finish are the most satisfactory construction for most dairy plants. It is desirable because it is economical in cost, is impervious to moisture, easily cleaned and readily replaced when it has become worn. Concrete with a hardener of steel filings in the surface coat wears better than the plain concrete floor with a sand and cement finish. It is possible to lay concrete over wood where the foundations are of proper strength. The rotting or settling of the wood foundation will cause concrete to crack. All concrete floors should have footings two feet in the ground for all heavy or fast moving machinery. Concrete floors will wear and depressions form in doorways and entrances to refrigerators, particularly where steel-tired trucks are used, and where there is continual standing or walking with shoes protected with iron plates. Iron floor plates or angle iron may be embedded in the concrete at the time the floor is laid. The iron being level with the concrete surface will protect the wear of the floor at such points. It is very desirable to provide such protection at points where heavy wear occurs.

Asphaltum and mastic floors are not satisfactory where hot water is permitted on the floor. Heat softens

the asphalt and leaves a black stain on the bottom of utensils placed upon it. This sticks to the hands and is responsible for a bad appearance of the utensils, and naturally is responsible for black finger marks in various places.

Terrazzo floors consisting of marble chips placed in concrete and left with a smooth surface make a very satisfactory appearance and are satisfactory for milk rooms if cans are not handled on their surface.

Tile floors in bottling rooms are desirable when carrying on a retail business in a public location because of their increased durability and better appearance. When milk bottling rooms are located where they can be seen by the public the advertising value alone justifies the increased cost of tile or terrazzo floors.

REFRIGERATOR ROOMS

The floors of refrigerator rooms should be concrete over insulation, such as cork board. The same level should be maintained in the floor of the refrigerator room as in the remainder of the plant, except that in case drains are not provided in the refrigerator rooms there should be a slight slope from the back and side walls toward the door for drainage.

A mistake frequently made in constructing refrigerator rooms is to lay the concrete in the room on the same level with the remainder of the plant; then when the insulating material is placed on top of this the level of the refrigerating room is several inches above the remainder of the plant, which makes trucking into the room very difficult.

If drains are installed in refrigerator rooms they may be plugged with cork and a ring to be removed when necessary for cleaning the room.

DRAINAGE

Two types of drains have been used, the stable cesspool type of drain being most satisfactory. It is important

that the grating over such drains be fastened in place so that they cannot be removed, which prevents material getting into and closing the drain pipe. Clean-outs should be provided at all turns in the drain line and every 100 feet on straight lines to make it possible to remove obstructions. Gutters running the length of manufacturing rooms and covered with metal grating have been used in some of the dairy plants constructed more recently. The use of gutters may make it possible to get the water off the floor rapidly, but the metal gratings are heavy, which makes more difficult their frequent cleaning. Most buildings with such gutters have an odor due to lack of regular cleaning. The cesspool drain is equal to the gutter if the outlet pipe is large enough to carry the water away rapidly.

VENTILATION

Sufficient ventilation in manufacturing rooms where steam and water are abundant is very important in milk plants. Rooms having no special provision for ventilation through the ceiling are moist, resulting in the rapid deterioration of most metal equipment. Ventilation is easily secured where manufacturing rooms are but one story high by passing metal flues through the ceiling of the building at several points. Patent ventilators of the twelve-inch "Arex" galvanized iron type permit steam and air to pass out, and the draught is regulated so that dust cannot enter through them into the building. Where manufacturing rooms cannot be ventilated through the ceiling, iron gratings placed in the outside walls directly against the ceiling permit a part of the steam to escape. Dampers may be used in such openings, closing them when dust is troublesome.

WINDOWS AND SCREENS

Double-hung windows are very satisfactory for dairy rooms, since they make it possible for screens to be placed

over the windows as a protection against flies. All screens in dairy plants should be hinged on the sides and open out, which is a great aid in both getting and keeping flies out of the rooms. Medium sized windows are more satisfactory than a smaller number of large windows in dairy plants, since all windows should be screened, and large screens are more difficult to keep in repair.

EQUIPMENT

In selecting equipment the same principle is involved as in planning a new building. It is important to know the merits of all types of equipment, and this is best accomplished by seeing and observing the efficiency of equipment in operation in various plants. Important considerations in selecting equipment are ease of cleaning and durability.

Attention to these points, which to people not familiar with handling dairy products might seem unimportant, will aid materially in maintaining a high standard of quality. Well constructed buildings are more durable and easier to maintain in a sanitary condition and in a well established business are a justifiable investment.

"New comforts and conveniences and safeguards slip into our lives almost without our realizing it."

THE ORGANIZATION AND ADMINISTRATION OF MILK CONTROL

L. C. BULMER, *Chief,* Division of Food and Dairy Inspection, Birmingham, Ala.

Progress toward the solution of the milk problem has been practically arrested in all but a few of our larger cities, due to inadequate organization and slipshod administration. Almost everywhere the public have been disappointed and the dairy industry discouraged by so-called "milk control." The fundamental objects have not been attained. The majority of consumers are still receiving milk of a poorer quality than is desirable or necessary. Milk producers look in vain for the long promised increased consumption of milk and are confronted as much as ever with the unscrupulous competition of dealers ineffectively controlled.

On whom must we place the responsibility of thus jeopardizing the people's right to a wholesome unadulterated supply of milk, of failure to promote better health by bringing about an increased consumption of good milk and hindering the growth and prosperity of an industry which no nation can afford to be without? Unquestionably, such responsibility falls on the shoulders of the health officer who fails to recognize the full importance of the milk problem in his public health policy, or who tolerates a milk ordinance which is impracticable, or who compromises a system of control by appointing officials who are untrained, incompetent and in some cases merely political "deadheads."

It is impossible to estimate with any degree of accuracy the results of such incompetency where the unsatisfactory conditions referred to exist. Probably not

20 per cent of our cities have what may be truly termed systematic control of the milk supply, the remainder having systems of control in various stages of disorganization. A chapter from the forthcoming report of a committee appointed to study "Municipal Health Department Practice," which appeared in the July edition of the American Journal of Public Health, presents some very interesting statistics. From this report, and from other reliable sources, the following facts may be quoted:

1. In this country there are approximately only 22 cities where the pasteurization of all milk is compulsory with the exception of certified milk or a corresponding grade.

2. Of 83 cities in the United States with a population of over 100,000, 35 cities have less than 75 per cent of their milk supply pasteurized, while 15 cities have less than 50 per cent of their milk supply pasteurized. It is clear that in many cities pasteurization is practically a commercial expediency and not a health measure, for the reason that 61 of the 83 cities quoted permit the sale of raw milk that does not meet with the requirements of either certified milk or with corresponding safety standards universally recommended as essential by authorities on this subject.

3. In spite of the recommendations of the "National Commission on Milk Standards" concerning the grading of milk, only 31 of the cities quoted have provisions for a grading system, and even among these 31 there is little uniformity as to requirements.

4. No figures are available concerning the number of cities in this country publishing the scores of market milk based on the sanitary condition of the dairy premises, methods employed, and bacterial and chemical composition. The number, however, is known to be very small.

Several of the smaller cities, however, publish the scores of dairy premises.

5. Of the cities studied only 43 require the scoring of dairy farms. The number of farms per 100,000 population is approximated at 621, while the number of official inspections per annum is estimated at between one and two.

6. The average practice, in so far as personnel is concerned, is the employment of between one and two inspectors per 100,000 population.

These are but a few of the striking facts that illustrate the manner by which we are endeavoring to control and safeguard our most important foodstuff at the present time. We are aware that contaminated milk is the cause of much disease. Knowing the congenial home that bacterial life finds in milk we can scarcely feel surprised that this is so, especially when we bear in mind the large quantity of milk still consumed in its raw state and the inadequate milk control in vogue in many places.

Imagine the task that confronts a personnel of three inspectors to control the milk supply for a city of over 200,000 people consuming approximately 15,000 gallons of milk per day, derived from probably over 1,000 different farms, produced by 7,000 to 8,000 cows and the product from the cow to the consumer passing through the hands of one to two thousand individuals. It may be assumed that not 75 per cent of this supply is pasteurized and the various operations may be taking place within a radius of anywhere from 10 miles to 100 or 200 miles of the city.

THE FUNCTION OF MILK CONTROL

The duties confronting a milk control personnel are roughly these:

1. Sanitary inspection of all farms, including the scor-

ing of premises and methods at milking time, devoting extra attention to dairies distributing raw milk.

2. Physical inspection of cows and checking of tuberculin tests.

3. Abatement of nuisances.

4. Supervision of milk distribution, including temperature tests, sediment tests and the collection of samples for analysis several times monthly.

5. Inspection and scoring of milk plants, milk depots, and frequently creameries and ice cream plants.

6. Supervision of the pasteurization process, and carrying out the usual routine procedure in regard to the check on shippers to milk plants.

7. Grading of all milk.

8. Issuing of milk permits to milk producers and handlers.

9. Controlling the illegitimate cow-keepers and peddlers who spring up like mushrooms overnight.

10. Supervision of milk handled in hospitals, schools, hotels and restaurants.

11. Last but most important of all in connection with systematic control is the making out of regular reports of work done and compiling complete records required to be filed for reference purposes.

The preparation of appropriate educational literature, the drafting of plans of new dairy buildings and the reconstruction of old premises and attending to current correspondence and clerical work are other important items that fall to the lot of a dairy division.

Each of these different functions in milk control presents a separate field which requires organizing in order that no branch will be neglected. It becomes necessary to split up the work into distinct classes or branches, such as (1) inspection and scoring of dairy farms, (2) inspection and scoring of milk plants and depots, (3) routine collection of samples during distribution (4) inspection of milk

supplies handled in volume in the city, and classification of other special branches as soon as the amount of work performed is large enough to necessitate routine handling.

The territory to be covered should be carefully zoned according to area and work to be performed, and such zones placed in charge of inspectors who may be held responsible for results. That there may be an intelligent interpretation of the work done, it becomes necessary that an inspector acting in a senior capacity should survey each zone with the individual inspector in charge, for the purpose of bringing about uniformity of operations, and also standardizing instruction given to milk producers and handlers, scoring of farms and plants, and the technique employed in the sampling of milk.

RECORDS AND REPORTS

Assuming a city has the necessary funds, the required law and the proper personnel, success or failure of a system of milk control will depend almost entirely on the business principles involved in office management. This is so in connection with all branches of public health administration, and it is a matter of surprise that this very factor is generally disregarded above all others in milk control.

In order to justify the object of such control, the existence of a dairy division and the expenditure of public funds. it is essential to show clearly the work performed in black and white, with statistics which will stand the "acid test." This is a matter of vital importance to the health officer, the board of health and to the appropriating bodies. It is of great significance to the general public and those participating in the milk business. What does our milk control accomplish? That is a logical question.

For the purpose of answering this question definitely and in order that all work may proceed methodically, a most complete system of reports and records must be kept. This record should include a complete list, revised regularly, of

all milk producers and distributers, including the grade of milk handled; scores or ratings compiled and tabulated monthly from daily reports of the sanitary condition of the premises, method of handling milk and its bacterial and chemical composition; precise information of sanitary surveys of all dairy premises; a clear record of tuberculin tests; the average quantity of milk consumed per capita; the amount of dairy products, other than milk, consumed; fluctuations in the price of milk; the benefits derived by the public from a cleaner milk supply and an increased consumption per capita; the benefit of milk control to the dairy industry in regard to increased sales and freedom from unscrupulous competitors.

We are all familiar with the fact that such information is called for from time to time, but how many health departments in this country can furnish such data accurately, or are able to compile annual reports, based on facts? Invariably most statistics are estimated, and where no proper record system is in vogue such information is not only erroneous and misleading, but worthless. There are many health departments that can easily tabulate all the data on file in regard to milk control on a sheet of note paper, and in consequence are obliged annually to manufacture a report that is virtually a waste of printer's ink.

Daily reports of every operation performed are fundamental, from which should be compiled the monthly report, which in turn can form the basis of the annual report.

THE APPROPRIATION REQUIRED FOR MILK CONTROL

From what has been said concerning the various branches of milk control it is obvious that the cost of the various operations and salaries of the required personnel is going to amount to a fairly formidable bill. The sum required will at least appear so to the appropriating bodies in certain of our cities.

The appropriation required will depend largely on the

number and qualifications and experience of persons employed. In my opinion, milk control should be in the hands of men who have not only had public health experience, but who have also had a very intimate acquaintance with agriculture, and particularly the dairy industry. Unfortunately the salaries paid by municipal health departments are not sufficiently inviting to attract the service of such men, while in some cities no effort is made to secure them, as the training of a dairy inspector is given very little consideration.

The personnel required will be influenced by (a) the population of the city (b) the radius from which milk is drawn, and (c) the percentage of the milk supply that is pasteurized. In regard to the latter it is not possible everywhere to require compulsory pasteurization, for such a measure in some cities is ahead of public thought and demand. This can only be changed by the actual experience of a milk-borne epidemic or through education, which will take time. Cities demanding raw milk, however, should necessarily pay for the extra vigilance required from a public health standpoint.

I. V. Hiscock, in his report on "Health Department Practice," shows the appropriation utilized for milk control in this country in 1920 varied between $.014 and $.13 per capita, the average for all the cities studied being $.04. Hiscock and his committee intimate in conclusion that they feel that an adequate allowance for milk control would be $.05.

With all due respect to Mr. Hiscock and the committee in question, the data of conditions existing in this country, which they themselves vouch for, all point to the fact that the slight increase suggested would not bring about any material improvement in the direction of better organization or additional personnel.

As an instance of this fact the city of Birmingham, Alabama, may serve as an example. Birmingham has a population of approximately 200,000 and at the time when the Hiscock committee made their investigation the health department were utilizing an appropriation of $10,500 per annum for milk control, or an expenditure amounting to approximately $.058 per capita. Those who were familiar with the milk supply of Birmingham at that time will substantiate the statement that the system of control was inadequate if not practically worthless. It was not possible then to even attempt the grading of milk, and if such a system had been inaugurated it would have merely afforded a means to milk peddlers to impose on the public. Market milk was regularly distributed containing one million or more bacteria per cubic centimeter, gross sediment was to be found in the average milk bottle, and it is not surprising that Birmingham consumed less milk for its size than possibly any other city in America, the consumption of milk amounting to approximately less than one-fifth pint per capita. Milk was then a product of ill repute, which many people avoided whenever possible.

This briefly was the situation confronting the present health officer in 1920, who, in spite of vigorous opposition on the part of raw milk dealers and certain political forces in the city, succeeded in bringing about the enactment of a milk ordinance in July, 1921, which, in so far as its adaptability to meet local conditions and the fairness of its requirements and standards is concerned, possibly ranks second to none.

IMPROVEMENTS BROUGHT ABOUT IN BIRMINGHAM BY ORGANIZATION OF MILK CONTROL

Some of the developments in Birmingham in connection with the control of the city milk supply during the past

fourteen months are very interesting. At the instigation of the health officer we are devoting, during the current year, $30,000, or an appropriation of approximately 15 cents per capita, to milk control. Our milk control staff, including two laboratory assistants, has been increased to ten, of whom five are B. S. graduates in agriculture, and one is a veterinarian. The actual results accomplished are looked upon with satisfaction, for while the milk situation in Birmingham is far from the ideal, it is realized that it is impossible to entirely rectify in the course of a few months undesirable factors that have existed for years. The following striking results have been secured:

1. Milk consumption per capita has been increased by 100 per cent.

2. The milk business is on a firmer foundation.

3. The organization of a producer's milk pool is completed, which will increase the volume of milk pasteurized from its present figure of 15 per cent to over 80 per cent. Modern requirements in regard to sanitation and milk hygiene, which necessitate better business methods, have been instrumental in bringing about this movement.

4. A thorough system of grading milk is in vogue.

5. The average bacterial content of market raw milk has been reduced from 780,000 per c.c., which was the average for a period covering three years before the adoption of the present milk ordinance, to an average now well below 50,000 per c.c.

6. The average bacterial content of pasteurized milk over the period quoted has been reduced from 217,000 per c.c. to less than 25,000 per c.c.

7. Milk scores are published monthly as a guide to the public. These scores are based upon sanitary condition of dairy premises, methods employed in handling milk, and the average bacterial and chemical composition of not less than three samples collected from each distributor.

8. Over 140 sterilizers equipped with 4 to 6 H.P.

boilers have been installed on dairy farms. Over 90 per cent of the dairies from which the Birmingham milk supply is derived score 80 per cent or over on the U. S. Department of Agriculture score card. Further improvements recorded during the past few months are, briefly: New barns, 8; new milk houses, 7; barns reconstructed, 25; milk houses reconstructed, 28; new sterilizers equipped with 4 to 6 H.P. boilers, 20; new sanitary toilets installed on farms, 36; toilets made fly-proof, 52.

9. The price of milk has decreased 25 per cent within the last year.

Such are some of the results accomplished in Birmingham by systematic milk control in a remarkably short period. It is costing the public 15 cents per capita.

Benefit to health brought about by increased consumption of clean milk cannot be estimated in dollars and cents. Money saved by the purchase of milk of better keeping quality can be more nearly gauged. What family in a city where milk control is lost sight of, does not squander 15 cents many times in a year on "sour" milk?

Milk control is a necessity from a business standpoint. It was estimated at one time that 22 per cent of the Birmingham milk supply was adulterated to the extent of over 10 per cent added water. In other words, the citizens were paying $58,000 a year for water that was added to their milk supply. Would it not be better to donate $58,000 per annum, if necessary, for milk control in order to eliminate adulteration and have clean milk? If such an object can be accomplished for $30,000 a year, all the better. This is a matter best left for the health officer to decide.

POLITICS WHICH ARE DISTURBING

Milk control, like all other branches of public health, should be organized against political interference. Most politicians at heart want a contented community. They

usually have sufficient private interest in a city to desire its growth and prosperity. And yet politics, as played by some politicians, is frequently the most disturbing factor in our midst. Above all things politics entering into a public health system is perhaps the most disconcerting.

Public health may be compared to public safety. They go hand in hand, for both are associated with the safeguard of human life. Quick growth and industrial expansion of a city depends in no small measure upon the degree of contentment and sense of security that can be instilled in the public mind, but people will not be contented nor settled in a city which is either unsafe or unhealthy. People begin to look for an opportunity to break the ties that hold them to a place where mortality is high and lawlessness rampant. Some politicians do not realize this, but the public should, and demand that both public health and public safety be removed from politics. When this is done perhaps milk control will find its proper place in public health policies.

THE SIGNIFICANCE OF MILK CONTROL IN A HEALTH POLICY

Sanitation, control of communicable diseases and infant welfare each holds, and should continue to hold, a very important position in public health administration. But what about milk? The milk question is so intimately associated with communicable disease and infant welfare that to ignore it or belittle its importance in a public health policy is to court disaster.

If the people of a community are well nourished they will be stronger and better able to fight off any disease that may attack them. Observance of the laws of sound nutrition should be one of the chief functions at the basis of public health administration. We must therefore have a clean, wholesome food supply to commence with. The consumption of more milk per capita is a commencing point, for good milk is our ideal food. But we must have safe milk before we can recommend its increased consumption.

A city will not obtain a safe milk supply until steps are taken to systematize its control. This invariably requires more adequate funds, improved organization, better milk laws, and administration based on common sense.

"There is no phase of Governmental activity which so vitally touches every citizen as the Health Department."

MARKET MILK CONDITIONS IN IOWA

O. P. THOMPSON, M. D., *State Dairy Inspector,*
Waterloo, Iowa.

In Iowa we have passed through the period of inflation in the price of milk of $3.50 per 100 lbs. paid to the producer by the dealer and 15 cents per quart charged the consumer, and have returned to the near pre-war price of $1.75 to $2.00 per 100 lbs. to the producer and 8 to 10 cents per quart to the consumer.

From answers to a questionnaire sent to local milk inspectors in cities of Iowa having more than 10,000 inhabitants, the following deductions are made:

The per capita consumption of milk in these cities is .73 pints. About 65 per cent have ordinances regulating the milk supply. Seventy-five per cent of all milk sold is bottled. All bulk milk is sold at wholesale and dipped milk is practically off the market. Eighty per cent of all milk sold is pasteurized and 50 per cent of cows furnishing this milk have successfully passed the tuberculin test. Since these figures were compiled, vigorous campaigns for testing cows have been inaugurated in a number of the cities, as well as in numerous smaller towns of the state, and it is estimated that 80 per cent of our dairy cows are tested at the present time. However, we have in Iowa no compulsory tuberculin testing law.

At the last session of our legislature a law was passed giving cities and towns the right to pass ordinances regulating their milk supply and to require all cows furnishing market milk to be free from tuberculosis as determined by the tuberculin test applied by an accredited veterinarian, exempting from such tests cows whose milk was to be efficiently pasteurized. Soon after this law was passed the

State Dairy and Food Commissioner, in conjunction with the State Dairy Council, State Veterinarian, Attorney General and other allied interests, compiled a tentative form of ordinance, using as a foundation for the same the report of the committee of this organization at the 1917 meeting. It was printed in pamphlet form, submitted to the proper authorities for passage, and at this time approximately 250 towns and cities of the state have this ordinance in effect.

The State Dairy and Food Commission have for several years, at the Dairy Cattle Congress at Waterloo, conducted a Market Milk Contest. In 1911, 1912 and 1913 the samples were submitted by the contestants. This method proved very unsatisfactory, as many would agree to submit samples, but few did so, and many samples reached the laboratory in unsatisfactory condition as they were improperly packed and iced.

In 1915 the State Dairy and Food Commission, having local representatives in all cities of 10,000 inhabitants or over (of which there are now 18) sent a refrigerator milk case to each city inspector with instructions to secure from a given number of their most prominent milk dealers two bottles of milk. These are shipped to our laboratory. One of these bottles is used for scoring, using the regular government score card for milk, and the other is used for exhibition purposes.

We conducted this exhibit in 1915, 1916 and 1917. In 1918 and 1919 the express service was so precarious we were obliged to discontinue it, but again conducted it in 1920, 1921 and 1922.

While this sort of competitive exhibit is not ideal, I do feel it has merit as it stimulates a rivalry between the different cities as well as the dealers in each city.

Inspectors are instructed to secure these samples from the wagons as it is being offered for sale. In other words, a representative sample of milk sold and not one prepared for exhibit purposes.

Time does not permit going into detail, but it is a source of satisfaction to me to be able to say to you that from the first the total average score of all these samples thus obtained has gradually increased, the score for this year being 75, and from these tests, as well as many others conducted by the local city authorities and by the State Dairy and Food Commission, I am justified in concluding that our milk supply in Iowa is improving.

"Two microbes sat on a dairy shelf
And watched with expression pained
The inspector's stunts; both said at once
'Our relations are getting strained.'"

REPORT OF COMMITTEE ON METHODS OF BACTERIAL ANALYSIS OF MILK AND MILK PRODUCTS

GEORGE E. BOLLING, *Chairman*

For the purpose of testing the comparative efficiency of various media to determine the number of bacteria present in milk, your committee has followed the general plan of work of the previous year.

We believe, as recent work indicates, that by far the greater number of bacteria present in market milk are derived from utensil contamination rather than acquired along with visible dirt. Inasmuch as these organisms are of the type developing best in media containing lactose, which substance is absent from the present standard medium, it was thought advisable to ascertain the effect the addition of this sugar had upon bacterial plate counts.

Seven laboratories, representing as many members of this committee, cooperated in this year's work. In each laboratory, milk was plated with several media, using the standard technique of the American Public Health Association. The media used were as follows:

1. Present standard meat extract agar.
2. Previous standard meat infusion agar.
3. Dehydrated (Bacto) agar, supplied by Digestive Ferments Co.
4. Dehydrated (Bacto) agar, supplied by the Digestive Ferments Co., plus 1 per cent lactose.
5. Dessicated milk agar, as developed by Dr. G. C. Supplee.
6. Ayers' milk powder agar, using spray process, skim milk powder..
7. Ayers' milk powder agar, using Just process, skim milk powder.

	Laboratory	Standard Extract Agar	Meat Infusion Agar	Dehydrated Bacto Agar	Bacto Agar with Milk	Dessicated Milk Agar	Milk Agar Ayers, Spray Process	Milk Agar Ayers, Just Process	Meat Extract A. + Lactose	Infusion Agar + Lactose
A	Raw...	100%	124.6%	110.0%	152.8%	167.4%	171.7%	175.7%	.....	.....
	Past....	100%	105.7%	173.3%	197.5%	200.0%	207.6%	223.4%	.....	.....
B	Raw...	100%	120.3%	108.6%	.....	.....	150.3%	.....	138.2%	.....
	Past....	100%	133.4%	113.9%	.....	.....	149.6%	.....	148.7%	.....
C	Raw...	100%	143.1%	133.9%	173.2%	.....	175.9%	.....	182.2%	190.4%
D	Raw...	100%	71.3%	108.3%	.....	.....	136.5%	.....	.....	.....
	Past....	100%	48.3%	339.2%	.....	.....	323.6%	.....	.....	.....
	Cert....	100%	27.4%	136.3%	.....	.....	51.5%	.....	.....	.....
E	No. 1 Raw...	100%	73.1%	58.1%	.....	.....	96.9%	.....	.....	.....
	No. 2 Raw...	100%	153.9%	111.1%	.....	.....	150.0%	.....	196.2%	196.2%
F	Raw...	100%	100.0%	110.8%	.....	.....	.....	.....	.....	.....
	Past....	100%	109.2%	124.2%	.....	.....	.....	.....	141.7%	.....
	Cert....	100%	95.3%	66.0%	.....	.....	.....	.....	132.9%	.....
G	Past....	100%	176.9%	188.4%	.....	.....	.....	.....	108.2%	.....
	Averages....	100%	105.9%	134.4%	174.5%	183.5%	161.4%	199.5%	149.7%	193.3%

8. Meat extract agar plus 1 per cent lactose.
9. Meat infusion agar plus 1 per cent lactose.

In the aggregate many hundreds of samples were plated. Space not permitting the inclusion of individual counts, a summary has been prepared which serves to visualize the results by assuming the average of all counts obtained upon the present meat extract agar to be 100 per cent and giving the relationship the average counts upon other media have to the standard 100 per cent. This summary is given in the table on page 204.

The results from the media in which milk powder or lactose was incorporated are most often materially higher than from the media which did not contain milk powder or lactose. On the basis of the number of highest and lowest counts obtained from each medium, the greatest number of highest counts and the smallest number of lowest counts were obtained from the media containing milk. From those media which did not contain milk, the reverse is true, and of this group the results from the standard extract agar and the previous standard infusion agar were least favorable.

If bacterial plate counts of milk are to record, as nearly correctly as is possible with a single medium, the bacterial content of the milk under examination, lactose appears to be a vitally necessary ingredient. The organisms developing best upon lactose certainly exercise the utmost influence upon the keeping qualities of milk and their inclusion in a plate count is essential. The present standard meat extract agar frequently either does not show these colonies at all within the 48-hour incubation period or they are so minute as to be easily overlooked by some technicians. So long as a most important group of bacteria predominate in market milk there appears to be no logical reason for employing a medium for correct official plate counts that fails to reveal their presence. The committee believes that a better coordination of work of the field inspector and the

laboratorian would follow if the latter employed a medium more suitable to record the bacteria more commonly present in market milk than the present standard extract agar.

From this year's work of the committee, it is evident that those media requiring more separate steps in their preparation are more likely to give uneven or erratic results than those more simply prepared.

We are more strongly than before convinced of the desirability of the distributing from a central source of a standard medium to all laboratories making official plate counts. This would tend to eliminate a prolific source of error and would render comparable the counts from different laboratories engaged in similar work. If the Hygienic Laboratory of the United States Public Health Service could supervise such a product in order that its nutritive value or potency would be assuredly maintained, in brief, exercise such oversight as it now gives to certain biological products such as vaccines, antitoxins and sera, it would make for better conditions than now exist.

The committee submits this report as one of progress, only.

"If there is to be an interesting tomorrow, we have more strength for today."

THE EXTENT OF TUBERCULOSIS IN LIVE STOCK IN THE UNITED STATES AND PROGRESS IN ITS SUPPRESSION

DR. J. A. KIERNAN, *Chief, Tuberculosis Eradication Division,* Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C.

I had the honor of addressing this association, in 1917, on the subject of the eradication of tuberculosis of livestock. At that time the Tuberculosis Eradication Division of the Bureau of Animal Industry had been organized less than three weeks. It is obvious, therefore, that the subject could have been discussed only from a theoretical standpoint, inasmuch as the work done was rather limited.

Five years have elapsed, however, and within that period cooperative arrangements have been entered into with the livestock sanitary authorities of every state and, in addition, cooperative work is carried on in the Hawaiian Islands and in Alaska.

The five-year period ending with this fiscal year was largely one of organization, and the past fiscal year, in addition to the actual results obtained in testing cattle, was largely devoted to solidifying cooperation between the many parties interested in completion of the work. This particularly applies to the cementing of the ties between the various livestock authorities, the Bureau, livestock commissioners of the various exchanges, the practicing veterinarians now on the approved and accredited lists, the farm bureau agencies, the livestock breeders' associations, public health officers and all others connected with the industry. So happy have been the results obtained that it can be safely said that, with few exceptions, the spirit of harmony and cooperation existing between these forces is all that could be accomplished in the time which has elapsed since organizing the work.

In addition to this much has been done towards gathering the necessary data and statistics upon which plans for

the complete eradication of the disease in livestock in the various states, and smaller county units, are based.

Forty-six and two-tenths per cent of the total area of the United States in square miles, which area contains 41.2 per cent of all the cattle in the United States, has only .6 per cent tuberculous cattle. This is contradictory to the impression which has probably existed that a majority of the cattle in the nation are confined to the territories known to be more or less heavily infected. As a matter of fact, only 16.6 per cent of the cattle of the nation in 5.8 per cent of the entire area are regarded as being badly diseased, the figures being taken from those areas containing more than 10 per cent of diseased cattle. It may be added that the data gathered in compiling these figures were taken from those submitted by the Bureau and state officials in each state and were based upon their knowledge of conditions in each county as was evidenced by actual tuberculin tests applied and by other relatively accurate means of estimation. A close study of these figures makes it more and more apparent that with the progress in the past five years continuing uninterrupted a number of states will be found practically free from the disease at the end of another five-year period. In fact plans which have been drafted for the conduct of the work in many states provide for the complete eradication of the disease within that period of time. During the fiscal year cooperation was extended to include all of the 48 states and territories of Hawaii and Alaska.

The growth in the number of field offices maintained and veterinarians employed is indicated by the following record of the work commencing with the fiscal year 1918:

Fiscal Year.	Field Offices End of Year.	Average Bureau Inspectors.	Average State Inspectors.	Average County.	Average City.	Average Other.
1918	17	53	36	..	..	..
1919	32	135	62	..	..	..
1920	35	155	101	..	..	..
1921	40	194	148	..	..	..
July, 1921, to July 30, 1922	43	247	172	19	8	11

APPROPRIATIONS

The appropriation made by Congress carrying on tuberculosis eradication work for the year ending June 30, 1922, was $1.978,800.00, available for use as follows:

Operating expenses	$ 978,800.00
Payment of indemnity	1,000,000.00

The combined State appropriations for tuberculosis eradication work totaled approximately $4,000,000.00. The amount provided for operating expenses was ample for the demands of the service only by reason of the fact that the indemnity funds were so limited as to prohibit the employment of the additional veterinary service demanded by the livestock industry. The original $1,000,000 was allotted to the various States on the basis of practically one-third of the amount of State funds available. On or about October 1st it became apparent that the appropriation was insufficient for the period covered by the appropriation. Interested livestock agencies were active in securing an additional $600,000.00 for the payment of indemnities which became available on December 15, 1921. This enabled the various offices to proceed with the work until about June 1st,, at which time the amounts allotted to several States again became exhausted.

Congress met the emergency in its appropriation bill for the fiscal year 1923, by providing that such part of $300,-000.00 of the $2,227,000.00 carried for tuberculosis eradication work as was needed be made immediately available.

Despite the increased appropriation, reports from the field offices indicated that not only were there many thousands of new herds waiting for tests but that there were also very many county units desirous of inaugurating work which were prevented by reason of the lack of the necessary appropriations. The waiting list of herds on June 30, 1922, totaled 35,239 herds which contained approximately 508,-

128 head of cattle. This is in comparison with the 14,440 new herds containing 216,000 head of cattle reported on the waiting list at the expiration of June 30, 1921.

In connection with the use of funds appropriated for the payment of indemnities for cattle slaughtered on account of tuberculosis the question of the disposition of reactors and the amount of salvage received by the owners for such cattle became a critical problem by reason of the reduced value of the animals on the farm and the consequent increase in the amount of indemnity to be paid when the animal was slaughtered. To overcome this handicap a letter was directed to all Inspectors in Charge requesting that they submit a monthly statement as to the disposition of all reacting cattle, the prices received and the value of the same class of cattle on the open market. In addition to this a traveling inspector of the Division was detailed to visit all the important market centers in the middle west for the purpose of interviewing agents of the packing companies and commission men and others interested in securing a relatively fair value for the diseased animals.

ACCREDITED HERD WORK

This project was continued, the plan having been modified slightly at the meeting of the U. S. Livestock Sanitary Association held in Chicago, November 28-30, 1921, inclusive, so as to take into the plan, to a larger extent, the accredited practicing veterinarians. As modified the uniform methods and rules now provide that accredited practitioners may, at the direction of the State authorities, tuberculin test herds undergoing original tests at the expense of the owners and without obligating the Federal Government for indemnity.

At the conclusion of the fiscal year, ending June 30, 1922, there were under supervision 71,806 herds containing 1,195,797 head of cattle. At the end of the fiscal year ending June 30, 1922, the records show there were 212,182 herds of cattle containing 2,616,395 head, an increase of 140,376

herds and 1,420,598 head of cattle. In other words, the work under this plan has been more than doubled during the year. These figures, however, include the area work which will be taken up under another heading. To make such an enormous increase in the herds under supervision it was necessary to test 2,384,236 head of cattle and to condemn 82,569 animals as diseased, or 3.5 per cent of the total cattle tested. The statistics for the year further indicate that at the conclusion of June 30th there were 16,216 fully accredited herds containing 363,902 cattle, as against 8,201 accredited herds containing 193,620 cattle on June 30, 1921, an increase of 8,015 accredited herds containing 170,262 head of cattle. Once-tested free herds increased from 49,-814 herds with 643,233 cattle to 161,533 herds containing 1,548,183 cattle, an increase of 111,717 herds containing 904,950 head of cattle. The complete records of the testing done in the various states during the year is shown in Table No. 1. Table No. 2 shows the total number of accredited herds and cattle, once-tested free herds and total herds and cattle under supervision, and also the herds and cattle on the waiting list in each state. That the accredited herd work grew so rapidly during the year is not surprising. In a measure it was due to the participation of the accredited veterinarians who were delegated to retest herds which had been freed from disease and to the interest generally displayed by this group of men. Additional examinations for accredited veterinarians were held on July 8, July 9, August 6, October 7, 1921, and January 24, February 20, June 14, June 23, June 30, 1922, and resulted in increasing the number of accredited men from 3,160 on June 30, 1921, to 4,-412 at the close of this fiscal year. Table No. 3 shows the number of accredited and approved veterinarians by states. The table on page 218 shows the progress of the work from 1917 to 1921, inclusive.

CATTLE TESTED BY THE VARIOUS METHODS UNDER COOPERATIVE TUBERCULOSIS ERADICATION WORK

Table No. 5 — FISCAL YEAR 1922

STATION	SUBCUTANEOUS			INTRADERMIC			OPHTHALMIC			COMBINATION		
	Herds.	Cattle.	Reacted.	Herds.	Cattle.	Reacted.	Herds.	Cattle.	Reacted.	Herds.	Cattle.	Reacted.
Alabama	8	173	0	57	814	0	0	0	0	766	24,590	164
Arizona	....	.....	....	.....	.....	.....	....	....	....	.....	.....	.....
Arkansas	0	0	0	15	453	3	0	0	0	41	1,587	28
California	2	46	0	165	2,844	66	0	0	0	5	2,026	80
Colorado	0	0	0	0	0	0	0	0	0	25	1,043	49
Connecticut	13	265	27	888	18,826	3,613	4	49	2	108	3,602	485
Delaware	6	11	4	1,106	8,823	986	5	19	2	246	1,822	73
District of Columbia	2	29	0	47	605	2	1	5	0	2	194	0
Florida	86	844	14	1,588	20,394	140	1	1	0	110	2,561	137
Georgia	21	410	6	743	18,533	252	0	0	0	15	587	19
Idaho	2	68	2	3,223	36,677	306	0	0	0	162	4,288	98
Illinois	99	1,269	41	3,463	37,801	2,779	0	0	2	604	12,422	213
Indiana	15	84	1	8,137	78,190	2,689	7	29	2	1,193	22,352	577
Iowa	21	858	31	4,996	97,786	6,273	0	0	0	910	20,656	506
Kansas	27	475	6	1,234	24,664	347	1	19	0	407	10,125	437
Kentucky	39	279	4	4,920	33,806	908	1	1	0	586	10,043	158
Louisiana	49	1,071	40	307	8,340	111	0	0	0	120	3,184	165
Maine	0	0	0	5,277	38,127	829	39	213	8	1	21	1
Maryland	59	665	38	2,865	33,837	2,972	35	345	23	218	4,255	419
Massachusetts	41	667	36	149	5,396	92	0	3	0	146	3,792	378
Michigan	49	823	20	15,481	131,985	4,201	0	0	0	1,257	27,645	1,188
Minnesota	2,984	62,173	1,838	0	0	0	0	0	0	1,269	27,889	648
Mississippi	2	26	2	2,242	19,744	145	0	0	0	87	2,890	30
Missouri	28	117	28	18,621	188,541	1,849	0	0	0	318	8,392	129
Montana	8	43	7	7,042	103,826	917	3	5	1	73	1,869	132

Nebraska	21	169	4	11,017	147,260	4,142	3	56	0	55	897	42
Nevada	0	0	0	938	9,453	271	0	0	0	25	176	14
New Hampshire	63	967	77	783	12,181	1,167	2	27	2	57	1,047	125
New Jersey	357	9,489	781	2	106	0	32	1,646	51	368	9,374	525
New Mexico	1	2	1	905	6,688	62	0	0	0	0	0	0
New York	674	15,945	2,014	3,058	45,383	5,138	0	0	0	2,422	45,266	4,755
North Carolina	31	88	1	20,223	68,421	788	1	1	0	55	1,744	35
North Dakota	27	248	8	2,036	37,330	1,080	0	0	0	672	14,963	265
Ohio	152	1,764	108	926	13,137	630	23	202	11	1,713	31,316	1,041
Oklahoma	0	0	0	991	26,877	865	0	0	0	278	8,428	94
Oregon	755	5,570	122	7,804	58,855	975	0	0	0	112	2,129	47
Pennsylvania	2,533	37,737	1,812	11	45	3	0	0	0	875	17,386	999
Rhode Island	1	21	5	42	1,234	45	0	0	0	19	494	44
South Carolina	4	17	0	722	15,974	139	0	0	0	160	4,825	115
South Dakota	24	371	13	334	9,507	380	0	3	0	395	9,688	295
Tennessee	59	1,031	8	3,344	38,129	231	6	33	1	124	4,478	113
Texas	0	0	0	223	16,854	314	0	0	0	112	9,234	225
Utah	1	21	4	4,833	25,332	252	0	0	0	53	502	27
Vermont	116	1,856	115	2,565	36,241	3,265	0	0	0	1,143	29,629	1,515
Virginia	11	197	3	2,459	39,008	1,485	7	34	3	272	7,175	210
Washington	10	148	1	8,502	81,238	1,805	1	9	8	115	2,250	43
West Virginia	7	110	10	1,392	13,409	233	0	0	0	504	7,714	177
Wisconsin	411	10,205	275	5,502	102,477	4,099	2	48	0	1,715	38,544	767
Wyoming	1	13	0	2,506	23,256	180	2	66	0	2	42	18
Totals	8,820	156,365	7,507	163,684	1,738,207	57,029	176	2,814	116	19,915	445,136	17,605

SUMMARY OF TUBERCULOSIS ERADICATION WORK IN COOPERATION WITH THE VARIOUS STATES, JUNE 30, 1922

Table No. 2

	Total Once-Tested Free.		Total Accredited.		Total Under Supervision.		Total Waiting List.	
	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.
Albany, N. Y.	4,511	53,615	565	12,380	6,543	196,560	5,000	125,000
Albuquerque, N. M.	724	5,575	.....	.....	883	6,827	155	2,800
Atlanta, Ga.	1,812	26,523	21	1,558	2,006	36,242	.....	.....
Augusta, Me.	6,748	56,203	523	6,413	8,555	71,726	800	2,536
Baltimore, Md.	1,632	16,698	386	7,572	3,455	34,043	1,500	.....
Birmingham, Ala.	735	17,444	79	3,458	837	26,344	.....	.....
Bismarck, N. Dak.	3,593	63,037	721	15,962	5,357	105,058	800	10,000
Boise, Idaho	5,056	40,454	116	4,031	5,607	51,371	700	3,000
Boston, Mass.	68	1,930	61	2,350	216	7,084	3	57
Boston, R. I.	17	544	14	304	42	1,213	3	64
Boston, N. H.	485	5,111	65	1,717	779	12,145	120	1,921
Charleston, W. Va.	2,029	17,337	224	4,828	2,426	26,475	240	1,700
Cheyenne, Wyo.	2,774	27,701	3	110	3,083	32,235	.....	.....
Chicago, Ill.	709	12,740	368	8,589	3,449	44,452	500	11,530
Columbia, S. C.	882	10,875	80	2,639	1,765	17,209	37	617
Columbus, Ohio	1,523	17,774	848	15,416	2,802	46,118	327	4,570
Denver, Colo.	7	269	1	37	18	759	53	2,965
Des Moines, Iowa	3,500	51,690	779	23,649	5,757	113,797	3,537	78,002
Fort Worth, Tex.	46	1,714	66	2,211	231	16,386	39	8,536
Frankfort, Ky.	5,347	41,273	194	5,500	6,781	57,251	1,000	5,000
Harrisburg, Pa.	1,039	14,598	1,165	19,501	3,005	49,454	445	.....
Hartford, Conn.	475	8,613	83	2,180	813	18,189	168	3,746
Helena, Mont.	9,914	126,466	116	6,358	10,845	159,851	.....	.....
Indianapolis, Ind.	8,970	62,290	1,308	22,326	11,753	109,557	1,600	16,000
Jackson, Miss.	352	11,026	140	3,241	674	15,933	125	3,000
Jefferson City, Mo.	18,703	177,465	389	12,400	19,734	205,792	.....	.....

Lansing, Mich.	13,496	113,519	385	7,642	16,727	129,711	12,236	120,984
Lincoln, Neb.	7,728	95,390	210	5,877	9,769	134,692	291	5,043
Little Rock, Ark.	39	845	35	1,084	81	2,000	2	90
Madison, Wis.	2,345	49,505	1,754	39,735	5,066	120,477	1,000	23,000
Montpelier, Vt.	2,460	35,573	1,165	17,675	4,440	65,415	1,036	15,920
Nashville, Tenn.	669	13,020	198	7,623	6,164	94,072	3	30
New Orleans, La.	516	11,542	63	2,681	591	17,023	25	.....
Oklahoma, Okla.	391	9,327	182	6,334	1,151	23,421	37	1,865
Olympia, Wash.	5,687	43,869	111	2,871	6,166	52,829	.....	.....
Pierre, S. Dak.	293	7,600	218	4,733	610	15,452	379	9,894
Portland, Ore.	9,163	90,987	170	4,144	9,333	95,131	1,000	10,000
Raleigh, N. C.	20,988	81,545	277	5,604	21,652	87,463	146	587
Richmond, Va.	1,300	14,407	675	15,792	2,410	42,599	.....	.....
Sacramento, Cal.	129	1,370	0	0	173	4,676	12	724
St. Paul, Minn.	2,022	38,759	1,506	34,833	4,222	91,872	1,827	36,540
Salt Lake City, Utah	6,238	21,994	77	2,457	6,855	42,763	.....	.....
Salt Lake City, Nev.	1,517	8,873	7	882	1,884	18,612	.....	.....
Tallahassee, Fla.	3,133	23,865	88	3,113	4,014	44,761	30	800
Topeka, Kans.	395	10,500	388	11,800	1,000	32,053	63	1,607
Trenton, N. J.	112	1,693	73	2,007	293	8,304	0	0
Trenton, Del.	1,120	4,690	125	1,470	1,825	9,625	.....	.....
Washington, D. C.	141	345	194	815	340	1,373	.....	.....
Total	161,533	1,548,183	16,216	363,902	212,182	2,616,395	35,239	508,128

RECORD OF TUBERCULIN TESTING
COOPERATIVE TUBERCULOSIS ERADICATION WORK

Table No. 1 FISCAL YEAR 1922

State.	Herds Tested.	Cattle Tested.	Reactors Found.	Per cent Reacted.
Alabama	861	25,647	164	.6
Arizona	.....	.....	.....	..
Arkansas	57	1,991	36	1.8
California	171	4,867	146	3.
Colorado	23	993	49	4.9
Connecticut	1,013	22,738	4,127	18.2
Delaware	1,364	10,542	1,064	10.1
District of Columbia	52	850	4	.5
Florida	1,791	23,850	302	1.3
Georgia	781	19,844	275	1.4
Idaho	3,383	40,232	406	1.
Illinois	4,155	51,552	3,033	5.9
Indiana	9,464	101,476	3,329	3.3
Iowa	5,874	118,467	6.738	5.7
Kansas	1,693	36,074	801	2.2
Kentucky	5,555	45,152	1,072	2.4
Louisiana	497	13,191	325	2.5
Maine	5,323	39,552	838	2.1
Maryland	3,157	38,656	3,430	8.9
Massachusetts	335	9,855	505	5.1
Michigan	16,787	158,853	5,419	3.4
Minnesota	4,484	97,465	2,492	2.6
Mississippi	2,327	22,774	177	.8
Missouri	18,967	197,979	2,005	1.
Montana	7,126	105,743	1,054	1.
Nebraska	11,132	148,561	4,149	2.8
Nevada	877	9,441	288	3.1
New Hampshire	908	14,206	1,373	9.7
New Jersey	706	19,606	1,292	6.6
New Mexico	914	6,723	64	1.
New York	6,123	106,826	11,900	11.1
North Carolina	20,180	69,599	750	1.1
North Dakota	3,771	69,819	1,828	2.6
Ohio	2,823	46,579	1,822	3.9
Oklahoma	1,230	36,156	950	2.6
Oregon	8,666	67,889	1,144	1.7
Pennsylvania	3,603	56,564	2,853	5.
Rhode Island	62	1,749	92	5.3
South Carolina	886	20,816	254	1.2
South Dakota	753	19,569	691	3.5
Tennessee	5,316	53,502	383	.7
Texas	321	26,138	549	2.1
Utah	4,887	25,849	284	1.1
Vermont	3,916	69,982	4,911	7.
Virginia	2,901	49,372	1,759	3.6
Washington	8,628	83,645	1,857	2.2
West Virginia	1,898	20,781	418	2.
Wisconsin	6,973	149,441	4,983	3.3
Wyoming	2,506	23,080	184	.8
Total	195,220	2,384,236	82,569	Av. 3.5%

TOTAL APPROVED AND ACCREDITED VETERINARIANS BY STATES, JUNE 30, 1922

Table No. 3

Approved.		Accredited.
89	Alabama	29
01	Alaska	00
18	Arizona	00
46	Arkansas	00
148	California	12
111	Colorado	00
67	Connecticut	43
07	Delaware	07
14	District of Columbia	07
18	Florida	00
88	Georgia	00
40	Idaho	33
462	Illinois	226
625	Indiana	434
769	Iowa	528
362	Kansas	127
122	Kentucky	64
71	Louisiana	35
53	Maine	29
59	Maryland	23
156	Massachusetts	68
428	Michigan	300
367	Minnesota	217
93	Mississippi	25
276	Missouri	197
61	Montana	22
336	Nebraska	201
15	Nevada	00
28	New Hampshire	17
85	New Jersey	50
14	New Mexico	00
547	New York	258
85	North Carolina	49
139	North Dakota	98
491	Ohio	299
96	Oklahoma	44
71	Oregon	14
373	Pennsylvania	279
09	Rhode Island	07
35	South Carolina	18
151	South Dakota	74
82	Tennessee	38
191	Texas	115
25	Utah	14
44	Vermont	33
81	Virginia	52
87	Washington	26
57	West Virginia	29
382	Wisconsin	271
35	Wyoming	00
8,010		4,412

COMPARATIVE TABLE
TUBERCULOSIS ERADICATION WORK
1917 TO JUNE 30, 1922

Year.	Herds Tested.	Cattle Tested.	Reactors Found.	Per Cent.
1917	.....	20,101	645	3.2%
1918	.....	134,143	6,544	4.9%
1919	.....	329,873	13,528	4.1%
1920	40,348	700,670	28,709	4.1%
1921	86,687	1,366,358	53,768	3.9%
1922	195,220	2,384,236	82,569	3.5%
Totals	322,255	4,935,386	185,763	Av. 3.8%

AREA WORK

The eradication of tuberculosis from livestock by means of tuberculin testing of all cattle within a given area is now the predominating work of the State and Bureau forces. The idea of circumscribed area work has advanced from the experimental state. It is now known that such movements are entirely practical and feasible. This has been evidenced by the rapidity with which counties have been put under test and completed in a number of states during the year—notably New York, North Carolina, Michigan, Wisconsin, Mississippi, Nebraska and others.

In those and other states in which the work was inaugurated every effort has been made to obtain as much county assistance as possible either through official county government, farm bureau agencies or others interested in the work. In some cases this assistance has taken the form of relatively large appropriations for the employment of veterinarians, purchasing tags, providing of transportation of State and Federal veterinarians and other incidental expenses. In others the cooperation has been limited to the providing of necessary automobile transportation. It is anticipated that county financial aid will become increasingly large when State laws are so adjusted as to permit counties to participate in that way. A notable instance of the growth of this movement is that of the State of Michigan, reports

from which indicate that $116,000.00 was appropriated by 20 counties for carrying on tuberculosis eradication work. Only a small part of this has been spent during the 1922 fiscal year. Fairly accurate records of money spent by the various counties, cities and Farm Bureau agencies show that $103,143.39 was spent during the past year. This is in comparison with the amounts expended by this Bureau and the State Governments. It is anticipated that county appropriations other than for indemnity will equal within a period of two or three years those made by the State and Federal Governments. Every effort is being made to encourage such appropriations with a view to having them large enough to permit of the employment of the necessary veterinary service to complete the work in the respective counties within a reasonable time.

That appropriations of this character and the assigning of State and Bureau Inspectors principally to the area work will greatly facilitate efficiency is indicated by figures collected for a period from January 1st to June 30, 1922, which show that 67.8 per cent of the herds, 47.6 per cent of the cattle and 37.4 per cent of the reactors were tested under the area project. In other words, approximately 50 per cent of the cattle tested during that period were included in so-called area testing. The cost of testing per head has been materially reduced where it was conducted under this plan. At the conclusion of the year ending June 30, 1921, the records indicate that nine counties in the United States had completed one or more official tests of all the cattle within these areas; that 50 were engaged in an active area campaign, and that 26 were contemplating the inauguration of the work in the near future. On June 30, 1922, there were 31 counties which had completed one or more tests; 138 counties which were engaged actively in an intensive campaign, and 296 counties which were doing preliminary work in preparation of an intensive movement. There are in the United States approximately 3,063 counties. It will be noted that 169

STATUS OF AREA WORK

JUNE 30, 1922

Table No. 4

State.	Preliminary.	Intensive.	Completed.	Total.
Alabama	8	...	...	8
Arizona	...	...	...	...
Arkansas	...	...	...	...
California	2	...	...	2
Colorado	...	...	...	...
Connecticut	...	...	...	...
Delaware	...	...	...	...
District of Columbia	...	...	...	...
Florida	...	...	...	...
Georgia	40	...	...	40
Idaho	25	...	1	26
Illinois	...	5	...	5
Indiana	2	3	...	5
Iowa	31	2	...	33
Kansas	1	1	...	2
Kentucky	28	5	...	33
Louisiana	4	...	...	4
Maine	4	11	...	15
Maryland	2	2	...	4
Massachusetts	...	...	...	...
Michigan	7	8	3	18
Minnesota	...	...	...	...
Mississippi	1	...	3	4
Missouri	4	18	...	22
Montana	2	2	2	6
Nebraska	2	16	2	20
Nevada	10	...	...	10
New Hampshire	1	...	...	1
New Jersey	...	...	...	...
New Mexico	7	1	...	8
New York	17	9	1	27
North Carolina	30	14	1	45
North Dakota	7	1	...	8
Ohio	...	...	...	...
Oklahoma	...	...	...	...
Oregon	23	6	7	36
Pennsylvania	1	...	...	1
Rhode Island	...	...	...	...
South Carolina	2	...	...	2
South Dakota	4	...	...	4
Tennessee	2	2	...	3
Texas	...	...	...	...
Utah	7	4	1	12
Vermont	4	...	...	4
Virginia	1	1	1	3
Washington	6	10	4	20
West Virginia	5	...	1	6
Wisconsin	7	6	4	17
Wyoming	...	11	...	11
Total	296	138	31	465

counties, or 5.5 per cent of the total number in the United States, are actively engaged in the eradication of the disease. This does not include those engaged in preliminary work. Table No. 4 shows the status of area work in the various States.

THE ERADICATION OF TUBERCULOSIS FROM SWINE

Continued attention was given this phase of the eradication problem. It is generally accepted that probably 90 per cent of all tuberculosis in swine is from cattle sources. Bearing this in mind it can be readily understod that the ultimate control and eradication of tuberculosis in swine depends upon its eradication from cattle. No data are available at this early date to indicate the influence which the area testing will have upon the incidence of the disease in swine. However, it is believed that freeing areas from bovine tuberculosis will reduce to the ultimate minimum the per cent found in swine. Figures on swine slaughtered in the United States, for the fiscal year ending June 30, 1921, indicate approximately 1.5 per cent increase in the disease. This on its face might seem discouraging. However, comparative tables from 1908 to and including 1921 indicate that the increase has not been so pronounced since 1916. Attention was given in the various States to the sources of infection and tracing down of those shipments of swine which were reported as having contained tuberculosis at the slaughtering establshments.

TUBERCULIN TESTING

The large number of cattle tested during the past year (2,184,236) afforded a wonderful opportunity for the regularly employed Veterinary Inspectors to perfect their knowledge of the various tests and continued progress was shown, not only in the individuals' knowledge of the work but also in standardizing methods throughout the service. This knowledge was also extended to the approved and accredited veterinarians who were taking over the accredited work.

Table No. 5 shows the use of the various methods of combinations thereof by States. The demand for area testing is largely responsible for the huge number of cattle tested by the intradermic method alone. This method has met the demands of the service as it has been reported that retests applied following the application of the intradermic test have shown uniformly good results. Of particular interest as showing the extent of the cooperation afforded by the various States are statistics which show that the Bureau forces tested 53 per cent of the herds, 55 per cent of the total cattle and obtained 49.5 per cent of the total reactors. This is believed to be as nearly a 50-50 proposition as can be obtained.

Investigation regarding the incidence of the disease in calves were continued during the last six months of the fiscal year. This showed that approximately 4 per cent of such animals were found to be infected. Without the use of the intradermic test these animals would have been permitted to remain in the herds.

Close supervision was again given the slaughter of reacting cattle with a view to ascertaining the percentage of no-lesion cases actually existing. It was found the same as last year, namely, 8.8 per cent. Of especial interest, however, in this investigation were the data (January to June inclusive) which showed that of the 42,770 reactors slaughtered 1,423, or 3.3 per cent showed skin lesions only; that 1 per cent of the total reactors showed udder lesions and that there were 62 varieties of other obscure lesions reported.

A close study of all these reactors indicates that approximately 17.8 per cent would be classified as spreaders of the disease; and that there were approximately 12 per cent either condemned or sterilized as unfit for food purposes. Other statistics gathered relative to reactors showed that during this six months' period 12,503 premises out of a total of 116,627 upon which herds were tested were found to contain reactors, or one out of every nine premises.

TUBERCULOSIS ERADICATION AS IT PERTAINS TO THE PUBLIC HEALTH

The question of bovine tuberculosis and its relation to public health remained one of the most important issues in the eradication campaign. Reports from the field offices indicate that many municipal health authorities enacted legislation looking to the providing of a more sanitary product from known healthy cows. These issues have apparently been met by the livestock owners in a cooperative frame of mind, for little trouble has been reported from the different localities where the enforcement of such regulation was made. There can no longer be doubt as to the wisdom of including the public health phase of the problem in the eradication campaign. Such hearty support has been afforded it by the majority of the medical profession and scientists interested in the eradication of both human and bovine tuberculosis as to insure its success. Notable support to the cause along these lines was given at the conferences on tuberculosis eradication work.

In connection with tuberculosis eradication as it pertains to municipal health work attention is drawn to the report of the Committee on the District of Columbia in the United States House of Representatives dated May 17, 1922, in reference to proposed milk legislation of the District of Columbia. In part this report states: "In the tuberculin test we have a ready method of detecting tuberculosis in cattle and to fail or refuse to avail ourselves of this means of protecting the people would be manifestly unwise and dangerous. In our judgment there can be no possible excuse for exposing any person to the dangers of tuberculosis however slight such dangers may be when we have a definite means of protection against that disease. * * * To discontinue this testing would be a definite step backward and would subject the people to unnecessary and unwarranted dangers." With this endorsement by a committee of the highest legislative authority in the land it would seem that the public

health phase of the question had been disposed of in a positive manner and that it should remain one of the great issues of the eradication movement.

During the year a Department Circular was prepared dealing with the tuberculin testing of livestock and submitted for publication. This will, no doubt, be available during the ensuing year, and it is expected that it will further standardize the different methods of testing.

An additional reprint of 210,000 copies of Farmers' Bulletin 1069 was received from the Public Printer during the fiscal year, making a total of 440,000 copies of this Farmers' Bulletin which have been distributed.

The poster—"Fight Tuberculosis"—devised during the fiscal year 1921 was received from the Public Printer and 60,000 copies have been distributed. It has met with universal approval of practically all officials who have had to do wtih its distribution. Dealing with both the public health and economic phases of the tuberculosis problem it was particularly well received.

PROPOSED ACTIVITY FOR THE FISCAL YEAR

There is no question but that the demand for circumscribed area work will be so great as to make that the main part of the movement during the coming year. From an economic viewpoint that is the only method of real tuberculosis eradication. The States and other interested parties are awakening to that fact which will, without question, result in the major portion of the work being done under the area plan. The other projects will be continued but will not be emphasized as extensively.

DISCUSSION

Mr. Daniels, Connecticut: How about the application of the tuberculin test to young calves?

Dr. Kiernan: The Bang system is discounted on account of infection of young calves. Badly infected herds do not

always react because they are made immune to tuberculin. We have found thrifty-looking calves generally diseased in certain individual cases.

"We should so live and labor in our time that what came to us as seed may go to the next generation as blossom, and that what came to us as blossom may go to them as fruit."

REPORT OF COMMITTEE ON MARKETING MILK AND MILK PRODUCTS

PROF. W. P. B. LOCKWOOD, *Chairman.*

The increased stress that milk dealers are placing on salesmanship is noticeable. Formerly a man who delivered milk was a "driver." Realizing this man's direct contact with the consumer has resulted in courses in salesmanship. Some dealers have put these courses on themselves, while others are paying outside agencies to do it for them. This includes two types of work: first, the acquaintance with the product, processing, etc., and second, actual contact work and the closing of a sale.

There has been a very great interest in advertising and educational work. Several large campaigns have been put on in such cities as Philadelphia, Baltimore, Pittsburg, Cleveland, Boston and Cincinnati, as well as campaigns in a large number of smaller cities. All of these have been based on the use of milk and have been carried on by subscription from both dealers and producers. It is recognized that these campaigns created new business rather than making a change in business from one dealer to another, as on the old basis of advertising. In all instances schools have received a large share of attention. Some places have done a little newspaper work and others have used billboard advertisements.

This propaganda has had a marked influence on the increased consumption of milk. The United States Department of Agriculture figures for 1919 indicate the per capita consumption of milk to be 42.5 gallons of milk per year, and at the present time the per capita consumption is 49 gallons per year. A recent survey of the market in Boston by the U. S. Department of Agriculture has shown that the increase in consumption of milk is above the increase in birth

rate. In Boston, it must be remembered, there has been practically four years of educational work and advertising. Part of this was under the auspices of the Council and part under the Dealers' Association. This work has brought out new high class material for distribution at home and through the schools. The advertising of milk by the milk industry is claimed to have noticeably reduced the amount of meat consumed in the country, and this has resulted in the meetings of the meat people to see what could be done to counteract its effect.

The most enthusiastic boosters of the milk industry have been the nurses, welfare workers, and public school teachers, who have actually seen what milk will do for those with whom they are working.

It is important to continue the school work, as new children are coming in and the other children must be resold on account of the tendency to spend their money for other things and even to accumulate bank accounts in money rather than in health.

In the Boston district the sale of milk in schools is on a very highly competitive basis among the milk dealers.

I feel that the members of this Association should be willing and that they are willing to do everything possible to help in this new movement for increased efficiency and for better health.

"Nowhere is the spirit of progress more evident than in the growing concern of society for the well being of the children."

REPORT OF SPECIAL MEMBERSHIP COMMITTEE FOR 1922

PROF. JAMES O. JORDAN, *Chairman,* Boston

It was decided last year, following our convention in New York, that the business of the Membership Committee would be carried on in a different manner this year. A committee was appointed with one member from each State in which we have members, and also from Ontario and Quebec. Thus the committee was one from which great strength could be expected.

The campaign was begun early in the year, and the members of the committee were informed of their duties, and were later given an opportunity to canvass for members, being supplied with stationery and blank forms for membership. They were thus enabled to do work in their vicinity, a factor which meant much to the success of the campaign.

Early in the year it developed that there was necessity for a considerable publicity campaign. This involved many letters which included various phases of the campaign work. It proved very helpful, for in this manner the chairman was enabled to ascertain the needs of numerous correspondents.

It was deemed necessary during the year to get in touch with the members of the Association three times; twice by a circular letter, and once by means of the postal card. In addition to these efforts many letters were sent to the association committee members. These latter were of an encouraging nature and enabled the committee members to do better work in behalf of the efforts being made to increase the number of those who indicated a desire to become associated with us.

The endeavor which was made for new members gave us great encouragement, and there has not been a month when we have not added some members to the Association. In all there have been sixty-five new members. This is a wonderful record of accomplishment, and is far in advance of what was expected. It shows what can be done by calling the attention of officials to the good work we are doing. That is all it is necessary to say; in fact, that was the keynote of our campaign.

I suggest that for the ensuing year a committee be appointed for continuing this work. It need not be as large as the committee of last year, and its chairman should be able to furnish time and energy to make this endeavor a complete success.

"Action is the parent of results."

ADDRESS

MR. SAMUEL H. GREENE, *Secretary, California Dairy Council,* San Francisco, Cal.

Mr. Greene said in part:

I am glad to speak to you. Our inspectors in California have not yet met in annual convention with the dairy people. The League of Municipal Authorities have an organization with which they hold their meetings.

There is a human phase in your work of great importance. We forget that we are dealing in substitutes, that we are substituting milk for 50 per cent of the babies that would otherwise go unfed. We think we have in this an important work.

In San Diego, authorities said, "We have no under-nourished children," We finally went to one school where twenty children were selected, some of whom were 25 per cent under weight for their height. Some of these children were four years behind in their grades. Teachers said they were poor scholars. We told the teacher we wanted to take them out of school one-half hour each day. The children were given one-half pint of milk daily, after which they were taught to lie flat on their backs and rest. They were also given one-half pint of milk when school was dismissed in the afternoon. One girl having a mean disposition was badly behind in her school work. Milk made her normal physically and mentally. She regained her proper grade in the school.

Statistics gathered show that on an average 30 per cent of our school children are under weight for their height and age. Fifty per cent of the 30 per cent are behind in school work. They require more school buildings and are an added expense to the state.

There is nothing connected with the industry that is more important than the use of milk by children. By keeping the men straight in the industry, you are helping the industry and all dependent on it.

"The future of this country rests entirely with its children, and every effort must be made to see that the boy or girl shall not begin life tragically shackled by the curse of preventable diseases or preventable ignorance."

PRODUCTION AND DISTRIBUTION OF LONDON'S MILK SUPPLY

MR. A. GORDAN RAYMOND, *of the United Dairies, Ltd.*, London, England.

Mr. Raymond said in part:

We have had great assistance in observing the way things are done here. In England farms are hardly up to your standard. We have no farms equal to some we have seen here.

Milk is cooled and placed in seventeen-gallon churns and dispatched directly, once daily, to the city. We have no refrigerating trucks in service. Dealers supply the churns for the farmer. We have to furnish at least a six days' churn supply on account of bad train service. On the arrival of the milk at the plant, the churns are tipped and the milk emptied into the tip tank, churns run to churn washer, 40 pounds water pressure forced through churns, after which they are put on steam block. Milk is pumped over regenerative heater, after which milk goes to a clarifier at 90°. From the clarifier it goes to the pasteurizer. Ninety per cent of our milk is pasteurized by the flash process. Pasteurizing apparatus of the holding type is now gradually being brought into use. The milk is then passed into ten-gallon churns, sealed and put in the cold store. It is sent out to distributing depots at midnight.

About 95 per cent of milk in London is delivered on push carts or barrows. From the churns milk is drawn through a tap to small cans. Bottled milk sent out is quite up to date. The bottles are similar to those used here. Not over 5 per cent of milk is now bottled. Drivers go out at 5.30 in the morning to deliver. They are back to the plant at 8.30. They polish up churns, go out again, and dip to small

cans as customers desire. Our system of delivery leaves much to be desired. We are here to learn better methods. Our drivers record amount delivered to consumers and each week bills are sent to consumers.

DISCUSSION

Mr. Estes, Michigan: What conditions seem to prevent the sale of bottled milk?

Mr. Raymond: The average housewife likes the penny better than the American housewife. The higher price will be difficult to secure until the public is educated.

Dr. Hollingsworth, Ottawa: Are producers or dealers licensed?

Mr. Raymond: All dairies are licensed and inspected, although we have no inspection of cattle whatever. Ninety-nine per cent of all milk is pasteurized. A few small men who push one or two barrows do not have their supply pasteurized.

"Here's to the man who plans things—makes things—who prates not of wonders of old, nor gloats upon ancestral gold, but slips off his coat and takes a hold—and does things."

SANITATION AND MILK SUPPLY OF LONDON

MR. ERNEST A. EVANS, *Member of the Royal Sanitary Institute, and Member of the Royal Institute of Public Health*

London, England

When Mr. Weld kindly asked me to address a few words to your convention on "Sanitation and the Milk Supply of London" and I rather rashly consented, I did not realize what I had let myself in for, as the subject covers so wide a field.

The difficulty will be to compress within narrow limits information that will necessarily be of interest to you, as like every other important problem the milk supply of any city can be viewed from various angles. I think it was Professor Harding of Illinois, who said that "good milk is like a good wife;" it can be described in many different ways, none of which does full justice to the subject.

As you are probably aware, my colleague and I are in this country making an investigation on behalf of the United Dairies of London, England, on milk plant equipment, method of milk distribution, and incidentally as to the educational work carried on by various organizations among the children as to the nutritive value of milk as a food.

What has impressed our minds most in every city visited is the stringent safeguards that are adopted to ensure an absolutely safe milk and the close cooperation that exists between health authorities, producers and distributors to attain this end. This is not so apparent in our country, although their interests are more or less identical, viz., the safeguarding of the milk so as to ensure a health-giving product.

I can assure you gentlemen in your official capacity that

our organization in London has a high ideal of service to the consumer, and I think I can even go so far as to say that many of our directors are inspired with altruisitic motives. Indirectly we have (by cooperation with the health authorities, both government and local) ensured that the milk as delivered to the home is without question of a high standard of quality and free from pathogenic organisms. At this stage it is even more important to us that its purity should be emphasized more than its food value, mainly owing to the attacks made on the milk supply by doctors and others who have only an imperfect knowledge of the subject and the unsatisfactory hygienic conditions which prevailed prior to the war.

In the year 1917, owing to the pressure of public opinion, a Committee was appointed by the British Cabinet to report on "The Production and Distribution of Milk in the United Kingdom." The terms of reference were as follows:

I. To stimulate production.

II. To conserve milk supplies during any period of excess.

III. To provide for the special needs of children in urban centres.

IV. To effect economies in the cost of production and distribution.

V. To organize supplies by administrative action so as to reach all sections of the community.

VI. Other kindred subjects.

This you will agree covered a wide field. Reference V, however, was more or less a war measure.

In 1919 the Committee issued their report and made various recommendations, putting on record their opinion that the average consumption of milk in the United Kingdom is much lower than is desirable in the national interest. The consumption per capita per day averages 0.25 pints liquid milk for Great Britain. This is less than

half the normal consumption of New York, where Dr. Copeland looks after the supplies so well. One point that came out in the investigation was that it was more difficult for the rural inhabitant to get milk than those living in cities. Detailed recommendations of the Committee were made on the following matters:

1. Management of milk on the farm.
2. Methods of management of depots and factories.
3. Treatment at railway stations and during rail transit.
4. Handling at city depots and methods of distribution.
5. Management of milk in the house of the consumer.

Although this report was issued in 1919, little progress has been made towards carrying these recommendations into effect, but there has been rather an insistent demand upon the part of a section of the public for clean milk, accompanied by a willingness to pay a higher price for milk of guaranteed purity. The Committee advocated the principle of grading milk, as it rewarded the farmers who take the necessary care with their herds and in the production of a cleaner and better quality product. Grading was advocated by our Dr. Eastwood as far back as 1909 in a report on "American Methods for the Control and Improvement of the Milk Supply." So you can realize that we are still about thirteen years behind the times. American methods have made enormous strides during this period.

The principle of grading and the effective control of the pasteurization of milk has recently received a big stimulus owing to a New Act of Parliament entitled "The Milk and Dairies (Amendment) Bill, 1922." In 1915 a bill had been passed which provided for the rigid supervision and tuberculin testing of cows, and the inspection of dairy farm buildings, but owing to the war its operation was suspended until this year. This bill, however, would have involved the country in an annual expenditure of £750,000 or about three and a half million

dollars. In view of the general economic situation and the need for stringent economy, the Amending Bill mentioned above has been passed, again postponing its operation until September 1, 1925. This bill also provides that milk may not be sold as "Certified," "Grade A," or "Pasteurized" except under license from the Ministry of Health, thereby ensuring that the regulations which they will ultimately frame will be effectively carried out.

Any order relating to milk and dairies made by the Minister of Health under this Act, or under any other enactment, must be laid before each House of Parliament 20 days before confirmation, which gives traders an opportunity of bringing forward objections and if unpracticable either get the order amended or annulled.

The trouble we have to contend with is that most of the provisions of our Public Health Act are permissive and not obligatory. Local authorities both rural and urban "may" (not "shall") make orders governing the hygienic conditions under which milk is produced; and in many cases orders when made are not enforced and therefore become a dead letter until we get an epidemic, milk-borne or otherwise, and then things begin to move.

The United Dairies have their own organization for dealing with these matters and have instituted a very rigid inspecton of the farms, the inspectors reporting to the Director of Milk Supplies, Mr. W. Price, who is responsible for at least 70 per cent of London's milk supply, on the

a. Sanitary condition of barns.

b. Cleanliness of the cows, particular attention being given to teats and udder.

c. Utensils.

d. Water supply and facilities for cooling.

e. Cleansing equipment.

Any failure to comply with a high standard is at once remedied.

We have also instituted Clean Milk Competitions among the farmers, dividing the country into zones and awarding silver cups to those farmers who secure the greatest number of points, the workers on the winning farms receiving medals and money prizes. These competitions are creating a great deal of interest and constitute a branch of our educational work.

Young Farmers' Clubs have been started all over the country by our Mr. P. B. Tustin, who is well known to some of you, and these are interesting the younger members of the community on questions of breeding and feeding of cows and the scientific production of milk.

In London the only bacterial standard we have is 30,000 bacteria per c.c. for certified milk, so that milk of any bacterial count can be sold with impunity, and *some is high.* The chemical standard is 3 per cent fat, 8.50 non-fatty solids. Nothing may be added to or taken from the milk. The quality of the milk we put out averages about 3.70 fat.

We have a large central bacteriological and chemical laboratory, where research work is carried out, in addition to laboratories in the individual plants. From the central laboratory a system of control and inspection has been organized covering every district in London.

Most of the milk is shipped into London from direct senders and the cans are not opened until they reach the pasteurizing depot. Samples are there taken for chemical analysis at least twice per month, oftener if necessary, but only a limited number for bacteriological examination.

At least 75 per cent of our milk is flash pasteurized, but the holding system is being introduced as rapidly as possible. Even with this system our bacteria tests work out below 10,000 per c.c. off the cooler. A lot of this work is nullified by exposure to the dust of the streets during delivery.

Every retail man's delivery outfit is washed and sterilized daily. This important detail receives very close attention. Our bacteriological tests of samples taken on the rounds range from about 20,000 per c.c. to 500,000 per c.c. varying largely according to the climatic conditions.

One other matter that may be of interest to you is the method of sampling adopted by the local authority. An inspector or his deputy stops a roundsman and asks for a pint of milk, for which he always pays. This he divides into three parts and seals the bottles, handing one to the man, and retaining the other two. One of these is analyzed, and if unsatisfactory a summons ensues. The dealer at the hearing has the option of having the third sample referred to the Government Analyst, but this does not often happen.

Time, both here and for preparation, does not permit of my giving you more than this brief and hurried survey, but before closing I wish to express publicly on behalf of the organization which we represent and personally the deep sense of obligation under which we are placed to Government officials (especially Dr. Larsen, Mr. Kelly and Mr. Clement, of the Dairy Division of Agriculture), public health authorities and the large distributing firms for the cordial welcome and courtesy shown and the amount of technical detail and information given us.

We can only hope that the result of our visit may arouse enthusiasm in London for bottle delivery, one of the most fascinating reforms which has ever engaged the attention of the industry. It is a movement on behalf of efficiency and will when carried to a successful issue reflect honour and credit to all concerned in the conflict between the present obsolete methods and the greater ideals of service to the community.

On one of your educational buildings in Cincinnati is inscribed these words:

"For broader and richer personal life."

I can only repeat this sentence when I say that a pure and safe milk supply will ensure health that will enable every child to enjoy this life in its fullest and broadest sense.

"I find the great thing in this world is not so much where we stand as in what direction we are moving."

RESULTS OF FURTHER INVESTIGATIONS OF REMADE MILK AND MILK POWDER

O. L. Evenson

U. S. Bureau of Chemistry, Washington, D. C.

In reconstituting or reconstructing milk or cream from butter, skim milk powder and water or butter and skim milk, some form of emulsifying or homogenizing machine is generally used to redistribute the fat in the plasma. To do this in such a manner that the fat globules will have the same relative gradation in size as in natural milk is manifestly a difficult problem. That the fat globules in emulsified remade milk are not in their natural gradation in size may be shown when a portion of the milk is centrifuged or put through an ordinary cream separator. In the case of emulsified remade milk the cream will not have the smooth consistency of natural cream and the skim milk will have a larger amount of fat than the skim milk from natural untreated milk. Also, if natural milk is put through an emulsifying machine, a small portion of the fat will be broken up into smaller globules so that the skim milk obtained from it will have a larger amount of fat than milk which has not been treated in this manner.

The object of this investigation was to obtain a practical test for milk which has been put through an emulsifying machine, basing the test upon the presence in emulsified or homogenized milk of a larger number of small fat globules than occurs in natural pasteurized milk.

The samples of remade milk were made from condensed skim milk and unsalted butter, skim milk powder, water and butter and from whole milk powder. The amounts of the different components were so chosen as to bring the per cent fat and non-fatty solids within the range for natural milk.

Samples of milk powder made by the different processes in common use were obtained from the manufacturers or purchased on the open market. Superheated condensed skim milk was obtained from a local ice cream plant and unsalted butter from local distributors.

The skim milk powder was first dissolved in water and warmed to about 45° C. before the butter was added. Condensed skim milk was diluted with the proper amount of water and likewise warmed before the butter was added. The heat was finally raised to about 63° C. and the milk was held at this temperature for a period of 20 to 30 minutes. It was then emulsified and cooled to about 5° C. Two different types of emulsors were used for this purpose. One of these emulsors is what is known as the "suction feed" type, having a tubular bowl which operates at a speed of about 16,000 r.p.m. In the other emulsor, the bowl, besides being constructed on a somewhat different principle, operates at a considerably slower speed and the milk feeds into the bowl by the force of gravity.

The natural milk used for comparison with the remade milk was obtained from herds maintained by the Dairy Division of the Department of Agriculture. The milk was pasteurized in the laboratory at the temperature of about 65° C. for 30 minutes.

The Röse-Gottlieb method was used to determine the per cent fat. This is the official method of the Association of Official Agricultural Chemists.

Experiments were at first made with an electrically driven centrifuge. Into a heavy glass tube 1¼ inch in diameter was poured 100 c.c. of natural pasteurized milk warmed to about room temperature. The same quantity of remade milk, warmed to room temperature, was poured into a similar tube. Both tubes were then centrifuged at about 700 r.p.m. for 10 minutes. The per cent fat in the lower 50 c.c. was then determined. It was found that in nearly every case there was a larger amount of fat in the lower 50 c.c. in

the case of remade milk than in the case of natural pasteurized milk. Experiments were then made with an ordinary cream separator. The separator was operated at the usual speed and the cream screw was set so as to obtain a cream of medium fat content. At certain times the position of the screw was changed but this did not appear to influence the amount of fat in the skim milk to any appreciable extent. Each portion of milk was warmed to about 35° C. before it was skimmed. Samples of mixtures of natural pasteurized milk and 15 to 20 per cent of remade milk were also skimmed in this manner.

The per cent of fat in the skim milk was determined and it was found that the cream separator did not remove the fat from emulsified milk as completely as from milk which had not been treated in this manner. Even in the mixtures there was a consistent, though small, increase in the per cent fat left in the skim milk. The per cent fat in the skim milk from 23 samples of natural pasteurized milk varied from 0.14 to 0.25, with an average of 0.19. In 21 samples of emulsified remade milk or emulsified natural milk, the figures varied from 0.40 to 0.86, with an average of 0.57.

The skim milk from 14 samples of mixtures containing 15 to 20 per cent of emulsified remade milk had 0.24 to 0.28 per cent fat, the average figure being 0.26.

The fat left in the skim milk is in the form of a very small globules, mainly those below 1½ microns in diameter, the larger number of these very small globules in emulsified milk being due to the action of the machine. The presence of a large amount of fat in the skim milk obtained with a cream separator from an unknown sample of milk as compared with the fat in the skim milk obtained with the same separator under the same conditions from a known sample of natural pasteurized milk is therefore an indication of the use of an emulsor or similar machine and this may be of assistance to the milk inspector in detecting remade milk.

A COMPARISON OF THE VISCOSITY OF NATURAL AND REMADE MILK

The relative viscosity was calculated from the formula:

$$V = \frac{\text{Time of flow of milk x specific gravity of milk.}}{\text{Time of flow of water x specific gravity of water.}}$$

To obtain the time of flow of milk and water, a specially constructed pipette was used which had a bulb capacity of about 5 c.c. and a capillary of such a size that the pipette drained in about 51 seconds, using water at 25° C. The temperature was kept within 0.1° of the desired temperature by circulating water. The time taken for the liquid to flow between definite points on the pipette was obtained with a stop watch.

Authentic samples of natural milk were obtained from the Dairy Division of this department. Also samples of market milk were obtained from local dairies for comparison. The samples of remade milk were made as before, from different kinds of skim milk powder, condensed skim milk, unsalted butter and whole milk powder. Two types of emulsors were used for this purpose in the manner described in the first part of this paper.

It was found that the temperature at which the milk had been held has considerable effect on the viscosity. All the samples were therefore kept as nearly as possible under the same conditions so as to obtain comparable results. It was also found that pasteurization at the usual temperature (63° C. for 30 minutes) tends to decrease the viscosity to a slight extent, while heating at 75 to 80° C. for 30 minutes considerably increases the viscosity.

The relation of viscosity to total solids, the viscosity of water being taken as 1, was represented by the expression $\frac{100\ (v-1)}{T\ S}$ in which v = the relative viscosity and T S = per cent total solids. When the viscosity was determined at 25° C. the value for the above expression varied as follows for a given number of samples: for natural pasteurized milk

from 5.68 to 7.18, for remade milk 6.37 to 12.60, and for mixtures containing 15 to 20 per cent remade milk, 5.96 to 8.37. The figures for the mixtures appeared to vary with the per cent remade milk present and the kind of powder used.

The viscosity is apparently a function of the per cent solids and the colloidal condition of the milk. The high viscosity shown by many remade milks is probably due to the change in colloidal condition brought about in the process of manufacture of the milk powder, this change in colloidal condition being manifested by a coagulation of the albumin and the presence of milk solids in suspension.

The effect of the machines used in making the remade milk on the viscosity was also studied and it was found that the two emulsors used had little or no effect on natural milk in this respect. The viscosity was increased considerably by homogenization at a pressure of 3500 lbs. A pressure of 1200 lbs. had only a slight effect on milk but considerable effect on cream.

Apparently, a remade milk made from a readily soluble powder to which nothing has been added and in which the albumin has not been coagulated will tend to give a figure for the relation of viscosity to total solids, $\frac{100\ (v-1)}{T\ S}$, little different from that of natural pasteurized milk, provided the fat globules have not been broken up by high pressure either in the process of manufacture of the powder or in the process of reconstructing the milk.

At the last meeting of this association a procedure was given for detecting remade milk when mixed with natural milk. The formation of a yellow color when the washed curd from milk powder is dissolved in sodium hydroxide served as the basis for this test. The appearance of this yellow color is evidence that some change has taken place in the curd as a result of the drying process. Further experiments have shown that the albumin of milk powder has also been changed in a similar manner. This can be demon-

strated by a color test somewhat different from that used on the curd. The theory was advanced that a small part of the lactose combines with the protein. Further experiments on the albumin seem to support this view. It has been found that in some remade milks in which there has been no or only a slight coagulation of the albumin, the latter nevertheless has undergone a change which can be detected by a colorimetric test. It seems that this test should be of considerable value to manufacturers as well as food control officials in determining the quality of a powder, inasmuch as changes are revealed which cannot be detected by the ordinary chemical analysis. This investigation has not yet been completed and further details will therefore be given later.

The writer wishes to acknowledge his indebtedness to the following members of the Bureau of Chemistry: to L. W. Ferris for assistance in the work on Viscosity of Natural and Remade Milk; to Dr. Charles Thom for suggesting the use of a cream separator; to Dr. E. A. Read for making microscopical observations on the skim milk samples; and to Dr. H. W. Redfield for assistance in preparing certain samples used in the Viscosity work. Also to the Dairy Division for the samples of natural milk used and to Mr. E. O. Williams for his assistance in the use of the homogenizer.

"Presumption leaps, prudence creeps."

REPORT OF COMMITTEE ON CITY MILK CONTESTS

RUSSELL S. SMITH, *Chairman*

City milk contests as a factor for the improvement of milk supplies of cities have not received the attention to which they are clearly entitled. This is especially true of the Eastern and Midwestern cities. Western cities and especially those in the States of Washington, Colorado, and California are far ahead of other cities in this regard.

The U. S. Department of Agriculture employs one Milk Specialist who spends nearly all of his time assisting Western cities in conducting milk scoring contests. For the fiscal year ending June 30, 1922, a total of 1,543 samples of milk, representing 48 Western cities, were scored. Of these contests 31 were surprise contests. The cities in California led with 41 city contests, 21 of which were surprise contests.

A comparison of the averages of the bacteria counts and of the total scores for the last two contests held in thirteen Western cities follows.

City	Average Bacteria Count. First	Second	Average Total Milk Score First	Second
Boise, Idaho	219,167	32,906	75.83	87.68
Seattle, Wash.	41,334	31,297	85.78	88.24
Tacoma, Wash	114,696	36,752	72.80	86.84
Pomona, Calif.	24,343	11,367	88.40	94.64
Redlands, Calif. . . .	23,845	12,425	91.10	92.29
Riverside, Calif. . . .	15.150	8,522	90.98	93.63
Long Beach, Calif. . .	33,421	11,823	86.56	90.67
San Diego, Calif.. . .	40,076	25,275	83.62	88.44
Pasadena, Calif. . . .	24,400	21,509	88.85	90.53
South Pasadena, Calif.	28,044	8,940	85.12	88.14
Santa Barbara, Calif. .	49,900	15,631	79.79	90.20
Richmond, Calif.. . .	90,160	17,100	70.20	89 22
Los Angeles, Calif. . .	19,354	12,690	90.07	91.65

In Orange County, California, samples of milk from practically all of the distributors in the county, represent-

ing the milk supply of ten cities, were collected and scored in the county laboratory. In Los Angeles County the same thing was done with samples from the supplies of eleven cities. The plan is to hold contests in these counties at more or less regular intervals and thus help to procure a higher quality supply for these cities than they could hope for working individually with small appropriations and limited laboratory facilities.

The California State Department of Agriculture has adopted the surprise contest method of improving the city milk supplies of the State and also uses the contests as a gauge of the quality of the supplies before approval is granted.

In cooperation with the milk inspection departments and the U. S. Department of Agriculture, milk contests were introduced in Colorado Springs, Boulder, and Greely, Colorado, during the past year.

In Idaho, the city of Boise has conducted milk scoring contests and similar contests have been introduced in Twin Falls and Pocatello.

In Oregon, milk scoring in Portland is carried on regularly by the State Department of Agriculture.

In Washington, the State Department of Agriculture cooperates with the U. S. Department of Agriculture in conducting contests in Seattle, Tacoma and Everett.

In Middle Western and Eastern cities periodical collection and examination of milk samples by city health departments takes the place of milk scoring contests. However, it might be well for milk control officials to encourage friendly rivalry by promoting surprise contests between city distributors.

One Eastern State has held a State contest in which representative surprise samples from different cities competed for a silver cup. Some objection has developed to such contests because of the relative differences in quantity of milk delivered by different dealers in different cities. It is

argued that the entry from each city should be rated according to the proportion of the entire supply which each sample represents. This plan would no doubt equalize the chances of all inspectors in their competition.

Some objection has developed relative to the score card for milk. It is argued that the present card entirely disregards the question of safety of the milk and that under such conditions a gold medal may go to a highly dangerous milk supply. Those who argue in the foregoing manner place the tuberculin test or pasteurization as the measure of safeness or healthfulness in milk, disregarding the human element entirely. The fact that classes are provided in milk scoring contests and that samples compete only within the class entered would seem to eliminate injustice to the competitors and danger to an unsuspecting public which, it is argued, would result if a gold medal were awarded to the highest scoring milk.

The safety of milk seems to be well taken care of when classes of milk, such as certified, pasteurized, and market, are provided and when the winning competitor in each class receives a prize.

It should not be forgotten that the main purpose of the milk score card is to improve the sanitary quality of the milk by instructing producers and dealers. Questions asked of those who fail to secure a high rating always reveal some point that could be improved and competitors who repeat their efforts usually receive higher scores as a result of their previous experience.

It has been argued that back of the competition lies a desire on the part of the producer or dealer to gain favorable recognition for his milk. It is only natural that the winner of such a contest should desire to receive the maximum gain possible and there is no doubt that scoring contests covering a period of time, such as are now in vogue in California, do result in recognition of the higher scoring milk

and better methods are constantly necessary if a high score is to be maintained.

Some objection has been made to the butterfat requirement of 4 per cent, which is necessary if the milk is to receive a perfect score on that item. The suggestion has been made that "Pasteurized Milk" should not be scored off if it has a butterfat content equal to the local legal requirement.

It would seem that so long as pasteurized milk competes in the "Pasteurized Milk" class, and if standardization or adjustment of composition is practiced by dealers who enter milk in competition in this class, that the ratings would be fair to all the entries. It seems inadvisable to lower the 4 per cent butterfat requirement on the milk score card to accommodate low testing milk or milk standardized or adjusted to a point near the local minimum legal limit. There would, no doubt, always be a tendency to standardize downward.

Samples of all milk entered in scoring contests at the National Dairy Show have uniformly tested higher than 4 per cent in butterfat, and as a lowering or raising of that requirement would not meet with the approval of the majority of competitors, it seems advisable to keep the requirement for perfect score on butterfat at 4 per cent.

The Committee believes that city milk contests, and especially surprise contests, should form an essential part of any milk inspection system as such contests indicate the degree to which sanitary essentials have been put into daily practice. After all, the final test of any milk inspection system must be the quality of the milk sold to the public daily and there is no better way of determining this than by periodical surprise contests and the awarding of suitable rewards to those who excel.

"In uplifting, get underneath."

BACTERIAL COUNTS OF MILK AS OBTAINED BY VARIOUS MEDIA

Presented to the Committee on "Bacterial Analysis of Milk and Milk Products" of the International Association of Dairy and Milk Inspectors at Eleventh Annual Meeting, 1922.

By G. C. SUPPLEE and G. E. FLANIGAN, from the Research Laboratory of The Dry Milk Company, Adams, N. Y.

The results shown hereinafter were obtained by the methods of procedure outlined in the communication from the committee chairman under date of June 27, 1922. Counts were obtained from 100 samples of milk by the use of various media, one plate from the same dilution being poured with each of the different media used. Plates were incubated at 37° C. for 48 hours.

The formulae and preparation of all media was according to the provisions set forth in "Standard Methods for the Bacterial Analysis of Milk," or, in the case of the milk media, according to the recommendations of Ayers and Mudge (1). The only exception was in the preparation of the desiccated milk agar. The hydrogen-ion concentration of the different media was adjusted when necessary; all media involved in the comparisons possessed the same Ph. value when used, in so far as could be determined by the colorimetric method.

Since there has been some conjecture as to the reason for specifying milk powder made by the spray process for the preparation of milk agar, it seemed desirable to incorporate in this series of comparisons a milk agar made with skimmed milk powder dried by the Just Double Cylinder process. Another additional medium not called for in the chairman's letter of instructions was also used in parallel

with the other media. This latter medium was a desiccated milk agar prepared by the Laboratory Division of The Dry Milk Company. The following table of results, therefore, includes the counts obtained from seven different media. The media used follow: Standard extract agar; standard meat infusion agar; dehydrated Bacto agar; dehydrated Bacto agar plus milk clarified according to Ayers; dehydrated milk agar; milk agar (Ayers) made with spray process milk powder; and milk agar (Ayers) made with Just Double Cylinder process milk powder.

COMPARISON OF COUNTS OBTAINED FROM VARIOUS MEDIA

(37° C. for 48 hours)

No.	Sample	Standard Extract Agar	Meat Infusion Agar	Dehydrated Bacto Agar	Bacto Agar with Milk	Dehydrated Milk Agar	Milk Agar (Ayers) Spray Process	Milk Agar (Ayers) Just Process
1	Raw Milk	3,000,000	3,450,000	3,050,000	2,900,000	3,600,000	3,400,000	3,850,000
2	" "	3,050,000	3,250,000	4,300,000	3,800,000	4,300,000	3,600,000	4,350,000
3	" "	5,400,000	4,400,000	5,000,000	4,500,000	5,400,000	6,600,000	5,600,000
4	" "	3,700,000	5,650,000	3,350,000	3,600,000	7,800,000	9,200,000	8,700,000
5	" "	2,200,000	3,900,000	2,050,000	4,950,000	4,950,000	7,500,000	8,300,000
6	" "	100,000	350,000	100,000	200,000	200,000	200,000	200,000
7	" "	5,950,000	5,750,000	3,250,000	14,200,000	15,250,000	14,400,000	14,500,000
8	" "	3,400,000	7,050,000	4,650,000	8,650,000	8,550,000	10,850,000	11,350,000
9	" "	1,700,000	2,850,000	2,350,000	2,800,000	3,250,000	3,750,000	4,350,000
10	" "	2,700,000	4,500,000	2,050,000	2,950,000	2,950,000	4,750,000	5,100,000
11	" "	900,000	1,100,000	1,000,000	1,850,000	1,550,000	1,650,000	1,400,000
12	" "	1,600,000	3,500,000	1,450,000	2,400,000	1,700,000	2,650,000	2,150,000
13	" "	1,250,000	3,400,000	2,500,000	3,050,000	3,900,000	2,850,000	3,900,000
14	" "	1,500,000	2,650,000	2,300,000	2,950,000	3,300,000	2,200,000	3,400,000
15	" "	2,250,000	3,500,000	3,700,000	3,400,000	3,600,000	3,300,000	3,550,000
16	" "	1,100,000	3,400,000	2,700,000	3,100,000	3,400,000	2,900,000	2,800,000
17	" "	9,900,000	11,400,000	16,300,000	19,500,000	22,200,000	23,050,000	22,800,000
18	" "	650,000	1,350,000	850,000	900,000	1,550,000	1,500,000	1,400,000
19	" "	1,950,000	650,000	2,100,000	3,250,000	1,500,000	3,400,000	2,300,000
20	" "	9,700,000	10,600,000	12,300,000	18,450,000	20,500,000	18,750,000	21,900,000
21	" "	250,000	450,000	150,000	450,000	350,000	300,000	750,000
22	" "	1,250,000	2,950,000	2,450,000	3,450,000	3,100,000	3,450,000	3,500,000
23	" "	5,550,000	2,050,000	5,150,000	5,750,000	2,400,000	4,000,000	5,750,000
24	" "	3,300,000	2,550,000	3,400,000	3,400,000	5,000,000	4,050,000	4,300,000
25	" "	2,200,000	800,000	1,750,000	2,200,000	2,000,000	1,800,000	2,050,000
26	" "	4,000,000	2,600,000	4,100,000	3,900,000	2,050,000	4,250,000	3,100,000
27	" "	2,000,000	2,150,000	2,850,000	1,650,000	2,100,000	2,550,000	3,600,000
28	" "	100,000	50,000	50,000	50,000	50,000	50,000	50,000

No.	Sample		Standard Extract Agar	Meat Infusion Agar	Dehydrated Bacto Agar	Bacto Agar with Milk	Dehydrated Milk Agar	Milk Agar (Ayers) Spray Process	Milk Agar (Ayers) Just Process
29	Raw	Milk	1,850,000	2,600,000	1,150,000	2,200,000	2,100,000	1,300,000	2,500,000
30	"	"	200,000	400,000	350,000	400,000	200,000	200,000	500,000
31	"	"	100,000	300,000	150,000	100,000	50,000	50,000	150,000
32	"	"	4,950,000	6,300,000	6,700,000	5,100,000	3,750,000	6,450,000	5,000,000
33	"	"	2,350,000	4,800,000	2,900,000	5,400,000	6,450,000	5,650,000	6,200,000
34	"	"	250,000	200,000	50,000	100,000	50,000	150,000	200,000
35	"	"	100,000	550,000	200,000	300,000	200,000	200,000	200,000
36	"	"	4,850,000	3,600,000	2,900,000	4,000,000	3,600,000	4,550,000	2,800,000
37	"	"	300,000	450,000	400,000	800,000	300,000	800,000	450,000
38	"	"	2,200,000	2,400,000	2,650,000	2,100,000	4,400,000	3,350,000	2,150,000
39	"	"	5,600,000	4,950,000	4,800,000	4,600,000	7,000,000	5,900,000	7,750,000
40	"	"	10,200,000	11,450,000	17,850,000	20,250,000	22,000,000	20,650,000	23,500,000
41	"	"	5,000,000	4,950,000	4,950,000	3,400,000	4,500,000	4,900,000	5,000,000
42	"	"	2,500,000	3,900,000	3,000,000	3,600,000	4,400,000	4,350,000	4,800,000
43	"	"	250,000	50,000	150,000	350,000	350,000	50,000	250,000
44	"	"	400,000	500,000	400,000	950,000	700,000	750,000	900,000
45	"	"	6,250,000	11,800,000	10,850,000	11,750,000	14,000,000	13,300,000	14,400,000
46	"	"	50,000	200,000	100,000	500,000	350,000	150,000	300,000
47	"	"	450,000	400,000	300,000	350,000	600,000	700,000	300,000
48	"	"	50,000	100,000	50,000	400,000	100,000	100,000	250,000
49	"	"	23,800,000	27,600,000	11,000,000	26,200,000	27,700,000	24,900,000	23,800,000
50	"	"	700,000	750,000	250,000	800,000	600,000	700,000	900,,000
51	"	"	350,000	100,000	100,000	100,000	250,000	200,000	200,000
52	"	"	1,850,000	9,100,000	10,250,000	15,300,000	20,200,000	20,500,000	17,300,000
53	"	"	250,000	600,000	400,000	800,000	700,000	750,000	800,000
54	"	"	650,000	700,000	450,000	1,250,000	1,050,000	950,000	1,500,000
55	"	"	30,000	90,000	80,000	30,000	60,000	50,000	90,000
56	"	"	10,000	40,000	40,000	100,000	50,000	60,000	60,000

57	"	"	10,000	20,000	30,000	80,000	110,000	150,000	110,000
58	"	"	60,000	210,000	150,000	200,000	100,000	90,000	150,000
59	"	"	30,000	10,000	80,000	40,000	60,000	10,000	20,000
60	"	"	40,000	100,000	130,000	130,000	170,000	150,000	140,000
61	"	"	1,520,000	1,560,000	1,880,000	1,480,000	1,610,000	960,000	1,200,000
62	"	"	70,000	90,000	250,000	150,000	240,000	110,000	160,000
63	"	"	300,000	190,000	300,000	260,000	210,000	12,000	110,000
64	"	"	300,000	150,000	220,000	190,000	340,000	170,000	260,000
65	"	"	30,000	70,000	390,000	320,000	280,000	120,000	120,000
66	"	"	10,000	10,000	90,000	20,000	50,000	40,000	60,000
67	Past.	Milk	6,000	3,500	24,500	30,000	24,000	32,000	34,000
68	"	"	17,500	15,500	50,500	49,500	50,000	51,500	49,000
69	"	"	12,500	32,000	23,500	32,000	34,000	37,500	36,000
70	"	"	235,000	221,000	220,000	317,000	301,000	304,000	311,000
71	"	"	35,500	47,500	94,000	95,500	111,000	96,000	112,000
72	"	"	40,500	73,500	92,000	87,000	60,500	61,500	62,500
73	"	"	22,000	16,000	14,500	28,000	28,500	25,000	25,500
74	"	"	32,000	59,500	69,000	62,000	153,000	129,000	144,000
75	"	"	7,500	5,500	50,500	53,000	62,000	50,000	45,000
76	"	"	185,000	156,000	251,000	353,000	398,000	430,000	415,000
77	"	"	10,000	9,500	128,000	105,000	94,000	92,000	97,000
78	"	"	5,500	4,500	62,000	59,000	63,500	62,500	63,000
79	"	"	12,000	6,000	83,000	84,500	78,500	54,000	69,000
80	"	"	15,500	8,700	48,500	43,000	31,500	27,000	44,000
81	"	"	7,000	1,000	1,500	10,500	3,000	4,000	6,500
82	"	"	13,000	2,000	8,000	14,000	14,000	8,000	16,000
83	"	"	27,500	4,000	95,000	113,000	92,500	122,500	125,000
84	"	"	115,000	96,000	120,000	124,000	122,000	123,000	126,000
85	"	"	23,000	47,000	123,000	141,000	112,000	132,000	131,000
86	"	"	72,000	58,000	77,500	50,000	14,500	60,500	62,000
87	"	"	94,000	126,000	170,000	182,000	183,000	229,000	243,000
88	"	"	212,000	256,000	200,000	251,000	262,000	260,000	275,000
89	"	"	8,600	3,000	56,000	46,200	57,500	54,000	59,000

No.	Sample	Standard Extract Agar	Meat Infusion Agar	Dehydrated Bacto Agar	Bacto Agar with Milk	Dehydrated Milk Agar	Milk Agar (Ayers) Spray Process	Milk Agar (Ayers) Just Process
90	Past. Milk	200	9,000	24,400	22,300	22,500	26,600	24,700
91	" "	1,300	200	3,300	2,200	2,600	2,200	3,400
92	" "	500	24,500	52,400	53,000	66,000	67,200	70,600
93	" "	300	100	1,200	200	400	300	200
94	" "	300	500	600	400	300	200	300
95	" "	1,600	3,700	11,900	6,500	10,800	11,200	12,600
96	" "	14,100	14,100	15,800	19,200	19,800	15,300	16,600
97	" "	5,900	4,800	5,700	5,800	5,900	6,200	6,000
98	" "	2,100	3,600	13,500	6,600	3,100	1,900	2,500
99	" "	500	1,100	2,000	3,000	1,000	1,200	1,200
100	" "	14,400	9,600	24,800	21,700	19,200	19,500	22,200
Average All Samples		1,598,098	1,989,129	1,834,076	2,448,206	2,678,816	2,731,268	2,832,308

A summary of the counts obtained from the various media is shown in Table II, in which the number of samples are tabulated with reference to the relative ability of each medium for the production of high and low counts.

TABLE II

COMPARISON OF MEDIA WITH REFERENCE TO PRODUCTION OF HIGH AND LOW COUNTS

Media	Per Cent Samples First	Per Cent Samples Second	Per Cent Samples Third	Per Cent Samples Fourth	Per Cent Samples Fifth	Per Cent Samples Sixth	Per Cent Samples Seventh
Standard Extract Agar	7	3	7	8	8	32	35
Standard Infusion Agar	8	6	11	13	15	24	23
Bacto Dehydrated Agar	16	10	7	13	18	23	13
Bacto Dehydrated Agar with milk .	15	19	15	22	20	4	5
Dehydrated Milk Agar	16	24	19	19	10	9	3
Milk Agar (Ayers) Spray process. .	14	20	23	15	16	9	3
Milk Agar (Ayers) Just process . .	34	25	22	6	9	2	2

SUMMARY

1. Taking the average of all results obtained from standard extract agar as 100 per cent, each of the averages from the other media show the following relationships to the standard extract agar results (100 per cent): standard infusion agar, 124.4 per cent; Bacto dehydrated agar, 114.7 per cent; Bacto dehydrated agar with milk, 153.2 per cent; dehydrated milk agar, 167.6 per cent; milk agar (Ayers), spray process, 170.9 per cent; and milk agar (Ayers) Just process, 177.2 per cent. It is significant that the milk powder agars give percentages (referred to standard extract agar as a basis) which are in close agreement with the results obtained by Supplee, Whiting and Downs (2) with lactose agar incubated under the same conditions.

2. The results from the four media in which milk was incorporated are all materially higher than the averages from the three media which did not contain milk.

3. On the basis of the number of highest and lowest counts obtained from each medium, the greatest number of highest counts and the smallest number of lowest counts were obtained from the media containing milk. From those media which did not contain milk the reverse is true, and of this group the results from the standard extract agar were least favorable.

4. The results from the different milk media indicate that some of these media are superior to others in regard to ability for developing maximum counts. The Bacto dehydrated agar to which milk was added appears to be slightly less efficient than the others. There is practically no difference in the results from the dehydrated milk agar and those from the milk agar made with spray process powder. The results from the milk agar made with Just process powder appear to be better than those obtained from other milk agars, both from the standpoint of slightly higher average count and from the standpoint of greatest number of maximum counts. The reason for this difference is not entirely clear, although it is not beyond possibility that the condition of the calcium salts in this product has had a bearing on the results. Bosworth (3) has shown that the amount of soluble calcium in Just process powder is materially lower than in natural liquid milk or in milk powder made by the Spray process. Furthermore, Ayers, Mudge and Rupp (4) have suggested that the lower calcium and magnesium content of washed agar may be responsible for the higher counts obtained from the media in which agar was so treated.

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

O. M. CAMBURN, *Chairman*

The Committee on Food Value of Milk and Milk Products submits the following short report.

In past years many dairymen and others felt that milk possessed properties other than those determined by chemical analysis. Although they had no proof of this, investigators and scientists in recent years have proven that milk does possess such properties, which are of vital importance to mankind and of unmeasurable value to under-nourished children.

Milk research work has been carried on in many countries. In numbers of instances the results obtained have confirmed each other and thus proven, have led, through educational work, to increased use of milk with most beneficial results.

A study of the diets of various races of people reveals the close relationship between the diet of a nation and the health of its people.

With the increased use of milk in the school room and factory, the milk inspector realizes the importance of cooperating with the agencies fostering this work, so that he can assure them of a safe milk supply.

The great increase in the use of milk has encouraged the creation of cheap so-called substitutes, with oil added to milk from which the all-essential milk fat has been separated. This unnatural manufactured product constitutes a menace to the public health, especially when fed to children.

Several States have laws prohibiting the manufacture and sale of this inferior product, and thus protect to a certain extent the health of the consuming public.

Every milk inspector may well consider the importance of

fostering and supporting similar legislation, in order that the public may know that it is receiving the full food value of whole milk when it purchases condensed or evaporated milk.

The subject matter of the numerous investigations is great and your committee respectfully suggests that a committee on Food Values of Milk be continued.

"In the continued production and distribution of the essentials of modern living there can be no substitute for milk."

ADS