THIRTEENTH ANNUAL REPORT

OF THE

International Association of Dairy and Milk Inspectors

INCLUDING PAPERS READ AT THE ANNUAL
CONVENTION IN DETROIT, MICHIGAN
OCTOBER 17, 18 AND 20, 1924

COMPILED BY
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OF THE

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"No action by the state can do more than supplement the initiative of the individual."
—Theodore Roosevelt.

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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, which shall direct the affairs of the Association when not in Annual Session, shall consist of the President, the three Vice-Presidents, and the Secretary-Treasurer.

AMENDMENTS

This Constitution may be amended 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[1]

SECTION 4. Members of the Association may elect as honorary members, at any stated meeting, on the recommendation of the Membership Committee, those whose labors have substantially added to the scientific knowledge of milk supply betterment, or those who have been of pronounced practical influence in the improvement of the milk industry. From such members no dues shall be required. They shall have the privilege of attending the meetings of the Association, but they shall not be entitled to vote.

ARTICLE 2

OFFICERS

SECTION 1. The officers of this Association shall be a President, a First, Second, and Third Vice-President, a Secretary-Treasurer, and two Auditors, who shall be chosen by ballot at the annual meeting of the Association, and shall hold office for one year, or until their successors are duly elected.

SECTION 2. The Executive Board shall consist of the President, the three Vice-Presidents, and the Secretary-Treasurer.

SECTION 3. The Membership Committee shall consist of the President, the three Vice-Presidents, and the Secretary-Treasurer.

ARTICLE 3

DUTIES OF OFFICERS

SECTION 1. It shall be the duty of the President to preside at all meetings of the Association. He shall examine and approve all bills previous to their payment, appoint all committees unless otherwise directed by vote of the

[1]Adopted October 29, 1915.

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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Cooledge, Prof. L. H.	Research Associate in Dairy Bacteriology, Michigan Agricultural College	East Lansing, Mich.
Cooley, Dr. R. S.	Asso. Health Officer in charge Food and Sanitary Inspection	City Hall, Lakewood, Ohio
Corlis, Dr. W. S.	Veterinary, Meat and Milk Inspector	Mt. Vernon, N. Y.

Cornehl, Dr. Hugo..	Dairy Inspector and Supervisor, Board of Health....	Detroit, Mich.
Dafre, Dr. G. R.....	Food and Dairy Inspector...	141 N. 10th St., Casper, Wyo.
Daley, John P.....	Milk Inspector.....	Beverly, Mass.
Daniels, H. O.....	Deputy State Dairy and Food Commissioner.....	Middletown, Conn.
Dinneen, Maurice...	Inspector of Milk.....	Town Hall, Winchester, Mass.
Dodson, Fred S.....	Health Officer.....	246 Union Ave., Framingham, Mass.
Dorian, Frank P., D.V.S.	Veterinary Inspector, Bureau of Health.....	Yonkers, N. Y.
Dotterrer, W. D.....	With Bowman Dairy Co.....	140-158 W. Ontario St., Chicago, Ill.
Douglas, D. K.....	Milk and Dairy Inspector, Dept. of Health.....	City Hall, Regina, Saskatchewan, Canada
Dyer, R. E.....	Chief, Dairy Inspection Division, Health Dept.....	Boston, Mass.
Earnshaw, Jackson E.	Sanitary Engineer.....	30 W. 59th St., Kansas City, Mo.
Eddy, Dr. C. W.....	With Telling-Belle Vernon Company	Cleveland, Ohio
Estes, Howard R....	Dairy and Food Inspector, Health Dept.....	Flint, Mich.
Evans, Dr. Fred....	Veterinarian	Sioux Falls, S. D.
Evenson, Oscar L...	Asst. Chemist, U. S. Bureau of Chemistry.....	Washington, D. C.
Fee, Kenneth F.....	Director, Bureau of Dairy Products, Dept. of Farms and Markets.....	Albany, N. Y.
Flanagan, Geo. A....	Food and Milk Inspector....	City Hall, Lynn, Mass.
Flanagan, Thomas F.	Food and Milk Inspector....	9 Oak St., Hartford, Conn.
Foelschow, G. W., D.V.M.	Chief Dairy and Milk Inspector	San Diego, Calif.
Foster, J. E.....	Chief Dairy and Milk Inspector	City Hall, Houston, Texas
Frank, Leslie C.....	Sanitary Engineer, Associate in charge, Milk Investigations, U. S. Public Health Service	519 Dexter Ave., Montgomery, Ala.
Frey, Dr. J. J.....	Superintendent of Dairy Service, State of California....	Route 4, Box 954, Sacramento, Calif.

Gamble, Prof. James A.	Professor of Dairy Husbandry, University of Maryland	College Park, Md.
Gauhn, Emmett R.	Supervisor of Food and Sanitation, Health Bureau	Rochester, N. Y.
Gibbons, John F.	Farm Inspector, Dept. of Health	Room 10, City Hall, New Haven, Conn.
Grapp, Dr. G. H.	State Dairy Inspector	816 Fidelity Bldg., Baltimore, Md.
Gray, Dr. J. R. T., Jr.	City Bacteriologist	Chester, Pa.
Grim, Dr. Geo. W.	Milk Control Officer, Board of Health, Lower Merion, Haverford, Narberth, Pa.	Ardmore, Pa.
Hamilton, Jesse H.	Food and Dairy Inspector	Box 185, Orlando, Florida
Harding, Dr. H. A.	Chief, Dairy Research Division, F. C. Mathews Co.	Detroit, Mich.
Hartnett, Daniel P.	Inspector of Milk	City Hall Annex, Holyoke, Mass.
Hay, Dr. L.	Dairy Inspector	Faribault, Minn.
Hiscock, Prof. Ira V.	Instructor in Public Health, Yale University, School of Medicine	New Haven, Conn.
Holford, F. D., D.V.M.	Chief Veterinarian, Borden's Farm Products Co.	110 Hudson St., New York City
Hollingsworth, Dr. J. B.	Chief Food Inspector	City Hall, Ottawa, Canada
Holt, Thomas	State Dairy and Food Commissioner	Hartford, Conn.
Holzman, J. A.	Chief Dairy Inspector	Dallas, Texas
Hornaday, W. A., D.V.M.	Dairy and Milk Inspector	Greensboro, N. C.
Huffman, R. P.	Food and Dairy Inspector	Wilmington, N. C.
Hulquist, J. A.	Dairy Inspector and Sanitary Inspector	Jamestown, N. Y.
Irvine, George	City Milk Inspector	Care Y. M. C. A., Ann Arbor, Mich.
Irwin, Ralph E.	Asst. Engineer, State Dept. of Health	Harrisburg, Pa.
James, J. C.	Director Laboratory and Food Inspector, Durham County Board of Health	Durham, N. C.
Jennings, J. R.	State Dairy Commissioner	State House, Phoenix, Ariz.
Jones, Fred E.	Health Commissioner and Inspector of Milk	Quincy, Mass.
Jordan, Geo. W.	Inspector of Dairies, Health Department	Detroit, Mich.

Jordan, Prof. James O.	Inspector of Milk	Room 1104, City Hall Annex, Boston, Mass.
Kelly, Ernest	Market Milk Specialist, U. S. Dept. of Agriculture	Washington, D. C.
Kilbourne, Chas. H.	Food and Sanitary Specialist	1476 Broadway, New York City
Knobel, Ed., D.V.M.	Inspector of Milk	Dedham, Mass.
Krause, C. A.	Dairy Inspector	Portsmouth, Va.
Kresse, O. A.	Milk and Dairy Inspector	City Hall, Houston, Texas
Krehl, E. C.	Detroit Creamery Co.	Detroit, Mich.
Ledbetter, D.	Milk and Dairy Inspector for Biltmore Dairy Farm	Biltmore, N. C.
Lees, Dr. A. F.	Dairy Inspector	Red Wing, Minn.
Leete, C. Sidney	Market Milk Specialist, Bureau of Dairying, U. S. Dept. of Agriculture	Washington, D. C.
Leman, Dr. H.	Agriculture, Dairy and Milk Chemist and Bacteriologist	Blumenau, Est. S. Catherina, Brazil.
Leslie, Roy F., D.V.M.	Chief of Bureau of Food and Dairy Inspection	127 City Hall, Cleveland, Ohio
Le Fevre, Peter E.	Asst. Market Milk Specialist, Bureau of Dairying, U. S. Department of Agriculture	Washington, D. C.
Lewis, Malcolm	Asst. Engineer, in charge, Milk Sanitation, State Board of Health	Raleigh, N. C.
Lockwood, Ralph F., M.D.	Health Officer and Milk Inspector	Lakewood, R. I.
Lockwood, Prof. W. P. B.	Managing Director, New England Dairy and Food Council, Inc.	51 Cornhill, Boston, Mass.
Lombard, Alfred W.	Massachusetts Dept. of Agriculture	136 State House, Boston, Mass.
Loomis, Frank J.	Inspector of Milk and Meat	Watertown, N. Y.
Lyons, Samuel	Milk Inspector, Board of Health	Detroit, Mich.
MacBride, C. S.	Milk Specialist, Detroit Creamery Co.	Detroit, Mich.
McInerney, Prof. T. J.	Milk Inspector and Asst. Professor of Dairy Industry	Dept. of Dairy Industry, Cornell University, Ithaca, N. Y.
Marcussen, W. H.	Director of Laboratories, Borden's Farm Products Company	63 Vesey St., New York City

Marquardt, Otto R.	Milk Inspector, Board of Health	Detroit, Mich.
Marquis, L. H.	Inspector of Milk	4701 Canal St., Houston, Texas
Maughan, M. O.	Secretary, National Dairy Council	910 S. Michigan Ave., Chicago, Ill.
Melican, Geo. D.	Milk Inspector	Room 6, City Hall, Worcester, Mass.
Melody, Dr. Geo. L.	Dairy Veterinarian, Dept. of Public Health	1085 Mission St., San Francisco, Calif.
Menary, Dr. A. R.	City Dairy Inspector	Cedar Rapids, Iowa
Miller, John F.	Inspector of Milk Pasteurizing Plants, State Dept. of Health	Albany, N. Y.
Moellenhoff, F. H.	Asst. City Chemist	Room 9, Municipal Courts Bldg., St. Louis, Mo.
Moore, Mrs. Edith L.	Bacteriologist and Chemist	City Hall, Houston, Texas
Murray, R. A.	Chief Milk Inspector	Highland Park, Mich.
Myll, Clifton O.	Milk Inspector, Board of Health	Detroit, Mich.
Oakley, Roger W.	Collector of Milk and Dairy Inspector	City Hall, Brockton, Mass.
O'Hara, Philip	Dairy Inspector	113 N. Ingalls St., Ann Arbor, Mich.
Palmer, Wm. B.	Executive Officer, Milk Inspection Association of The Oranges, N. J.	City Hall, Orange, N. J.
Parker, Horatio N.	City Bacteriologist, Health Dept.	Jacksonville, Fla.
Pearce, Dr. C. D.	Chief Veterinarian, The Borden Company	350 Madison Ave., New York City
Pease, Dr. Herbert D.	Director of Pease Laboratories	39 W. 36th St., New York City
Pelton, L. C.	Supervisor, Dairy and Livestock Div., State Dept. of Agriculture	Olympia, Wash.
Phipps, W. H., D.P.H.	Supervisor of Production, Missouri Dairy Co.	1207-1209 Locust St., Kansas City, Mo.
Plimpton, Geo. E.	Chemist	534 Boston Ave., West Somerville, Mass.
Posson, R. J.	Market Milk Specialist, U. S. Dept. of Agriculture	Washington, D. C.

Price, Dr. Wm. H.	Sanitarian, Detroit Creamery Co.	Detroit, Mich.
Proper, C. F., M.D.C.	Chief Dairy and Food Inspector	El Paso, Texas
Pyper, Dr. S. T.	Chief, Bureau of Food Inspection	Dayton, Ohio, care Health Dept.
Quigley, J. V.	Dairy Adviser, Kansas City Consumers' League	408 E. 11th St., Kansas City, Mo.
Rice, Dr. John L.	Health Officer	City Hall, New Haven, Conn.
Richmond, Dr. A. R. B.	Chief of the Division of Food Control, Dept. of Public Health	137 Howland Ave., Toronto, Canada
Roadhouse, Prof. C. L.	Professor of Dairy Industry, University of California	University Farm, Davis, Calif.
Robinson, Herbert S.	Dairy Inspector, Health Department	Boston, Mass.
Romberger, E. E.	City Milk and Meat Inspector	Reading, Pa.
Rosinek, Ing. Frantisek	In charge of Bureau for Reorganization and Reconstruction of Sanitary Control of Milk and Milk Products. Ministry of Health	Prague, Vyschrad, Vrahslavova S., Czecho-Slovakia
Rothenberger, Geo. L., V.M.D.		Esterly, Pa.
Russell, Alfred M.	Agent, Board of Health, and Inspector of Provisions	P. O. Box 56, West Newton, Mass.
Schletty, Peter	Dairy and Milk Inspector, State Dairy and Food Dept.	461 Ohio St., St. Paul, Minn.
Schofield, Dr. Earle F.	Milk and Food Inspector	Greenwich, Conn.
Scott, W. M.	Chief Milk Inspector	Auditorium Hotel, Denver, Colo.
Seaman, Carl O.	Milk Inspector	14 South St., Manchester, N. H.
Sheffield, M. H.	Chief Milk, Meat and Food Inspector	Grand Rapids, Mich.
Shoults, Dr. W. A.	Director of Food Division, Provincial Board of Health	Winnipeg, Manitoba, Canada
Shrader, Dr. J. H.	Director, Bureau of Chemistry and Food, City Health Dept.	311 Courtland St., Baltimore, Md.

Smisek, M. J.	Milk and Dairy Inspector	St. Paul, Minn.
Smith, Dr. Clarence E.	Commissioner of Health	Dept. of Public Health, Greenville, S. C.
Smith, Edwin J.	Chief Milk Inspector	Detroit, Mich.
Smith, Russell S.	Market Milk Specialist, Bureau of Dairying, U. S. Dept. of Agriculture	Washington, D. C.
Spoon, J. P., D.V.S.	Milk and Meat Inspector	Burlington, N. C.
Stahl, C. L.	Dairy Director, Virginia State Dairy and Food Div.	Richmond, Va.
States, M. V.	Inspector, Department of Health	Detroit, Mich.
Stevenson, A. F.		95 E. Ridgewood Ave., Ridgewood, N. J.
Strauch, Thos. J.	Chief Dairy Inspector, Bureau of Health	Richmond, Va.
Strickland, Franklin N.	Executive Secretary-Chemist, Board of Food and Drug Commissioners	Providence, R. I.
Supplee, Dr. G. C.	Director of Research Laboratory, The Dry Milk Company	Bainbridge, N. Y.
Taylor, Geo. B.	Bacteriologist, Chestnut Farms Dairy	Washington, D. C.
Terrill, R. M.	Milk Inspector, City of Detroit	Northville, Mich.
Tolland, Alexander R.	Dairy Inspector, Health Department	Room 1102, City Hall Annex, Boston, Mass.
Trotter, Dr. A. M.	Chief Veterinary Inspector, Corporation of Glasgow	60 Hill St. (East), Glasgow, Scotland
Vance, Miss Sarah H.	Director, Bureau of Foods, Drugs and Hotels, State Board of Health	Louisville, Ky.
Vener, Benj.		336 Green Ave., Brooklyn, N. Y.
Wallis, Wm. H.	Milk Collector	City Hall Annex, Somerville, Mass.
Walmsley, Dr. F. D.	Vice-President, Borden's Farm Products Co. of Illinois	326 W. Madison St., Chicago, Ill.
Ward, Dr. A. R.	Asst. Chief, Dairy Research Division, F. C. Mathews Co.	Detroit, Mich.
Ward, Willard E.	Agent, Board of Health, for Milk and Food Inspection	14 Town Hall, Brookline, Mass.

Warner, W. J.	State Milk Inspector	Andover, Conn., R. F. D. 2
Washburn, Prof. R. M.	Director of Laboratories, International Dry Milk Co.	503 Wilmac Bldg., Minneapolis, Minn.
Way, H. O.	Consulting Bacteriologist	Cleveland, Ohio
Weed, Ralph E.	Chief Milk Inspector	City Hall, Troy, N. Y.
Weld, Ivan C.	Investigator for Chestnut Farms Dairy	Washington, D. C.
White, J. T.	Milk Inspector	1130 Seward Ave., Detroit, Mich.
Whittaker, H. A.	Director, Div. of Sanitation, Minnesota Board of Health	Minneapolis, Minn.
Whittlesey, J. M.	Commissioner on Domestic Animals, State of Connecticut	State Capitol, Hartford, Conn.
Widmayer, Fred J.	Food and Milk Inspector	Scranton, Pa.
Wines, E. H.	Dairy Inspector	105 Stevens Ave., Highland Park, Mich.
Wing, Dr. Chas. C.	City Veterinarian and Asst. Health Officer	Room 613, City Hall, Oakland, Calif.
Yates, J. W.	Director, Food and Dairy Div., Hospital and Health Board	Kansas City, Mo.
Young, Dr. Hulbert.	Manager, Walker-Gordon Laboratory	Linden Ave. and Dolphin St., Baltimore, Md.

HONORARY MEMBERS

Evans, Dr. Wm. A.	Health Editor, Chicago *Tribune*	Chicago, Ill.
Pearson, Dr. Raymond A.	President, Iowa State College.	Ames, Iowa
Woodward, Dr. Wm. C.	American Medical Association, Bureau of Legal Medicine and Legislation	535 N. Dearborn St., Chicago, Ill.
Van Norman, Prof. H. E.	President, National Dairy Association	Suite 222, 910 S. Michigan Ave., Chicago, Ill.

Thirteenth Annual Convention

HOTEL WOLVERINE

DETROIT, MICHIGAN

FRIDAY, OCTOBER 17, 1924

FIRST SESSION

The Thirteenth Annual Convention of the International Association of Dairy and Milk Inspectors was held at Hotel Wolverine, Detroit, Michigan. The convention was called to order by President J. B. Hollingsworth.

A former president of the Association and former health officer of Detroit, Dr. Wm. H. Price, welcomed the Association to Detroit and called attention to the rapid growth of the city, its many industries and points of interest. President Hollingsworth responded and expressed the pleasure which the members of the Association felt in coming to Detroit, and delivered the presidential address.

In the absence of Dr. Supplee, chairman, the report of the Committee on Dairy Methods was presented by Vice-President C. H. Chilson.

The report of the Committee on Bovine Diseases was presented by its chairman, Dr. W. A. Shoults, of Winnipeg. After discussion a recess was taken at 12:30 o'clock.

SECOND SESSION

The afternoon session was called to order by President Hollingsworth at 2:15. Mr. C. H. Chilson and Prof. C. O. Wisler presented a paper on the subject, "A Study of Continuous-Flow Machines."

Prof. James O. Jordan, of Boston, presented a paper entitled, "How Boston Handled the Milk Problem."

A paper on "The Extent of Milk Pasteurization in Cities of the United States," by Ira V. Hiscock, Assistant Professor, and Robert Jordan, Instructor, Department of Public Health, Yale School of Medicine, New Haven, Conn., was read by Prof. Hiscock.

Dr. A. R. Ward and Mr. F. O. Adams presented a paper entitled, "Tests of Certified and Pasteurized Milk for B. Coli-like Colonies on Endo Medium."

Mr. W. D. Dotterrer presented the results of a survey of bottle-washing methods and equipment. The convention then took a recess.

THIRD SESSION

The convention was called to order at 8:05, with President Hollingsworth presiding. A paper prepared by Dr. John L. Rice, Health Officer of New Haven, and Prof. Ira V. Hiscock, of the Yale School of Medicine, New Haven, on the subject, "The Use of Milk in Urban Communities," was read by Dr. John L. Rice.

Mr. Chas. F. Chrisman, representing the American Child Health Association, was introduced and spoke briefly regarding the activities of that organization.

Mr. Emmett R. Gauhn, Supervisor of Food and Sanitation, Health Bureau, Rochester, N. Y., gave a talk illustrated with stereoptican views, describing the activities of his department in supervising the milk supply of Rochester. Mr. Gauhn's talk was the concluding number of the session.

SATURDAY, OCTOBER 18

FOURTH SESSION

The convention was called to order by President Hollingsworth at 9:30. In the absence of Mr. Alexander R. Tolland, of Boston, his paper, having for its subject, "What the

Dairy Division has Done for Boston," was read by Prof. James O. Jordan.

Mr. Peter Schletty, of St. Paul, read a paper on "Dairy Methods."

Mr. H. O. Daniels, Deputy State Dairy and Food Commissioner, of Hartford, Conn., had as the subject of his paper, "Ventilation of the Dairy Stable as a Vital Factor in the Production of Milk."

Mrs. Bion R. East, of Detroit, gave the results of her observations while serving milk lunches to Detroit school children.

The report of the Committee on Serving Milk in Schools, prepared by Prof. W. P. B. Lockwood, of Boston, in the absence of Professor Lockwood was read by Vice-President Strauch.

The convention then took a recess, during which time the members, as guests of former president Dr. Wm. H. Price and Vice-President C. H. Chilson, were taken in automobiles to Belle Isle Park, where luncheon was served. Following the luncheon, the drive continued to the 1,900-acre farm of the Detroit Creamery Company, near Mt. Clemens, where an opportunity was extended to observe the production of certified milk. Under the personal guidance of Dr. Price and Mr. Chilson, the members were shown through the stables, with accommodations for more than 500 cows, and through the modern sanitary dairy building, where certified milk is cooled and bottled for the Detroit market.

FIFTH SESSION

The evening session was called to order by President Hollingsworth at 8:15. In the absence of former president A. W. Lombard, the first speaker of the evening was Dr. Roy F. Leslie, of Cleveland, who read a paper on the subject, "Proper Production the First Essential."

In the absence of Dr. Grapp, of Baltimore, the paper

which he contributed, on the subject of "Actinomycosis and Public Health," was read by Dr. Laurie, of Toronto.

"Foot-and-Mouth Disease and its Relation to the Public Milk Supply" was the subject of a paper contributed by Dr. Chas. C. Wing, City Veterinarian of Oakland, Cal. In the absence of Dr. Wing his paper was read by Dr. W. A. Shoults. The convention then took a recess until Monday morning.

Monday, October 20

SIXTH SESSION

The morning session was called to order at 9:10, and upon invitation of President Hollingsworth, First Vice-President Strauch presided.

"Two Years' Experience with the Methylene Blue Reductase Test in Improving Milk Supplies," was the subject of a paper read by Mr. C. S. MacBride, of the Detroit Creamery Company.

"The Methylene Blue Test as an Adjunct to Milk Inspection," was the subject of a paper prepared by Mr. C. H. Chilson, Director of Dairy and Food Inspection, Health Department of Detroit, and Mr. E. J. Smith.

A paper on the subject, "The Use of Eosin-Methylene Blue Culture Media in Milk Examinations," was read by Mrs. Edith L. Moore, Bacteriologist and Chemist, Health Department, Houston, Texas.

"Contrast in the Keeping Quality of Raw Milk Supplies With and Without the Application of the Reductase Test," was the subject of a paper prepared by Drs. H. A. Harding and Archibald R. Ward, Dairy Research Division of the Frederick C. Mathews Company. At the conclusion of this paper a recess was taken.

SEVENTH SESSION

President Hollingsworth called the convention to order at 2:15. Mr. Thos. J. Strauch, of Richmond, read a paper

on "Methods Used for Cooling and Storing Milk on Farms by Dairymen Selling Milk in the City of Richmond."

Dr. Geo. W. Grim, Mr. Samuel M. Heulings, and Dr. David W. Horn, Milk Control District No. 1, Associated Suburban Boards of Health, Ardmore, Pa., were the authors of a paper read by Dr. Grim on the subject, "Some Experiments with Holding Tanks."

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

Mr. Howard R. Estes, Dairy and Food Inspector, Flint, Mich., read a paper, "The Practicability of the Cooledge pH Test in the Improvement of a City Milk Supply."

At the conclusion of this paper a brief recess was declared, following which the business session of the Association was held. Reports of the Secretary-Treasurer and Auditors were received and adopted. Officers for the ensuing year were elected as follows:

President, Thomas J. Strauch, Richmond, Va.

First Vice-President, Dr. G. C. Supplee, Bainbridge, N. Y.

Second Vice-President, C. H. Chilson, Detroit, Mich.

Third Vice-President, Dr. W. A. Shoults, Winnipeg, Canada.

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

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

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

1. *Resolved,* That we express our thanks to Dr. Wm. H. Price and Mr. C. H. Chilson for the luncheon on Saturday, for the trip to the Detroit Creamery Company's Certified Milk Farm, and for numerous courtesies extended during our convention.

2. *Resolved,* That the Association express its thanks to the J. B. Ford Company, Parke, Davis & Company, the

Detroit *News,* the Digestive Ferments Company and the F. C. Mathews Company for courtesies extended.

3. *Resolved,* That we express our thanks to Mrs. Bion R. East, Prof. C. O. Wisler, and Mr. E. J. Smith for the papers presented at this convention.

Brief addresses were made by several members.

EIGHTH SESSION

Dr. J. H. Shrader, Director of the Bureau of Chemistry and Food, Health Department, Baltimore, Md., read a paper having for its subject, "The Relation of Prepasteurized Milk to Certain Forms of Gastro-Enteritis in Infants."

Ira V. Hiscock, C. P. H., Assistant Professor of Public Health, Yale School of Medicine, New Haven, Chairman, reported for the Committee on Food Value of Milk and Milk Products.

"A Summary of the Work of the National Dairy Council" was the subject of a paper presented by Mr. M. O. Maughan, Secretary of the National Dairy Council, Chicago, Ill.

As the program for the convention was completed, and there appeared to be no other business requiring attention, the convention finally adjourned.

PRESIDENTIAL ADDRESS

DR. J. B. HOLLINGSWORTH, Ottawa, Canada.

It is my pleasure, as well as my duty, to welcome the members of the International Association of Dairy and Milk Inspectors to our Thirteenth Annual Convention.

It is fitting that this Association should be called international, for in its scope, influence and effects, it leaps the bounds of nations. Dealing as it does with the basic food of the human family, our Association serves the human race.

The range of subjects to be dealt with in our program, by men of wide experience, special knowledge and scientific training, is evidence of our realization of the importance of our work. We are reminded of the truth of the following statement, made some years ago by one of our former presidents:

"Present-day milk inspection has come to be mainly educational and cooperative between the various parties concerned, the producer, the distributor and the consumer, and progress made has depended more on successful application of the sciences of economics, chemistry, bacteriology, sanitary science, human and veterinary medicine and dairy farm management, than on routine police work, which is most satisfactorily reserved for the final elimination of hopeless elements among producers and distributors."

The increased attention given to research work, the close observation and increasing efficiency of the chemical and bacteriological examination of milk and milk products, the practical scientific knowledge being brought to the dairyman in caring for the many problems of farm sanitation, transportation, and many others relative to the proper care and distribution of milk will be dealt with by men who are masters of their subjects and will lead, I trust, to discussion by others which will be of further benefit to all.

The value of a convention such as this, to my mind, is found not only in the papers read and the interchange of information and ideas, but also, and mainly, I think, in the promoting of a better understanding of the worth of the work in which we are all engaged. In the routine of everyday work and the necessary attention to endless petty detail, vision is sometimes limited, and permanent and far-reaching results often seem quite remote. When we meet in our convention, however, and each man finds himself one of a large body of enthusiasts and each one working along his special line to better conditions and promote the physical welfare of our race, vision is widened, courage is aroused, work is no longer drudgery, but a service in a cause well worth while.

The strength and influence of the Association is reflected to some extent by statistics recently compiled by our Secretary. Membership in our Association has grown from ten to approximately 200. The present membership represents four countries outside of the United States and Canada, and 32 States and the District of Columbia within the United States.

The Association has held twelve annual conventions, the proceedings of which have been published in twelve annual reports. These reports contain a total of more than 3,000 pages and include 371 papers, on almost every phase of the milk industry and its regulation. These published proceedings are supplied regularly, by request, to many State university libraries, to city and other libraries, as well as to the membership and to other interested individuals. Foreign countries represented by requests for copies include France, England, Ireland, Scotland, New Zealand, Australia, India, Japan, The Netherlands, Switzerland and Peru.

Our membership is so widely scattered that no matter where the annual convention may be held, many members are unable to attend. Yet the range of territory covered and the international character of the Association is a

source of strength, as it brings together in one body men of differing points of view and varying experience, broadens our information and extends our usefulness. More active work by our various committees should help to keep the interest of the membership throughout the year. The arrival of the published report is eagerly awaited by the far-away member, who, even though he cannot attend the convention, should feel he is part of the organization and necessary to its well-being.

I am wondering if we could not have regional groups of Association members, each group led by a capable and enthusiastic man who would be willing to work to increase our membership in his own locality and among inspectors of his own acquaintance. The spirit of loyalty and helpfulness to the organization could be fostered by such groups of members, who might meet from time to time in an informal way to discuss matters of common interest.

This is only a suggestion as to one way by which the members of the Association may be aroused and the usefulness of the organization increased. If any of you have ideas on the subject, please talk them over with the officers or let us have your views in a letter.

It is far more desirable that the membership should be increased than that the dues should be increased. With an enlarged membership there would automatically come a better furnished treasury, and with more money in hand the Association could greatly enlarge its usefulness. The more important committee reports, after receiving the approval of the Association, might be printed in pamphlet form and more widely distributed to those who would most profit by them and reach many to whom the more expensive annual report cannot now be supplied. The Association, after due investigation, might lend its assistance and official approval to movements by individual members for the improvement of conditions in their own fields. It might with profit follow the suggestion of a former president and

investigate the relationship of milk inspection to the other agencies for the promotion of child welfare. Or it might enter the field of child welfare independently, appointing a committee which would stand ready to help members in their efforts to educate the public as to the value of milk and milk products in the feeding of both children and adults.

The mention of child welfare brings me to a consideration of the most important of all questions connected with our Association. What is the purpose of all our effort? Why does the Association exist? It is a waste of time and energy to keep any organization active merely for the sake of the organization. If we do that, we shall soon be unable to see the forest for the trees. Our Association must be a means to an end. The service of the public, and especially of the children, through the increased efficiency of inspectors who are members of this body is a most worthy undertaking. May we not expect to see as a result of our labors a far better nourished and more healthy people—a people who will be in better condition to fight the battles of life and to win the victories, not only of the body, but of the mind and spirit as well.

"Upon the success of our work much depends; not only as regards our own welfare, but as regards the welfare of mankind."

REPORT OF COMMITTEE ON DAIRY METHODS

Copper in Milk and its Relation to the Vitamine Potency

Dr. G. C. Supplee, *Chairman.*

A review of the evolution of milk control methods reveals the fact that our present practices are in the main an embodiment of applied principles originally contributed by the sciences of chemistry and bacteriology. During recent years evidence involving new principles has been accumulated in the field of chemistry, and particularly that branch of biochemistry which deals with matters of nutrition, which may ultimately have a marked influence on certain dairy methods. Reference is made to the discovery of the vitamines and especially to the potency of these factors in milk and dairy products. It is not the intent of the committee to present an academic discussion of the significance of these substances in their relation to human nutrition; nor is it the purpose of the committee to prophesy the extent to which this new knowledge will affect milk handling methods. It is the object of the committee, however, to bring before you certain information which may prove to be pertinent in maintaining a milk supply of high nutritive value.

Since the first announcement of the discovery of the vitamines, numerous investigators have contributed valuable data concerning the factors which tended to destroy or diminish their potency. Naturally a certain amount of attention was directed to factors involved in the production and handling of milk. For illustration, it appears to be a well-established fact that the vitamine potency of milk is influenced by the kind and quality of the feed; also, the effect of pasteurization has been given some attention, and while

the data as yet are meager and incomplete, the greater part of the evidence indicates a slight diminution of the antiscorbutic vitamine during the pasteurization process. Investigations of this general nature, namely, a study of the effect of present-day practices on the potency of vitamines in our natural foods, are being carried out in numerous laboratories and occasionally a contribution of seemingly significant import becomes available. It is the potential significance of one of these recent contributions which forms the basis of this report.

In the Journal of the American Medical Association, issue of March 22, 1924, Hess and Weinstock again focus the attention of the medical profession on the detrimental effects of oxidation on the antiscorbutic vitamine in milk and suggest a similar detrimental action on the fat-soluble vitamine of this product. The greater significance of their data, however, lies in the fact that diminution of vitamine potency may result from minute amounts of copper dissolved in milk from copper utensils and apparatus in common use in the milk plant. After briefly stating the results of preliminary experiments in which milk was pasteurized in glass and copper containers, the following comments are made:

> "It will be noted that the guinea pigs which received milk heated in the copper vessel all developed scurvy within a month, whereas those which received similar milk plus 2 c.c. of orange juice throve well, gained steadily and did not develop scurvy. Evidently the failure to gain and subsequent death was the result of a lack of antiscorbutic vitamine and not due to the injurious effects of copper. The group that was fed the milk heated in a glass container failed to develop scurvy, but did not thrive or gain so well as those which received orange juice. This we interpret as indicating, as pointed out by several observers, that 100 c.c. of pasteurized milk may not contain an

optimal quantity of the antiscorbutic factor and, accordingly, that the growth of these animals suffered from this deficiency. The milk heated in the glass vessel was found to contain 0.4 part per million of copper, as determined by the potassium ethyl xanthate method, whereas that heated in the copper container contained 14 parts per million."

After a further explanation of experiments in which it was found that as low as 2.5 parts of copper per million parts of milk resulted in an appreciable destruction of the antiscorbutic vitamine, the authors discuss the practical and industrial aspects of the question. Certain paragraphs taken from the discussion and conclusions follow:

"The question naturally arises as to the degree to which milk becomes contaminated with copper in the course of industrial processes, more particularly pasteurization, condensing and drying. This depends on many factors, and will vary according to whether the process is well supervised or there is carelessness in handling the milk. The degree to which the milk is exposed to air is very important, not only with regard to oxidation and destruction of the antiscorbutic vitamine, but indirectly with respect to the amount of copper that goes into solution. This point was brought out convincingly in experiments carried out a few years ago by Golding and Feilmann, who showed that if air was allowed to bubble through milk, or if copper gauze was suspended on its surface, the amount of copper that was dissolved increased enormously. These results have been substantiated by Rice and Miscall, who employed oxygen and air in testing the extent to which copper went into solution. Interpreted in terms of industrial methods, this would mean that open pasteurizers, coolers and holding tanks will give up much more copper than vacuum pans, and that when such apparatus is employed, it is especially important that

copper should not come in direct contact with the milk.

"It is evident that the greater the surface exposed and the longer the time of exposure, the more will be dissolved. Temperature is likewise a factor to be considered. As in the case of most chemical processes, the solvent power will be greater when the solution is warm than when it is cool, and it has been found that milk attacks copper much more readily at the temperature of pasteurization, 145°F., than at room temperature. This action does not seem to be increased, however, by raising the milk to the boiling point. Some experiments indicate that the amount of copper that is brought into solution depends on the acidity of the milk. It is probable that this action does not run parallel to the degree of acidity, but that there is an optimal level, below and above which less copper is dissolved. Moreover, interacting chemical reactions may be involved in this process.

"Bearing these considerations in mind, let us inquire into the ratio of copper that has been found in milk heated industrially by various processes. These observations may be prefaced by the statement that we have found but little increase in copper in samples of pasteurized milk bought in the open market in New York City. As stated, milk normally contains about 0.4 or 0.5 mg. of copper per liter, which is 4 or 5 parts per million. This amount was increased merely to 0.6 or 0.7 mg. in the samples that we tested, indicating that in these instances, the pasteurizing apparatus was well cared for. This favorable condition probably does not obtain everywhere or at all times. It has been found that the passage of milk through sanitary piping from which the tin was worn resulted in an increase in copper content by as much as .2 mg. of copper per liter, or 2 parts per million. In a report

furnished by Dr. H. D. Pease, it appears that as high as 4.52 parts per million of copper were found in the milk in the old type of heater, and 1.82 from the bottling machine. Contamination frequently results in the course of condensing or evaporating milk, as the condensing apparatus is very difficult to keep clean, and copper lactate accumulates readily on the pans. Experiment has shown that condensing in copper vacuum pans caused an increase in the copper in milk from 0.38 to 2.98 mg. per liter, which was further increased by storing in copper containers. These investigators determined the copper in ten samples of sweetened condensed milk and in six of evaporated milk which represented nine brands. The amount of copper per kilogram varied from 2.4 to 4.8 mg., averaging 3.7 mg., and the conclusion is drawn that 'taking 0.5 mg. per liter as the amount of copper naturally present in cow's milk, it is evident that the milk had added considerable quantities of copper in the process of manufacture.' Were it not for the fact that condensing is carried out in a vacuum or partial vacuum, condensed milk would be deprived of almost all its antiscorbutic vitamine. As the result, however, of the exclusion of air in the course of the heating process, such milk may retain the greater part of its antiscorbutic potency.

"A survey of these various investigations leads to the conclusion that, under ideal industrial conditions, such as obtained in modern, well-equipped and properly supervised plants, the danger is not great of the contamination with copper being sufficient to lead to a significant destruction of the antiscorbutic vitamine. On the other hand, it is probable that with the increase of pasteurization throughout the United States, the normal 0.5 mg. of copper per liter is at times raised by means of contamination to the 2.5 mg.

per liter, a percentage which our investigation has demonstrated leads to a considerable destruction of this vitamine. It should be borne in mind that these experiments have not determined the minimum amount of copper necessary to bring about a partial destruction of this factor. It is possible, if not probable, that less than 2.5 mg. has a deleterious effect, for it is unlikely that destruction should suddenly begin just at the ratio which we arbitrarily selected.

"In this study we have focused our attention on the antiscorbutic vitamine; but as is well known, fat-soluble vitamine A is likewise sensitive to oxidation, and readily destroyed by oxidative processes. It is probable, therefore, that additions of copper lead to a destruction also of this vitamine in the course of pasteurization, condensing, etc. It would be interesting to carry out a similar series of experiments on rats to determine the loss of the fat-soluble vitamine as the result of catalytic action.

"At present, contaminations of foods with copper or other metals are judged by the standards of toxicology. This criterion is manifestly inadequate, for even nontoxic traces of these substances suffice to bring about the catalytic destruction of the vitamines."

The contamination of milk and dairy products by metals possessing catalytic properties and their deteriorating effect upon obvious quality features has been known for a long time and it is considered unnecessary to cite the numerous investigations dealing with this problem. The investigation from which we have already quoted at length further extends our knowledge of these deteriorating factors, and the results are particularly significant in view of the fact that this deterioration cannot be measured by any of the means now commonly employed in milk quality control. In view of the limited data available it may be argued that it is yet too early for those interested in upholding maximum

quality standards for the milk supply to interest themselves in this question. There is undoubtedly some wisdom in such an argument, but nevertheless it is believed that milk control officials may advantageously take into consideration at an early period any factors tending to diminish or impair the natural nutritive value of milk. Therefore, the committee desires to bring the present status of this question before you in the form of an informative report.

In view of the very recent appearance of the report from which we have quoted, and in the absence of any appreciable amount of similar data from other sources, it was deemed desirable to send letters of inquiry to prominent nutrition workers, sanitarians and others. Accordingly, letters soliciting personal opinions and unpublished data bearing on the question were sent to fifteen well-known investigators. Replies were received from all but two, who at the time were spending some months abroad. As was to be expected, some did not wish to be quoted at the present time because of lack of opportunity for personal experimentation on the problem. The views of those whom the committee were authorized to quote follow:

> Dr. R. A. Dutcher, Head of Department of Agriculture and Biological Chemistry, State College of Pennsylvania, writes as follows:
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> "I have your letter of July 19th, and in answer will say that I have done no actual experimental work relative to the influence of copper (in solution) on the vitamine content of milk. We have just finished some work on Vitamine B in evaporated milks made by vacuum pan and (Ruff) air blast methods. The Ruff evaporator contains no copper lining, while the vacuum pan is made almost entirely of copper. We have no evidence that Vitamine B is injured in either process when the evaporated milks are compared with the raw milk from which they were made.
>
> "As you already are aware, evidence is accum-

ulating to show that Vitamine C may be susceptible to the presence of copper salts. We have just submitted manuscript to the Journal of Industrial and Engineering Chemistry which shows that milk may be evaporated and pasteurized in contact with glass and steel and dried to a powder without losing its antiscorbutic properties. The work of Rice and Miscall (J. Dairy Science, 6, 261, 1923) shows that copper does dissolve and is a factor to be considered.

"It is very evident that Vitamine C is susceptible to oxidative changes when excessively heated (in solution) in the presence of oxygen. It would appear that copper salts (and possibly other salts) act as catalytic agents hastening the destructive process. It is quite evident also that water must be present to bring about this oxidative destruction, for we have submitted dried materials to heat and oxygen without appreciable vitamine loss, while the same material in solution lost its antiscorbutic potency (with less heat) in the presence of oxygen.

"Personally, I have the feeling that dissolved copper can do no good and it is entirely possible that it is capable of doing some harm."

Dr. H. Steenbock, Professor of Biological Chemistry at the University of Wisconsin, writes in part as follows:

"Reasoning from generalities from what is known in regard to the effect of small amounts of heavy metals upon oxidation and upon enzymic processes, it is not at all surprising to me that Hess and Weinstock obtained such results as they did. In fact, to my mind there is no question but what there are many reactions of this nature which are totally unappreciated in their bearing on the stability of various compounds with which we have to deal in milk."

Dr. Cornelia Kennedy, Assistant Professor of Agri-

cultural Biological Chemistry of the University of Minnesota, writes as follows:

"I have read the paper of Drs. Hess and Weinstock to which you refer. I am inclined to think that their evidence indicates that under certain conditions the introduction of copper salts into milk or the contamination of milk with copper through the use of old or imperfectly designed apparatus may be very detrimental to the antiscorbutic vitamine. No concrete evidence was presented, however, to show that this is actually an important factor in the commercial handling of milk. I am inclined to believe that the results of Hess and Weinstock had best be interpreted as a warning rather than as a problem to be met. With the facts at hand, the dairy manufacturers can insist on apparatus from which there is no danger of contamination with copper salts of the dairy products involved."

Prof. E. B. Hart, Professor of Agricultural Chemistry of the University of Wisconsin, writes as follows:

"By all means recognition of the factors disturbing or reducing the food value of milk should be brought to the attention of milk producers and distributors. It, milk, serves now as one of the chief and important sources of Vitamine A and catalyzers of oxidative changes should be particularly exposed, because of their influence on the amount of this factor. In the case of Vitamine C, these oxidative processes are not so important because of the general use of other sources of this food factor. Milk is not an important source of the antirachitic factor, but it is such an important source of calcium and phosphorus that it plays an important role in normal bone formation, provided the antirachitic factor is provided. There is no evidence at present that the antirachitic factor is destroyed by pasteurization, although there is evidence

that this factor is destroyed by long-continued oxidative reactions. Its destruction, under the influence of catalysts such as copper, needs study."

Dr. H. D. Pease, Director of the Pease Chemical and Biological Laboratories of New York, writes in part as follows:

"I am inclined to believe that even if no very obviously deleterious effects could be shown to be directly attributable to the advent of small amounts of the possibly toxic metals to foods, that none the less as time goes on those processes which tend to introduce these minute quantities of metals will be so improved and changed as to eliminate either the metals or their possibly undesirable effects, for the general tendency is to get away from metals to less 'active' and corrosive coatings."

Mr. S. M. Heulings, Sanitary Engineer, Haddonfield, N. J., writes in part as follows:

"The handling of milk in milk plants is something that would be quite difficult to do without the use of metals, and it would therefore seem that whatever metal is to be used in contact with the milk should be that metal which up to the present state of our knowledge is the least, if at all, injurious to the milk. I think that the present stage of the investigations along this line, so far as I am aware, indicate that a copper surface next to the milk may be highly dangerous, this danger increasing rapidly as dirty or corroded condition of this copper is permitted. As Dr. Hess states, short exposure on clean copper shows but little injurious results. From many years experience, I know full well what it means to keep copper in a milk plant clean, and any laxity in this cleaning sets up conditions that are undoubtedly highly dangerous to the milk consumer. In my opinion the only way to safeguard the milk consumer from these dangers is to prohibit

absolutely the use of any copper surface that will come in contact with the milk. In so far as I am aware, tin has not been shown to be dangerous, although research work may develop knowledge of such condition."

Prof. O. F. Hunziker, formerly chief of the Dairy Department of Indiana Agricultural Experiment Station, and at present Manager of the Manufacturing Department and Director of Research for the Blue Valley Creamery Company of Chicago, writes in part as follows:

"I note with interest that your Committee on Dairy Methods desires to bring the subject of the effect of copper on milk before the membership of your Association at its next annual meeting and that you desire an expression on my part on this subject.

"Permit me to state that I have not had an opportunity to personally study the effect of the journey of milk through a milk handling establishment in connection with the use of copper containers, etc., from the standpoint of the influence of such treatment on the wholesomeness of the milk and I am, therefore, not qualified to make any statement on this specific point.

"I have been in close touch, however, with the effect of contact of milk and milk products with copper containers on the flavor and keeping quality of the finished product, and as there may be a fairly close relation between these two subjects, my observations regarding flavor and keeping quality may be of some service in the consideration of the subject of wholesomeness.

"Our experience and observations suggest the following deductions:

"1. The presence of even minute quantities of copper, copper salts, or copper oxides in milk and milk products tends to incite or intensify oxidation

and catalysis that cause rapid deterioration of the flavor of the product.

"2. The passing of milk or other fluid milk product through copper equipment, such as flash pasteurizers and flash coolers, does not contaminate the product sufficiently with copper or copper compounds to noticeably injure the flavor or keeping quality of the product.

"3. Prolonged holding and especially prolonged heating of milk and other fluid milk products in copper containers is exceedingly disastrous to the flavor and keeping quality of the product.

"4. Unclean and unpolished surfaces, as well as copper surfaces exposed to air and light, such as surface coil coolers, are far more intense in their detrimental effect on flavor and keeping quality than clean and polished surfaces, and surfaces protected against air and light.

"5. Containers and pipes constructed of alloys of coppers, such as german silver and the like, have a similar effect as the copper itself.

"6. Equipment in which the surfaces of the copper or the copper alloy are completely and heavily coated with tin successfully guards against the destructive effect of the copper on the product, but the tin coating is usually of short duration.

"7. For prolonged holding, with or without heat, equipment constructed of glass-lined steel is by far the safest construction from the standpoint of the protection of the milk product against the detrimental effect of metals and metallic salts."

In addition to the opinions quoted above, it was deemed desirable to secure information relative to the prevalence of exposed copper in milk plants throughout the country. Questionnaires were sent to seventy-five members of this Association. Fifty replies were returned, which are summarized as follows:

Question No. 1. Do the milk plant score cards or items for inspection with which you are familiar call attention to exposed copper with which milk comes in contact?

Of the 50 replies received, there were 45 unqualified negative answers and one affirmative answer. Three of the explanatory statements are quoted as follows:

"We make routine investigations of pasteurizing plants to identify and eliminate any defects in the construction or operation of this plant, and do not use a score-card system. Wherever exposed copper surfaces are found that come in contact with milk the recommendation is offered for re-tinning.

"Inspectors direct attention to such conditions when found and insist upon immediate correction.

"I do not remember a single dairy score card which calls attention to the question of exposed copper. This omission is probably due to the fact that the period of formation of dairy score cards preceded that in which the connection between copper and certain undesirable flavors was appreciated."

Question No. 2. During your experience in milk and milk plant inspection have you observed relatively much or little copper with which the milk comes in contact?

Of the 50 replies received, 36 stated that according to their observations there was comparatively little exposed copper in milk plants at the present time, whereas 12 stated that there was considerable exposed copper in the milk plants under their jurisdiction. Two stated that the greatest prevalence of exposed copper was in small plants.

Question No. 3. What particular pieces of equipment where exposed copper comes in contact with the milk are most prevalent?

In summarizing the answers to this question it is found that coolers are mentioned 24 times; pasteurizing vats and heating coils 29 times; sanitary piping 6 times; receiving vats 8 times; and bottle fillers twice.

Question No. 4. In your opinion have milk-plant operators been active in the last five years in eliminating conditions in which milk was exposed to metallic copper?

The opinion of 28 milk inspectors is to the effect that there has been considerable improvement during the past five years, whereas 12 are of the opinion that there has been no appreciable improvement in their territories during that time. The remainder of the replies furnished no definite opinions. In considering the particular manner in which elimination of exposed copper had been accomplished, glass enameled equipment was most frequently mentioned. Replacement with new apparatus of the same type was frequently mentioned, and the introduction of nickel was mentioned but once.

As stated heretofore, the immediate object of this report is to present information concerning a problem which has become recognizable as a consequence of recent advances in the field of biological chemistry. That the subject is of concern to the dairy industry cannot be denied, although the degree to which those interested in promoting public health through the milk supply will accept responsibility for its complete correction is yet to be determined.

Information from milk control agencies indicates that heretofore little or no attention has been given to the possible detrimental results from contamination by metals which accelerate oxidative changes, particularly copper. This situation is entirely logical in view of the meager data incriminating such metals. Furthermore, it is found that the majority opinion of the inspection officials indicates that but

relatively little exposed copper exists in the average pasteurizing and bottling plant. Many statements are offered, however,which indicate a relatively large exposure in certain sections and particularly in the smaller plants. On the basis of our information, therefore, it is illogical to assume that contamination of milk by metallic copper exists to a sufficient degree to constitute a universal menace to the healthfulness and nutritive value of the urban milk supply. On the other hand, it is practically certain that such contamination does take place in numerous instances and with more or less frequency. The proportion of the milk thus affected cannot be estimated. Fortunately there are numerous indications of a well-defined tendency toward the elimination of exposed copper with which milk comes in contact. This tendency appears to have been stimulated by general progress in milk-plant management as a whole and by improvement in the design and construction of equipment.

In conclusion it may be stated that although at present the experimental data are too meager and the general information is too incomplete to warrant a final statement regarding the extent of the menace to the nutritive value of the milk supply resulting from copper, the information and findings of competent experimenters are nevertheless sufficiently adequate to recommend that future appraisals of milk-plant methods give greater cognizance to the degree to which milk may be contaminated by this metal during its journey through the establishment.

"Wisdom's wonders are only for the diligent seekers."

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

DR. W. A. SHOULTS, *Chairman*

While extensive application of present-day methods for diagnosing tuberculosis in cattle and the wide-spread pasteurization of market milk supplies have done much to lessen the danger of human infection, this is still the most important of bovine diseases that may be communicated to man through the medium of milk or other dairy products.

In pasteurization we have a weapon that can be relied upon to destroy the vitality of the tubercle bacillus without impairing the food value of milk, but inasmuch as compulsory pasteurization under efficient supervision is largely confined to cities, the consumers of milk derived from private cows and dairy herds supplying the smaller urban centers are usually left entirely unprotected in so far as this important safeguard is concerned.

The real solution of the problem, therefore, appears to lie in attacking the trouble at its source by a well-organized attempt to eradicate tuberculosis from cattle. True, this involves an undertaking of considerable magnitude, but results already achieved under the Federal policies of the United States and Canada, particularly by the application of what is known as the "area plan," furnish the basis for a reasonable hope that the disease may in time be eradicated from the herds.

In January, 1923, a "restricted area" for the purpose of tuberculosis eradication was established in the Province of Manitoba, about fifty miles from the city of Winnipeg, by the Federal Health of Animals Branch of Canada. This area is twenty-four by thirty miles in extent, comprises three municipalities or counties, and is known as the Carman Restricted Area.

The first test was completed on March 16, 1923. In all, 1,235 herds, consisting of 16,550 cattle, were submitted to the intradermic test. Of this number 922, or 5.57 per cent, reacted. The number of infected premises was 344. The total compensation paid for reactors was $32,653.33.

The second test was applied about nine months later. At this time 15,600 cattle were tested, of which only 87 head, or slightly over one half of one per cent, reacted. The number of infected premises was reduced to 67, and the total compensation paid for reacting animals amounted to only $3,144.

It is scarcely necessary to state that these results have been most gratifying to the people directly concerned. Such a policy, in addition to being an essential feature of the campaign against human tuberculosis, is admittedly in the interest of the commercial success of the cattle industry, and should be pursued with all the vigor that financial considerations will permit.

FOOT-AND-MOUTH DISEASE IN CALIFORNIA

The foot-and-mouth disease epidemic which occurred early in 1924 and still continues, although now apparently under control, was not in itself the serious calamity which it was made to appear by the newspaper publicity which was given it. The total loss involved, including the indemnity for animals slaughtered, the expense in administering the work and the inconvenience due to quarantines, was not equal to that caused by a late frost in the spring or an early rain during the fruit-drying season in the fall, which is likely to happen and does happen every few years. Out of some 30,000 dairies in the State, not over 500 were affected. In other words, only one out of sixty was affected. There are in the State of California over 600,000 dairy animals over eighteen months of age, and there were destroyed but 23,000 dairy animals of all classes, including heifers and calves.

The real damage which resulted from foot-and-mouth disease was due to the unreasonable economic quarantines which were effected by many States against California, to which livestock sanitary officials were forced by public hysteria, in turn stimulated by excitable press reports. Quarantines, for example, which prohibited moving canned beans and all products from the soil even though they came from a section of the State removed by several hundred miles from the nearest point of infection, were wholly uncalled for and were not in accord with the necessary quarantines which were established by the Bureau of Animal Industry of the United States Department of Agriculture. The most able representatives of the Bureau of Animal Industry were on the ground where the infection existed and knew the exact extent and, better than anyone else, the danger of transmitting through carriers and otherwise. It would seem highly desirable that the quarantine deemed necessary by these representatives, who not only have full knowledge of local conditions but are equipped by training and their experience in previous epidemics, should be accepted by other States in formulating their quarantines, which are, to some extent, of course, necessary.

A case in question was the quarantine against pasteurized dairy products. Dairy products have always been received from other countries where the disease not only existed in the animals, but where milk from animals actually suffering with the disease is converted into butter and cheese, and in some of these countries the pasteurization of products is not so well developed nor so adequately supervised as in America. While we accept products from these countries under such conditions, many States positively refuse to receive pasteurized dairy products originating in parts of California removed by hundreds of miles from the nearest point of infection and with the additional safeguard that a State representative was maintained in each and every plant receiving any materials whatever from

territories surrounding an infected area. It was the sole duty of these State representatives to continually supervise the sterilization of the raw materials which were used in the manufacture of these products and to sterilize the equipment used in connection therewith. Such discrimination, therefore, can only be explained by ignorance of the conditions or thoughtlessness, and will, no doubt, be corrected when full information is in the possession of persons concerned.

While foot-and-mouth disease is perhaps the most contagious and most rapidly and easily spread of any known infectious disease, it is *not* mysterious in its spread and it is usually possible to explain the source of each individual herd infection. This is especially true if all of the facts can be obtained. Where the facts can be obtained it is shown that about 90 per cent of all infections arise through the human carriers and 9.9 per cent of the remaining 10 per cent is caused by the movement of the animals themselves or their raw products, mainly meats. The remaining one tenth of 1 per cent is perhaps due to the hundreds or perhaps thousands of miscellaneous things which may act as intermediaries between susceptible animals.

The disease kills but a very small percentage of the animals affected, but the economic loss in countries where it has established itself is very great. In Germany, where the price level is lower than in the United States, it amounts to about $10 a head per herd for each bovine animal. It places a heavy burden upon industry through the loss of flesh and stunting of meat-producing animals, the temporary discontinuation and permanent injury to the milk flow of milk-producing animals, and the loss of calves through abortion which almost universally results from infection in pregnant cows.

From a knowledge of the nature of the spread of the disease, it is possible to arrive at fair and effective methods of controlling its spread. Comparatively little effort

directed to those factors which are most potent in the spread of the disease will avail much more in effectual results than a great deal of energy expended for the control of those factors which may only by the remotest chance act as a spreading agency or which perhaps *never* transmit the disease.

This suggests that the first efforts should be directed to preventing the transmission of the disease by human carriers. Naturally, this does not apply to the general public, as it was frequently misinterpreted during the recent epidemic. All infectious material must originate with the animals affected with the disease and therefore only those humans who have direct or indirect contact with infected animals can act as carriers. The most strenuous measures should therefore be applied to restrict the movement of individuals from infected herds or infected communities to noninfected premises where contact can be made with susceptible animals. This a most difficult matter to control because of the disposition of most humans to feel that regulations in general are good and apply to almost everybody else but not to themselves. It is amazing to see how dairymen or cattlemen, with ample opportunity to know the danger of spreading the disease through repeated warnings, will, in the face of these things, through curiosity, visit a neighbor's herd suspected of being affected to attempt a diagnosis before it is discovered by officials and an effective quarantine placed on the premises which would positively prohibit the going of individuals to or from the premises. It has also happened that a person who observes some symptoms on the part of one or more of his animals, which may be wholly unrelated to foot-and-mouth disease and dissimilar to any of the symptoms of the disease, will call for a neighbor whose animals have been affected by the disease to come to his place to attempt a diagnosis instead of calling someone who is qualified, with the almost inevitable result that four or five days later his animals actually do develop positive symptoms of the disease.

The methods of dissemination above mentioned suggest that the thing which is second in importance is the human element in the spread of the disease. Quarantine officers must direct much time and effort to control the movement of animals and animal products from infected districts, or the moving of things which come in immediate contact with infected animals. These two suggestions as to quarantine measures relative to control of dissemination by individuals immediately associated with livestock and the moving of animals apply to the communities surrounding infected premises. Premises which are actually affected with the disease are rigidly quarantined against moving of people and products, since anything from the premises might carry the virulent material.

With these reasonable and necessary quarantines, attention should be directed to the elimination of the source of infection, which after all is the most important single thing in controlling foot-and-mouth disease. For this, the slaughter method is necessary. When one animal in a herd contracts the disease it is but a short time until practically all the animals in the herd are affected. To wait for it to develop in each animal, to attempt treatment, or in any way temporize with conditions, is simply to permit the development of more virus, to contaminate more carriers, to further spread the disease.

Successful control, therefore, depends on patrolling daily or twice daily, if possible, all susceptible animals within a radius of several miles in every direction and at receiving points for livestock. Then just as soon as the first evidence of the disease is found on new or previously infected premises, the animal must be destroyed. When the control organization became fully perfected in California, the destruction and burial of large herds was frequently accomplished within from twenty-four to forty-eight hours after discovery of infection in the herd, thus preventing the development of infectious material which would be spread to other

herds, and eliminating just as quickly as possible the danger involved from the spread of contamination by having them available to infect carriers.

The best knowledge available at the present time seems to indicate that the disease entered California through garbage from vessels which had previously visited ports where foot-and-mouth disease existed, bringing with them animal products which were used for food. Scraps of these products in the garbage were discharged from ships at the navy yard near Vallejo, California, where it was fed to swine. This probably occurred during December, 1923. The disease was discovered simultaneously by two veterinarians in Oakland, California, about the middle of February, 1924. A survey of the community showed about fifteen herds affected in the vicinity of San Francisco Bay. Rigid quarantine measures were at once invoked, large forces of United States Bureau of Animal Industry and State veterinarians were concentrated at the source of the infection, and in a short time the disease was well under control.

Unfortunately, through some means unknown, the infection was carried about two hundred miles south into a herd of approximately 20,000 cattle and sheep, and in a very extensive cattle district bordering on an extensive dairying section. Whether or not this spread occurred subsequent to the original discovery is not known, but in any event it is almost certain that some individual acted as a carrier in this instance. Before the disease was recognized in the San Joaquin Valley, meat scraps from animals slaughtered had reached the garbage pails in the community and some of the animals infected had been moved to San Francisco and Los Angeles, where the disease occurred in the stock yards. In San Francisco it was quickly suppressed, but in Los Angeles it was spread to a dairy herd in the vicinity of the stock yards, possibly by rats, and soon an extensive epidemic occurred in that locality. The disease

was finally eradicated in that section, but in the meantime the movement of cattle to the mountains carried infection into the mountainous territory of Tuolumne County, where it has been kept under the best control possible, considering the difficulties involved, but where some traces of infection still no doubt exist and will remain as a menace until sufficient time has elapsed to justify the conclusion that the last of the infection has disappeared.

About the first of October, however, foot-and-mouth disease was discovered in Texas. Indications at the present writing are that this infection had an origin independent from that of California, the evidence seeming to point to South America, where the disease is perpetual. California will maintain quarantines against Texas, but they include only such restrictions as are recommended as necessary by the United States Bureau of Animal Industry.

DISCUSSION

Question: Will some member of the committee tell us more of the symptoms of foot-and-mouth disease?

Dr. F. D. Holford, New York: Foot-and-mouth disease often affects the udder, as well as the feet and mouth of cows. Blisters appear. Cattle refuse to eat because of soreness of the mouth. A prominent symptom of foot-and-mouth disease is the constant smacking of the jaws of the affected animal. Each time a blister ruptures, millions of germs escape and contaminate wherever they fall. The disease can be carried by all sorts of animals or birds, as well as in hay or litter, and it is evident that it has sometimes been carried long distances in hay used as packing material for merchandise.

"There are two classes of persons who give us most of our troubles—those who insist on impossibilities and those who want nothing done at all. The former see everything but the difficulties; the latter see nothing else."

REPORT OF COMMITTEE ON PASTEURIZATION OF MILK AND CREAM

DR. WM. H. PRICE, *Chairman*

At the 1923 convention of this Association, the Committee on Resolutions proposed the following, which was adopted by the Association:

"Whereas, Properly supervised pasteurization is of invaluable service in protecting and conserving milk supplies in the following respects, namely:

"1. Pasteurization facilitates maintenance of abundant supplies of milk on the market; and

"2. Pasteurization is the only adequate safeguard for milk supplies; and

"3. Pasteurization assists in maintenance of abundant supplies of safe milk at prices lower than otherwise would be required; and

"Whereas, There have been offered for sale, or free, a variety of appliances and methods as substitutes, or alternatives, for holding pasteurization; and

"Whereas, These substitutes, or alternatives, offer variation in temperature of heating, or in time of holding, from those defined in this Resolution, and may even suggest elimination of heating, or elimination of holding, altogether; and

"Whereas, This Association knows no safe and satisfactory substitute or alternative for properly supervised holding pasteurization; therefore, be it

"*Resolved,* That the International Association of Dairy and Milk Inspectors, in annual convention assembled, defines pasteurization as follows:

"Pasteurization is the process of heating milk to a tem-

perature of approximately 145 degrees F., never lower than 142 degrees F., holding every portion of the milk at that temperature for a period of at least 30 minutes, and then promptly cooling below 50 degrees F. Invariable recording of temperature and holding period by a tested thermograph is imperative, as is also protection against subsequent contamination, by filling into adequately sterilized final containers immediately after pasteurization and at the place thereof, by healthy operatives, and storage below 50 degrees F. until delivered to consumers; and further, be it

"*Resolved,* That the International Association of Dairy and Milk Inspectors endorses properly supervised holding pasteurization as the only adequate safeguard for milk supplies; and further, be it

"*Resolved,* That this Association notifies the public of the inadequacy of substitutes, or alternatives, for pasteurization as herein defined."

This resolution stamps pasteurization as the great reality of milk control from the safeguarding standpoint, and as one of the great realities of public health administration. The adoption of the resolution was the culmination of a long series of reports and papers regarding the subject by committees and individual members of the Association. Those reports and papers presented the origin, history and development of the pasteurization process; the research and experience which had confirmed its efficiency as a safeguard for the public health and as a conserver of milk supplies; the construction, equipment, and procedures required for its successful operation; the limitations and lapses that must be avoided; the recording of data regarding the process; methods of laboratory and of private and official control; and the possibilities and limitations of extending the employment of pasteurization in actual practice. Such new data as have developed since the last annual convention tend to confirm the conclusions summarized in the foregoing resolution.

COMMUNICABLE DISEASES TRANSMITTED THROUGH RAW MILK SUPPLIES

During December, 1923, and January, 1924, a town in Iowa, of population about 7,500, was visited by an outbreak of 41 cases of typhoid fever; of these, 38 consumed raw milk delivered by one milk dealer. The health authorities definitely traced this epidemic to that raw milk supply.

A curious attitude toward pasteurization and protection of the public health may be read in the Iowa Statutes, as disclosed by the following extract:

"Be It Enacted by the General Assembly of the State of Iowa:

"Section 1. That chapter three hundred forty-two (342) acts of the thirty-seventh general assembly (C.C. Sec. 3595) be and the same is hereby repealed and the following enacted in lieu thereof:

"Cities and towns, including cities under special charter, in addition to powers already granted, shall have within their corporate limits the power by ordinance (1) To provide for the inspection of milk, skimmed milk, buttermilk, and cream, for domestic or potable use. (2) To establish and enforce sanitary requirements for the production, handling and distribution of milk, skimmed milk. buttermilk and cream for domestic or potable use. (3) To compel the tuberculin test by an accredited veterinarian for dairy cattle supplying milk for human consumption. (4) To provide for the pasteurization of milk, skimmed milk and cream, (and here is the significant language; the italics are inserted by the committee) *except that produced from a cow or herd of cows which have been placed and maintained under State or Federal supervision for the eradication of tuberculosis, provided that a cow or herd of cows shall be considered under such supervision when there is on file in the office of the commission of animal health an application for such supervision, and except that produced from a cow or herd of cows which have been tested and found*

free from tuberculosis by an 'accredited' practicing veterinarian."

For protection against milk-borne communicable diseases Iowa, apparently, offers her citizens a certificate of tuberculin test, or an application on file for a tuberculin test; and when cattle have been tuberculin tested, or an application for a tuberculin test is on file, Iowa prohibits municipalities within her borders from requiring the employment of the only adequate safeguard for milk supplies.

The following is quoted from the June 16, 1924, issue of *Health News,* published by the New York State Department of Health:

"In *Health News* of June 2, there was a brief note concerning an outbreak of gastro-enteritis among children in and about New Rochelle. Drs. Richie and Williams, District State Health Officers, report that the epidemic apparently was one of paratyphoid fever transmitted through milk from a certified dairy.

"The report is based upon the investigation of 50 cases, the onsets of which were from March 5 to May 7. These cases occured in New Rochelle and in neighboring municipalities. Each of the 50 cases was said to have used certified milk produced at and sold by a single dairy. Water as a causative factor was eliminated because the primary districts represented were served by a number of different water supplies.

"The youngest case was three months old; 49 of the 50 cases studied were under six years of age. The remaining patient, forty years of age, had a gastric ulcer and was on a special diet which included this certified milk.

"When the investigation was commenced only one patient was still in the acute stage. *Bacillus Paratyphosus B* was found in the stool from this case at the State Laboratory. Subsequently another case was found, in the stools of which the same organism was discovered. Examination of the stools of the workers at the dairy was made by a

local laboratory and in one instance *Bacillus Paratyphosus B* was isolated; later this finding was confirmed at the State Laboratory. One of the active cases was the baby of this carrier's family. We are informed that the carrier has left the farm and is no longer in New York State.

"One of the interesting features of the investigation was the early discovery in one of the cows of an acute mastitis from which *Streptococcus hemolyticus* was isolated, and the conclusion might readily have been drawn that this was the cause of the epidemic. The subsequent findings emphasize the necessity for thorough and complete information before arriving at definite conclusions regarding the source of any epidemic."

In the June 4, 1924, bulletin of the Dairy Research Division of the Frederick C. Mathews Company, Dr. H. A. Harding reports the following outbreak of typhoid fever transmitted through a raw-milk supply in Portland, Oregon:

"During March, 1924, there developed a typhoid epidemic among the patrons of a second raw-milk dairy. The dairy was likewise of high standing on the basis of the score card, and the production of the milk had been surrounded with all of the safeguards which are commonly considered desirable at the farm. The cattle were tuberculin tested, the utensils, barn, and cows were satisfactorily clean and the people engaged in handling the milk were believed to be healthy. This epidemic resulted in 26 cases and three deaths to date.

"A careful search for the source of the typhoid bacilli included tests of the excretions from all of the people coming into contact with the milk. The examination of the fourth set of samples showed that one of the milkers was a typhoid carrier. While the germs could not be found in his feces, they were present in his urine to the extent of practically 10,000,000 per cubic centimeter. The carrier was a man of approximately 70 years who gave no history of having ever had typhoid fever. He had been employed in

connection with this dairy for about three months and it is not clear why he had not sooner become the occasion of an epidemic. The evidence at hand suggests that he probably passes the typhoid germs only at intervals.

"As soon as the connection between the typhoid epidemic and the raw-milk dairy was recognized the Health Department required the pasteurization of the milk and the epidemic soon came to an end."

A circular, dated August 26, 1924, issued by the United States Public Health Service, contains a tabulation of some of the information upon 61 milk-borne epidemics reported to that office as having occurred in the United States between 1918 and 1923. Of these, 40 epidemics are reported as having been transmitted by raw milk, four epidemics by pasteurized milk, while in the cases of 17 epidemics the nature of the milk is not stated.

The inclusion in this list of four epidemics charged as having been transmitted by pasteurized milk invites inquiry regarding the nature of the pasteurization process, the temperatures and holding periods employed, the presence of a tested thermograph, and whether infection gained access to the milk previous to or after the pasteurization process. This committee has attempted to collect that important information.

Regarding one of the epidemics, we are informed as follows by the health authorities of the affected city:

"For your information would state that this outbreak originated in the families of two farmers, brothers, who were supplying one of our pasteurizing plants with their milk supplies. The cases were not recognized as scarlet fever by the attending physician, and the shipments of milk continued; it was not until about a month later when the cases broke out in this city that investigation disclosed the source of the trouble.

"Investigation at the pasteurization plant, so far as recording charts and inquiries were concerned, showed that

all milk was pasteurized, but we have never been satisfied that a portion of the milk supply from one or both of these farms may not have been bottled and distributed without pasteurization, although positively denied by the pasteurization plant management.

"We cannot accept the idea that pasteurized milk caused the spread of the disease, although we are not in position to *prove* that the milk was NOT pasteurized."

The following information is furnished us by the health authorities of another of the affected cities:

"In our outbreak, a check of the charts failed to supply any information, although we had been suspicious of this particular plant and had had some trouble with the owner of it, both as to pasteurization temperatures and adulteration of milk. But for 140 days previous to this outbreak, the charts from the recording thermometers were apparently O. K. A check of the producers and Widal tests on all of them failed to disclose any carriers in the country and a line-up of the employees of the plant showed that the brother of the owner had been sick with what was diagnosed as influenza first, and afterward as rupture, and finally as typhoid. As he had been engaged in bottling the milk after pasteurization, there was every reason to believe that he was responsible for the outbreak, because when he was taken out of the creamery and the utensils sterilized, our typhoid cases ceased except those that, of course, had their infection at an earlier date."

The following information is furnished us by the health authorities of another of the affected cities:

"In answer to your favor of September fifth, I would say that the milk outbreak referred to by the United States Public Health Service under date of August 26, was the same as that referred to by Dr. Godfrey in his article in *The Nation's Health*. It is not certain that it was due to pasteurized milk, and indeed is not absolutely certain that

it was a milk outbreak at all, though personally I believe that it was."

The fourth epidemic charged as having been transmitted by pasteurized milk was personally investigated by a member of this committee. The records of the health department clearly indicated that infection had been transmitted through a milk supply. The health authorities state that this was a non-cooperative dealer and are convinced that the milk supply was not pasteurized at the time of the occurrence of the epidemic.

This investigation supports the conclusions of last year's resolution regarding pasteurization. Pasteurization is no safeguard against subsequent infection, which must be guarded against; and the heating of milk to other temperatures, or for other periods of holding, than those defined in the resolution may not be found effective. The presence of pasteurizing equipment in the plant is not assurance that all milk passing through the plant is pasteurized; neither is a properly recorded temperature chart. These are matters for competent official supervision to insure.

It will be remembered that last year, this committee summarized Dr. Godfrey's analysis of 16 outbreaks of communicable diseases reported as having been transmitted by pasteurized milk, in each of which it was shown that no infection had survived proper heating and holding. These evidences warrant the conclusion that communicable disease infections do not survive pasteurization in actual practice. In the event that they are alleged to have done so, full information would disclose either subsequent infection or lapse from proper temperature or holding period.

THERMAL DEATH-POINT OF TUBERCLE BACILLI IN MILK

The *London* (England) *Lancet,* issue of August 18, 1923, reports "A Critical Investigation into the Thermal Death-Point of Tubercle Bacillus in Milk, with Special Reference to its Application to Practical Pasteurization,"

by F. W. Campbell Brown, M.D., Ch.B. Aber., D.P.H. This was an intensively controlled study under laboratory conditions. Tubercle bacilli are accepted as being most resistant of all pathogenic organisms occasionally transmitted through milk. Campbell Brown narrates the advantages of pasteurization in preventing milk-transmission of communicable diseases, the limitations of other procedures therefor, and, with much detail, the possible causes of varying results in previous studies of this subject, which variations he attributes largely to lack of control of certain details in laboratory technique.

This is a study of much importance, and the care with which it was conducted and the detail with which it is reported seem to warrant the conclusion that it will prove to be the final word on this subject. It is desirable that this study be available for reference in the literature of this country; therefore, your committee requested permission to reprint the entire article in the annual report of this Association. Dr. Campbell Brown granted this permission; the *London Lancet* permits the publication of only about one third of the article. This committee has summarized the article to about one third of its original text.

Campbell Brown used 35 different sources for obtaining strains of both the human and the bovine types of tubercle bacilli. The total number of cultures finally used exceeded 250 in number. Exhaustive details of technique were employed to obviate possible errors. Heavy infection was aimed at, to secure quick and decisive results. No animal was killed before the tenth week after inoculation, in order to allow time for latent diseases to become manifest, and in case of doubt reinoculations with the doubtful lesions were made. The presence of the disease in the positive animals was in most cases quite definite, being made manifest by abscess-formation at the site of inoculation, enlargement of lymphatic glands, presence of tubercle or

necrotic areas in the liver, spleen, lungs, etc. The following quotes Campbell Brown:

"Results obtained. These are given in the tables, which contain only a summary of the results obtained, and do not convey to the reader any idea of the vast amount of time and work spent on carrying out these experiments. The animals used, including those required for reinoculation, exceeded 280 in number; and the time taken in carrying out this part of the tests alone—i.e., in inoculating, supervising, and performing autopsies upon them—extended over six months.

"Tables 1 and 2 give all the results obtained with 15 bovine strains, using 60 degrees C. (140 degrees F.) as the temperature factor. It will be noted that in the great majority of cases ten minutes' exposure to this degree of heat is not sufficient to prevent the bacilli from causing tuberculosis in the guinea pig, while even 15 minutes is not sufficient in some cases. However, a period of 20 minutes was found either to kill the bacilli or so to enfeeble them that the protective forces in the guinea pig were able to prevent the latter from becoming tuberculous. Three strains, Nos. 3, 7 and 12, gave rather doubtful results after 20 minutes' exposure, but on reinoculation with the doubtful lesions no tuberculosis developed in any of the animals used. It was unfortunate that the control animal for strain No. 13 died accidentally, but the fact that the animals given this strain heated for 10 and 15 minutes developed tuberculosis proves that the strain was a virulent one, and it has therefore been included with the others in Table 1.

TABLE 1. (Bovine Strains)

INFECTED MILK SUBJECTED TO 60° C. (140° F.) FOR VARYING EXPOSURES AS STATED BELOW

Time of Exposure at 60° C. (in minutes)

Strain	C	10	15	20	25	30
1	+	+	—	—	—	—
2	+	+	—	—	—	—
3	+	+	+	—?	—	—
4	+	—	—	—	—	—
5	+	+	—	—	—	—
6	+	—	—	—	—	—
7	+	+	—?	—?	—	—
8	+	+	+	—	—	—
9	+	—	—	—	—	—
10	+	—	—	—	—	—
11	+	+	+	—	—	—
12	+	+	—	—?	—	—
13	—	+	+	—	—	—
14	+	—	—	—	—	—
15	+	+	—	—	—	—

C = Control animal.
+ = Tuberculosis found at autopsy.
— = No tuberculosis found at autopsy.

RESULT.—All rendered non-lethal at or before 20 minutes' exposure to 60° C. Refer to Table 2 for doubtful cases.

TABLE 2

CONFIRMATION TESTS FROM DOUBTFUL LESIONS OF GUINEA PIGS IN TABLE 1

Strain	Lesion from animal treated with milk at 60° C. for	Guinea pig	Guinea pig
3	20 minutes	—	—
7	15 "	—	—
7	20 "	—	—
12	20 "	—	—

RESULT.—Doubtful lesions as recorded in Table 1 were found to be caused not by living but possibly by dead bacilli.

TABLE 3. (Bovine Strains)

INFECTED MILK SUBJECTED TO 70° C. (158° F.) FOR VARYING EXPOSURES AS STATED

Time of Exposure at 70° C. (in minutes)

Strain	C	1	3	5	10	15
1	+	+	+	—	—	—
2	+	—	—	—	—	—
3	+	+	—	—	—	—
4	+	+	—	—	—	—
5	+	+	—	—	—	—
6	+	—	—	—		

Strain	C	1	3	5	10	15
7	+	+	+	—	—	—
8	+	—	—	—	—	—
9	+	—	—	—	—	—
10	+	+	—	—	—	—
11	+	+	—	—	—	—
12	+	+	+	—	—	—
13	+	+	+	—	—	—
14	+	+	—	—	—	—
15	+	—	—	—	—	—

RESULT.—No virulent bacilli were found after five minutes' exposure to 70° C.

"While the essential object of these tests is to determine the thermal death-point of the bovine type—the type which is most likely to be found in cow's milk—yet it should be borne in mind that there is always the possibility of contamination of milk by the human type of the bacillus. Contamination with the latter may occur from tuberculous dairymen. It is important, therefore, that the thermal death-point of the human type also be ascertained. For this purpose ten human strains were tested, and the results obtained are given in Tables 4 and 5. It will be observed that there would appear to be little or no difference in the thermal death-point between the bovine and human types of this organism.

TABLE 4. (Human Strains)

MILK INFECTED WHEN AT 67° C. AND MIXTURE KEPT AT 60° C. (140° F.) THROUGHOUT EXPOSURE PERIODS

Time of Exposure to 60° C. (in minutes)

Strain	C	10	15	20	25	30
1	+	+	—	—	—	—
2	+	—	—	—	—	—
3	+	+	—	—	—	—
4	+	—	—	—	—	—
5	+	—	—	—	—	—
6	+	+	—	—	—	—
7	+	+	—	—	—	—
8	+	+	+	—	—	—
9	+	—?	+	—?	—	—
10	+	+	—	—	—	—

RESULT.—In all cases an exposure of 20 minutes at 60° C. was sufficient to render the bacilli non-virulent. Reinoculation of doubtful results got with No. 9 proved negative.

TABLE 5. (Human Strains)

MILK INFECTED WHEN AT 77° C., AND MIXTURE THEN KEPT AT 70° C. (158° F.) THROUGHOUT EXPERIMENT

Time of Exposure to 70° C. (in minutes)

Strain	C	1	3	5	10	15
1	+	—	—	—	—	—
2	+	—	—	—	—	—
3	+	—	—	—	—	—
4	+	+	+	—	—	—
5	+	+	—	—	—	—
6	+	+	—	—	—	—
7	+	+	—	—	—	—
8	+	—	—	—	—	—
9	+	+	+	—	—	—
10	+	—	—	—	—	—

RESULT.—No virulent bacilli remained after five minutes' exposure to 70° C.

"I believe that when tuberculous milk is *heated either at 60° C. for 20 minutes or at 70° C. for 5 minutes, it can safely be assumed that the bacilli are killed.* If they are not actually killed, they are so enfeebled that the normal powers of resistance of the guinea pig find the former an easy prey, and no tuberculosis develops. This statement can in all probability be applied to man. More especially is this the case when it is not to be expected that the milk he drinks would ever contain such numbers of bacilli as have been given to the guinea pigs. Therefore, *tuberculous infection* from milk treated with either of these two combinations of temperature and time factors may be entirely disregarded from an administrative public health point of view."

Campbell Brown discusses at length the relative merits of these two combinations of temperature and time factors. His article terminates with the following conclusions:

"1. It has been shown that by using 25 strains of the tubercle bacillus no wide difference in the thermal death-point is found.

"2. The thermal death-point of this organism is practically similar for human and bovine types.

"3. The previous wide variations in results have been

due to too little care in carrying out the experiments, and to the fact that the lesions caused in test animals had not previously always been given sufficient time to develop and be accurately diagnosed.

"4. If a temperature of 60° C. be used, it requires 20 minutes' exposure to this degree of heat to prevent milk so treated carrying infection to the guinea pig.

"5. If a temperature of 70° C. be used, it requires five minutes' exposure to ensure the same results.

"6. Of these combinations of time and temperature factors, the former excels the latter, when the *food value* of the treated milk is also considered.

"7. The writer is of opinion that, until bovine tuberculosis can be stamped out at its source—namely, in the ox—proper pasteurization of milk is the only safe method of rendering milk safe as a diet for human consumption." (To the last conclusion this committee adds the following: It is of course quite obvious that stamping out tuberculosis in the ox furnishes no protection whatever against transmission of typhoid, scarlet fever, diphtheria, septic sore throat and possibly other communicable diseases through the medium of milk supplies. Pasteurization destroys these other infectious agents, as well as the tubercle bacillus.)

The Committee on Pasteurization regards this investigation by Dr. Campbell Brown as one of the most complete and conclusive studies with milk supplies on record.

TESTING THE TIME FACTOR IN HOLDING DEVICES

At the World's Dairy Congress, in 1923, Mr. C. Sidney Leete, Market Milk Specialist, Dairy Division, U. S. Department of Agriculture, read a paper entitled "Continuous-Flow Holders used in Pasteurization, Especially in Regard to the Time Factor, from a Bacteriologist's Viewpoint," which is of definite and practical interest to those concerned with the operation of pasteurization and its supervision.

Mr. Leete discusses the essential factor that safety in the final product requires the holding of every particle of milk at proper pasteurizing temperature for the full period of 30 minutes, the absence of assurance of safety in milk of low bacterial count when the proper pasteurizing temperature has not been maintained for the full period of 30 minutes, and the disadvantages and limitations of the color test and the temperature variation test as means for determining the length of holding with different types of equipment in actual plant operation. He then describes the development and application by the Dairy Division of another test for determining the holding period, by means of a harmless, easily controlled, distinctive and easily recovered organism—*B. prodigiosus*. The equipment under investigation is operated without heat and with water instead of milk as the medium, a culture of the organism is inserted into the affluent when the equipment is running at its rated or ordinary operating capacity, and the interval of elapsed time between the insertion of the organism into the affluent and its recovery from effluent of the holder is noted. Mr. Leete reports the following conclusions:

"Results of studies made with the test upon continuous-flow holders, both under actual commercial conditions and in the laboratory, point to the fact that careful qualitative bacteriological analysis of milk pasteurized by this method should be made. It must be remembered that a low-count milk does not always mean a safe milk. If apparatus which produces a low-count milk and yet does not hold for 30 minutes is used, the bacteriologist must view such apparatus with distrust, for the safety factor is not assured. In many instances, the actual flow through the machine does not coincide with the theoretical flow.

"From the viewpoint of a bacteriologist, pasteurization means not only a low count but a safe milk. A temperature of 145° F. for 30 minutes is essential for safety. Manufacture and use of continuous-flow holders should be based

on actual bacterial tests rather than on estimates and theoretical flow. With other types of holders, especially those having numerous valves and cams, where there is a chance of leakage, or the holding time is apt to be shortened by any means whatsoever, the above-mentioned test will prove of value."

Several members of the committee have seen this Dairy Division test applied in actual practice and believe it more accurately discloses the actual holding period than other tests so far devised. This test uses water at tap temperatures instead of milk at pasteurization temperature, and the committee recognizes that factors which influence the holding time embrace speed of flow, uniformity of speed of flow, temperatures, and uniformity of temperatures. Methods of testing which do not employ milk, and temperatures and methods of heating such as are used in the actual pasteurization of milk, may occasion question as to the entire accuracy of conclusions; but in this instance we are of the opinion that such questions are of technical and academic rather than of real importance. The committee recommends that members of this Association secure and study Mr. Leete's paper as soon as it is available for distribution.

"PIN-POINTS," "FINE COLONIES."

For several years past, individual investigators have observed the development of myriads of "pin-points" or "fine colonies," so-called, in milk which it had been supposed had been subjected to all the requisites for efficient pasteurization—proper temperature and holding period, in adequately cleaned and sterilized equipment. This phenomenon occurred only at intervals, and disappeared as mysteriously as it came. In some instances these colonies were present soon after pasteurization only; fifteen to twenty-four hours' storage at 40 degrees F. caused their disappearance to a great extent. They apparently effected

no physical or chemical alterations in the milk; its nutritive and keeping qualities and taste were apparently as good as normal; and no untoward clinical results have been attributed to it.

During the past year, a considerable number of laboratory workers, acting independently, in various parts of the country, have contributed papers regarding the causes and favorable conditions for the development of these "pin-points." Summarized with utmost brevity, these papers tend toward the following theories: A type, or flora, of bacteria exists which multiplies at pasteurizing temperatures long continued—two and one half hours and longer. This flora is seldom or never associated with udder milk, but is commonly present in milk produced otherwise than under surgically aseptic conditions, and is always associated with milk which has been in contact with contaminated utensils, particularly milking machines. Prolonged holding—more than two and one half hours, such as some portions of the milk are subject to in continuous-flow holders—at pasteurizing temperatures, causes the multiplication of these bacteria to numbers exceeding the total count of the original raw milk. Finally (and this is a very significant point if true), these bacteria may be detected only by laboratory methods of comparatively recent date—use of media ingredients developed since the outbreak of the War, the higher permissible H ion concentrations, possibly combined with a standard incubation temperature higher than optimum for the development of what have heretofore been considered the normal, nonpathogenic bacteria of market milk.

The urgent necessity for clarifying this "pin-point" situation is obvious. Individual members of this committee have observed the phenomenon; but the committee has made no concerted study of it. The foregoing theories are merely summarized from the literature. However, it is not reasonable to assume the origination during the past

few years of a new flora which manifests itself in the phenomenon of "pin-points" in pasteurized milk. Possibly changes in ingredients of media and methods of bacterial estimating have brought to light a variety of bacteria previously undetected. Further suspicion seems to have been cast on the utility of continuous-flow holders. The phenomenon of "pin-points" and "fine colonies" may be largely an academic problem for solution by the bacteriologists; but it is not likely to prove entirely so, for the following reasons:

1. It seems to have been demonstrated that extreme temperatures held for extreme periods—such as boiling for 24 hours—will produce curdling in some milk, and this is evidence of some sanitary significance in thermophiles.

2. Absence of thermophiles in udder milk and their common presence in milk which has been associated with contaminated utensils invites inquiry regarding the utility, from the theoretical and the practical points of view, of more sanitary methods of milk production.

3. The utility of continuous-flow holders is involved in further suspicion by this new light regarding thermophiles.

No conclusions are presented in this report regarding the phenomenon of thermophiles, "pin-points" and "fine colonies." The committee merely discusses the subject for the purpose of emphasizing the fact that the integrity of pasteurization as defined by this Association is in no way involved by the phenomenon. Pasteurization, as defined, promotes abundant supplies of market milk, it adequately safeguards, and it assists in restraining prices below what otherwise would be required, now as formerly.

PASTEURIZATION OF DAIRY PRODUCTS OTHER THAN FLUID MILK

Previous committees have confined their reports almost exclusively to pasteurization of milk for fluid distribution.

This was most important, because of its volume, of the infants and invalids who may be its ultimate consumers, and of the greater sanitary returns that may be expected to proceed from the safeguarding of that product. Further, the temperature and holding period limits for pasteurization of milk for fluid distribution are more narrow and exacting than may be determined to be necessary for other dairy products. For these reasons, previous committees have concentrated on the imperative temperature and holding period—142-5° F., held 30 minutes—requisite for milk for fluid distribution, and have avoided confusing that issue by references to higher temperatures held shorter periods that may be permissible for other dairy products.

It is believed that the narrow limits of temperature and holding period requisite for pasteurization of milk for fluid distribution have now been clearly fixed; and it is believed that no confusion to that issue need now arise from a discussion of pasteurization of dairy products intended for conversion or manufacture into sweet and sour cream, ice cream, condensed milk, butter and cheese. To that end the committee has canvassed the literature and sought information by interview and correspondence regarding the relation between the public health and these "conversion" or manufactured dairy products, and regarding the possibilities and limitations of securing pasteurization when transmission of communicable disease is to be apprehended from such products. Not all authorities have been interviewed, and without doubt, many data have escaped the attention of the committee. Therefore, this discussion need not terminate in recommendations for resolutions by the Association. On the other hand, a common understanding of the subject is sought. If this can be arrived at, it is reasonable to expect that a large part of the dairy industry will voluntarily anticipate requirements to insure the safety of their products.

This committee declines to recognize as pasteurization

any "flash" system of heating without holding, regardless of the fact that cream-layer is not a factor with dairy manufactured products, nor of the consideration that from the nutritional standpoint they occupy a different sphere from milk. Under some circumstances, "flash" pasteurization may be considerably destructive of germ life, possibly under laboratory conditions equally destructive with holding pasteurization. But such conditions are difficult of operation under plant conditions and impossible of adequate supervision by the authorities. This committee recognizes pasteurization at 142-5 degrees F., held 30 minutes, and pasteurization at 160 degrees F., held not less than 10 minutes, for milk intended for manufacture.

CREAM

Raw cream is capable of transmitting all the infections sometimes associated with raw milk. It is also subject to spoilage. Cream is often gathered from more distant sources than milk, and these more distant sources are likely to be less susceptible of sanitary inspection and control. The commercial value of cream is not impaired by pasteurization. There has been comparatively little study of the thermal death-points of pathogenic organisms in cream; but it is permissible to assume that these death-points are the same with cream as with milk.

These facts lead inevitably to the conclusion that all cream should be pasteurized before distribution, at 142-5 degrees F., held 30 minutes, or at 160 degrees F., held 10 minutes.

In the case of sour cream—a comparatively high fat content dairy product of thick consistency to which cottage cheese is sometimes added, and which is usually consumed by spreading on bread—the skimmed milk from which the cottage cheese is made should be pasteurized by the holding process, as well as the cream.

SKIMMED MILK

The statutes of a considerable number of States contain the provision that skimmed milk, buttermilk and whey must be pasteurized by creameries and cheese factories before being returned to farmers for animal feeding. Boards of animal industry are usually alert to enforce this provision. Here is an object lesson for boards of health.

ICE CREAM

Experience has demonstrated that ice cream manufactured from raw-milk products has all the proclivities of raw milk and cream for spreading communicable diseases. Pasteurization of the ice cream mix correlates well with ice cream manufacture as practiced by large and well-operated establishments. Such plants homogenize the entire mix, except flavoring, for the advantages to be obtained in producing uniformity in distribution of the butterfat, controlling over-run, and in decreasing the danger of churning in the freezers. Mojonnier and Troy are authorities for the following statement: "The best temperature at which to homogenize ice cream mix is generally accepted as being 140 to 145 degrees F. This is considered the best practice from the bacteriological point of view, and, also, mix homogenized at this temperature does not become pasty, nor does it so easily acquire excessive viscosity."

Homogenization is performed immediately after pasteurization, and the desirable temperatures for both processes are identical. It remains, then, only to add the requisite 30-minute holding time to obtain the advantages of both these factors—pasteurization for safety and uniformity, homogenization for quality in the product.

In small plants which do not homogenize it is doubtless permissible to sanction 160 degrees F. held not less than 10 minutes, as an alternative to 145 degrees F. held 30 minutes, though it is not evident what advantage would accrue to any

person concerned by adopting the higher temperature. In any event, there are advantages in pasteurization of the whole mix rather than of the milk ingredients only, although the latter practice would doubtless forestall transmission of milk-borne infections.

CONDENSED MILK

Condensing, for both case and barrel goods, involves heating milk to, and usually higher than, the temperatures required for pasteurization. Pasteurization need not, therefore, be considered in connection with condensed milk.

BUTTER

The committee has searched the publications of Mortensen, Hunziker, Schroeder, and Heineman and finds practical unanimity of opinion among all those authorities regarding pasteurization of milk and cream intended for manufacture into butter. They recognize the "flash" process, which this committee would not care to assume the responsibility for. Their opinions may be briefly summarized in the following quotations from Hunziker:

"Pasteurization does not make possible the manufacture of fancy butter from a poor grade of cream, but it does help the creamery to minimize the injurious effect of contamination of milk and cream with diverse types of germ life and ferments injurious to the quality of the butter and possibly dangerous to the life and health of the consumer. * * * So far as the writer is able to determine, there are no cases on record which show that any of these diseases were transferred to man through the medium of butter. On the other hand, experimental data of considerable magnitude are recorded, which unmistakably show that cream produced either by gravity creaming or by centrifugal separation of milk infected with *B. tuberculosis,* also contains this organism and that butter made from such cream, when

inoculated into guinea pigs, produced the disease and caused the animals to die from generalized tuberculosis.

"In some States the pasteurization of cream for butter-making is compulsory, and the result of recent investigations indicates that the great bulk, approximately 90 per cent, of all butter made in American creameries is manufactured from pasteurized cream. The processes of pasteurization used in the creameries are largely those above prescribed (which include "flash" at 185 degrees F.) or their equivalent, so that it is reasonable to state that by far the great majority of American factory-made butter that enters into State and interstate commerce may be considered safe from the standpoint of its freedom from virulent disease germs and viruses.

"Most of the farm dairy butter, however, is made from raw cream. If the cream from which it is made is free from disease germs it is obviously equally safe as the creamery butter, but similarly to farm-peddled milk, which is rarely pasteurized, so does farm butter offer no guarantee as to its safety to the consuming public."

A recent communication from Dr. Schroeder contains the following interesting information: "As additional information I might say that the Experiment Station has been testing quite a number of samples of butter relative to their contamination with tubercle bacilli, during the past two or three years. The results obtained with these tests are very gratifying, because they show only a very low percentage of infection. But they do show two things, as follows: 1st, that high-priced, fancy butter made from raw cream is not necessarily safe; and, 2d, that some butter is made from badly infected cream in which the killed tubercle bacilli are sufficiently numerous to cause nonprogressive, stationary or retrogressive lesions in experimental animals. If butter of the latter kind was not made relatively safe by pasteurization I would not care to have the responsibility for the harm it would do."

CHEESE

The committee has consulted the general literature and especially the publications of Heineman, Schroeder, and Sammis, and has had the benefit of direct communications from the two latter, regarding the desirability and the practicability of pasteurizing milk and cream intended for manufacture into cheese. We have also read the report of Professor Rich, relative to the Michigan epidemic of cheese-borne typhoid fever. The latter is the only epidemic that has come to our attention in which cheese was shown to have been the transmitting agent. Difficulties arise in attempting to present with proper proportion and relative value the necessity for and the limitations of pasteurization of milk and cream intended for manufacture into cheese. The public health is paramount; if it be threatened, adequate measures for its protection are imperative. Cheese is a valuable food; and much of it is manufactured from raw milk and cream. What is the nature and the extent of the dangers to be apprehended from consumption of such cheese? What are the possibilities and the limitations of removing those dangers by pasteurization? We quote the following from Dr. Schroeder, Professor Rich, and Professor Sammis:

Dr. Schroeder says, in the Sixth Annual Report of this Association: "We may safely say, and we say it with great satisfaction, that cheese (Cheddar, etc.) of the kind that requires some time to ripen (50 days or more) rarely if ever contains true living, pathogenic bacteria when it is marketed, and it does not seem likely that such cheese is apt to contain dangerous products of bacterial origin.

"Cream cheese, which is an elegant, palatable, nutritious article, * * * until quite recently was heavily contaminated with tubercle bacilli of the kind which have their origin in the bodies of tuberculous cattle. * * * The proper pasteurization of the milk and cream used in making

cream cheese would accomplish something more than the elimination of virulent tubercle bacilli; it would also destroy dangerous germs of the colon and septicemia groups, which are not at all uncommon in milk, and the presence of which in food no sanitarian can view without alarm.

"Cottage and Neufchatel cheese, which could reasonably be used much more commonly than is now the case—are much less frequently infected with tubercle bacilli than cream cheese. But this should not be used as a reason for making them from raw milk. The fact that they are at times contaminated with tubercle bacilli and that the centrifuge or cream separator, which tends to eliminate tubercle bacilli from skim milk, cannot be taken, off hand, as doing the same thing with the dangerous germs of the colon groups, or the bacteria which have independent motility, are sufficient reasons to make it desirable that all milk used in the manufacture of cottage or Neufchatel, and all other varieties of *fresh* cheese, should be pasteurized."

Prof. E. D. Rich, Sanitary Engineer of the Michigan Department of Health, in the March, 1923, issue of the *American Journal of Public Health,* reports an outbreak of about 50 cases of typhoid fever with four deaths, from May to July, 1917, in and around a village in Michigan. This outbreak seems definitely to have been traced to cheese as the transmitting agent. The following is quoted from Professor Rich's summary of his report:

"It was also found that cheese had been used at the other public gatherings previously investigated. Revisits to all of the cases showed that all but two of the cases had eaten cheese. The material was purchased at the village store and from there it was traced backward through several dealers to the cheese factory where it was made. It was found that these two cheeses * * * were part of a batch of ten which had been sold before being cured so long as is customary. Some of the others went to (two other cities in Michigan) where typhoid fever developed from their use."

Although it is likely that other outbreaks of the same nature have occurred, this is the only one of specific communicable disease definitely traced to cheese as the transmitting agent which has come to the attention of the committee. In this outbreak, the cheese conformed to the experience in such cases of Dr. Schroeder, namely: it had not been cured so long as is customary.

The practicability of pasteurization of milk and cream intended for manufacture into cheese is deserving of consideration. It must be considered if it is hoped to arrive at conclusions capable of being sustained in actual practice. Regarding this phase of the subject the committee is indebted to Prof. J. L. Sammis, of the Department of Dairy Husbandry, University of Wisconsin, who has supplied us with a direct communication from which the following is abstracted:

"The difficulty of making cheese from pasteurized milk in past years and also the expense of pasteurization has prevented very much attention being paid to it. We were, I believe, the first to devise a satisfactory method for the making of American cheese with pasteurized milk; and applying our methods (a large city creamery) has utilized their surplus milk in the manufacture of cheese for several years and made over a million and a quarter pounds of this cheese which sold with good success in the regular market, without any special label or without any special quality which would distinguish it from ordinary cheese.

"These people have pasteurizers in their plants in regular use and thus are able to pasteurize the milk when it is made into cheese without any additional expense or investment. We never advise a small cheese factory to put in a pasteurizer, although it has some advantages. We think that the small cheese factory employing one or two men might better devote their energies to securing a better milk supply or a

cleaner, more sanitary milk supply than attempt to correct the faults which occur in the milk, by pasteurization.

"As a rule if the milk is not clean, the cheeses are apt to be bad-flavored and gassy, that is, spongy and full of holes, and pasteurization will correct these faults in the cheese to a considerable extent. However, more careful attention to the milk on the farm, keeping it cool and clean, will also prevent these faults from occurring, and we think that the cheesemaker should give all possible attention to securing a clean milk supply rather than try to remedy the trouble after the milk has become dirty.

"While it seems fairly possible that a typhoid epidemic might arise from cheese, yet such cases are exceedingly rare apparently, and at the present time I do not think the cheesemakers would be able to stand the expense of the investment and operation of pasteurizers, nor does it seem likely that the advantages would be proportional to the expense involved. Cheese is rarely manufactured in large central factories as condensed milk and ice cream, and often butter, are made, but most frequently in small country factories employing one or two men handling 5,000 to 10,000 pounds of milk a day. There are nearly 3,000 of these factories in Wisconsin alone and it would be quite a task to supervise all these factories with respect to pasteurization and insure thorough and complete work.

"The pasteurization of milk for cheesemaking has received most of its impetus at our Station from the department of bacteriology, for the reason that it is desirable to kill any disease germs in milk, but the commercial applications of pasteurization to the cheese industry did not arise from this source. It was found and was observed by us that after the milk has been pasteurized, it can be made into cheese by a fixed routine schedule of operations which are different particularly as to the absence of accidental and daily variations in detail from the ordinary cheese-factory practice, and this fixed schedule as to time

of operations in large factories as the result of pasteurization has enabled them to make large quantities of cheese with much less skilled labor and at a lower cost. Thus the city milk dealers are able to begin making cheese with the aid of eight or nine helpers who have never seen a cheese factory before, who have been engaged for bottling milk, under the supervision of one skilled cheese-maker and handling pasteurized milk.

"The fixed time schedule for all the different vats enables the routine process to be carried out without difficulty, whereas if the milk was not pasteurized, it would be practically necessary to have a skilled cheese-maker at each one of the vats, as none of them would work alike, but some faster and some slower, and each would require careful watching."

Regarding pasteurization of fluid milk, skimmed milk, cream, and ice cream mix, positive conclusions are warranted. Regarding pasteurization of milk and cream intended for manufacture into butter and cheese, summaries of the foregoing data are offered. These conclusions and summaries are as follows:

1. The facts regarding pasteurization of milk for fluid distribution are adequately summarized in the resolution with which this report begins.

2. Adequate safeguarding requires the pasteurization of cream, skimmed milk, and ice cream mix. With these latter commodities, not lower than 160 degrees F. held not less than 10 minutes may be considered a safe alternative for 142-5 degrees F. held not less than 30 minutes, which is the only recognized combination of time and temperature for fluid milk. However, the latter combination of time and temperature factors is in closer harmony with efficient plant practice.

3. This committee does not recognize the "flash" process. It may be that heating milk or cream to 185 degrees F. momentarily is considerably destructive of germ life;

but difficulties arise in maintaining that temperature under plant conditions and in its supervision.

4. No reports of actual outbreaks of communicable diseases transferred through butter have come to the attention of the committee. However, pasteurization of milk and cream intended for manufacture into butter is desirable, and the trend of the industry is favorable to the process. Either of the two combinations of time and temperature factors is recommended.

5. Only one actual outbreak of communicable disease transmitted through cheese has come to the attention of the committee. Others have probably occurred when a proper period of storage had not been maintained.

Under specially favorable conditions it is practicable to manufacture good cheese from pasteurized milk and cream; but such specially favorable conditions are not generally present in that part of the cheese industry concerned with the manufacture of the American Cheddar type of cheese. Pasteurization is desirable for the milk ingredients entering into the manufacture of cottage, "cream" and other cheese whose normal process of manufacture does not involve a period of approximately 50 days' storage before marketing. Present information warrants the conclusion that 50 days' storage is destructive of specific infectious organisms in cheese.

At the conclusion of the report of the Committee on Pasteurization, Prof. I. V. Hiscock moved that the thanks of the Association be extended to Dr. Price and his committee for the admirable report presented. The motion was carried unanimously.

THE EXTENT OF MILK PASTEURIZATION IN CITIES OF THE UNITED STATES

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AND
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The development of the milk industry, due in part to the concentration of groups of people in cities and increased recognition of the value of milk as a food, created an important problem for milk inspectors and health officials. To secure adequate supplies for urban centers it became necessary to obtain milk from various types of dairies and to transport it long distances. Under such circumstances, close supervision by local health officials of conditions surrounding the production and handling of milk, particularly in the large cities, became increasingly difficult. To meet the need for some practicable and economical method of supplying the public with safe milk, pasteurization was introduced. While it is not the purpose of this paper to deal with methods of milk production, it should be stated at the outset that pasteurization is not a substitute for sanitation, but should be coupled with periodic inspection at the dairy and careful supervision at the milk plant.

The principle of pasteurization was first applied to milk in certain sections of Europe, notably Germany and Denmark. A machine now known as the Danish pasteurizer was introduced in this country about 1895; while a "continuous-flow" pasteurizer of the "holding" type was designed about this time by Mr. S. M. Heulings of New

York. According to Kelly and Clement,[1] this was doubtless the first continuous-flow, holding pasteurizer, although a vat pasteurizer had been in use previous to this time.

In spite of early opposition to pasteurized milk on the part of the public and of many health officials, it is now generally recognized that proper pasteurization by the holding process is the most practicable method of producing safe milk on a commercial basis. Many of the early criticisms of pasteurization may be attributed to defects in the process, which have now been largely corrected, to inexperienced operation, and to unfortunate experiences in the use of the "flash" method. Modern milk regulations now contain carefully prepared definitions [2] of pasteurization by the holding process, and the "flash" system is usually prohibited by law.

During the past few years questions have been repeatedly raised concerning the proportion of milk now pasteurized in various types of cities in this country, and the extent to which it is feasible to encourage or require pasteurization. Certain health officers in small cities, for example, who are able to make frequent inspections of dairies and milk plants and know the milk dealers somewhat intimately are inclined, for the protection of their supplies, to rely primarily upon the results of these inspections, laboratory analyses, and the cooperation of milkmen or their physicians in reporting communicable diseases. Other health officers in small cities believe that these safeguards are not entirely adequate, that clean milk is not necessarily safe milk, and that pasteurization of the major portion of the supply should be required. This is also the attitude of practically all the health officers in the large cities where pasteurization is more generally practiced.

A recent letter from a health officer in one of these large

[1] Kelly, Ernest, and Clement, Clarence E. *Market Milk*, John Wiley and Sons, New York, 1923.

[2] For a satisfactory definition of pasteurization see the Report of the Committee on Pasteurization of the International Association of Dairy and Milk Inspectors, p. 137, 1923.

cities raised the question of the advisability of incorporating into the milk ordinance a clause requiring universal pasteurization. This city has had for several years an undue prevalence of typhoid and other intestinal infections, some of which have unquestionably been due to the unsanitary quality of the milk, and the health officer rightly turned to the one method of protection against milk-borne communicable diseases which has proven effective. This action would not be without precedent in a small community, at least, for in Tarboro, North Carolina, an ordinance prohibiting the sale of milk or cream unless pasteurized in accordance with the standard set forth in the ordinance, and also prohibiting the sale of milk by unlicensed persons, has been held valid by the Supreme Court of North Carolina in a case where judgment of conviction for violation of the ordinance was affirmed.[3] As indicated in another paper before this Association, Winona, Minnesota, is also a community in which universal pasteurization of the milk supply has been adopted. Questionnaire returns received by Ayers[4] from 266 large and small communities in 1921, should also be mentioned for they indicated that in 14 cases 100 per cent of the milk supply was pasteurized.

In order to gain information concerning the questions above indicated, the assistance of health officers and milk inspectors throughout the United States was invited. In response to the question, "What per cent of milk sold in city or town (in January, 1924) is pasteurized?" replies were received from the officials of over 200 cities and towns, of 46 States and the District of Columbia. These communities varied in size from New York City to towns of 10,000 population and were fairly well distributed in the various sections of the country. Through the courtesy of the American Child Health Association these data were supplemented and checked with information obtained by

[3] Public Health Reports, June 13, 1924.
[4] Ayers, S. H., Bul. 342, U. S. Dept. Agri., Oct. 10, 1922.

personal visits of representatives of this organization to a large number of cities of 40,000 to 70,000 population.

A study of the reports from this large and representative group of 205 cities and towns of the United States indicates that pasteurization of a portion of the milk supply is employed in 176 of them. Twenty-seven of the 29 communities in which no milk is pasteurized have less than 25,000 population. For the group as a whole, in 39 cities (19 per cent of the total) 90 per cent or more of the supply is pasteurized; in 72 cities (35.1 per cent) 50 to 89.9 per cent is pasteurized; in 55 cities (26.9 per cent), 10.1 to 49.9 per cent is pasteurized; and in 39 cities (19 per cent), 10 per cent or less of the supply is pasteurized. As indicated here graphically, pasteurization of a large portion of the supply is, as we might expect, considerably more general in the large cities than in the small communities, although there are a few notable exceptions to this situation.

Proportion of Milk Pasteurized in Groups of U.S. Cities — 1924

Cities of Population:	Number of Cities in Group	%	Proportion of Cities in each Group in which the % Pasteurization on Jan 1, 1924 was —			
			90 and over	50-89.9	10.1-49.9	10 and under
250,000 and over	18	75 / 50 / 25	72.2	22.2	5.6	0
100,000 to 250,000	26	75 / 50 / 25	19.2	65.4	15.4	0
50,000 to 100,000	46	75 / 50 / 25	23.9	41.3	32.6	2.2
25,000 to 50,000	44	75 / 50 / 25	11.4	38.6	38.6	11.4
Less than 25,000	71	75 / 50 / 25	7.0	21.1	25.4	46.5
All Cities	205	75 / 50 / 25	19.0	35.1	26.9	19.0

R. Jordan

In the majority of the larger cities all milk, except that from tuberculin-tested cattle, must be pasteurized. Incidentally it may be remarked that tuberculin testing of all cattle, whether or not the milk is to be pasteurized, is required in a few instances. In case the milk is to be pasteurized, however, this measure is chiefly desirable from the standpoint of animal industry and preservation of herds, rather than for the protection of public health. Individual reports show that 12 out of 18 cities of 250,000 population and over pasteurize 95 per cent or more of their total supply.

In 85 per cent of the cities of 100,000 to 250,000 population, over half of the supplies are pasteurized, but in only 19 per cent of them is 90 per cent or more thus treated. Pasteurization has progressed somewhat further in these cities than in the next population group (50,000 to 100,000 population), where only two-thirds of the cities report that at least half the supply is pasteurized, although in eleven of the forty-six cities, 90 per cent or more of the supply is thus treated.

Of the 115 cities or towns of less than 50,000 population, only ten report that 90 per cent or more of the supply is pasteurized; while 38 indicate that 90 per cent or more of the supply is raw milk. In 50 per cent of the cities of 25,000 to 50,000 population, at least one half the supply is pasteurized. Only 28.1 per cent of the communities of less than 25,000 population have 50 per cent of the supply pasteurized. It is interesting to note that whereas 90 per cent or more of the supply is pasteurized in 72 per cent of the cities of 250,000 population and over, only 7 per cent of the supply is thus treated in communities of under 25,000 population. In 46.5 per cent of the cities under 25,000, the extent of pasteurization amounts to only 10 per cent or less of the total supplies.

It is obvious that the problems of the small town are considerably different from those of the large city. This observation applies to the question of milk control as well as

to many other factors. It has been stated by Miller that if a dairyman or milk concern handles as much as 300 or 400 quarts of milk per day, pasteurization of that milk will probably not add more than 2 or 3 cents per quart to the cost. [1]As a result of practical investigation, this author states as a reasonable conclusion that a safe milk supply is possible for any town consuming 400 quarts of milk or more per day.

A practical experiment, inaugurated in Tarboro, North Carolina, in 1918, has proved the feasibility of this scheme. As previously indicated in this paper, a milk ordinance was passed by the town council requiring all milk sold in town (not exceeding 400 quarts in 1918) to be pasteurized. A central plant was constructed, and is owned and operated by the town. A personal letter from the city clerk last year and reference to articles which have appeared in magazines describing the operation of the plant indicate that the project has been successful from the standpoint of supplying safe milk to satisfied customers at a reasonable cost.

The question of the extent of pasteurization in different sections of the country is also of some interest, but can be answered definitely only after extensive study of data from an even larger number of communities than are here included. A study of available data suggests that pasteurization of a large proportion of the supply has been more widely adopted in cities of the Middle Atlantic and North Central States than in those of the South Atlantic, South Central and Mountain States, while cities of the New England and Pacific States fall in an intermediate group. There are obviously many individual exceptions to this statement, however, as indicated by the experience above

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[1] Miller, K. E. "Safe milk for the small town." Public Health Reports, Dec. 13, 1918. For additional studies of cost see Bowen, John T., "The cost of pasteurizing milk and cream." U. S. Dept. Agri., Bul. 85, 1914.

noted in North Carolina and by several other instances of such cities as Salt Lake City, Utah; Richmond and Roanoke, Virginia; Washington, D. C., and Baltimore, Maryland, in which 95 per cent or more of the supply is pasteurized. It is clearly apparent that any studies of this situation must take into consideration, among other factors, that of population.

Has the proportion of milk pasteurized in different cities changed materially during recent years? In answer to this question, data were assembled for 75 cities (43 of 100,000 population and over) for the year 1920 to compare with the records of 1924. Increases of 10 to 63 per cent were reported for 20 cities, with decreases of 10 to 20 per cent for 6 cities. An increase of from 10 per cent to 30 per cent was reported during the period for 15 cities, and from 30 per cent to 63 per cent for 5 other cities. The largest increase noted was in Birmingham, Alabama, which showed an increase in 4 years from 17 to 80 per cent in the amount of milk pasteurized. Two other cities, New Haven, Connecticut, and Binghamton, New York, each showed increases of 35 per cent, from 55 to 90 per cent, and from 50 to 85 per cent, respectively.

It is generally believed, and has apparently been demonstrated in individual cases, including Birmingham, Minneapolis and New Haven, that per capita milk consumption in a community gradually increases as health department efforts to improve milk supplies become effective. As pasteurization is one of the most important measures in milk control, we were interested to see if there is any relationship between the proportion of milk pasteurized and milk consumption. While our present data do not indicate a very high correlation between these two factors alone, it is gratifying to observe that cities in which both careful supervision and pasteurization have been actively employed for several years show relatively higher figures

for per capita daily consumption than do cities in which these measures have been slower in developing.

Finally, it cannot be urged too strongly that official regulation should conform to sanitary knowlege more completely than is the case at present. A somewhat careful study of milk ordinances indicates that many of them should be revised in the light of modern experience and accepted practice. With the regulation requiring the pasteurization of all milk not of grade A raw quality, should, of course, come a stringent definition of pasteurization and a thorough system of inspection of dairies and of pasteurizing plants.

In the past it has seemed desirable that a small amount of very high grade raw milk should be available, such as is provided through the activities of certified milk commissions. As indicated by a recent epidemic in New York State,[1] certification does not necessarily protect against communicable disease. It is also significant that no epidemic of disease has ever been traced to properly pasteurized milk.

In view of the satisfactory development of pasteurization in small as well as in large cities during the past ten years, it may be anticipated that even greater progress in safeguarding our milk supplies will be made during the next decade.

[1] *Health News*, New York, June 16, 1924.

DISCUSSION

Dr. H. A. Harding, Detroit: Certain raw milk advocates intimate that the days of pasteurization are numbered. Did you anywhere discover such a sentiment?

Prof. Hiscock: We found no such sentiment.

Mr. Wm. B. Palmer, New Jersey: In New Jersey our ordinance requires certified or pasteurized milk. The courts have held that individuals could, if they so desired, get raw milk in the form of certified.

"There is no evil in the world without a remedy."

REPORT OF COMMITTEE ON MILK PLANTS

C. E. CLEMENT, *Chairman*

There has been considerable development in the equipment of milk plants in the last year or two. Many new developments in pasteurizing machinery were shown at the National Dairy Show at Milwaukee. Some of the companies who formerly exhibited continuous-flow holders, of the series-of-tanks type, did not show this type of holder but, instead, had on exhibit a holder of the compartment type operated automatically. It is apparent that the former type of holder will not be as popular in the future as in the past. This change has no doubt been brought about by the agitation which has taken place in the past few years regarding the ability of such apparatus to hold every particle of milk the required length of time.

Another development in pasteurizing equipment that has recently taken place is the automatically controlled valve for vat pasteurizers. A series of three or more vats using these automatic valves will constitute a continuous system of pasteurization and the operator does not have to turn any valve. The temperature is also automatically controlled. This is one of the newest developments in equipment for pasteurization and its efficiency will be closely watched.

Recent developments in bottle-washing machinery present the question of steam versus other agencies for sterilizing milk bottles. There are several new bottle-washing machines, some of them depending upon the application of caustic solution for sterilization and others depending upon the application of a final rinsing in a solution containing chlorine. Where health departments require, the manufacturers of these machines will install an additional unit to their

machine for the sterilization of the bottles by steam. In view of the wide use of these new types of bottle washers, and the fact that many health departments permit their use without the steaming unit, it seems appropriate that a thorough study should be made of the efficiency of these other agencies for sterilizing milk bottles.

While there is considerable objection to the use of chlorine in certain cities, and many cities prohibit its use, investigations carried on by the Minnesota State Board of Health have demonstrated to their satisfaction that chlorine is a very effective agent for sterilizing milk bottles, and they recommend it at all the plants under their supervision in the State of Minnesota. The results of some of their investigations are reported in the following bulletins:

> "An Apparatus for Sterilizing Milk Bottles at Small Milk Plants and Dairies," by H. A. Whittaker and R. W. Archibald, published by Minnesota State Board of Health.
>
> "Relative Efficiency of Sterilizing Milk Bottles at Pasteurizing Plants in Minnesota," by H. A. Whittaker, R. W. Archibald, and L. Shere. Reprint No. 918 from Public Health Reports, May 2, 1924.

With any type of bottle washer, it is very important that the solutions be kept at the proper strength, the pumps run at the proper speed, and proper pressures and temperatures maintained at all times.

Milk inspection departments of various cities are realizing the importance of broadening their scope of work to include inspections of city milk plants and country receiving stations. In connection with the inspection of milk plants and stations, it should be remembered that notwithstanding the great amount of new equipment which has been added, the personnel of the employees is a very important factor. Many instances have been observed by members of this committee where the installation of modern sanitary

equipment resulted in very little improvement in the product either as regards bacterial content, acidity, sediment or flavor, while, on the other hand, some of the best products pass through plants having old-fashioned and exposed surface equipment. Dealers should use great care in selecting their plant employees. Large dealers should inaugurate a system of instruction, as many of them have done with their salesmen.

One of the most difficult conditions for milk officials in some localities to supervise or to correct is the receiving from producers of milk which is dirty, too warm or has been exposed. This matter must necessarily be left to the judgment and integrity of the plant manager. Naturally his his judgment would be largely influenced by the attitude of his employers in the matter of rejecting warm or dirty milk, and in the enforcement of sanitary methods. Producer-owned plants are often the worst offenders in this respect, as the plant manager, no matter how efficient he is, is placed in a position of having to censor and penalize his own employers.

In districts where there are competing milk dealers maintaining milk stations, local managers are naturally less strict in regard to rejecting warm or dirty milk for fear of losing their trade to other dealers. If a standard could be established and adhered to by all dealers, and all milk rejected that was below the standard for acidity, sediment or temperature, it would go a long way in the opinion of this committee toward correcting some of these conditions which are difficult to control. The better class of milk dealers would no doubt be willing to cooperate in this matter.

COUNTRY RECEIVING STATIONS

For information relative to location, construction, and equipment of country receiving stations reference is made to last year's report. In some sections of the country receiving stations have been established in large numbers

quite close to each other. Probably the original cause for this was competition between dealers. Often these stations have fallen into the hands of one dealer and many instances have been noted where it would be economy to consolidate two or more stations. The work of two stations could, in many instances, be carried on with practically one half the equipment and labor now used if the stations were consolidated, and even then the producers would all be within a radius of about eight miles of the station. Such consolidation would result in economies in overhead and operation of the dealer and also facilitate the work of the milk inspectors.

At many stations milk is pumped into large glass-lined insulated tanks after being cooled. From these tanks it is transferred to tank trucks which transport the milk to the city. Usually at these stations only one man is required to operate the plant, as there are no cans to handle or wash. At many of these stations there are facilities for cleansing the producer's cans, the producer doing the work. In the Philadelphia district there is a large number of these "one-man stations." Tank cars are also coming into use in this district for transporting milk from the station to the city. Brine pipes are installed in these cars and in each car there are two glass-lined tanks, each holding 3,000 gallons of milk. Brine is pumped into the pipes at the country station. The tanks are not insulated, but they are installed in a regular refrigerator car. In one shipment covering a distance of over 50 miles the milk in one of these cars arrived in Philadelphia at 34 degrees F., which was said to be two degrees lower than when it left the country, although three hours had elapsed. Where there is enough milk at one station to fill a tank truck, or one tank in a tank car, this method of transportation seems to be very satisfactory and considerable labor at station in handling of cans can be eliminated.

"Knowledge is more than equivalent to force."

SURVEY OF BOTTLE-WASHING METHODS AND EQUIPMENT

W. D. DOTTERER, *Director of Laboratories,* Bowman Dairy Co., Chicago, Ill.

A comprehensive survey of bottle-washing methods and equipment requires a rather lengthy history of various types of machinery. Such a lengthy discussion is of doubtful value in our convention, where all are familiar with most of the types of machines used to clean and sterilize milk bottles. Many present are familiar also with the latest types of machines. The older methods of bottle washing consist for the most part in soaking the bottles for varying periods in solutions of cleansing preparations and then washing with a brush by hand. After washing, the bottles are treated with steam or hot water for sterilizing purposes. A great many washers of the pressure type are also used. In these, the inverted bottles are carried over jets of washing solution, jets of rinse water, and then over jets of either hot water or steam to sterilize them. Both of these methods are fairly good in cleaning bottles and can easily be so operated as to produce entirely satisfactory bottles from a bacteriological standpoint.

In the last few years a new principle of cleaning milk bottles has become quite common. Machines employing this principle have been in use for a number of years in the beer and soft-drink industry, but have been adapted to the milk industry only comparatively recently. The new and important feature of these machines is the provision for soaking the bottles in a strong solution of caustic soda for varying lengths of time and with various methods of applying the caustic. In some machines the bottles are soaked in a single vat of solution. When this is true

the temperature must be comparatively low to prevent breaking bottles by too sudden changes in temperature. Usually temperatures of 120° F. to 130° F. are as high as can be used. Other machines have more than one vat so arranged that temperatures as high as 150° F., 160° F. or even 180° F. may be safely used. The higher temperatures assist in loosening the dirt and add to the effectiveness of the caustic as a sterilizing agent. One machine has been put on the market very recently which carries the bottles over a spray of caustic solution for the entire period of soaking. As soon as any dirt is loosened in the bottle it is carried away and does not lie in the bottle to act as a protecting layer to prevent the caustic coming in contact with the deeper layers of dirt.

The essential feature of these machines is the strong caustic solution used to soak the bottles. In this the machines are quite similar, the greatest difference being in the provision in some machines to use higher temperatures in one or more of the soaking vats, and in the use of a constant spray of solution in place of the dormant soak. Some washers are not strictly dormant soaking machines, for the bottles are emptied and filled several times during the process.

After leaving the caustic bath there are different methods of finishing the process. Some machines scrub the bottles both inside and out with brushes. Some use the so-called air brush, which is a mixture of air and water under high pressure. Some use brushes on the outside only and some no brush at all. Considering the variation in the methods and the sometimes exaggerated claims of the manufacturers, there is little difference in the results. The results are far in advance of the older methods of washing where mild soaking solutions were used on account of the handling that was necessary.

Removing the visible dirt from milk bottles may not be considered as important by this organization as the removal

of bacterial contamination. This may be true, but a bottle, to be readily sterilized, should first be clean. Furthermore, we are all interested in the use of milk as a food, and clean, attractive-looking bottles have an important influence on sales. From a bacteriological point of view the caustic soaking method of cleaning bottles is very efficient. Most of the bottles come from the caustic bath practically sterile.

Some experiments carried out for the Chicago Department of Health show that caustic soda in much weaker solution than that used in these machines is a very effective sterilizing agent. In these experiments the solutions in actual use in several machines were tested twice daily for a period of two weeks, for the purpose of determining the rate of deterioration in the solution, including specific gravity, alkalinity, and germicidal properties as determined by the ability of the solutions to destroy colon bacilli. All of the solutions tested killed heavy suspensions of colon bacilli in less than five minutes at a temperature of 120° F. The weakest solution found contained 6.9 grams of caustic soda per liter and was strong enough to kill a heavy suspension of colon bacilli in less than five minutes at 120° F. After diluting the above solution with an equal quantity of water, bringing the caustic content to 3.45 grams per liter or about one third of one per cent, it still killed the colon bacilli as described before. The solution required by the Chicago Health Department is at least one per cent, which gives a good margin of safety. In actual practice much stronger solutions are used in order to secure better results in cleaning. In fact, it seems that any caustic solution which cleans bottles in a satisfactory manner is strong enough to kill the bacteria with which it comes in contact.

The rinsing which follows the caustic bath is an important part of the process, for if the rinse water be contaminated the bottles will not be satisfactory. Although the contamination may be dangerous, depending upon the character of the germs added to the bottle, the actual

danger is probably slight in most cases, but it must be considered a possibility. To overcome this objection some cities require that bottles receive a final treatment with hot water or steam. Since these machines are generally designed to deliver the bottles directly to the filling machines, hot bottles must be cooled at once. Cooling is expensive and unless the cooling medium is applied to the outside of the bottles, there is a chance of recontamination. Even when applied to the outside, a contaminated cooling water is unsatisfactory on account of the small amount of water which will remain suspended on the lip of the bottle and run into the bottle when it is placed in an upright position. Another method of final treatment is to rinse the bottles with a solution of chlorine made either from one of the preparations on the market or from liquid chlorine such as is used in chlorinating water supplies. Liquid chlorine is perhaps more satisfactory on account of the ease with which a continuous stream of chlorinated water may be supplied, so that fresh water is used at all times instead of recirculating the solution over and over. We have found that such treatment produces a satisfactory bottle when chlorine is used at the rate of two parts per million. Stronger doses up to 50 parts per million do not impart a flavor or odor to the milk.

In order to test out the germicidal action of chlorinated water, 28 bottles were contaminated with water used to rinse a very dirty bottle which contained, among other things, a quantity of partly decomposed milk. This water was poured from one to another until all were contaminated. Four of the bottles were used as controls and contained so many bacteria that an actual count could not be made, but there were over a million indicated by the very crowded plates. The remaining 24 bottles were put through the chlorine-rinsing part of the machine. This consists of six jets of solution of about one second's duration each. The chlorinated water contained at this time 1.84

parts per million. Of the 24 bottles, eight contained 100 or fewer bacteria, 14 contained between 100 and 500, and two contained more than 500, the greatest number being 800 per bottle. Undoubtedly a great many of the bacteria were removed by the mechanical rinsing, but the chlorine also was evidently very active.

Results secured with empty bottles sent in from bottling stations to the laboratory show practically the same results bacteriologically, whether steam, hot water or chlorine is used as a sterilizing agent. Either of the three methods properly applied will produce bottles which average less than 500 bacteria per bottle. So far as the bacterial count in milk placed in such bottles is affected, such bottles are entirely satisfactory. The capacity of a quart bottle is 960 cubic centimeters. In order to increase the count in milk put in bottles contaminated to the extent of 100 bacteria per cubic centimeter, the bottle would have to contain 96,000 bacteria. It is clearly evident that bottles properly washed and sterilized by any method are not an important source of bacterial contamination.

"Every occupation that is not essentially a service to others is unworthy."

THE USE OF MILK IN URBAN COMMUNITIES

IRA V. HISCOCK, C. P. H., *Assistant Professor of Public Health,* Yale School of Medicine,

AND

JOHN L. RICE, M.D., *Health Officer,* New Haven, Conn.

The unique value of milk as a food, particularly for children, has been recognized for many years. It has been frequently stated that one of the most important nutrition problems with which the health officer is concerned is to secure an adequate supply of safe milk. Although it has been generally believed that a large proportion of the cities of this country fall short of a desirable standard for per capita milk consumption, it has not been entirely clear in the minds of many milk inspectors, and of the public, as to just what this ideal standard should be. Other questions have been raised as to the availability of records for milk consumption in different sections of the country, and the present indication as to whether or not the use of milk is on the increase.

In answer to the first of these questions, as to what is the desirable per capita consumption of milk in a typical American community, there is considerable evidence to support the statement made by Emerson [1] at the World's Dairy Congress last year to the effect that the entire community would save expense and serve their nutritional needs best if as much as one quart of whole milk were used as a food for each member of the population daily. In a radio release issued September 22 of last year by Commissioner of Health of the State of New York, Dr. Matthias Nicoll, Jr., it was also stated that children should have at least a quart of milk or its equivalent in milk products daily. The results of research work by Sherman and

[1] Emerson, Haven. "Per capita milk consumption," A. J. P. H. *14*, No. 4, April, 1924.

Hawley[1] have shown that optimal storage of calcium is made when the diet contains one quart of milk a day for each child.

How nearly do the cities of the United States approach this standard? Through the cooperation of health officers and milk inspectors, data as of January, 1924, have been assembled concerning the amount of milk sold in 168 cities and towns of 46 States and the District of Columbia. These communities vary in size from New York City to towns of 10,000 population and are fairly well distributed. We are also grateful to the American Child Health Association, through whose courtesy these data were checked and supplemented with information obtained by personal visits of representatives of that organization to cities of 40,000 to 70,000 population.

A study of the reports of this large group of cities shows that the per capita consumption on the average amounted to 0.81 pints per day. By classifying the group according to five population divisions, it is found that cities of 250,000 and over have a higher per capita figure than any of the other population groups, amounting to 0.84 pints per capita per day. As indicated in the following table, there is very little difference in the amount of milk sold per capita in the cities of 100,000 to 250,000, (0.79), 50,000 to 100,000 (0.76), 25,000 to 50,000 (0.75), population divisions. For the cities and towns of less than 25,000 population, 0.58 pints of milk per person were sold daily.

TABLE I

PER CAPITA CONSUMPTION OF MILK IN GROUPS OF CITIES CLASSIFIED ACCORDING TO SIZE OF POPULATION, 1924.

Population	Number of cities	Pints of milk sold in city per person per day
250,000 and over	18	0.84
100,000 to 250,000	25	0.79
50,001 to 100,000	28	0.76
25,000 to 50,000	27	0.75
Less than 25,000	70	0.58
All cities	168	0.81

[1] Sherman, H. C., and Hawley, Edith. "Calcium and phosphorus metabolism in childhood." Jour. Biol. Chem., *53*, 375, 1922.

There is, of course, considerably greater variation in per capita milk consumption for the individual cities of the various groups than among the different population groups. Of the 168 cities and towns included in the above table, 29 reported a daily per capita consumption of one pint or more,[1] in four cases amounting to over a pint and a half.[2]

Forty-nine cities and towns reported a daily per capita consumption of less than one-half pint, 34 of them being southern communities. The remaining 90 cities and towns reported a daily per capita milk consumption of .5 to .99 pint per capita.

There is some evidence to suggest a fairly definite variation in the amount of milk consumed in different sections of the country. For example, a study of the data for these 168 cities indicates somewhat lower figures for the southern cities, particularly those of the South Atlantic group. This situation is not entirely accounted for by the fact that this group includes a fairly large proportion of small and medium-sized cities, which, according to Table I, have lower averages for per capita milk consumption than do the larger cities. It has been previously noted, too, that a large proportion of the communities with figures of less than a half pint per capita are of the southern groups, although there are several individual exceptions. For the cities under study the New England, Middle Atlantic and Pacific coast cities average the highest in the per capita amount of milk consumed daily.

In general it is believed that the price of milk, under present circumstances at least, is not a controlling factor in determining the extent of milk consumed in a community.

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[1]Among the large cities in which it is reported that at least one pint of milk per person is consumed daily are included Boston, Mass., Newark, N. J., Indianapolis, Ind., Louisville, Ky., and Los Angeles, Calif.

[2]Everett and Methuen, Mass., Topeka, Kans., St. Petersburg, Fla.

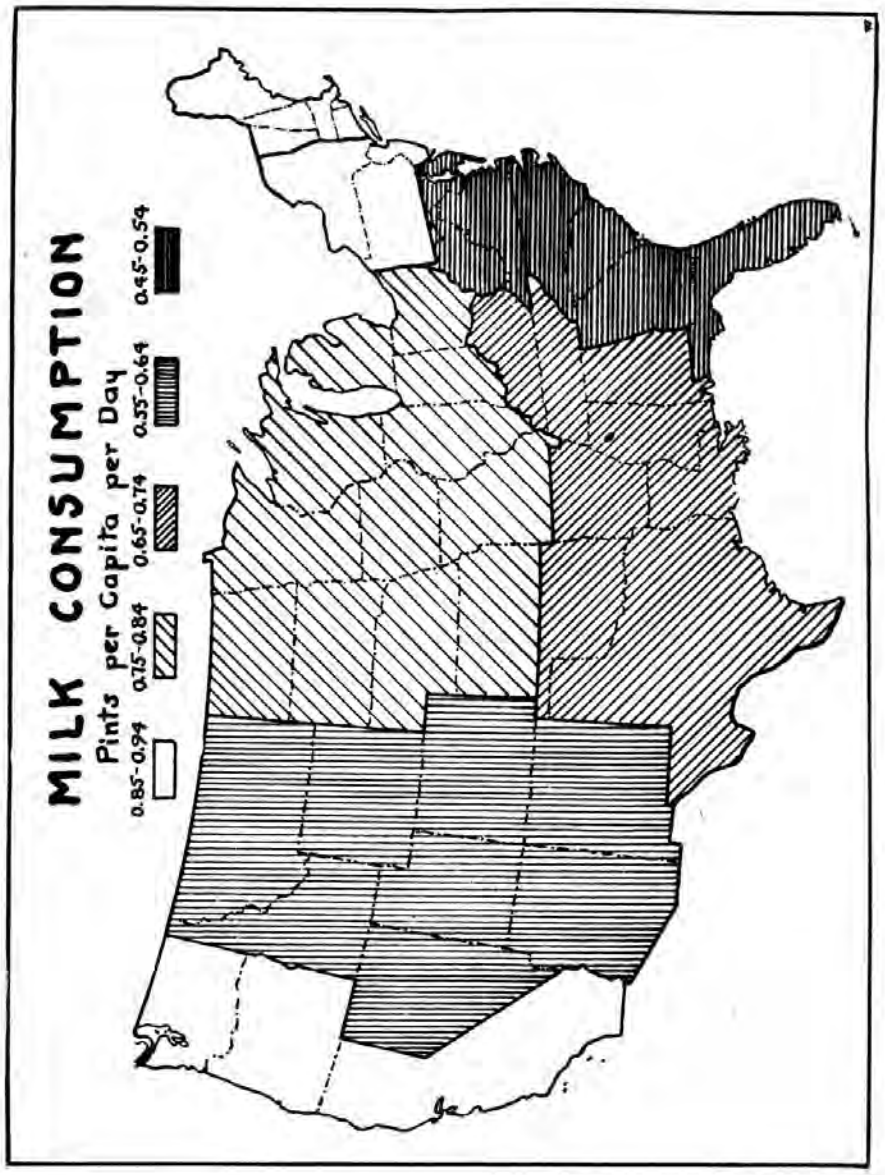

TABLE II

Classification of 53 cities according to per capita milk consumption and price of milk.

Per capita milk consumption	Number of cities in which price of milk in 1924 was: 12 cents or less	13-15 cents	Over 15 cents	All cities
.40 quart or less	10	18	6	34
Over .40 quart	4	11	4	19

From the above table it may be observed that of 10 cities in which the price of milk was over 15 cents per quart, four reported an average per capita milk consumption of .40 quart daily. This is the highest percentage of cities of these three groups reporting an average of .40 quart of milk consumed daily per person.

Obviously there are families in every city who do not have adequate funds to purchase as much milk as is desired by them. There are many other families who do not appreciate the relative value of milk with respect to other foods. or understand that in comparison with other foodstuffs, the present prices of milk are not high.

During the past few years, health and nutrition workers have urged particularly the increased use of milk, and vegetables, with a relative decrease in the use of meat. Dr. H. C. Sherman [1] of Columbia recommends that 44 per cent of the food expenditure of the average family should be for milk and its products, with only 12 per cent for meat and fish.

It is encouraging to note that milk consumption in many cities is on the increase. According to the United States Department of Agriculture in 1900 the urban and suburban population of the United States purchased milk and cream, exclusive of milk used in the making of butter, cheese and condensed milk products, to the extent of one half of a pint per capita per day throughout the year. The average per capita consumption of whole milk in the United

[1] Kelly, Ernest, and Clement, Clarence E. *Market Milk.* John Wiley and Sons, Inc., N. Y. 1923.

States was reported by this authority to be .93 pint per capita per day in 1917 and .94 pint per day in 1920. This amount had risen to a little over one pint in 1923, and represented a total increase in the amount of milk used for household purposes over the previous year of approximately five billion, two hundred million pounds of milk.[1]

It may be observed that these data obtained by the Department of Agriculture for the country as a whole indicated a higher average figure for per capita milk consumption than was reported by the Committee on Municipal Health Department Practice of the American Public Health Association for a group of large cities.[2] Reports from the 168 cities and large towns of this study also show a slightly lower average figure than has been estimated for the entire urban and suburban population of the United States. It may be that in certain instances, particularly in the smaller cities, the data for urban communities here submitted do not include records of milk produced in one- or two-cow dairies, which are always difficult to supervise, as knowledge of their existence is not always available to milk inspectors.

Several of the large cities which reported a daily per capita consumption of less than one-half pint in 1920 show somewhat higher figures in 1924, as indicated by the following partial list.

	1920	1924
Baltimore, Md.	.35	.50
Indianapolis, Ind.	.47	1.27
New Orleans, La.	.34	.51
Birmingham, Ala.	.13	.46
Jacksonville, Fla.	.39	.40
Memphis, Tenn.	.29	.65
Norfolk, Va. ,	.48	.47
Oklahoma City, Okla.	21	.47
Richmond, Va.	.34	.35

[1] During 1923 over 50 billion pounds of whole milk were used in this country for household purposes, nearly 52 billion pounds were used for manufacturing, over 4 billion pounds were fed to calves, and over 3 billion pounds are estimated by the Department of Agriculture to have been wasted.

[2] Hiscock, Ira V. Milk Inspection, Chapter, Public Health Bulletin 136, U. S. P. H. S. July, 1923, p. 168.

Among the other large cities showing increased milk consumption during this period we find Minneapolis (.59 pint 1920, .74 pint 1924); New Haven (.80 pint 1920, 1.02 pints 1924); and New York (.71 pint 1920, .92 pint 1924). Relatively few cities show decreases during this period. New York City has had the benefit of an excellent program of milk supervision for several years. During the past four years, milk supervision in such cities as Birmingham, Minneapolis, and New Haven has been developed to a high degree of effectiveness, coincident with increased milk consumption.

In an effort to teach the value of milk and milk products and to increase milk consumption, health officials and representatives of the milk industry have utilized various measures. Among the different lines of activities which have proved of practical value are the press, bulletins and pamphlets, lectures, exhibits, pageants, essays, posters, and the radio. Special essay contests and poster contests have been included in the program in Richmond and a few other places. Many of the posters used by the New England and National Dairy Councils are excellent and radiate the cheer and optimism which should go with successful posters. Favorable reports have been received from the departments of education who have utilized measures of this character among school children either in connection with their nutrition classes or as special educational features of their work. School milk lunches can serve a useful purpose if sufficient care is exercised to secure a high grade of milk, produced and delivered under health department supervision. Special campaigns for increased milk consumption have also proved successful in several instances.

As an illustration of one of the measures employed by milk dealers, we may refer to the use of milk supplemented by a small amount of chocolate and sugar. This mixture of milk and chocolate is prepared under the same conditions as

whole milk and distributed by dealers in milk bottles along with their regular trade. Such beverages are given various names: as, "Angel Drink," "Chocolated Milk," "Chocolishus." Such mixtures are made of either whole or skimmed milk. The addition of chocolate gives a taste to milk that appeals more strongly to certain individuals than does the taste of ordinary fluid milk, and no doubt this dairy product will tend to increase consumption of milk among this group of people.

Obviously, health officers and milk inspectors, as well as milk producers, may render important service in the community through efforts to educate the public in regard to the value and care of milk. When a city health department has reached a point in its development where the health officer is satisfied that the milk supply is safe, he will undoubtedly be most eager to participate in a well-directed program to increase milk consumption to a degree which will correspond with an ideal standard for his community. To safeguard the public, a broad, scientific program for milk control is required which shall reach the producer, the middleman, and the consumer. It is desirable that the milk regulations be in accord with modern standards and that they be in successful operation in order that there may be a system of supervision, inspection, and control which reaches from the dairy farm to the consumer. Milk consumption should be increased to a desirable limit in all communities, and the consumer should be guaranteed a product that is safe and wholesome.

DISCUSSION

Dr. Harding: Referring to the reference regarding the preparation of milk drinks by the addition of chocolate, it has been our observation that the sale of such milk rarely exceeds a period of two months and for about two seasons. The taste of the sweetened chocolate milk does not appeal

strongly. Most of us like Irish potatoes daily for a lifetime, but sweet potatoes only at certain seasons, and then only twice a week.

"The greatest remedy for ills,
For you and all your ilk,
Is not in powder or in pills—
It's milk, my friend, just milk!"

HOW BOSTON HANDLED THE MILK PROBLEM

PROFESSOR JAMES O. JORDAN, *Inspector of Milk,*
Boston, Massachusetts.

In 1923, when it became known in Boston that 93.43 per cent of the milk used in the city was pasteurized, there was a desire to still further improve our milk supply.

The balance of the milk which was used was either certified milk, or raw milk from several farms having accredited herds, or ordinary raw milk.

The owners of the business just mentioned were men who had to be seen and convinced that it was incumbent on them to improve their herds, and the kind of milk they were selling. A list was made out which included thirty-one names, and the most of those on the list produced milk for sale in Boston. All of these men received calls, beginning as early as December 7, 1923, by a member of the Milk Division, who made as many calls as was necessary to get the owner to agree to pasteurize his product, or else have his herd tested upon the accredited plan.

Arrangements were made with the Bureau of Animal Industry, and with the Division of Animal Industry in behalf of the State, to have these cows tested. The work was all completed between January 1st and July 15th. The time had to be extended with four herds because the appropriation ran out, but just as soon as money was available the work was completed. All told, there were twenty-three places where the test was applied. The number of cows which reacted was 214, or 34.24 per cent, and 411, or 65.76 per cent, failed to react. The percentage of reactors was very high, some herds thought to be very healthy losing the greatest number. For instance, there was one herd of seventy-three cows which lost twenty-five by this

test. Another lot of forty-seven cows lost thirty-six and in one herd of twenty-four cows twenty-two cows were condemned. There were two small herds of six cows each which contained no reactors. This percentage of cows which reacted would be very much larger if it were not for the fact that I have included in this list one herd of one hundred and seven cows in which there was only one reactor. Within the City of Boston proper there are now only one hundred and seventy-three cows. All other cows are outside the city limits.

Some of the milk producers after having the test applied to their cows lost so many cows that they concluded it would be better to have a pasteurizing outfit installed, and some of them have even gone out of the business. All told, the number of dealers changing from the sale of raw milk to the sale of pasteurized milk was seven, and two are buying their milk pasteurized from other dealers. The quantity of milk which these nine dealers sell plays a very important part in our percentage of pasteurized milk, and calculation now shows that 96.72 per cent of our milk supply is pasteurized.

It became necessary to have a regulation which would cover this important change and so, on March 7, 1924, Article XII, known as "Tuberculin Tested and Accredited Herds and Pasteurization," was adopted by the Boston Health Department and went into effect May 31, 1924. That regulation is as follows:

> *Section 1.* On and after May 31, 1924, all raw milk, whether certified or not, offered for sale in the City of Boston, shall be drawn exclusively from tuberculin-tested and accredited herds, or tested herds on the way to accreditation, under Federal supervision, and shall, when offered for sale, contain not more than 100,000 bacteria per cubic centimeter. A license to sell such milk shall be procured from the Health Commissioner and at the time of the applica-

tion for a license to sell such milk the dealer shall make known to the Health Commissioner the results of all tests during the previous year upon animals owned by him or under his control.

Section 2. On and after May 31, 1924, all milk not meeting the requirements as contained within Section 1, before being offered for sale, shall be pasteurized and shall comply with the following requirements: Shall be natural cow's milk not more than seventy-two hours old when pasteurized, shall be subject for a period of not less than thirty minutes to a temperature of not less than 140 degrees Fahrenheit and not more than 145 degrees Fahrenheit; and shall be immediately cooled to a temperature of 50 degrees Fahrenheit or lower.

Section 3. The heaters or pasteurizers used in the pasteurization of milk shall be equipped with suitable automatic time and temperature recording devices indicating to what temperature the milk has been heated, the length of time it was subject to such heat, as well as the time when such record was made. The record so made shall be preserved for one year by every milk dealer and shall be open to the inspection of the Health Commissioner or his authorized agent whenever requested.

Section 4. No pasteurizing equipment shall be used for the pasteurization of milk that is not approved by the Health Commissioner or his authorized agent.

Section 5. All cream and skimmed milk offered for sale not obtained from milk meeting requirements of Section 1, shall be pasteurized in accordance with the provisions of Section 2, or obtained from pasteurized milk.

Section 6. All ice cream offered for sale shall be manufactured from cream obtained from milk meet-

ing the requirements of Section 1, or from pasteurized milk.

Section 7. No milk offered for sale shall be pasteurized more than once.

Section 8. Pasteurized milk when offered for sale shall contain not more than 100,000 bacteria per cubic centimeter.

Of course under the standards of bacteria for pasteurized milk and for raw milk, which are only 100,000 bacteria per cubic centimeter, it will mean that on the basis of figures our supply will not be as good as when the bacterial limit was larger, but in time this will be improved. Those who had cows which require testing are soon to receive visits from those whose duty it is to inspect the cows and then we shall know the percentage of animals which react, if any do react, on the application of the tuberculin test the second time.

"At the birth of every problem there is born a solution."

REMARKS BY MR. E. R. GAUHN

Supervisor of Food and Sanitation, Health Bureau,
Rochester, N. Y.

The picture of dairy and milk inspection shown by us this evening was not intended to teach inspectors proper methods of dairy or milk inspection, but rather to show a means whereby publicity may be given the work of inspection in your own communities. The people who eventually pay the bills are interested in the mechanics of dairy inspection and laboratory examination and appreciate being shown how the work of which they hear so much is actually carried out. They are able through the medium of a picture to better understand the kind of work done and understand the necessity for it.

There are, of course, some difficulties in the way of making a picture clear to those who are not acquainted with the kind of work done and the reason therefor, but we have found that even though they do not understand the reason for some of the action in the picture, they do get the general trend of what is being done and they carry with them, when milk inspection is mentioned, a mental picture of the examination of milk, of the dairy from which it comes, of the creamery through which milk passes, of the distributing agency that handles it before delivery to the consumer, and, finally, of the bottle of milk as they receive it.

Once this work is understood, there will be less difficulty in securing its continuance and extension. It will tend to relieve the erroneous impression that any one factor in milk inspection should be unduly stressed, and create a right impression that it is a combination of all the factors from the dairy to the consumer, each having its proper weight, that determines the acceptability of milk in the market.

"What the eyes see, the heart believes."

WHAT THE DAIRY DIVISION HAS DONE FOR BOSTON

ALEXANDER R. TOLLAND, *Supervisor of Pasteurization,* Health Department, Boston, Massachusetts.

Dairying in Massachusetts has failed to keep pace with the growing population, therefore many cities and towns now have to depend on other States for their milk supply. The geographical position of Boston is such that we can only go West or North for our milk supply, as practically all milk produced in Massachusetts is consumed by local cities and towns, and as our population increases, so does the milk-producing area. Our files show 40,000 producers in Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York and the Province of Quebec, but they are not all active, as 15,000 of this number represent a shifting supply, depending on market conditions. Many of these supply summer hotels, and at certain periods of the year local cities and towns offer a better market. Approximately 25,000 active producers are sending seventy carloads of milk to Boston daily. Maine supplies thirteen cars, New Hampshire ten, Vermont thirty-four, Connecticut two, Massachusetts two, New York seven, and about three cars of cream is received from Quebec.

This field is so large that it is impossible to inspect new dairies immediately upon application. Previously an applicant was allowed to ship pending an inspection, but this method proved unsatisfactory, so the following application form embodying all the essentials of the score card was adopted.

Dairies applying for permission to ship are visited by the creamery manager, the application form is filled out by him and mailed to this department for approval or

BOSTON HEALTH DEPARTMENT—DAIRY DIVISION

Room 1001, City Hall Annex

Application form for new dairies to be investigated and form filled out by creamery manager or agent

Name of applicant.....Owner of farm.....
Location (Town).....State.....Post Office.....
Shipping Station (Town or R. R.).....Train leaves.....A. M.....P. M.
Creamery (name, owner and location).....When delivered daily.....
Present disposition of milk or cream.....Source of water supply.....
No. of cows.....No. milking.....Amount Produced Quarts.....
What other animals if any are kept in stable.....
What buildings are used in production and handling of milk .....
.....
Of what are they constructed.....Height.....Width.....Length of tie up.....
Is it ventilated.....How.....No. of stanchions.....Square feet of light in tie up.....
Where is manure stored.....If in cellar, how is cellar ventilated.....
Is milk room used exclusively for milk utensils and for cooling and handling milk and cream?.....
Where is milk strained and cooled .....
Is ice used for cooling?.....Size of ice house.....
How many tons are cut and stored annually?.....
Has your milk or cream been rejected by any public or private agencies?.....
If so, when, by whom, and for what reason?.....
Date.....Signed .....Creamery manager or agent
Application received Boston Health Department by.....Date .....
Investigation if any, with result.....
Application approved (rejected).....Notified.....
Date .....

Explanatory remarks may be placed on back of card.

rejection. If the report shows conditions not up to the standard maintained by this department, permission is refused the dealer to purchase milk from this producer. In this way many dairies which might send a poor quality of milk to Boston have been stopped. If, however, the report of the creamery manager shows methods and equipment to be satisfactory, permission is given the dealer to purchase this producer's supply, pending an inspection by this department. The card is then placed in our files, and when our inspector reaches the territory these applicants are visited by him, and his score supplants the application form in our files.

The first step of an inspector upon reaching his territory is to visit country creameries. Plants are scored and reports sent to Boston. Insanitary conditions are reported to the dealer purchasing this product, or if a creamery is operated by the producers the matter is taken up with them directly. About 210 creameries supply Boston licensed dealers. Last year we were able to inspect 179 country plants and this year we will cover all of them. Plants have shown great improvements; many new water supplies have been provided, modern equipment installed, and a number of new plants were built supplanting old ones condemned by this department. After equipment and methods have been inspected, samples and temperatures of milk are taken as brought in by producers supplying this plant. We try to have milk delivered to a plant under 50 degrees Fahrenheit, and do not accept milk over 60 degrees. In one day 30,000 pounds of milk was returned to producers at various creameries in one State.

Inspectors are equipped with bacteriological outfits and we have been using the Breed method for the past six years. Direct microscopic counts indicate a number far in excess of the number found by the plate method. They also differentiate between clean and dirty milk, and pus and streptococci are easily detected. Counts have shown

a gradual decrease, and producers show a desire to cooperate in reducing counts. We consider this method of examining the milk under the producer's eye, so to speak, to be of great educational value, and it has been of marked assistance to the inspector on his subsequent sanitary inspection in inducing the producer to readily carry out suggested improvements. Many sections showing extremely high counts years ago now show a good count, due to proper handling and icing of their product.

CITY MILK PLANTS

At present 113 plants are operated by dealers supplying Boston, delivering to consumers through stores, teams and trucks approximately 380,000 quarts of pasteurized milk, 15,000 quarts of raw milk from Federal accredited herds, or herds in the process of accreditation, and 3,000 quarts of certified milk. Up to June 1, 1924, about 18,000 quarts of raw milk was sold in Boston. In March, 1924, the Milk Regulations were amended by the addition of Article 12 calling for milk drawn from accredited herds or pasteurized. This regulation became effective May 31, 1924. The final count was reduced to 100,000 bacteria per cubic centimeter instead of 500,000. This campaign started in December, 1923, and finished about July 1, 1924, as the government appropriation reimbursing dealers for reactors was exhausted before May 31st, and some dealers who signed for test were compelled to wait for the new appropriation. The herds of thirty-one dealers were tested and showed approximately 35 per cent reactors. Seven raw-milk dealers installed pasteurizers and two others buy over half of their supply pasteurized from other dealers, and two raw-milk dealers sold out. The seven dealers pasteurizing changed 3,000 quarts of raw milk to 3,000 quarts of pasteurized milk and today Boston's milk supply is 96.72 per cent pasteurized. All pasteurizing plants are equipped with suitable automatic time and temperature recording devices

showing the temperature to which the milk has been heated and the period of time held. Records so made are kept on file for one year for the Health Officer. Plants are well equipped and many small dealers have installed new equipment.

HIGH BACTERIOLOGICAL COUNTS

All counts over 100,000 bacteria per cubic centimeter are checked to determine the cause. Many times unclean equipment, poor refrigeration, unclean bottles, etc., are responsible for such counts. When we are unable to locate the cause of the counts readily an efficiency test is made and invariably the cause of count is located and demonstrated to the dealer, who is then given an opportunity to remove it. The efficiency average of our pasteurizing plants is 95.05 per cent, ranging from 82 to 99.15 per cent, and the output of these plants ranges from 400 quarts to 50,000 quarts daily. Efficiency tests are made on bottle-washing machines and bottle caps, and the results in some instances are amazing. Counts on bottles range from 40 bacteria per c. c. to 16,000 bacteria per c. c. and bottle caps from 20 bacteria to 12,000 bacteria. Most bottle-washing machines are made to do efficient work, although at times jets are plugged if the operator becomes careless and allows this to happen. Washers will show unclean bottles with a careless employee operating this type machine. Small dealers generally use a rotary brush and one-case sterilizer for bottle washing, and unclean bottles are more frequently found. We still have a few dealers capping bottles by hand. These caps are not kept in sealed tubes, hence are more easily contaminated. We have requested these dealers to start machine capping by January 1, 1925.

When the Dairy Inspection Division was inaugurated in 1911 the producer who used a milk room and iced his product was the exception rather than the rule, while today conditions are exactly reversed, and the results are plainly

indicated in the reduced bacteria counts. From a condition in which our supply was less than fifty per cent pasteurized, we now have a milk supply which is 96.72 per cent pasteurized. We realize that we have not yet reached the millennium but we are greatly encouraged to persevere in our educational work.

"Education alone can conduct us to that enjoyment which is, at once, best in quality and infinite in quantity."

VENTILATION OF THE DAIRY STABLE AS A VITAL FACTOR IN THE PRODUCTION OF MILK

H. O. DANIELS, *Deputy Dairy and Food Commissioner,*
Hartford, Connecticut.

We have reached the day when an effort to get and keep only clean, healthy dairy cattle, free from tuberculosis and other diseases, is paramount with a great number of our dairymen. State and Federal agencies are striving to interest and cooperate with our farmers in getting the tuberculin test applied to their herds, with the result that the demand for this service is far in excess of their ability to comply, on account of lack of funds for carrying on the work. This latter feature makes it all the more urgent that our dairymen, when once they have had their herds tested and all reacting animals removed, take special pains to thoroughly clean up their stables and repair them so as to provide more healthful homes for the cattle that do not react, or for the new herd of sound animals that takes the place of the reactors. Thus it becomes absolutely necessary to consider the question of better ventilation of our stables to keep our cattle healthy. This in turn helps to provide a dairy product in the form of milk that, by this effort, makes for a more healthful human food. Pasteurization of milk can then be added if desired.

To come right down to a brief, practical, common-sense view of ventilation, let us use this hall as an illustration of a stable, study how to get fresh air into a stable from all sides of the building and how to take the foul air out without creating a draft on the animals.

First, I would count the number of cows or animals that would be confined in the stable, and then I would arrange for an outlet air shaft, or shafts, large enough to allow

one square foot of air area for each five animals. If thirty cows should occupy a stable it would require an outlet area of six square feet, or a shaft two feet by three feet, or possibly two shafts 18 inches by 30 inches, if such outlets could be more favorably located. These shafts should be built down to within twenty inches of the stable floor, or can be built to the floor but left open twenty inches up on one or more sides, somewhat after the plan of an open fireplace.

It has been proven that an outlet shaft will draw about forty feet from any direction, so that one shaft of a size suitable to meet the needs of the herd contained in a stable will take care of a stable 80 feet by 36 feet, if the shaft is nearly centrally located. The shaft can be placed at the middle of one side, if properly built, or can be built on both sides and brought together into one shaft at the roof of stable, and will thoroughly and constantly remove the foul air from the stable.

The shaft should be insulated against cold if built on the outside of a barn or stable, but if it comes up through hay bay, can be built of single material until it comes out of roof. If made air-tight of matched boards, then it should be well insulated. Over the top of the shaft, if roofed over, a flat ceiling should be placed, and then with openings some sixteen to twenty inches deep below this ceiling on two sides only, a current of air going up is discharged out of these openings, creating a vacuum at top of the column. This is constantly replaced from below and thus a steady upward current is created. We thus make use of two forces in nature, the warm output current in the shaft and the wind force blowing across the top, creating more suction. Various plans and placing of outlet ventilators can be made. In all cases, the prevailing direction of outside winds should be considered and free open outlets in that direction made use of.

In the matter of inlet air ventilators, small box-like shafts should be placed on as many sides of stable as

possible. I would suggest as a proper size a 6-inch by 12-inch inlet opening, with suitable number of these so placed throughout the length and breath of stable to measure, in the aggregate, approximately the same air area as the outlet shafts. These inlet air shafts can open at side walls at ceiling and turn down at bottom, either between studding or on outside of building, some three or four feet and can be so placed as to work automatically with outlet shafts, in most kinds of weather. To supplement the use of inlet air shafts in this stable (which, of course, is well lighted with numerous windows) I would suggest tipping the windows in at the top, using wing pieces on each side of window and arranging windows with spring bolts so they can be opened, partly closed or closed according to the severity of the weather. When a stable has been equipped with a ventilating system after the manner proposed, proof of its proper working can be seen on frosty mornings by the column of warm air coming out of a ventilation flue. The instant thought, "The barn is on fire!" is followed with the comforting assurance that it is only foul air coming out of the stable.

Just for contrast, let us consider for a moment the condition of a stable poorly ventilated or not ventilated at all. I feel sure if some of you have had occasion to enter a stable in the early morning for inspection and have been met with the almost overpowering rush of foul air, you will agree with me that the cattle kept in such a stable must be suffering from such an unwholesome condition. Almost invariably the interior is dark, full of hanging cobwebs, and damp. There are unclean side walls, broken platforms under cows, and slippery floor. Cows are more or less unclean, lacking in vigor and looking in many cases sickly. Attendants have no spirit of enthusiasm for their work, and the milk is drawn and carelessly strained, with no idea of cleanliness or sanitation.

Would not this herd be considered eligible for infection with tuberculosis under conditions which are wholly favorable for its development? I know of instances of this kind where whole herds have been destroyed after the tuberculin test has been applied. How much better to get our milk supply from a healthy herd or one where every precaution has been taken by the dairymen to secure such a herd and from dairymen who have provided clean, light, well-ventilated stables in which to keep their cows.

One of the first things that our present Dairy and Food Commissioner, Mr. Holt, requested of his deputy was to try to help develop some plan of inspecting the dairy stables and milk dealers' plants in our State, using a score card system that would make for improvement in our dairies after inspection. After considerable study, the score card we are now using was evolved. Ventilation of the stable is given a very prominent place and score on this card, copy of which is left at each place when inspected.

In the six or more years this card has been used we have been gratified to see how welcome our inspectors have been when they have made their visits. Inspections have not been considered as criticisms, although offering suggestions for improvement, which in many cases have resulted in early adoption of the methods. The general average rating with the score card has been raised very materially, or about forty per cent, during the past six years.

While all the dairies in our State are not yet fully improved, there has been so much effort along this line that our department is kept busy making plans for reconstruction of stables and for ventilation of stables and drawing plans for new modern barns and stables.

The milk supply of our cities is now cleaner and more wholesome than ever before. I feel sure the proper venti-

lation of the dairy stable is a vital factor in maintaining healthy cattle on our dairy farms, which in turn helps to make possible more wholesome milk for human consumption.

"So much one man can do
That does both act and know."

REPORT OF COMMITTEE ON SERVING MILK IN SCHOOLS

PROF. W. P. B. LOCKWOOD, *Chairman*

This report may well be considered as a continuation of the report of last year. Additional information has been secured by bringing out several factors that were previously more or less obscure.

It seemed desirable to learn the number and location of the cities where milk is served in schools and the precautions taken to safeguard the milk, the need of such service, and results of the work. A questionnaire was mailed to the proper authority in each city in the United States having a population of 100,000 or over and to the largest city in those States in which there is no city of this size. Seven were mailed to leading Canadian cities. Others were mailed to smaller cities represented by members of the committee not represented in the above list.

There were replies from 43 cities, representing 23 States and the District of Columbia, and five from Canadian cities, as follows:

City	State or Province	Began to serve milk in schools
Birmingham	Alabama	1921
Little Rock	Arkansas	1920
Denver	Colorado	1921
New Haven	Connecticut	1920
Bridgeport	Connecticut	1921
Hartford	Connecticut	?
Wilmington	Delaware	1922
Washington	District of Columbia	Several years ago
Indianapolis	Indiana	1919
Beverly	Massachusetts	1921
Brookline	Massachusetts	1920
New Bedford	Massachusetts	1919

Detroit	Michigan	1915
Flint	Michigan	1921
Grand Rapids	Michigan	1918
St. Louis	Missouri	1920
Asheville	North Carolina	1923
Fargo	North Dakota	?
Newark	New Jersey	1912*
Paterson	New Jersey	1922
Buffalo	New York	1911*
Syracuse	New York	1919
New York	New York	1912*
Rochester	New York	1920
Akron	Ohio	1921
Cleveland	Ohio	1921
Dayton	Ohio	1919
Reading	Pennsylvania	1922
Scranton	Pennsylvania	1921
Greenville	South Carolina	1920
Memphis	Tennessee	1921
Dallas	Texas	1914*
Fort Worth	Texas	Not started
San Antonio	Texas	Not started
Salt Lake City	Utah	Several years ago
Norfolk	Virginia	1914
Bellingham	Washington	1919
Walla Walla	Washington	1920
Tacoma	Washington	Not given
Yakima	Washington	1921
Milwaukee	Wisconsin	1919
Unidentified No. 1	?	1921
Unidentified No. 2	?	1920
Calgary	Alberta	1921
Quebec	Quebec	Not started
Regina	Saskatchewan	1919
Toronto	Ontario	Not given
Vancouver	British Columbia	1920

* On special nutrition program.

Of those reporting, only two reported no milk service.

From previous reports and conference with Miss Hoover, of the Bureau of Dairying of the U. S. Department of Agriculture, the writer knows that the larger cities in the States that are not serving milk are the exceptions and not the rule and that a great number of smaller cities and towns are providing such service. The practice is general where the milk supply warrants it.

It is interesting to note that while a few of the cities started to use milk in the schools as early as 1911 and 1912, the largest number started in 1918, 1919, 1920 and 1921. This indicates the use of milk in the school health program, which received a great impetus immediately following the war.

Of the cities reporting, 31 reported special care is taken by some authority to insure the proper safeguarding of the supply. Fourteen cities report they consider the precaution taken by their boards of health sufficient guaranty of the supply.

The milk in all cities, with the exception of six, was pasteurized. Four of these specified either certified or Grade A Raw, with only two reporting unpasteurized milk of no special grade used, but that the milk inspector was active in helping the schools to get a safe supply. The milk in all cases was reported as refrigerated or coming to the school cold and kept in a cool place until used. Thirty-three cities reported special prices for school milk, while all but six cities reported special service of the dealers.

With very few exceptions the milk was reported as served in bottles with straws. In the exceptions reported, it was a case of serving in cups.

An immense amount of health educational work is being done through the schools with the children, by means of nutrition classes in which the parents participate and the follow-up work of the nurses. This is indicated by reports and data that are difficult to classify and tabulate. Two

illustrations will show how health directors and school authorities are watching for results that may be studied and become a guide for them.

DENVER PUBLIC SCHOOLS SPECIAL LETTER 1923-24
APRIL 21, 1924

To Principals:

Questionnaire Concerning Mid-Morning Lunch:

I am submitting to you a questionnaire on the mid-morning lunch. Please fill out and return by May 15, 1924.

1. Did you serve the mid-morning lunch?
2. Which dairy supplied you?
3. Was the service satisfactory? If not, state reason.
4. How many children took this lunch?
5. How many children were served with free milk?
6. Who paid for the free milk?
7. How much school time was required daily?
8. How much teacher or principal time was required daily?
9. Did you compare the gain in weight and growth of children using milk with the children not using milk? (If so, send a copy of your study to the Department of Health Education).
10. Did the children who took the lunch show improvement in:

    School progress.
    Attention.
    Reduced restlessness.
    Less sign of fatigue before noon.

11. Do you think the serving of the milk has any educational value?
12. Was there a reduction in the consumption of candy by your children?

13. Did you have fewer absences on account of illness?

Sincerely yours,

A. L. BEAGHLER,

Director Health Education.

April 21, 1924.

As a result of this survey he reports as follows:

Effect on children taking milk:

(a) Physical: Gains in weight and reduced nervousness.

(b) Mental: It has reduced fatigue, which has helped the mental condition of many.

Dr. I. F. Thompson, M. D., Director Bureau of Child Hygiene in the office of the Health Department of Milwaukee, has collected data from 67 schools on the following questions:

1. Do you serve a milk lunch?
2. If not, why not?
3. How many served each day?
4. Per cent of pupils 10 per cent underweight.
5. Do all underweights have milk?
6. Room provided.
7. Classroom.
8. Hallway.
9. Do pupils take charge of preparing lunch?
10. Improvement noticed.

We will simply give the answers to Question 10.

1. No service. Price too high.

2. Much in some classes. Parents of many children note improvement.

3. Seems improvement as children are more satisfied; less restless, more attentive.

4. ————————

5. No service. Principal considers children well cared for in homes.

6. No service. Children encouraged to drink milk in home.

7. Better attention; more active; healthier, more vitality; wide awake; amount to more; gain weight.

8. No service. Interfered too much with school. Many parents depended on milk lunch for morning meal. Price of milk went up.

9. No service. We see none. Many do not like milk. By questioning, many have coffee; some, home-brew.

10. Deaf children.

11. Better work. Note: difficult to collect for milk from some children. Irregular.

12. Do not notice any particular improvement. Most of them taking milk are healthy ones.

13. Convinced there is improvement but cannot tell how much.

14. No service. Did not have facilities for the work. Have just finished equipping a room for this purpose in basement. Will serve next year.

15. A decided improvement.

16. No service. Most of pupils take milk at home.

17. We think there is an improvement but have not tested out to see.

18. ————————

19. No service. We serve penny lunch at morning recess and at noon.

20. Teachers report they cannot detect much improvement.

21. Many who are underweight are of nervous type. Milk lunch fits them for better work.

22. Slight improvement in most cases; some marked; all show physical improvement.

23. Eliminates restlessness; gives listless children more zest for work.

24. Under supervision of teachers improvement in 33 1/3 per cent. No change in rest.

25. Have not measured improvement.

26. No service. We tried the experiment for three years and have data which shows that the improvement, if any, was not commensurate with the effort spent. We found children not taking the milk lunch gained as much, if not more, than those who did take it. Some mothers of the so-called underweights objected to their taking milk at school. Again we found some underweight children who could not drink milk.

27. No service. Not on record.

28. Teachers say children are happier and do better work.

29. We believe they do better work.

30. No service. Children have full amount at home. Six per cent pupils ten per cent underweight.

31. No service. Very few underweights. No time for milk lunch. Parents can serve milk lunches much better at home three times daily.

32. Not any in classwork but those taking lunch seem more rested.

33. No service. Price too high for majority. Served four years until price increased.

34. No service. Warm lunch served at noon.

35. There is generally a marked improvement in the classwork of pupils having milk lunch.

36. Improvement among younger. Less fatigued. More restful and refreshed.

37. Very little noticeable, but children seem better able to stand day's work.

38. Pupils more alert toward close of morning session. A small per cent have reached normal.

39. A general improvement in health and happiness.

40. No service.

41. Children more wide-awake. Feel more inclined to work.

42. No service. No room to serve it. One small basement room available—is neither heated nor equipped. Last

year's trial in classroom resulted in grease-stained floors, even with utmost care.

43. Not noticeable.

44. No service. Building routine upset owing to its being painted.

45. No service. Children who need it cannot afford the price. The Milwaukee Welfare Division provides two quarts for three anæmic children. These are served in office four times daily.

46. Kindergarten only. Probably more energetic.

47. No service. On account of painting and repair work it was not possible to arrange. Should be planned for next year.

48. No service. Sell sandwiches, crackers and milk. Seems to build up.

49. Kindergarten only. Children gain in weight.

50. No service. We intend to begin serving lunch after Easter vacation.

51. No service. No room until this semester. Expect to serve after Easter.

52. None.

53. They seem to have more ambition for work and respond better.

54. No service. Children get milk at home. Lack space. Few cases of real need, can be handled by nurse.

55. No service. Increased price of milk. No clerk. Lunch takes too much time of either principal or teachers to take care of it.

56. No service. Up-to-date medical department. Teachers and myself have not thought it necessary. School is changing. Next year I may want it.

57. No service. Pupils seem to have good care at home. Especially weak pupils have been discussed with parents.

58. Some improvement in most of pupils.

59. No decided change.

60. Thirty-three per cent improved much, 19 per cent improved some; 34 per cent not improved.

61. Teachers do not believe improvement in classwork. Impossible to assign improvement to classwork.

62. No service. Remodeling building. To have room next year.

63. Improvement noted in five pupils drinking milk.

64. Mentally more alert. Physically more active and happier.

65. Attention better. Less restless. Sense of satisfaction and comfort makes for peace.

66. Primary grades show much improvement. In the upper grades not many take milk but teachers see improvement in those that do.

67. Almost every teacher states that she notes a great improvement in pupils taking milk.

A partial report of the Nutrition Clinic of Milwaukee for 1924 is as follows:

32 schools weighed and measured pupils.

23 per cent of all children were 10 per cent or more underweight.

26 per cent of all the children were drinking milk in 1923.

33 per cent of all the children were drinking milk in 1924.

86 per cent of those drinking milk gained in weight.

In going over the above, one gets a good cross-section of conditions in different parts of a city, of the attitude of the teachers, the attitude of parents and the results of nutrition work.

We would like to call your attention to the report of the Committee on Health Welfare of Paterson, N. J., for 1922-23, published by the Board of Education. The letter of Kathryn D. Noonan, Chairman of the Committee, follows:

Hon. P. J. Tierney, President,
Board of Education,
Paterson, N. J.

Dear Mr. President:

The Committee on School Hygiene of the Board of Education have the honor to present to you and to the other Commissioners of Education the first annual report of the health activities in the public schools of our city.

May we express our appreciation to those persons who in any way helped to prepare this report. Our sincere thanks are given the members of the entire Department of Education who served in any way in the distribution of milk for the year. By their service, the children in our schools are forming the excellent habit of drinking milk, which promotes health, a fundamental objective in education, today.

Very truly yours,

KATHRYN D. NOONAN, Chairman
FREDERICK AIMONE
JOHN J. FEENEY

This is followed by a systematic presentation of the work, giving:

1. The milk distribution totals, amount of milk, money spent, etc. (There were 631,212 half-pint bottles distributed at a cost of $30,530.24).

2. Report of the medical inspector.

3. Report of the President of the Board of Health and the bacteriologist and chemist.

4. Notice to dairymen as to standards for school milk—"Safe for Infant Feeding List"— including standards adopted by the National Committee on Milk Standards by the President of the Board of Health.

Following is the report of the Superintendent of Schools:

Miss Kathryn D. Noonan, Chairman
Committee on Health Welfare, of the Board of Education
Dear Madam:

The health of school children is one of the most important problems of school administration. For several years

the Board of Education has made liberal expenditures for the physical welfare of our boys and girls; but the year 1922-3 has been one of unusual activity in this work. In July the Board appointed a Supervisor of School Hygiene, a Supervisor of Nurses and a Supervisor of Physical Education. Five additional nurses were appointed, a new dental clinic was opened at School No. 5, with two dentists and an office assistant in charge, and two new open-window classes were organized in February for the care and instruction of anæmic children and children with tubercular tendencies. The Board of Health conducted a child-welfare station at School No. 10, where a trained nurse gave advice and instruction to mothers on the care of children of preschool age. Arrangements have been completed to open two more child-welfare stations at School No. 2 and School No. 4.

But one of the most interesting developments of the health work carried on during the year was the sale of fresh milk to pupils during school hours. This work was started when some of the principals, after consulting the records of the medical inspectors, discovered that there were in the schools a great many children who were below the normal weight. To overcome this, arrangements were made in several schools to sell milk at cost to children and to give them a period in the middle of the morning session when they could drink the milk. This plan was so successful that other schools adopted it and during the year 1922-23 every elementary school in the city conducted some plan for milk distribution. The work included the posting of "weight-for-age" charts in the classrooms, with frequent records of the gains in weight by the children and regular reports to parents on the physical condition of pupils. Definite health instruction was included as part of the course of study.

In May, 1923, the Board of Education, on the recommendation of the State Committee on Health Welfare,

adopted the following rules for milk distribution and other health activities in the schools.

1. Milk shall be distributed in all public schools, preferably from a central distributing point in each building, from 10:00 to 10:30 A. M.

2. Milk shall be distributed in half-pint bottles with straws and crackers.

3. Free milk shall be given to certain pupils as far as funds permit upon recommendation of school nurse or school physician or other competent authority.

4. The milk served in public schools is to be obtained from dealers whose names appear on list furnished by Board of Health, marked "Safe for Infant Feeding," etc.

5. Any milk delivered in an unsatisfactory condition to any school is to be immediately reported to the office of the Board of Education and will be so reported to the Board of Health, with the name of the dealer, and data pertaining to the subject, etc.

6. The Director of School Hygiene shall arrange schedules of lectures to be given by physicians in the public schools on the value of drinking milk. These lectures shall be given during the first month of each school term. Immediately after these lectures the height and weight of each pupil shall be recorded by the school nurse on forms provided by the Board of Education for this purpose. A third record of height and weight shall be entered on these forms during the month of May in each year. These records shall be sent home with the monthly scholarship reports for their information. Health charts shall be posted in each classroom.

7. The Director of Visual Education shall show Health Pictures in all schools during the year.

8. Milk distributed in public schools shall not only be endorsed and passed upon by the Board of Education

but shall be administered with the closest cooperation of the Board of Health.

9. June 30th of each year, each principal shall render a report of milk distribution in his school to the Superintendent of Schools. The items to be reported as follows:

a. School.

b. Enrollment.

c. Number of bottles distributed—September to June, inclusive.

d. Number of free bottles distributed.

e. Number of pounds of crackers.

f. Name of milk dealer.

g. Remarks.

10. These reports to be compiled and summarized by the Superintendent of Schools, the Supervisor, and the Director of Visual Education in yearly bulletin form. This bulletin is to contain additional reports from interested principals and teachers. These bulletins to be printed and distributed in July of each year.

The list of dealers mentioned in Rule 4 is furnished by the Board of Health and is marked by that Board "Safe for Infant Feeding."

(Names of 10 dealers given.)

All of these sources are under State Board of Health Supervision, and under State License.

The detailed statistics on the milk distribution in the schools are printed in another part of this report.

JOHN R. WILSON
Superintendent of Schools

The popularizing of the use of milk in the school has helped to improve the home nutrition problem. It does not solve the whole problem but is one of the outstanding factors

and has been used in many places as a starting point and one with which to help build the whole health program.

The committee wishes to thank those who furnished the data for this report and to say that it regrets that it was unable in this brief report to call attention to the many good things furnished.

"He is the best scholar who has learned to live well."

PRACTICAL OBSERVATIONS WHILE SERVING MILK LUNCHES TO SCHOOL CHILDREN

Mrs. Bion R. East, Detroit, Michigan.

This paper is based upon observation in schools where milk lunches were served by women's clubs, during a period of ten years of directing and four years of personal service in preparing and serving the lunches.

The earliest requests for supplementary feeding came to women's organizations through principals and teachers of schools in congested districts. These lunches consisted of milk, graham crackers or sandwiches, and were started as a temporary relief measure. The situation was believed to have arisen from a purely economic condition which proved to be only indirectly related to it, as the following information, obtained as a result of inquiries made to the children, proves:

1. Many children received insufficient breakfast; as, for example:

(a) So-called coffee with sweet buns or cakes.

(b) Only a dish of prepared breakfast food. Inasmuch as this took a quantity of milk to soften, it was the better of the two types.

2. A larger group had no desire to eat breakfast. The reasons given were:

(a) Lack of time to eat, due to getting up late.

(b) Some parents left very early for work, before children were up, and parents or children neglected to prepare any food.

The preparing and serving of these lunches began with volunteers through women's organizations. As the demand came from more schools for the lunches, the volunteer services became difficult to supply; therefore the schools

gradually assumed the responsibility of the milk-lunch distribution. The clubs still continued to finance the bills until the money was turned in from the schools and covered all deficits when children were unable to pay for milk received.

The early haphazard service has gradually developed into a practical educational procedure, as the following quotation from a letter from a school principal shows:

"The sale of the tickets, including making change, the counting of the day's receipts, wrapping of coins and banking, are all lessons in arithmetic. Being in line for tickets at a certain time and quietly waiting their turn teaches them self-control and courtesy. Pupils who prepare bottles and crackers on the tables in the hall for distribution are strengthened in executive ability, while the little ones who eat the lunch are certainly stronger, brighter, and happier for having it."

The teaching of the milk-drinking habit, however, could not be carried out to the fullest extent in the home, where it rightfully belongs, because families did not purchase enough milk to meet requirements. The reasons were, first, economic conditions in the home, and, second, ignorance of the value of milk as a food.

During war days, when skimmed-milk stations were placed in the schools, the influence on the home was very noticeable because:

1. It gave children sufficient quantities to show results.
2. Pre-school children were reached.
3. Foreign mothers could put into practice the teachings of public agencies to use milk in their recipes in place of water.

After the war period, when nutrition was especially stressed by the Government, the casual observations of the children's conduct and appearance gave way to a systematic weighing and measuring, and the investigation of conditions causing malnutrition. The nutrition class was the

outcome, and came into existence to find a proper way to cope with the conditions found. These classes when they can operate under favorable conditions—as part of the school program and not an appendix—will prove more than satisfactory.

No one doubts the value of dairy products in the child's diet, much less the value of milk as an indispensable food. However, the question arises as to the value of continuing the serving of milk to the extent to which it has been carried in the past, now that the public agencies are gradually meeting the needs of local conditions with open-air schools, open-window rooms, nutritional classes, and hot noon lunches, which are being served as rapidly as suitable space can be provided.

The serving of milk indiscriminately at the present time in districts where economic conditions do not demand it is a grave mistake, because the children should not need supplementary food except in individual cases, where it could be made only a temporary problem until suitable cooperation could be gotten from the home. It is a matter of education and not relief in these districts, and responsibility should be forced upon the home when the home is able to meet the situation. There will be for some time a few schools where the milk lunch will have to suffice until the needs can be properly taken care of.

The milk lunch has served as a splendid opening wedge in the study of the nutritional problem through the home and school. But the educational work must be extended to reach the pre-school child and its diet. Milk lunches should be made available in baby clinics, day nurseries, habit clinics and nursery schools, as well as for the child at home, in order to emphasize the teachings of the use of milk, fruits and vegetables in the diet.

There is a still greater need for workers to extend this real service to humanity by putting on such educational campaigns in schools, to impress potential young mothers

with the need of such foods in their diet that they may give to their infants before birth the necessary nourishment. They should be taught to supply normal mother's milk so long as possible before resorting to cow's milk, which of course is the best-known substitute for mother's milk. It is agreed by authorities that normal mother's milk contains the elements in suitable form and proportion to assure proper growth of a child's body. The enamel which protects the teeth from decay and disease begins to form on the permanent teeth before birth and is completed during early childhood. Its proper formation is impossible without certain elements contained in the mother's and child's diet. Enamel of poor structure cannot be improved in later life, as is the case with other structures of the body. It would seem most logical, as well as economical and humane, to teach prevention rather than correction at so vital a source.

Milk interests have been accused of having commercialized the Government's after-war propaganda for increasing milk consumption. Granting this, there could be no more legitimate or valuable advertising, and as far as the public is concerned, let us have more educational advertising campaigns.

DISCUSSION

Prof. Hiscock: Who determines who shall receive lunches? Who fixes the price, and do you have medical advice?

Mrs. East: We depend on teachers and principals of schools for information, especially in poor districts. The Health Department advises regarding children who are 15 per cent or more below average weight. Special instruction is given those who need it most in nutritional classes. Some children pay three or four cents. Some pay one cent, others nothing. Some children who cannot pay in money perform little duties about the schoolroom.

A member: Is the use of milk compulsory?

Mrs. East: Very few cases rebel. It is a "come-on game" in some cases. We cannot control everything, as we are a voluntary organization.

"All that we send into the lives of others comes back into our own."

PROPER PRODUCTION THE FIRST ESSENTIAL

DR. ROY F. LESLIE, *Chief of Bureau of Food and Dairy Inspection,* Cleveland, Ohio

To us, pasteurization is essential and should be properly controlled, but by overemphasizing the importance of pasteurization many people have today come to believe that if milk is pasteurized, that is all that is needed. This sometimes has a tendency to lower the morale of the dairymen and tends to lower the quality of milk delivered in the city. No matter how well milk is pasteurized, if it arrives at the pasteurizing plant in bad condition with a high bacteria count, it can never be made into the good, pure, wholesome product that it should be.

People are being encouraged to use more dairy products, and we should be able to say that milk comes from clean herds, clean stables, is handled right all along the line and is only pasteurized as a final precaution. This need not necessarily increase the cost of the milk if the work is carried on gradually, for as dairymen become more interested in their business and have better producing cows and larger dairies, this is enough in most cases to provide for improvements. Here let me say that expensive equipment is not essential for a good dairy, but that common sense and a strict ruling as to cleanliness are necessary. When we have good dairies and know that our product is produced and handled right, the public will also know it, and when we have the public convinced that their milk supply is not only safe, but that it is also pleasing and palatable, I believe we will see the consumption of dairy products properly increased.

As stated above, pasteurization is essential for the bulk of any city's milk supply and will, no doubt, continue to be

essential. However, it should be looked upon as an additional safeguard and should never be employed as a method to prepare unfit milk for market. Every city that passes a milk ordinance includes the provision that milk come from healthy cattle.

Assuming now that we have a healthy dairy herd, there are many other points that should be emphasized in the proper production of milk. These points are often classified under three heads:

1. Clean.
2. Cool.
3. Covered.

The third point can be disposed of easily, as it means only that the milk should not be exposed to contamination.

The second point is of vital importance, but in a way can be taken care of by taking the temperature of milk as it arrives at the different milk plants.

The first point, though, is the one that should concern us most here today, for the advancement of our work depends more and more on the impression that the public receives by visiting our different dairy and milk plants and obtaining first-hand information as to the methods being used in the protection of this vital product. You cannot overcome the bad impression that a visitor obtains when he steps into an unclean dairy and finds dirty cattle, filthy milk utensils, and things that we have all seen and understand too well.

It is well to say that a dairy should be clean and the milk be properly taken care of, but to how many would this statement carry a picture of our modern and up-to-date dairy? To have something more definite, then, we must have certain rules and regulations, and they must be adequately enforced.

As districts increase in size and more dairies have to be visited, it is necessary to plan in a way that more work can be accomplished. We have a system that facilitates inspec-

tion work. A card is given to the dairyman at the time the inspector visits the farm, the card to be signed and returned to the inspector when the work has been completed. This card puts the dairyman, in a way, on his own honor and saves any unnecessary revisits by the inspector. At the time this card is given, the same notation that is marked on it is also made on the score card. When the card comes back the notation "R. C." (received card) "..... date" (date received) is made on the card and on the score card, which has been filed away in a follow-up file. The card is now returned to the inspector and he visits the dairy again; the dairyman having signed the card, no questions should be asked. If the work is not done, the dairy is excluded. If the work is completed, the inspector marks the card with the date and the word "complied" and turns it back to the office. The score is then marked "complied," with the date of inspector's visit, and taken from the follow-up file and filed with the regular scores.

If the card doesn't come in when it is due, a form letter of inquiry is sent out. If this does not bring a reply, a second letter is sent out in a few days, advising that unless the question is adjusted it will be necessary to exclude the dairy. In a few cases only have we found it necessary to exclude the dairy. In a way, this might be called long-distance milk inspection, but it works, the only thing being that you must check back on the cards by revisits; otherwise the dairyman loses his respect for the card and the work will fail.

The following questionnaire is used for new shippers:

QUESTIONNAIRE FOR NEW SHIPPERS

Number of Cows..... Kind of Breed.....
What Kind of Barn Have You?.....
What Kind of Floor?.....
Is Your Barn Built With Drop And Equipped With Stanchions? .....

Have you a Tight Ceiling Over The Cattle?.....
How Many Square Feet Of Light?.....
How Many Cubic Feet Air Space Per Animal?.....
Are There Other Animals In Barn Besides Cattle?.....
Have You Separate Ceiled Milk House With Cement Floor
Vat and Drain? .....
Is Your Stable Whitewashed?.....
What Is The Condition of Barnyard?.....
Disposal of Manure?.....
Date .....
Name .....
Location of Farm.....
Telephone Number.....

This helps a lot in taking on new dairies and again puts a dairyman quite a bit on his honor and causes him to become more interested. In the past, perhaps, we have carried too much of the burden of inspection. Let's treat the dairyman fair, but let's make him see that he must do his part. When this questionnaire, properly filled out, is at hand one can readily tell whether the dairy should be allowed to start shipping, and the owner is advised by letter accordingly. The check-up is made by an inspector when he is again in that district.

Sometimes it is necessary to send letters and notices back to the producer. The sooner these reach him, the better effect it has on him and the more it helps not only him, but the milk dealer who wants good milk and the consumer who is entitled to good milk. To accomplish this effect, we use an envelope, provided with an eyelet in one end and a string to tie it on the can. The notice or letter is put inside the envelope, the envelope is then tied on the can, and we practically have a special delivery letter. The envelope mentioned can be used to advantage in checking up on cleanliness of the milk by use of a sediment tester which is practical, efficient, and does work that the producer can see and understand.

From time to time circular letters are sent to producers. Letter No. 1 relates to proper cooling. Letter No. 2 relates to clean milk, Letter No. 3 relates to approved dairy, and Letter No. 4 relates to better barnyards. I think the next letter will be on the subject of better ventilation.

Why shouldn't a dairy present an attractive appearance, with a few plants here and there around the milk house, with a little grassy plot, and good surroundings?

Let us have more light. Additional windows can often easily be put in, and windows can be kept clean.

Let us have a boiler in the boiler room. A good milk room should be provided for handling milk only. It is also becoming more and more important that a room in which to wash and sterilize milk utensils with live steam under pressure be provided.

"And all may do what has by man been done."

THE EFFECT OF THE TUBERCULIN TEST OF CATTLE ON THE MILK SUPPLY OF A CITY OF ABOUT 100,000 POPULATION

H. E. BOWMAN, *Inspector of Milk,*
Somerville, Massachusetts

When I decided to tell this association about some of the difficulties we encountered in obtaining what we believe is now one of the safest milk supplies to be found anywhere in the world, it occurred to me that the title, "The Effect of the Tuberculin Test of Cattle on the Milk Supply of a City of about 100,000 Population," would be appropriate, though perhaps a bit misleading.

For quite a number of years the Milk Department had tried in vain for legislation making pasteurization compulsory. Finally, in 1922, Massachusetts adopted the Federal plan for accredited herds. This gave my department the opportunity it had long sought, and immediately the wheels were set in motion to pass a regulatory measure prohibiting the sale of raw milk *except* from herds that had adopted the Federal plan and been tested within six months, such tested herds showing a clean bill of health. At first considerable opposition was encountered, but by giving the dealers six months to obtain new milk supplies which would meet our requirements, it was felt that *hardship* would be imposed upon *none*. This was done, and with the exception of one large dealer and two small dealers, all swung into line. This was not quite satisfactory, so a conference was held to determine their grievance and to adopt moral suasion if possible, feeling that it might be better to extend the time ninety days further rather than to force the issue in the courts.

At the end of the ninety days all obstacles had been

removed. The few dealers selling raw milk were obtaining their supply from properly tested clean herds.

The balance of the dealers were selling pasteurized milk. At the present time less than one per cent of the milk sold is raw milk. The total daily consumption of milk is between thirty-five and forty thousand quarts; not bad in a city with between 99,000 and 100,000 population.

Before this regulation was promulgated, about twenty dealers out of sixty were selling a raw product, though about eighty-five per cent was pasteurized and retailed by the forty dealers.

The regulation promulgated follows:

"Regulation 105 adopted by the Board of Health of the City of Somerville, July 3, 1922, is hereby repealed and Section 56 of the Regulations of the Board of Health of the year 1917 is hereby amended by adding the following regulation thereto, and said regulation is hereby made and adopted, and it is the opinion of this board, and it hereby adjudicates that said regulation is necessary for the public health and safety, respecting causes of sickness, and for the suppression and the prevention of the spread of contagious diseases among domestic animals and for other purposes within the city of Somerville.

"Regulation 105.

"No person shall in the city of Somerville sell, exchange or deliver or have in his custody or possession with intent to sell, exchange or deliver milk brought into said city unless the cows from which said milk was produced, or, in case said cows are in a herd of cattle, all the cattle of such herd have been tested within six months prior thereto by the tuberculin test as established under the laws of Massachusetts and have been certified not to react to the tuberculin injection and to be otherwise healthy. This regulation shall not apply to pasteurized milk. This regulation shall take effect January 1, 1923.

"Whoever violates the foregoing regulation shall forfeit not more than one hundred dollars."

It will be seen that while this measure dealt almost exclusively with raw milk, it really had the force of a pasteurization law and *worked out as such.* The dealers who were unable to obtain milk from accredited herds were forced to install pasteurizing machinery, also giving the department an opportunity to supervise the installation of the same and obtain for the city of Somerville, Massachusetts, a milk supply as safe and sanitary as it is humanly possible to make it.

While my subject was somewhat misleading, I felt justified in using it, as the effects were directly due to the acceptance by Massachusetts of the Federal accredited herd plan, and I trust the suggestion may be helpful to some other community in their need.

"Attempt the end, and never stand to doubt;
Nothing's so hard but search will find it out."

ACTINOMYCOSIS AND THE PUBLIC HEALTH

Dr. G. H. Grapp, *State Dairy Inspector,* Baltimore, Md.

Actinomycosis is a disease produced by a fungus which develops in the depths of living tissues in man and the ox, producing grave and sometimes incurable lesions, most commonly in and about the jaws. Actinomycosis is very common in America, and is also met with in all parts of Europe.

VARIOUS LOCALIZATIONS

Although the disease generally attacks the mouth, tongue or pharynx, it may invade the œsophagus, rumen, reticulum, liver and intestines, larynx, trachea, lungs, peritoneum and even the udder.

CAUSATION

It seems problematical whether the germs to be found in the pus or saliva of affected animals ever directly infect new hosts, and it is difficult to carry out infection in this manner, even in very sensitive experimental animals. Nevertheless, the persistence of the disease in certain byres would seem to support the view of direct infection.

On the other hand, it is proved that the actinomyces is a parasite affecting vegetables, principally the graminaceæ, and that domestic animals are most commonly infected through injuries caused by vegetable substances. This is suggested by the discovery of the debris of grain at the point where the lesions have originated.

Inoculation is commonest in the mouth and on the surface of the tongue, parts which are, so to speak, permanently excoriated. The shedding of the temporary molars favors such accidents, and this is why actinomycosis of the jaw is, relatively, so common.

The region of the incisors may also be inoculated during the shedding of the milk teeth, but as the infected food comes more closely, and for much longer periods, in contact with the molars, it is easy to understand why actinomycosis is rarer in the region of the incisors.

The conditions are less favorable for inoculation of the pharynx, because food does not remain in position there for more than a second or two, but when the epithelium has been shed as a consequence of laryngitis or pharyngitis, infection may occur.

As regards cutaneous inoculation, the parasite seems dangerous only when the skin is excoriated or injured, either accidentally or as a result of surgical interference.

Actinomycosis of the lung is probably caused by the germs being inhaled along with the inspired air.

LESIONS

The lesions are very peculiar in character. The tissues invaded are finally completely destroyed.

Once lodged within an organ, the disease shows a tendency to extend in all directions, and despite the defensive reaction of the tissues it soon forms numerous parasitic centers. In bones, for example, actinomycosis invades the spongy tissue with the greatest ease. It causes subacute ostitis, which leads to diffuse suppuration of the bone, destruction of the compact layers, and the development of an abscess with fungoid exuberant, granulating walls which show no reparative tendency whatever. The pus of the abscess and the liquid from the fistula contain varying quantities of yellowish grains, representing clusters of actinomycetes.

The surrounding tissues, muscles, tendons, skin, etc., are all involved before long in the inflammatory process, and the granulating masses themselves are invaded by the yellowish parasitic tufts. All fistulæ are surrounded by enormous zones of infiltration, which on incision exhibit a

lardaceous appearance. On examination it may appear that the lesion is confined entirely to the bone, though this is exceptional. Ordinarily the neighboring tissues are also destroyed, and not infrequently there is communication with the external air. Sections then display a fungoid tissue, interspersed with perforated lamellæ of bone and lardaceous tissue containing cavities crammed with actinomycetes.

The lesions in the parotid regions, the neck or other parts attacked, always present the same appearance, viz.: wide, tortuous bifurcated fistulæ, with exuberant granulations, both in the direction of the cavities and the exterior, together with lardaceous induration of the tissues, and abundant fetid liquid pus.

When it affects the tongue the parasite is to be found in the submucous region, where it causes little swellings, which, under some conditions, rapidly undergo ulceration. The subjacent regions, the interstitial connective tissue, and the muscular tissue become infiltrated, hardened and progressively sclerosed. The tongue is gradually hypertrophied and soon it becomes as hard as wood, whence the term "wooden tongue."

Actinomycosis of the lung may easily be mistaken for tuberculosis, for the centers, although usually confined to one lobe, may also be disseminated. The lesions, however, are surrounded by an abundant fibrosclerous inflammatory tissue.

In the abdominal cavity, particularly in sows, actinomycotic lesions occur as little masses, varying in size between that of a pea and that of a haricot bean, attached to the peritoneum, and filled with pus containing mycotic grains.

DIAGNOSIS.

Actinomycosis is usually easy to recognize, both on account of the special character of the lesions and the presence of the little grains formed by the parasite.

The practitioner will rarely fail to recognize at once the signs of actinomycosis of the jaw, but actinomycosis of the tongue is more apt to be mistaken for deep-seated sclerosing glossitis, although a careful examination will always enable the different symptoms to be distinguished.

It is more difficult to recognize the disease in the case of growths in the pharynx and œsophagus, for until after removal, simple polypi cannot be distinguished from actinomycotic growths. In such cases the adminstration of iodide of potassium affords valuable indications.

Prognosis is grave, whatever the clinical form of the disease. Important advances, it is true, have lately been made, and the iodide of potassium treatment is of greatest value, but too much must not be expected of it, and its benefits have certainly been exaggerated. Clinical experience suffices to prove that only actinomycosis of the soft tissues can be cured by drugs, bony lesions being amenable only to medical and surgical treatment combined. Even combined treatment is often unsuccessful.

ACTINOMYCOSIS AND THE PUBLIC HEALTH

The interest which is shown concerning this cattle disease is largely due to the fact that the same disease attacks human beings.

Because of its slow progress, its tendency to remain restricted to certain localities, and the absence of any directly contagious properties, it has thus far failed to arouse any anxiety in other countries as to its influence on the cattle industry. It is not even classed as one of the infectious diseases of which statistics are annually published. Its possible bearing on public health has, however, given the disease a place in the public mind which it hardly deserves.

It has already been stated that the actinomyces fungus found in the human disease is considered by authorities the same as that occurring in bovine affections. It is therefore of interest to conclude this article with a brief discus-

sion of the disease in man and its relation to actinomycosis in cattle.

In man the location of the disease process corresponds fairly well to that in cattle. The majority of cases which have been reported in different parts of the world—and they are now rather numerous—indicate disease of the face. The skin, tongue or jawbones may become infected, and by a very slow process it may extend downward upon the neck and even into the cavity of the chest. In many cases the teeth have been found in a state of more or less advanced decay and ulceration.

In a few cases disease of the lungs was observed without coexisting disease of the bones or soft parts of the head. In such cases the fungus must have been inhaled.

The disease of the lungs, after a time, extends upon the chest wall, when it may corrode the ribs and work its way through the muscles and the skin. An abscess is thus found discharging pus containing actinomycotic grains.

Disease of the digestive organs, caused by this fungus, has also been observed in a few instances.

Granting the identity of the disease in man and cattle, the question has been raised whether cattle are responsible for its occurrence in man. Any transmission of the infectious agent may be conceived of as taking place during the life of the animal and from meat after slaughter.

That human beings have contracted actinomycosis by coming in contact with diseased cattle is not shown by the cases that have been reported, for the occupations of most of the patients did not bring them into any relation whatever with cattle. While the possibility of such direct transmission is not denied, nevertheless it must be considered as extremely rare.

Practically the same position is maintained at present by most authorities as regards the transmission of the disease to man by eating meat. Israel, who has studied this question carefully, found the disease in Jews, who never ate pork,

and who likewise were protected from bovine actinomycosis by the rigorous meat inspection practiced by that race.

Furthermore, it must be borne in mind that actinomycosis is a local disease, causing great destruction of tissue when the fungus multiplies, but very rarely becoming generally disseminated over the body from the original disease focus. The fungus is found only in places where the disease process is manifest to the eye, or becomes so in a very short time after the lodgment of the fungus.

Only the greatest negligence would allow the actual diseased parts to be sold and consumed.

Finally, this parasite, like all others, would be destroyed in the process of cooking.

Most authorities do not believe that actinomycosis in man is directly traceable to the disease in animals, but are of the opinion that both man and animals are infected from a third source, which has already been discussed above. How far these views may be modified by further investigations of the parasite fungus itself, no one can predict.

There are still wide gaps in our knowledge, and the presentation above simply summarizes the prevailing views, from which there are dissenters, of course. An attempt to give the views of both sides on this question would necessitate the summarizing and impartial discussion of all the experiments thus far made—a task utterly beyond the scope of the present work.

Whether an animal affected with actinomycosis could be used for human food after all diseased organs and tissues have been thoroughly removed is a question, the answer to which depends on a variety of circumstances. Among these may be mentioned the thoroughness of the meat inspection itself, the extent of the disease and the general condition of the animal affected.

The Federal meat-inspection regulations require that carcasses of animals showing generalized actinomycosis shall be condemned. If carcasses are in a well-nourished

condition, showing uncomplicated localized lesions of actinomycosis, they may be passed after the infected organs or parts have been removed and condemned.

When the disease of the jaw is slight, strictly localized, and without pus formation, fistulous tracts, or lymph-gland involvement, the tongue, if free from disease, may be passed.

The heads affected with actinomycosis (lumpy jaw), including the tongue, shall be condemned, except that when the lesions in the jaw are strictly localized and slight in extent, the tongue may be passed, if free from disease.

Primary actinomycosis of the udder is rare, but when present it appears in the form of nodes varying from the size of a bean to that of a walnut, enclosing soft purulent contents and imbedded in one or more lobes of the gland.

In rare cases the gland is enlarged. Sections of the udder show enlargement of the affected lobules which contain small yellow points in their centers, so that the cut surface appears granulated, and suggests the picture of miliary tuberculosis.

While there are no cases on record, so far as I know, of actinomycosis being carried by milk, I recommend that all cows affected with this disease found in dairy herds be removed from the herd.

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"When things can't get any worse, there is only one way they can go."

FOOT-AND-MOUTH DISEASE AND ITS RELATION TO THE PUBLIC MILK SUPPLY

DR. CHARLES C. WING, *City Veterinarian*
Oakland, California

On February 17, 1924, I received a telephone communication from Dr. J. J. Hogarty, Alameda County Livestock Inspector, that there was a suspected case of foot-and-mouth disease located at the Shore Acres Dairy, about ten miles from the city of Oakland. I was also advised that several veterinarians would meet at this dairy the next day for a consultation.

Having had no experience with this disease up to this time, I of course was extremely anxious, inasmuch as this particular dairy sold Guaranteed Raw Milk, and supplied a great number of hospitals in Oakland and San Francisco, and was situated in a section where considerable milk is produced.

The Shore Acres Dairy was milking 192 cows and producing about 560 gallons of milk per day. On February 18, I visited the dairy in company with Dr. H. E. Foster, Health Officer of Oakland, and Dr. R. R. Root, Deputy Dairy Inspector of Oakland. We met Dr. J. J. Hogarty, Dr. Jacob Traum, of the University of California, Dr. Rudolph Snyder, of the U. S. Bureau of Animal Industry, and Dr. Clemens, a practitioner of Hayward. Dr. Snyder and Dr. Traum both had had experience with foot-and-mouth disease.

We spoke to Mr. Charles H. Collins and found out that the milk secretion had dropped from close to 4,000 pounds daily to about 1,200 pounds daily within a period of six days, which would indicate that the disease had been in the herd for about a week.

Upon examination the cattle were found to have the characteristic lesions in the mouth, vesicles on the teats of some, and a few foot lesions, and were becoming stiff and lame. The ropy saliva was drooling from the lips and several refused to eat the wet mill feed in the manger.

Although a positive diagnosis was not made at this time, on account of the seriousness of the situation I placed a quarantine on the dairy and prohibited any person from leaving the premises, and this order was enforced by a deputy sheriff who was stationed at the gate with orders not to allow any one to pass.

The next dairy discovered supplying raw milk was one belonging to Mr. Giblin on High Street, Oakland, who, although his dairy was located in Oakland, sold his entire output in the city of Alameda. Dr. Lyttle, of the State Department of Agriculture, and myself found the cattle at this place in an advanced stage of the disease. After considerable difficulty, Mr. Giblin remembered that he had had the disease for about three weeks on his premises. The animals were drooling and foot lesions were common; in fact, some of the animals had to be goaded before they would attempt to get on their feet, and practically all of them were lame, some on one or two feet, and others on all four. This dairy had about 50 milking cows. While Dr. Lyttle and myself were at the dairy the distributor arrived for the milk. After thoroughly disinfecting his rig and clothing we allowed him to go without the milk and the premises were quarantined immediately, with adequate guards provided.

By the way, I forgot to mention that I was in a rubber outfit and so was every inspector.

As we left the dairy we washed off our rubber outfit with a 1-1000 bichloride of mercury solution, paying particular attention to the soles of our boots and under the heel of the boot.

Mr. Strong, who operated a dairy comprising fifteen

milking cows selling Grade A Raw Milk, was the owner of the next place supplying raw milk located in this city, and the same methods of quarantine were adopted.

By this time foot-and-mouth disease had been found in three counties: Alameda, Contra Costa, and Solano. The most distant point was in Solano County, about thirty-two miles from Oakland.

While I am on this, I will digress and relate to you an instance where milk was the medium of transmitting the disease from one dairy to another.

A dairy in Solano County was shipping milk for pasteurization and distribution in the city of Berkeley. The owner of the city milk plant also owned a dairy of 180 milk cows located at the lower end of Alameda County, and having a surplus of milk on hand, he separated some and sent the skim milk in a raw state to his ranch to be fed to hogs. About a week later he noticed the hogs, nine in number, becoming lame, and knowing the dairy in Solano County had been quarantined for foot-and-mouth disease, he became suspicious and killed and burned the hogs, thinking that he would eliminate any possibility of infecting the cattle. In about one week he noticed two cows drooling and telephoned to my office that he was suspicious of having the disease at his dairy. Dr. W. C. Herrold, of the U. S. Department of Agriculture, happened to be with me when I received the information, and the dairy being located twenty-five miles from Oakland, he phoned Dr. Perry Zenor, who was in charge of the district. As there is a regulation that a positive diagnosis must be confirmed, we drove to the dairy and met Dr. Zenor returning. He stated that the case was positive, so we continued on our trip and confirmed his diagnosis, and over 400 head of stock, including dry cows, young stock, and bulls, were dead and covered up within 48 hours.

These two centers of infection were fifty-seven miles apart. The infection was positively transmitted by milk as

there was no other connection, and the ranch in Alameda County was fifteen miles from any other center of infection.

A careful survey was made of all hospitals supplied by the Shore Acres Dairy, and the customers supplied by the other dairies furnishing raw milk, and as far as I have been able to determine, not a case in the human being has been located in this epidemic, which would lead one to believe that the human being's resistance to foot-and-mouth disease is relatively high, as there could not have been a more favorable opportunity for a milk-borne epidemic.

A full-time inspector was placed in each city milk plant, watching the sterilization of cans and disinfection of trucks hauling from the country and checking on the pasteurizing equipment. This was more for the sake of preventing the spread of the disease than to protect the consumer.

"We must not stint one necessary action, in the fear to cope malicious censurers."

DAIRY METHODS.

PETER SCHLETTY, *Dairy and Milk Inspector,*
State Dairy and Food Department,
St. Paul, Minnesota

Is there such a thing as uniform standard dairy methods? I have not seen much of it, except in the town of Winona, Minnesota. All the profound knowledge and information furnished by dairy professors and milk experts is in vain so long as milk is bought and paid for on the butterfat basis only. Nothing is paid for the higher quality, which would induce the adoption of better methods for the production of clean, wholesome milk for human consumption.

Winona, Minnesota, has adopted a system of inspection and a method of paying for quality that has resulted in a clean, wholesome milk supply. Out of sixty dairies, sixteen were picked at random and inspected last fall which scored an average of fully seventy-five points on the Government score card. Nearly all barns were up-to-date, with cement floors, gutters, good drainage, light and ventilation. The yards were clean and no manure piles. The stables were clean. Most of the cows were clipped at the flanks, looking clean and slick. Many of the herds were fit for the show ring. Every dairy has a milkhouse, a clean iced cooling tank, and cement floor, with mostly trapped tile drains. Small-top pails are used by all. Cleanliness and good order prevail. All cows must be tuberculin-tested, and all milk is pasteurized at 145° F. for 30 minutes, to comply with the rules and regulations of the State Board of Health.

Milk must arrive at the plants at 55° F. and without visible dirt, and must contain 3.5 per cent butterfat or be rejected. A double set of cans are used, which are

thoroughly washed, sterilized, and inverted to drain and dry on metal racks. These cans are exchanged next day with patrons. Some method, I say.

Samples for fat and bacteria are taken on irregular days, once a week, to a well-equipped laboratory for analysis. Temperature and sediment tests are taken twice per month. The equipment and utensils in the well-lighted and ventilated three milk plants are in the best of condition as to cleanliness and sanitation.

The wholesale price paid the producers is based on the retail price of milk. When the retail price is 10 cents per quart, the farmer gets $2.82 per 100 pounds of milk. When the retail price is 11 cents per quart, he gets $3.10 per 100 pounds. When the retail price is 12 cents per quart, he gets $3.38 per 100 pounds. About 2,000 gallons of milk and 200 gallons of cream are consumed daily by the people of Winona, a city of about 20,000 people.

The average bacterial count per year is less than 12,000 and the fat content is held strictly at 3.5 per cent for milk, 20 per cent for cream, and 30 per cent for whipping cream. The city ordinance requires a bacterial standard of not more than 25,000 per c.c. for milk and 50,000 for cream after pasteurization when delivered to the consumer, and not more than 100,000 before pasteurization.

The pioneer work for this ideal condition in Winona was started and put into operation some years ago by Dr. R. W. Archibald, then City. Milk Inspector and now milk expert with the State Board of Health. He had to conquer hard opposition at Winona in order to make progress. The good work has been kept up and perfected by a real health officer, Dr. W. V. Lindsey, and his able and energetic assistant, Dr. N. R. Roettinger. The result is that every one is now satisfied, both producer and dealer. The consumer gets the best milk that can be produced and at a lower price than in the larger cities.

During the late period of depression, when farmers

were complaining about the low prices received for their products, I would ask them if the milk or cream check received was not the best income, and they admitted freely that it was. Why, then, treat the dairy business as the most neglected side line? In many sections we see new hog houses, new hen houses, garages, and many milk producers now drive a higher-priced car; and yet, where are the promised milk-house or insulated cooling tank, a very much needed silo, necessary repairs on the barn or milk house? In many cases the answer received has been: "If the milk business is getting so particular, I better quit." In such cases, I am tempted to say to the dairyman, if he is a retailer of raw milk, if that is his conception about the needed care in handling such a highly perishable food product as food for babies, the sooner he quits the better for all concerned. Our task, however, as inspectors is to exercise patience and try to convince the dairyman of his mistaken conception in his own interest. In many cases our efforts are rewarded with good results, as we do feel rewarded when a stubborn, antagonistic man becomes a cooperating friend in the production of clean and wholesome milk. Sometimes, however, our appeals are in vain and we have to expect disappointments.

A most common mistake is the ever recurring surplus of milk in spring and early summer, and the inevitable shortage during fly time, heat and droughts in the latter part of the summer season. This condition could be avoided to some extent by having the cows freshen in the fall or early winter to equalize the milk flow throughout the year. Cows fresh in the winter will come to an almost full flow again in the spring. Also winter calves are of more value than spring calves.

Too often only the poorest part of a farm is fenced off for the cow pasture, such as sloughs and brush land, whereas the best meadow grass is none too good for a good dairy cow. In Simmental, Switzerland, even on the Alps, par-

tition fences are made to provide practically fresh pasture from spring to fall by the method of moving the herds back and forth. Often we see acres of rich tillable soil around the farm building lying idle and strewn with all kinds of old machinery, wood piles, junk and litter, and manure piles, whereas soiling crops, quick-growing millet, alfalfa, fodder corn, oats, barley, etc., could be planted and then fed to the cattle in a sheltered shed, during the hot, dry, fly-time season. This system requires some extra labor, but it would pay.

The methods for making success of a dairy are simple and well-known. Good-producing, healthy, clean and well-fed cows, regularity and attention to details, clean milking and clean utensils, good cooling on the farm, and care in transportation and delivery to keep the milk as cool as conditions will permit, are points that but few follow religiously, and which the great majority neglect.

"Our grand business undoubtedly is, not only to see what lies dimly at a distance, but to do what clearly lies at hand."

TWO YEARS' EXPERIENCE WITH THE METHYLENE BLUE REDUCTASE TEST IN IMPROVING MILK SUPPLIES

C. S. MacBride, Detroit Creamery Co., Detroit, Michigan.

In the evolution of milk inspection and control various tests have been adopted by those in charge of this work as aids in detecting milk of poor quality. We are using the acidity test, the sediment test, the bacterial count, and the dairy farm score card.

The acidity test depends on the presence in the milk of acid-producing organisms and does not take into consideration large numbers of organisms in milk that produce no acid.

Thorough straining nullifies the sediment test, and numerous investigators have shown that sediment and bacteria in milk have no direct relation.

The bacterial count—both plate and microscopic—requires the services of skilled technicians, and the plate count, in addition, requires extensive laboratory facilities usually not available in small communities. Without doubt the Standard Plate Method when properly used gives an index to the quality of the milk, but its use is limited.

To give the best results the dairy farm score card should be used at milking time.

The Detroit Creamery Company milk shed covers a semicircular area having a radius of about seventy-five miles from Detroit, and is made up of approximately forty-five hundred patrons. Obviously, any system of bacterial inspection of the milk as it arrives at our country receiving stations would of necessity have to be rapid, efficient, and comparatively inexpensive. The methylene blue reductase test seems to offer the best solution to this problem. We

have used the test for the past two years and during that time have made approximately nine thousand tests.

The following equipment is necessary:

A water bath spaced for holding test tubes.

Thermometer.

Small alcohol lamp.

One-c. c. pipettes.

Test tubes.

Methylene blue solution made up with standard tablets.

Our method of operation is as follows:

Test tubes calibrated for 10 c. c. are plugged with cotton, sterilized at our main laboratory, and taken to the country receiving station. As each patron's milk is released from the weigh can, a ten c. c. sample is taken by holding the test tube under the milk. The sample is marked with the patron's number or name on a small label at the top of the test tube. The samples are packed in ice until all the milk is received. Then the cotton plugs are removed, the tubes placed in a water bath and 1 c. c. of methylene blue solution added to each sample. The water bath is kept at a constant temperature of 37.5° C. with the alcohol lamp. The tubes are watched closely for color reduction and when completely reduced the reduction time is noted. Using this method, we can easily test our largest receiving stations of two hundred patrons in three hours from the time of receipt of the last patron's milk.

The first question that will be asked is, "Does it check with the bacterial count?" It does not check exactly, but closely enough so that we can be certain that milk shown to be of poor quality by the reductase test almost invariably gives a high bacterial count. We find that our comparison of the reductase test and the Standard Methods plate count substantiates the classification as given in the latest issue of "Standard Methods of Bacterial Analysis." Our series of checks give the following relation:

TABLE I

Reduction Time (minutes)	Average Bacterial Count
0— 20	44,200,000 (13 samples)
20—120	8,880,000 (31 samples)
120—330	2,440,000 (32 samples)
330—plus	33,200 (22 samples)

A question arises as to whether the reductase test is sensitive to the lactic group of organisms. To determine this, milk was inoculated with lactic starter and incubated at 70° F. Standard Methods plate counts and reductase tests were made during the incubation, with the following results:

TABLE II

Incubation Count	Reduction Time (minutes)	Plate Count
1 hour 33 minutes	12	36,400,000
1 " 53 "	9	44,000,000
2 " 17 "	7	77,000,000
2 " 55 "	5	82,000,000
3 " 17 "	4	122,000,000

From the above data it can be seen that the reductase test is sensitive to the more important member of the lactic group.

Any test used as an aid in milk inspection is effective only in so far as the results obtained by its use give to the official in charge an index as to the quality of the milk supply. We believe the reductase test will do this more rapidly and effectively than any other test now in use, and that it is the easiest way of classifying the patrons of a station as producers of good milk or bad milk. To demonstrate this, tests were made at one of our receiving stations during the summer of 1923. Reductase tests were made on three successive days. A number of patrons were grouped as producers of milk of good or poor quality. Standard Methods plate counts were made on these groups on the fourth day. From the following tables, it can be seen that the reductase test accomplishes this purpose very accurately.

TABLE III

Good Milk Producers	Reduction Time (minutes) 1st day	2d day	3d day	Plate Count 4th day
Patron No. 5	180	180	180	16,500
" " 8	180	180	180	29,000
" " 15	180	180	180	600,000
" " 35	180	180	180	90,000
" " 56	180	180	180	35,500
" " 76	180	180	180	4,500
" " 99	180	180	180	13,000
" " 106	180	180	180	4,500

Tests carried only three hours.

TABLE IV

Poor Milk Producers	Reduction Time (minutes) 1st day	2d day	3d day	Plate Count 4th day
Patron No. 11	5	5	5	20,000,000
" " 25	7	5	19	20,500,000
" " 27	5	25	32	5,800,000
" " 33	13	30	20	5,100,000
" " 69	22	5	35	5,100,000
" " 109	30	30	37	1,300,000

At each of our country receiving stations we have a small percentage of patrons who can be depended upon at all times to produce a poor quality of milk. The reductase test is especially adaptable in segregating this class. By the betterment or elimination of this small class, the milk supply of a station can be graded up very rapidly. As an illustration of this condition, we will take the reductase test on nine out of 130 patrons of one of our larger stations.

TABLE V

Patron's Number	Reduction Time (minutes) 1st test	2d test	3d test	4th test
10	120	25	50	30
40	55	120	40	25
43	120	5	10	45
62	40	5	35	15
66	..	120	30	30
77	120	120	10	15
84	40	120	15	10
127	105	20	10	15
132	120	20	65	50
Air temperature	41° F.	52° F.	63° F.	72° F.

Our method at present consists of making reductase tests for two or three consecutive days at a receiving station.

All patrons whose milk is reduced in less than two hours on two of the three days are noted on a list given to the station manager. In this way the station manager knows where to look for poor milk and can give this milk careful examination as it comes to the receiving platform.

The reductase test makes possible the rapid determination of the quality of a raw milk supply. The accuracy and simplicity of the test should recommend it to the inspector and to the milk plant operator. It has long since passed the experimental stage, as it has been used in Europe for years. Professor Orla Jensen, writing in the *Milk Plant Monthly* of August, 1924, says in part: "Eighty per cent of the milk dealers of Finland purchase milk on the reductase test. This has had the effect of practically eliminating Class 3 and 4 milk from the market. The producers of these grades of milk could not stand the sharp price reductions made on milk of poor quality. The test is used extensively in Denmark and Holland for the same purpose."

We have in the reductase test a simple, accurate, and inexpensive method of determining the quality of raw milk.

"The man who trusts men will make fewer mistakes than he who distrusts them."

THE METHYLENE BLUE TEST AS AN ADJUNCT TO MILK INSPECTION

C. H. CHILSON AND E. J. SMITH, Department of Health, Detroit, Michigan.

The purpose of milk inspection is to better milk supplies. With this in view, the inspection service is always seeking some simple method of determining the quality of the product at the lowest possible cost and in the shortest time. The methylene blue or reductase test seems to come the closest to solving this phase of the inspector's problems of any test yet promulgated. This test has been accepted by the Standard Methods Committee on Milk Analysis of the American Public Health Association and the Association of Official Agricultural Chemists. It gives information of value in detecting poor quality milk, but should not be regarded as a substitute for the bacterial counts. It should not be used for fine grading. It fits in where it is impossible to use the bacteria count method. This applies, particularly, to the country milk inspection. The inspector wants to know who is producing good milk. The taking of temperatures, the score card of the farm, and the sediment tests all play their part, but they do not register the quality of the milk. The methylene blue test will do this, so we can add another link to the chain of practical milk inspection.

THE TEST

The methods of procedure are outlined in the Fourth Edition (1923) of "Standard Methods of Milk Analysis," [1]

[1] (a) Fourth Edition, "Standard Methods of Milk Analysis."
(b) "The Influence of Certain Factors on the Methylene Blue Reduction Test for Determining the Number of Bacteria in Milk," by Hastings, Davenport and Wright, Department of Agricultural Bacteriology, University of Wisconsin. Reprinted from Journal Dairy Science, Vol. V, No. 5, September, 1922.

so very little space will be given to this phase of the work.

Here it suffices to say that 10 c. c. of milk are measured into a test tube to which 1 c. c. of the methylene blue[2] is added. This is incubated at a temperature of 98°-100° F. and readings made at the end of 20 minutes, one hour, two hours, three hours, four hours, and five hours. If at the end of 20 minutes the milk is decolorized, it is to be considered as a very bad milk. Bad milk is decolorized in less than two hours, but not less than 20 minutes. Milk of fair average quality is decolorized in less than five and a half hours, but not less than two hours. Good milk is not decolorized in five and a half hours.

SYSTEM EMPLOYED

Vat samples, representing milk from the milk dealers' country receiving stations, are taken at the milk plants immediately after its arrival. Such samples are taken for three consecutive days. When results show that the milk falls into the bad or very bad class, the test is carried into the country. At the country receiving stations each shipper is sampled for three days. The inspector then visits the farms of those that show bad milk and tries to learn why such milk is being produced. Reasons in most cases can be found, and if the producers show no improvement at the end of three days, the milk is excluded from the market as fluid milk.

The equipment necessary consists of a galvanized iron incubator of two compartments. The samples are placed in the racks and then incubated in the water bath. By the aid of an alcohol burner, the water can be held at the desired temperature for proper incubation.

The results accomplished on the supply of three milk plants during the months of June, July and September are shown in Chart I. In June, between 85 and 100 per

[2] Recommended in "Standard Methods of Milk Analysis."

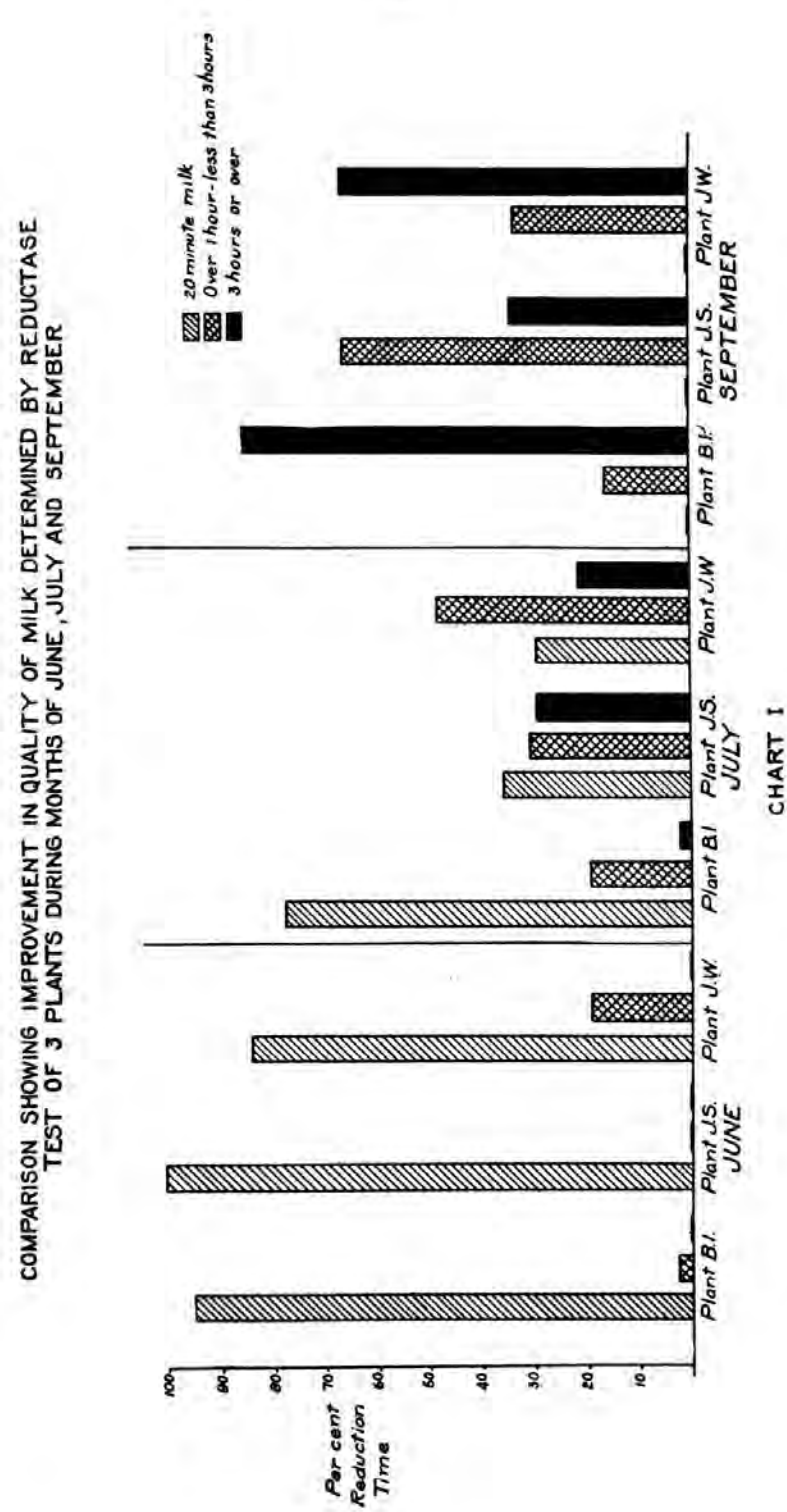

CHART I

cent of the raw milk coming into the three plants was "20-minute milk"; from 0 to 15 per cent was between one- and three-hour milk, or what could be termed as good milk. During July, improvements are noted in all but one plant. Plants J. S. and J. W. reduced their "20-minute milk" from 85 to about 43 per cent, and increased their "over-three-hour milk" from 0 to about 25 per cent. During September, the "over-three-hour milk" was increased noticeably in all the three plants.

The results accomplished in the country, covering a period of four months, are shown in Chart II. These results are from samples taken at different stations within the milk shed. Each producer's milk was sampled on three consecutive days. The figures in the chart represent a total of each day's findings for the 1,500 producers during the four months.

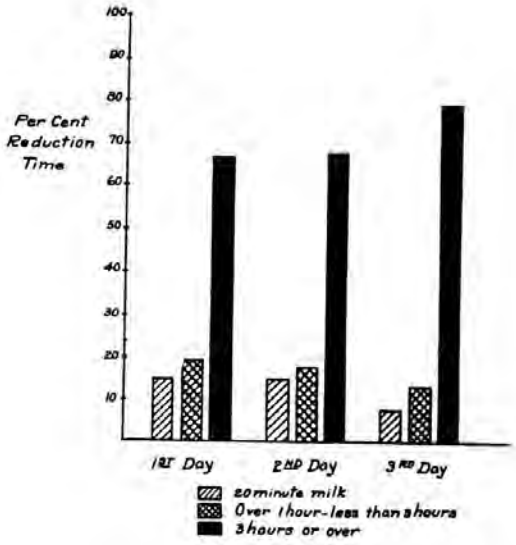

CHART II

Intensive work at a single station is shown in Chart III.

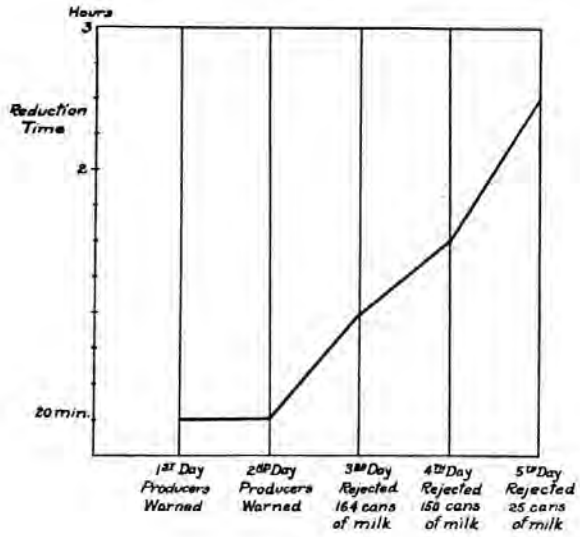

CHART III

DETECTION OF ABNORMAL UDDER CONDITIONS

The reductase test was used to test the milk from individual cows and in some of the animals a reduction was shown, indicating poor quality milk. Animals with a positive mastitis condition were checked and a reduction was noticed in from five minutes to half an hour, depending upon the severity of the condition. Abnormal udders showed high counts. This may be one cause for high-grade milk having high counts at different times. Milk from diseased udders should not be used. The test will assist in detecting this condition.

The following table shows the work that has been done on individual herds:

INDIVIDUAL HERD TESTS

No. Animals	Date	METHYLENE BLUE RESULTS 20 Min.	1 Hr.	2 Hrs.	3 Hrs.	4 Hrs.	5 Hrs.	Remarks
61	6–15–24	..	1+	..	..	..	60—	This animal showed no physical evidence of a diseased udder. Check test made on this cow showed same results.
25	7–8–24	..	..	..	..	..	..	Jersey herd. Entire herd clean.
32	8–12–24	1+	31—	31—	31—	31—	31—	Milker claimed one quarter bad.
73	8–28–24	73—	2+	1+	70—	70—	70—	No physical evidence of diseased udders.
38	8–1–24	1+	37—	37—	37—	37—	37—	Cow had a bad case of mastitis in three quarters. Milker said he noticed something was wrong.
38	9–24–24	..	..	2+	36—	36—	36—	One cow drying up. Milk not being used. No physical evidence of diseased udders in other animals.
38	9–25–24	..	..	2+	36—	36—	36—	Test repeated on same herd.
28	9–23–24	28—	28—	28—	28—	28—	28—	Test shows herd to be clean.
28	9–24–24	28—	28—	28—	28—	28—	28—	Same herd. Test repeated.

CONCLUSIONS

1. A series of tests covering a period of several months has shown that the reductase or methylene blue test is of value to inspection.

2. It enables the inspection service to sort out the bad and good milk.

3. When used for testing individual cows it will show abnormal udder conditions.

Note: Credit is herein extended to Inspector O. R. Marquardt for his valuable suggestions and assistance in constructing the field incubator. Information in detail regarding its construction will be supplied on request.

DISCUSSION

A member: Would you use the methylene blue test in preference to the bacteria count?

Mr. Chilson: We only use the methylene blue test to tell whether milk is good or bad. We believe there is nothing that takes the place of the bacterial examination.

"There must be a certain trust placed in the common sense and common honesty of those who are to enforce the law."

THE USE OF EOSIN-METHYLENE BLUE CULTURE MEDIA IN MILK EXAMINATION

MRS. EDITH L. MOORE, *Bacteriologist,* Department of Health, Houston, Texas

My position in the Health Department of Houston, Texas, has given me my first experience in charge of a health department laboratory in a Southern city. My work previously had been well above the Mason-Dixon line, where climatic conditions are entirely different.

When I made my first examination of milk samples procured by the dairy inspectors, I was amazed to find upon running the cultures that there was an unusual number of gas-producers. This was in 1919. Our laboratory at that time was examining about fifty milk samples a week and I continued to notice the gas-producers present with litmus-lactose agar with positive Endo plates. I began to look about for some other medium that would be more efficient and would differentiate the colon bacillus from other gas-producers, and in this way give our Health Department information as to whether these different samples of milk were contaminated from unclean sources of production or from methods of handling. Gas-producers, of course, should not be found in pure fresh milk, and therefore we attempted to eliminate them from our supply.

In 1921, Dr. Eaton, of the United States Public Health Service, then stationed in Beaumont, Texas, became aware of my quest for a reliable medium and suggested that I communicate with Dr. Max Levine, of Ames, Iowa. In answer to my letter, Dr. Levine sent a formula for eosin-methylene blue culture medium and the manner of identifying organisms with it. I immediately adopted this method and have used it ever since. In the usual technique, the

material to be cultured is to be spread over the surface, but we find it of greater advantage to place one tenth of one cubic centimeter of undiluted milk on the plate and pour the medium over it.

After 24 hours' incubation in the ordinary incubator at a temperature of 37 degrees C., the gas-producers show as bubbles. The colon bacillus, if present, shows its green floresence either on the top or bottom of the medium, and the *lactis aerogenes* presents well-marked colonies with brownish centers. The colon bacillus is used as an indicator of the cleanliness of the animal and the condition of the milking barn. The *lactis aerogenes* and other gas-producers indicate the cleanliness of the utensils and whether the old milk has been removed from the crevices of the milk pails, cooler, etc.

In my opinion the laboratory is most necessary in the production of clean, wholesome milk. The inspectors should be furnished with daily reports of the samples examined, with chemical analyses and bacteriological counts, and also these bacterial indicators of which I have previously spoken; namely, colon bacillus and *lactis aerogenes*. With such information the inspector is in much better position to locate the source of contamination of milk and can better direct the dairyman how to remove it.

I wish it distinctly understood that I used for counting the bacterial colonies ordinary nutrient agar, in the manner now prescribed by the United States Public Health Service. In addition to this, I run each sample on the eosin-methylene blue medium, giving us three plates, two for counts and one for colon.

The work in our laboratory became much more extensive in 1921, when we adopted this method in all cases, and I will therefore quote the following table on the observation of 3,000 samples of milk. The figures will show how valuable the eosin-methylene blue culture medium is. We have been able to give excellent information to the milk

inspectors regarding the source of contamination, and they, in turn, have accomplished excellent results in having these dairies cleaned up.

July and August Records, 1921 to 1924, Inclusive.

	1921	1922	1923	1924
Percentage of samples of milk showing colon bacilli.....	45%	21%	28%	13%
Percentage of samples of milk showing gas-producers not colon.	35%	36%	35%	25%
Percentage of samples of milk not showing gas-producers.....	18%	37%	37%	56%
Percentage of samples of milk showing colon, *lactis aerogenes*, and other gas-producers.....	2%	6%	12%	6%

The percentage of colon is highest in counts ranging from 100,000 to 500,000, decreasing as they pass the 500,000 mark.

PERCENTAGE OF MILK SAMPLES WITH COLON PRESENT

	1921	1922	1923	1924
Counts up to 50,000.....	7%	10%	2%	4%
50,000 to 100,000.....	15%	52%	11%	10%
100,000 to 500,000.....	39%	13%	38%	44%
500,000 to 1,000,000.....	20%	10%	27%	25%
1,000,000 plus	6%	5%	14%	8%

Our inspectors, of course, use the scoring system. However, I have always tried to impress upon them that the bacterial count gives us valuable information. In addition to number, we must know the *kind* of bacteria if we are to know about the cleanliness of the dairies. I have found the eosin-methylene blue culture medium to be reliable and it can be employed with great advantage in milk work, as well as in water analysis.

DISCUSSION

Dr. H. O. Way, Cleveland: What methods are used to prevent contamination with *B. coli?*

Mrs. Moore: Flanks, udders, and tails are kept clipped. Animals are kept clean by the use of water.

"Truth is truth to the end of reckoning."

CONTRAST IN THE KEEPING QUALITY OF RAW MILK SUPPLIES WITH AND WITHOUT THE APPLICATION OF THE REDUCTASE TEST

H. A. HARDING AND ARCHIBALD R. WARD, Dairy Research Division, Frederick C. Mathews Company, Detroit, Michigan.

INTRODUCTION

The methylene blue reductase test has been fairly widely used in Denmark and Sweden for some years, and in the fourth edition of the "Standard Methods" of the American Public Health Association it is listed as a provisional method. In the recent report of the referee on dairy matters it is proposed that this test be made a completely official method, and this report will be up for formal adoption at the next annual meeting of the Association.

The test consists in mixing 10 cubic centimeters of milk with 1 cubic centimeter of a standard methylene blue solution, holding the mixture at 100° F., and noting the interval before the blue color totally disappears. The milk is divided into four classes, depending upon the interval which elapses before the color disappears, as follows:

Interval before Decolorization	Class No.	Keeping Quality of Milk
20 min.	4	Very bad
20 min. to 2 hrs.	3	Bad
2 hrs. to 5½ hrs.	2	Fair
More than 5½ hrs.	1	Good

The results of this test are roughly comparable with the standard bacteriological plate counts and even more closely comparable with direct determinations of the keeping quality of the milk. By the use of this test it is feasible to locate the very bad milk in twenty minutes and the bad milk

within two hours, while the results of the standard plate bacterial counts cannot be obtained under two days. This sharp reduction in the time element is largely responsible for the rapidly increasing popularity of the reductase test in connection with the inspection of raw milk. The added advantage that an operator can handle two hundred or more samples in an outfit which can be taken into the field and operated at the point where the samples are secured likewise commends the test to the inspector.

The interest of the milk distributor in the quality of the raw milk coming to him should be quite as keen as is the interest of the milk inspector, and in an increasing number of milk plants the application of the reductase test to the incoming milk has become a routine matter.

The experience already gained has demonstrated that when the information furnished by this test is properly used, there results a marked improvement in the keeping quality of the general milk supply. The most convincing comparison would be to contrast the quality of the milk produced on a number of farms before and after this test had been applied. However, the development of a high keeping quality milk supply is a slow-moving proposition even under the best of conditions and the accumulation of all of the data happens only exceptionally.

The present paper is a presentation of what seem to be typical records of milk supplies which have had nothing more than the conventional inspection, as contrasted with the condition of the raw milk supply in cases where the information regarding keeping quality has been used as a basis for improvement.

PRESENT CONDITION OF RAW MILK SUPPLIES

It is a matter of common experience that the keeping quality of the raw milk supply varies widely during the year, being poorest during warm weather. Accordingly,

measurements, to be comparable, should be made under similar temperature conditions.

The following measurements were made in July, 1924, and represent the quality of the milk supply of individual producers coming to three large milk plants in Pennsylvania, and one in Kentucky.

Reductase Class	Dairy No. 1 Per cent	Dairy No. 2 Per cent	Dairy No. 3 Per cent	Dairy No. 4 Per cent
1	18	6	29	2
2	29	29	33	32
3	22	28	23	50
4	31	37	15	16

It will be noted that the percentages of the supply from individual producers included in Classes 3 and 4 were 53, 65, 38 and 66 respectively. If the condition of these four dairies is really typical of the general milk supply, slightly more than one half of the milk coming to the milk plants has an undesirable keeping quality, and at least during the heated season approximately 25 per cent of the supply has so poor a keeping quality that it should not be accepted.

IMPROVEMENTS WHICH HAVE BEEN ACCOMPLISHED

At approximately the same time as the tests in Pennsylvania, a test was made of 128 producers furnishing a dairy in Connecticut. This dairy had been supplementing its field inspection work by reductase tests and bringing the results of these tests immediately to the producers. This series of tests may be summarized as follows:

Reductase Class	Per cent
1	78
2	19
3	3
4	0

This showing of no producers in Class 4 and only 3 per cent in Class 3 is in sharp contrast to the showing of 25 per cent in Class 4 and 30 per cent in Class 3 in the case of the other dairies.

It is of course obvious that the mere testing of the milk of a producer will not have any effect upon his product unless the results of this test are used efficiently. The value of this test lies in the ease and accuracy with which the desired information regarding the keeping quality of the milk can be obtained.

In Pennsylvania, not far from the earlier mentioned dairies, a milk distributing company has been making microscopic counts of milk as delivered at its plant and bringing this information to the producers. This has been continued for about four years and in midsummer a reductase test of the producers gave the following result:

Reductase Class	Per cent
1	84
2	15
3	1
4	0

In this dairy, 99 per cent of the producers were delivering a raw milk which was entirely acceptable from the standpoint of keeping quality.

SUMMARY

Of all of the available means of estimating the keeping quality of milk samples, the reductase test is one of the easiest to make, and the one which gives the desired information more quickly than any other which is reasonably reliable. For this reason it is rapidly coming into use in connection with the inspection of raw milk supplies.

It commends itself to the inspector because the equipment for making the test can be taken to any desired point and a large number of samples can be handled with a small loss of time.

The results can be made convincing to the producer, who may readily follow all of the details of the test and observe the rate of decolorization in the samples of his own product.

When the producer is convinced that his product does not possess the proper keeping quality, it is relatively easy to bring about such changes in the methods of production as will result in the desired improvement.

The results here given are in keeping with other field observations, which indicate that one quarter of the raw milk reaching the receiving platform in hot weather has a very bad keeping quality and at least another quarter of it could well be characterized as bad in keeping quality.

Experience has shown that both classes of milk can be practically eliminated by determining the facts accurately and by bringing the facts home to the milk producer.

In practically all cases the difficulty of the producer lies in improperly cared for milking machine, improperly prepared milk cans, improperly cooled milk, or a combination of two or more of these factors.

"He who does not improve today will grow worse tomorrow."

METHODS USED FOR COOLING AND STORING MILK ON FARMS BY DAIRYMEN SELLING MILK IN THE CITY OF RICHMOND

T. J. STRAUCH, *Chief Dairy Inspector,* Bureau of Health, Richmond, Va.

The market milk supply of Richmond, approximately 50,000 quarts daily, is produced on 215 dairy farms located in 23 counties of the State. It is produced by 7,500 cows. The largest herd consists of 175 cows and the smallest of 18 cows. The dairymen supplying the city use four methods for cooling and storing milk on the farm.

The first method which I will describe is one followed by a number of dairymen whose farms are located close to the city. The cows on these farms are milked at 5 A. M. and between 1 and 2 P. M. The milk is cooled after each cow is milked by running it over a cooler. About five gallons of well water, having a temperature of 58 degrees F., is used to cool one gallon of milk. The milk from these dairy farms, located within 12 miles of the city, is delivered to the distributing plants in Richmond by motor trucks twice daily, and within one hour after milking. Because of the short time between production and delivery to the distributing plants, producers who send their milk to the city twice daily are able to deliver milk with a low bacterial content, provided proper methods have been used in its production and handling on the farm.

We have had considerable criticism of the plan of milking cows at 5 A. M. and again at 1 P. M., that is, having a long and short interval between milking hours. The only disadvantages we have been able to find in this plan are the variations in butterfat content and the quantity of milk produced during the different periods. Cows, if milked at

1 P. M., after having been previously milked at 5 A. M., will at the afternoon's milking give about one half the quantity of milk that they gave in the morning. However, the milk drawn at the afternoon's milking will test considerably higher in butterfat. The cows do not seem to suffer any ill effects from this system of milking.

The second method of cooling used is the same as the first, with the following exceptions:

The cows are milked at even hours; that is, twelve hours elapse between each milking period. The milk is delivered to the distributing plants in the city once daily, the night's milk being stored in well water over night on the farms. These dairy farms are located about 12 miles from the city and the milk arrives at the plants about 9 A. M. daily. The milk held over night on the farm is therefore about 16 hours old when it arrives in the city, while the morning's milk reaches the plants about one hour after milking has been finished on the farm. The results obtained from the use of this method of storing the night's milk have not proved satisfactory during the hot weather.

The third method of cooling used is as follows:

The cows are milked about 5 A. M. and 5 P. M. The milk is first cooled as in the two methods previously described, by running it over a corrugated cooler through which well water passes. By using this type of cooler and about five gallons of water for cooling each gallon of milk, the temperature of the milk can be reduced to about 62 degrees F., or within four degrees of the temperature of the cooling water. A second cooler of a smooth, conical type, in which water and ice are placed, is used for a second cooling of the milk. By the use of this cooler the temperature of the milk is further reduced to 52 degrees F. The milk is then placed in an insulated concrete tank containing ice and water. For the best results ice should be put into this tank with water long enough before milking so that the water will be at a low temperature when the milk is

ready to be placed in the tank. Where milk has been first pre-cooled, as described above, and by the use of a second cooler is reduced to about 52 degrees F., and the water in the storage tank is at a temperature of 45 degrees F. when the milk is placed in the tank, only about two pounds of ice per gallon of milk will be required to cool and hold the milk well below 50 degrees F. over night. As the dairies using this method for cooling and storing evening's milk are located over 60 miles from Richmond, the milk is shipped by railroad to the city, arriving at the plants in the city about 2 P. M. The evening's milk is therefore about 21 hours old on arrival at the plants, and the morning's milk less than 10 hours. The results obtained by dairymen who are using this system for cooling and storing milk have proved to be very satisfactory.

The best results have been obtained by using insulated concrete tanks constructed in the following manner:

The total thickness of the walls should be at least 10 inches, consisting of a two-inch outside wall of concrete, a four-inch layer of cork and an inside concrete wall of four inches. Cork is also used for insulating the bottom and the cover to the tank. The cork should be coated with and set in hot asphalt.

The dairy farms on which the fourth method of cooling is used are equipped with small mechanical refrigerating plants. Where these plants are in use, the milk is cooled to and stored at a temperature below 40 degrees F. At the present time only ten of our dairymen are using this system for cooling and storing milk, but as the results have been very satisfactory, I look for a great increase in the use of small refrigerating plants in our section of the country in the near future.

"Heaven ne'er helps the men who will not act."

SOME EXPERIMENTS WITH HOLDING TANKS

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The ability of so-called continuous-flow pasteurizing equipment to hold every particle of a given volume of milk for a definite period of time has been the subject of investigation for a number of years. The general construction of continuous-flow equipment and the principle upon which it depends for efficient operation suggests to the mind of the engineer serious doubt of its ability to perform the function for which it is constructed. The uncertainty in the treatment of milk, the impossibility of obtaining any record of the time for which the milk treated has been held renders this class of apparatus a menace to the public health and its use in plants pasteurizing milk for public consumption should be prohibited by law.

Milk control officials today are practically unanimous in the opinion that the mere retarding of milk in its passage through appliances of various description so as to require a definite time for a given volume to pass a certain designated point does not in any reliable way indicate that every particle of milk appearing at the outlet at the end of the apparatus has of necessity been held the required thirty-minute period. That this has been recognized by some manufacturers is apparent when we examine the apparatus and note the various appliances, floats, baffles, spreaders, perforated plates and vortex-breakers designed and used to overcome variations in rate of flow, cross currents, vortex formations and mixing.

In view of the apparent uncertainty of the results attain-

able by equipment of this character when used to bring about the pasteurization of milk in such a way as to render it safe for human consumption, it is not surprising that various tests have been brought forth in an attempt to determine the time required for a definite portion of a liquid to pass through such apparatus.

In all probability the test which depends upon the time required for a color to pass through the apparatus has been most widely used, the usual method of applying the test being that of injecting a small quantity of concentrated aqueous colored solution in the inlet pipe after the apparatus has been filled with water at ordinary temperature and placed in continuous operation. A determination is then made of the time required for the color to appear at the outlet at the end of the system. Some of the indicators used for this purpose are methylene blue, fluorescein, potassium permanganate, and uranin.

Another test designed to determine efficiency of holding is known as the *temperature test,* and consists of momentarily elevating the temperature of the fluid as it passes through the heater on its way to the holders. A thermometer is placed at a convenient point at the end of the system and the time required for the superheated fluid to cause a sudden elevation of the mercury column in it ascertained.

A test similar in principle to the temperature test has also been reported. The test consists of injecting a concentrated alkali solution in the inlet at the entrance of the holders while the apparatus is in continuous operation. Tests for alkalinity are then made with litmus paper at the outlet of the holder, noting the time required for the fluid at the outlet to turn red litmus paper blue.

Quite recently a test for continuous-flow pasteurizers has been reported by the Dairy Division of the United States Department of Agriculture. Organisms of the prodigiosus group are introduced at the inlet of the holder, when the apparatus, filled with water at ordinary temperature, is

running continuously. Samples of water are then taken at the end of the system at intervals of two or three minutes. The samples are plated and incubated. From presence on the plates of the colored colonies produced by the test organism, the time required for pathogens to pass through the apparatus has been inferred.

While these tests parallel the actual conditions in milk-plant operation quite closely, they have nevertheless frequently been criticized by those directly or indirectly in the employ of the manufacturer, or the milk dealer, or by both. These criticisms for the most part have been based upon an alleged significant difference between the behavior of milk at pasteurization temperature and the behavior of water at ordinary temperature.

While our experiments show that it makes little difference practically whether one uses warm milk or cold water under similar conditions in conducting tests on continuous-flow equipment, from the beginning it seemed important to give proper attention to such variations as those of temperature, specific gravity and rate of flow of the fluids used in testing continuous-flow apparatus. Our findings show the absolute necessity of controlling these variables. Our findings also indicate the certain unreliability of this class of apparatus, as these variables are likely to occur in milk-plant operation where they may be uncontrollable or even unknown.

In the course of enforcing the pasteurization regulations for five cooperating health boards in Southeastern Pennsylvania, which define pasteurization as does the Pennsylvania State Department of Health, the United States Public Health Service, the British Ministry of Health, the Dairy Division of the United States Department of Agriculture, the National Commission on Milk Standards, the Committee of the Sanitary Engineering Section of the American Public Health Association, and many experienced scientists of unquestioned ability in the dairy field, as a process whereby milk is heated to a temperature of not

less than 145 degrees F. and held at not less than 145 degrees F. for not less than thirty minutes, several installations of continuous-flow equipment having vertical tanks have been met with. No fruitful effort was being made by the operators of this equipment to record the holding time of the milk undergoing treatment, the thermometer bulb inserted at the end of the system simply recording temperature and length of time the apparatus was discharging milk. Two installations (similar in design)one consisting of two tanks of approximately 146 quarts capacity each and the other three tanks of approximately 500 quarts capacity each, were encountered. From the outset it seemed probable that some mixing must occur in such apparatus and that in consequence thereof some of the milk could not be held for the proper length of time. If this was correct it is obvious that the milk so treated, and sold as *pasteurized,* was in fact a potential menace to the health of the community.

In order to determine experimentally the ability of such equipment, alleged to conduct the flow of milk in such a way that the *first* milk to enter would always be the *first* milk to leave, and vice versa, the apparatus described was duplicated and installed in the laboratory.

EXPERIMENTAL WORK

Several experiments using water in place of milk and using a color solution made by dissolving imported uranin in water, were first carried out under the authority of and at the expense of the Board of Health of Lower Merion Township.

NOTES UPON THE LABORATORY EXPERIMENTS

The designations "H-tank" and "L-tank" refer respectively to the higher or first tank and to the lower or second tank.

"The time required to fill the tank to overflowing"

RECORD OF LABORATORY EXPERIMENTS UPON CONTINUOUS-FLOW PASTEURIZERS AUGUST, 1924.

No. of experiment.	H. Tank—Time req. to fill to overflowing.	L. Tank—Time req. to fill to overflowing.	Fluid used in experiment.	Test solution used.	H. Tank—Location at which color was looked for.	H. Tank—Time interval between addition of color, etc., and observation of it in overflow.	L. Tank—Location at which color was looked for.	L. Tank—Time interval between original addition of color or other test solution and observation of it in overflow.	TEMPERATURE OF FLUID AT ENTRANCE. °C	TEMPERATURE OF FLUID AT EXIT. °C	TEMPERATURE OF ROOM AT EXIT. °C	SP. GRAVITY OF TEST SOLUTION ADDED.	SP. GRAVITY FLUID USED IN THE EXPERIMENT.
	Min.-Sec.	Min.-Sec.				Min.-Sec.		Min.-Sec.					
1	4–	....	Water	Uranine	Pet cock	4–10	.....	....	....	....	....	1.010	1.001
2	2–07	....	Water	Uranine	Overflow to L	20	.....	....	....	....	....	1.010	1.001
3	2–03	....	Water	Ammonia	"	15	.....	....	21.8	21.6	....	0.900	1.001
4	2	....	Water	Ammonia	"	50	.....	....	21.5	21.7	22.8	0.900	1.001
5	1–57	....	Water	Ammonia	"	2	.....	....	21.5	21.7	22.8	0.900	1.001
6	2–09	....	Water	Uranine	Overflow from central stand pipe	9–46	.....	....	....	....	21.2	1.010	1.001
7	0	....	Water	Uranine	Overflow to L	1–48	.....	....	21.4	21.4	20.0	1.010	1.001
8	0	....	Water	Ammonia	"	15	.....	....	21.4	21.2	....	0.900	1.001
9	0	....	Water	Ammonia	"	1	.....	....	21.4	21.4	20.0	0.900	1.001
10	4–20	9–30	Water	Uranine	"	4–54 4/5	Final	9–49 4/5	21.8	22.6	24.4	1.010	1.001
11	2–15	5–25	Water	Uranine	"	2–57	Exit	6–16 2/5	21.4	21.0	18.4	1.010	1.001
12	0	0	Water	Uranine	"	52 2/5	"	1–44 3/5	....	....	....	1.010	1.001
13	0	0	Water	Ammonia	"	40	"	1–50	....	....	....	0.900	1.001
14	0	1–30	Milk	Uranine	"	4–16 1/5	"	5–30	22.4	....	24.4	1.031	1.033
15	0	1–30	Milk	Uranine	"	1–30	"	13–28 4/5	27.0	17.0	....	1.031	1.032
16	0	1–30	Milk	Uranine	"	1–24 4/5	"	3–19 2/5	30.5	30.0	....	1.031	1.033

refers to the following procedure: In experiments 1 to 6, 10 to 11, and 14 to 16, the fluid in one or both of the tanks was allowed to come to rest after the tank or tanks was about full. Then the flow was reestablished at the usual rate, and time was counted from the instant when the flow began to enter the tank until the time when the tank began to discharge through its overflow pipe.

Ammonia was used in some experiments to offset the academic objection that filtered uranin solution was to a greater or less extent colloidal and therefore contained solid particles heavier than water suspended in it. Ammonia, being a gas, could not come under this objection.

Ammonia was also used to offset the academic objection that uranin solution was heavier than water and therefore could fall through the water. Ammonia water and all aqueous ammonia solutions are lighter than water.

The presence of ammonia was tested for by filling 50 c.c. Nessler tubes at the overflow at regular time intervals. The tubes were then mounted in order in a rack, and when the experimenter was ready 1 c.c. of Nessler's reagent was added to each tube. Blanks or controls were run in all instances.

Experiment 6 was also performed to offset to some extent the objection founded upon the fact that uranin solutions are heavier than water. In this experiment an iron pipe was mounted as a stand pipe in the center of H-tank, and the water and color were introduced in stream flowing in just the opposite direction to the one in all the other experiments. The experiment shows that the uranin solution, which is heavier than water, passed up against gravity with the stream of water.

Experiments 14 to 16 were performed with skim-milk instead of water. The uranin solution was made, and then mixed with some milk, and this mixture adjusted to be lighter than the main body of the milk in the experiments. About 1 ounce of uranin to every 450 quarts of milk is

ample for such tests. In making up uranin solutions the following rule, which is approximately true, may be used as a guide.

If the solution is made by dissolving solid uranin in weighed amounts in water, then divide the grams dissolved per liter of water by two; the result will equal the lactometer reading of the uranin solution. If a uranin solution of unknown strength is on hand, take its lactometer reading and multiply it by two; the result will equal the number of grams of solid uranin per liter.

In Experiments 1 to 13, a special device was used for introducing the test solution. This device consisted of a large tubulated glass bell-jar, inverted, and provided with a piece of rubber hose running through the tubulus and half way up the jar. This served as an overflow pipe. The water used in the experiments was introduced by rubber hose tangentially into this bell-jar, in which it circled about until the level had risen to that of the rubber overflow pipe. This rubber overflow pipe discharged directly upon the screen in the H-tank.

When using uranin, a solution containing 10 grams per liter was fed into this glass, mixed from a burette set to deliver 2 c.c. (i. e. .02 gram uranin) per minute.

When using ammonia, 25 c.c. of concentrated ammonia water that had previously been sealed up in a thin glass bulb blown upon a six-inch test tube was weighted down with iron weights and then placed carefully in the mixer. At the desired moment this thin glass bulb was crushed by a push with a stout glass rod, thus releasing the ammonia water into the much larger volume of water circling about in the mixer.

The uranin used was the sodium salt of fluorescein, $C_{20}H_{10}O_5N_{a2}$. It was the Uranin A Powder made by the Badische Anilivi-und Soda-fabrik, Ludwigshafen a Rhein.

The quantity of uranin present at time of detection was always very small. The whole amount within the tank or

tanks at the time of detection can be calculated easily from the data given for the time interval along with the stated rate of delivery of 2 c.c. per minute from the burette.

The foregoing experiments conducted in the laboratory furnished a basis for the field work that followed.

Arrangements were made by the Health Department for the conducting of tests by their officials (by us) at each milk plant where the nonpositive continuous-flow method of pasteurizing was practiced.

The first test conducted was at a milk plant with a daily output of about five hundred quarts. The equipment consisted of a milk pump, tubular heater, dump tank and an arrangement of two tanks with capacity of about 146 quarts each. The method of operating this equipment consists of pumping milk through the tubular heater and thence to the top of the first cylindrical tank, where it falls by gravity upon the center of a horizontal perforated pan, through the perforation of which it passes to the compartment below. An outlet pipe connects with the base of the tank and conveys the milk to the top of the second tank. The second tank is equipped with an outlet similar to the outlet in the first tank, and during continuous operation discharges through an overflow to the cooler.

Frequent visits were made at this plant for the purpose of observing the usual method of operating the equipment and for the purpose of ascertaining the usual rate at which the milk is caused to pass through the apparatus. It was observed that from forty to forty-two minutes were required to fill the two tanks, that the capacity of the tanks together was approximately 292 quarts, and that the entire output of the plant, 424 quarts, passed through the apparatus in slightly less than sixty minutes. With these data at hand the rate of flow was calculated, thereby establishing a standard based on the actual operation of the equipment itself. This standard of operation was adhered to in testing the efficiency of this equipment.

MILK PLANT TEST NO. 1.

Seven hundred quarts of skim milk were purchased. The temperature and specific gravity of each can of milk were taken and the cans arranged in such order for dumping as to reduce to a minimum any effect caused by difference in temperature or specific gravity. The milk was then dumped in the dump tank, at the rate of one 46-quart can every six and a half minutes, and from there pumped through the tubular heater into the first cylindrical tank, maintaining a flow rate throughout the test of 6.7 quarts per minute. Due to the absence of automatic temperature control equipment and the accompanying difficulties connected with maintaining uniform temperature of the milk by means of hand-controlled valves, heating was deemed inadvisable. In 24½ minutes the first tank was full and an overflow to the second tank established. When the 47th minute was reached, the second tank had filled to within two minutes from overflowing. An empty quart milk bottle was placed beneath the inlet pipe to the first tank. During the brief time required to fill this bottle a quart of a test solution, previously prepared by dissolving 30 grams of imported powered uranin in 500 c.c. of water, filtering same and adding skim milk in quantities sufficient to make one quart, was poured upon the spreader pan. The average specific gravity of the skim milk used in conducting the test was found to be 1.0323. The specific gravity of the mixed color milk test solution was found to be 1.0308. The time at which the colored milk was introduced was taken separately on two stop watches. Having added the colors, the milk flow continued at the same rate. Samples of milk were collected in colorometric tubes both at the outlet of the first tank and at the bottle filler, and compared with controls for presence of color. Samples containing distinctly colored milk were obtained at the outlet of the first tank in one minute, 51 4/5 seconds after the colored milk was added. Samples containing distinctly colored

milk were obtained at the bottle filler below the cooler in two minutes, 47 2/5 seconds, indicating that a portion of this colored milk, although lighter than the uncolored milk itself, had passed through the entire system in less than three minutes. The fact that the flow rate maintained throughout the test was somewhat slower than that used under ordinary operating conditions is noteworthy.

Having established, both by laboratory experimentation and by actual test with milk upon the apparatus in the milk plant, that some of the milk passes through in an incredibly short time in the smaller, two-tank type of so-called continuous-flow pasteurizers, the question concerning the holding efficiency of the larger continuous-flow installation, composed of three instead of two tanks, had next to be answered.

MILK PLANT TEST NO. 2.

A test was carried out upon a large three-tank continuous-flow installation operating at a rate of 3,000 quarts per hour. Save for the additional tank and the increase in size, this equipment is in general like that already described. The course of the milk through the apparatus is essentially unchanged. The stationary spreader at the top of the tank is in this large installation replaced by a conical float which rises on the surface of the milk as the tank fills. During continuous operating the float remains on the surface of the milk just below the inlet of each tank and serves to break the force of the stream of milk as it pours down from above at a rate of approximately fifty quarts per minute. For economy, skim milk was utilized in place of whole milk in conducting the test of this apparatus.

Three thousand quarts of skim milk were used. The milk was dumped in the weigh cans according to the regular custom of the plant and pumped to a storage tank which had been previously emptied and cleaned. Following thorough agitation, the specific gravity of the milk was found

to be 1.0341. The milk was then permitted to flow by gravity from the storage tank to a pre-heater where it was pre-heated to 90 degrees F. From the pre-heater the milk followed the usual course, entering a small open-top tank, from which it was pumped through a tubular heater where it was *heated* to 147 degrees F., and then forced into the continuous-flow tanks at a rate slightly less than 47 quarts per minute. Thirty-four minutes and ten seconds were required to fill the entire system. The measured capacity of the three tanks is 1,590 quarts.

The plant was allowed to operate for eight minutes after the tanks had become filled and a continuous flow established. Temperature of the milk at the outlet of the first tank at this time was 147 degrees F., and at outlet of the third tank slightly below 146 degrees F.

Five quarts of a mixed color milk solution of uranin (prepared in the same manner as described in the previous test) with specific gravity 1.0315 was poured upon the float at top of the first tank. The time of introducing the colored milk was taken on two stop watches. Samples of milk were collected in colorometric tubes, both at the outlet of the first tank and at the outlet of the third tank and compared with controls for the presence of color. The lids of the tanks were removed before starting the test, thus affording a better opportunity for observing the results. Due to formation of foam, more or less milk and color overflowed during the run.

Samples containing distinctly colored milk were obtained at the outlet of the first tank in 4 minutes and 12 seconds. Samples containing distinctly colored milk were obtained at the outlet of the third tank at end of system in 17 minutes, 58 2/5 seconds, more than twelve minutes short of the minimum holding time required to pasteurize milk. The temperature of the milk was controlled by an automatic temperature controller. Temperature of the milk at the inlet to the first tank and at the end of the system were taken

throughout the test. At no time was a variation noted greater than two degrees between that of the milk entering the system and that leaving. The temperature through the run was maintained between 147 and 145 degrees F.

The results obtained by numerous investigators of the nonpositive type of continuous-flow pasteurizers lead to certain definite inferences. The water used in place of milk, apparently because of the general belief that the opacity of the milk would render the color test useless, was observed to be flowing from the outlet, tinged with color in an incredibly short period of time. Organisms of the *prodigiosus* group, whether inoculated into milk or water, appeared on the plates made from samples taken at the outlet only a few minutes after the time they were introduced at the inlet. Unfortunately, however, the *prodigiosus* organism is destroyed before the pasteurization temperature is reached and in consequence thereof this organism cannot be used as an indicator if it is desired to duplicate the actual operating conditions of the equipment undergoing test. While these tests in a general way demonstrate holding inefficiency, their method of application has frequently exposed them to attacks based on a contention that the actual operating conditions have not been duplicated.

For the most part the tests in common use to demonstrate holding inefficiency are fundamental and many subsidiary questions have been left unanswered. One of these relates to differences in specific gravity and viscosity of unheated water and milk at pasteurization temperatures, whether they influence the results of the test, and if so, to what degree. Another question to be answered is whether or not the behavior of pathogenic organisms in naturally infected heated milk may be considered identical to that of an aqueous solution of uranin in heated milk. Until absolute proof to the contrary has been produced the interests of public health demand that pathogenic organisms must

be considered to move with heated milk at no less speed than does color.

The results obtained clear up much of the mystery concerning holding inefficiency of continuous-flow pasteurizers and at the same time suggest a test which may be used to advantage in the milk plant by health officials for the purpose of demonstrating holding inefficiency. When considering the two tests herein reported it is important to note, first, that the holding efficiency of the apparatus was tested with *milk;* second, that the milk was *heated* to the usual pasteurization temperature; third, that the specific gravity of the uranin colored milk used as an indicator was *less* than the specific gravity of the milk itself; and, fourth, that the equipment was operated in the same way and under the same conditions as was the custom in preparing milk for sale as pasteurized, with the exception of a slight diminution in the rate of flow. The rate of flow and specific gravity were arranged intentionally in this way, the object being to give the apparatus the benefit of any difference that might arise concerning these points. In no instance have our tests indicated that the milk had been held the required period of thirty minutes.

When vats or tanks are used singly or in series in the so-called positive system of milk treatment, the time recorded on the chart, and referred to as the holding time, does not in any measure indicate the minimum positive holding period of the milk undergoing treatment. In all cases, except where the temperature of the milk is lowered at the end of the holding period, the chart indicates not only the holding time, but also the time required for the level of the milk in the vat or tank to recede during emptying to a point just below the bulb of the recording instrument (generally placed through the wall of the vat or tank nearer the bottom than the top) making it under such conditions necessary for the health officer to venture a guess concerning what has actually happened to the milk. When these vats or tanks are

supplied with milk at the pasteurization temperature, and used only to maintain temperature during the holding period, it is impossible to determine from the chart the proportion of time utilized during holding and the portion of time utilized in filling alone, or the portion of time utilized in emptying to a point below the bulb of the recording instrument.

No record whatever is made of the milk that may be flowing in, or flowing out, or of the milk that may be flowing both in and out of the alleged holding vat or tank from leaking valves or other causes during the supposed holding period.

Experiments are now in progress to adapt a commercial temperature and time-recording instrument to vats or tanks (used singly or in series as all or a part of an apparatus for pasteurizing milk) so that a complete and positive record of the actual time of holding, as well as temperature, will be recorded on a chart. These experiments indicate that such an instrument can be made by any or all of the manufacturers of the instruments now used by the dairy industry without departing from the standard construction in any essential detail.

CONCLUSION

The utilization of dyes, alkali, variations in temperature of a flow, or organisms to determine the minimum time to which milk must be actually held in an alleged holder of a continuous-flow system is of value to the public health only as a demonstration of inefficiency. The varying and often uncontrollable and unknown conditions of milk and milk-plant operation render it dangerous to assume that milk would be safe for public consumption on account of a test of the apparatus indicating a proper holding time, or a test made with pathogens indicating the efficiency of its germ-killing power. Milk treated in this identical or similar apparatus, thereafter, under conditions that might be unin-

tentionally or unknowingly at variance with the conditions of the test may be highly dangerous if infectious when raw. Therefore, the time for which milk has been held in the treatment to effect pasteurization must be removed from a matter of conjecture to a matter of recorded fact.

The interests of public health will not tolerate doubtful practices. The burden of proof that *all* of the milk received the pasteurization treatment rests upon the milk dealer. Unless convincing, undebatable and overwhelming evidence (supported by a record setting forth the actual treatment to which the milk has been subjected) can be produced by the milk dealer, showing that pasteurization has been effected, health authorities are justified and it is their sworn duty to exclude the milk from sale. The safety of the public health demands that health authorities be furnished with a complete record of milk treatment, including temperature and actual time of holding to which all the milk has been subjected. This is essential if we are to know whether or not pasteurization has been effected. The use of apparatus not adapted for the connection of instruments to make such records should not be permitted by the health authorities.

"The work of science is to substitute facts for appearances and demonstrations for impressions."

THE PRACTICABILITY OF THE COOLEDGE pH TEST IN THE IMPROVEMENT OF A CITY MILK SUPPLY

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The pH method of testing milk is an attempt to measure the activity of those organisms present which influence the keeping quality of the product. The bacterial count of a sample of milk gives but a very rough idea of the time that will be required for the sample to sour. Results have shown that one sample may have a flora consisting of 5 per cent inert organisms, while another sample may have as high as 75 per cent inert organisms. Thus it is possible for a sample of milk containing 500,000 bacteria per cubic centimeter, many of which are inert, to have a better keeping quality than another sample having a low count of very active organisms.

Laboratory experiments show that many samples of milk which would be condemned by city bacteriological standards are actually excellent samples when judged as to keeping quality and type of fermentation which takes place upon standing.

There has come to my notice lately a practice used in a certain milk plant in which representative samples of market milk are incubated at body temperature and left to sour, the time taken for the sample to sour being used as an index of keeping quality. Determinations were made by tasting the samples at various intervals.

The pH method has been simplified recently to such an extent that as many as 350 samples have been given scores in a single day. The test is made as follows:

Neutral broth containing the indicator, Brom thymol

blue, which may now be bought in the desiccated form, is sterilized and 10 c.c. portions placed in a test tube. One tenth cubic centimeter of the milk to be tested is placed in a tube of the broth and incubated. Change in reaction of the broth is measured at intervals by comparing the milk-broth tubes with standards. Thus the activity of the organisms present in the sample is judged by the rate of change in the reaction of the broth. The tubes are incubated not to exceed eight hours.

Occasionally the end of the eight-hour period comes at some inconvenient time. Experiments have shown that the milk-broth preparation may be held at a low temperature for a period long enough to place the final reading after the eight-hour incubation period and at any time desired. For instance, samples of milk obtained at four o'clock in the afternoon may be tested by placing one tenth cubic centimeter of milk in the broth tube, holding the mixture over night at a low temperature, and starting the incubation period at eight o'clock the next morning.

Any method of milk quality judging must be convenient, inexpensive, and reliable if it is to be called practical for use by those interested in milk quality control. The pH method meets these requirements and its usefulness and practicability may be judged by the following:

One of the smaller raw-milk dealers in our city had been having trouble about the middle of the winter with the keeping quality of his milk. His milk supply was produced on seven farms.

Samples of milk from the producers' cans were secured one morning on arrival of the milk at the bottling plant. The broth tubes were inoculated at nine o'clock and incubated. Readings were secured at five o'clock that afternoon. The results showed six of the seven producers to be supplying milk of from good to excellent quality. The seventh producer delivered milk having the poorest of poor keeping qualities. An inspector made a visit to his farm the next morning and

discovered a filthy milking machine and a conical cooler which had not been treated with hot water for a long time. The conditions were remedied during the day, and the milk dealer's supply became normal soon after.

The pH test has been put to practical use in locating "weak spots" in pasteurizing plants. The milk is sampled as it arrives at the plant. Samples are then taken from the weighing can, from the filter, from the holding tank before the coil heaters, after having been heated, after the thirty-minute holding period and just before the cooler, after the cooler, before the bottler and after the bottling and capping operation, and finally from wagons on delivery the next morning.

The results are obtained eight hours after incubation starts, and the remedy can then be applied immediately.

Many times it is believed injustice has been done to milk dealers through the publishing of bacterial counts in newspapers, with a resulting misinterpretation by the readers. To avoid such errors and to give the people of our city a comprehensive idea of the general condition of the milk supply, a form of score card was devised for publication. It was based upon the percentage idea, 100 per cent being perfect. Needless to say, perfection has never been reached. The score value was divided as follows:

Fifty points were allowed for keeping quality, based upon the pH keeping quality test; twenty points for sanitation of the milk-bottling plant; twenty points for the condition of the official samples collected; and ten points for butterfat content, 4 per cent milk and above being given full credit.

In scoring milk-bottling plants the following points were considered: cleanliness of utensils, cleanliness of employees, absence of flies, cleanliness of containers, general appearance of the entire plant, exposure of milk to contamination, and other features.

Credit was given under the samples score for absence of sediment, cleanliness of bottles and correct labeling.

Weekly milk samples were obtained and scored and inspections were made of each bottling plant at least once each week, sometimes oftener. The data were compiled weekly and published in the papers. Averages were kept for twenty weeks, and the proprietor of the highest-scoring plant was presented with a loving cup, which was to be permanently retained if won three times in succession.

The public became greatly interested and likewise the milk dealers. The operator of one milk plant offered his employees a bonus of ten dollars each if they won the contest. Needless to say, the employees left nothing undone in their endeavors to win the bonus. The physicians became interested and a copy of the data, published weekly in the Health Department bulletin, was mailed each physician in the city.

These data have been compiled now for about two years. Besides being of great interest to the public and milk plant operators, they are very useful in indicating the general trend of the quality of the supply. Curves showing the keeping quality of the supply in graphic form have been made and posted in our office. When the curve has a tendency to dip toward the questionable point, more time is spent on the milk supply.

Collection of milk samples takes about six man-hours a week, laboratory tests about six man-hours per week by a technician, and compilation of data about four man-hours. Thus, for a total of sixteen man-hours of work we are able to give to the people of the city a fairly good idea of the quality of the milk. We show to the public the conscientious milk plant operators' results and also the results of those who are inclined to slight the sanitary laws.

The fact that competition enters into the score card results excites the interest of the public and more especially of the milk plant operator. We all know that interest in a horse race or football game is generally inspired by the

competition of the contestants; likewise in our score card results the dealers are edged on by the competitive idea. It is not claimed that this score card method is a solution for all the ills of a city milk supply, but it has proved very beneficial in our city of 130,000 population, in which the milk is distributed by twenty licensed dealers.

One of the smaller dealers has recently asked us to grade his producers' milk by means of the pH test, he being willing to pay a premium for milk of good keeping quality. Undoubtedly this will be done for a short time, although we know full well that it is impractical for a department such as ours to continue this method for any considerable time. We believe the interest excited among producers will be reflected in the production of a better grade of milk, and that the methods of producing it will be remembered for a long time by the producer.

In conclusion, it is our belief after two and one half years' experience with it, that the pH method of testing milk is reliable, rapid and inexpensive. Its easy results are readily comprehended by most people who use milk and who are interested in securing a supply of satisfactory sanitary and keeping quality.

"Satisfaction always comes to the person who has accomplished something through effort."

REPORT OF COMMITTEE ON FOOD VALUE OF MILK AND MILK PRODUCTS

PROF. IRA V. HISCOCK, *Chairman*

The primary purpose of this report is to refer to recent data which have been assembled by recognized investigators concerning the unique food value of milk, and to urge that efforts be directed toward the stimulation of increased milk consumption in those communities where modern methods of milk supervision have now been successfully employed. Consideration will also be given to the food value of certain milk products, and to the effects of various procedures designed to improve the sanitary quality of milk without seriously diminishing the food value of the product.

The Committee on Food and Nutrition of the National Research Council, April 3, 1920, called attention to the fact that the milch cow returns in human food which she yields a very much larger share of the protein and energy of the feed she consumes than does the beef animal. Dr. Armsby, in the *Yale Review,* January, 1920, also pointed out that the dairy cow possesses the highest efficiency of any domestic animal, both as regards conversion of food into milk and availability of the product to man.

Continued investigations over a long period of years and practical experience have given conclusive evidence that cow's milk contains all the essential food elements in a form which is easily assimilated. It is considered a most suitable food for consumption by man and indispensable in the diet of infants and invalids. Careful studies of the relative merits of artificial and breast feeding for infants indicate the superiority of the latter, and we agree that breast feeding of infants should be encouraged whenever possible. For

infants who for one reason or another can not be breast-fed, however, properly modified cow's milk remains the most popular.

Studies of the value of different grades of milk in infant feeding by Washburn and Jones[1] suggest that the size of fat globules has no practical bearing on the relative value of milk in infant feeding. The alleged superiority of Holstein milk, if really existent, seems from these studies more likely to be due to its low fat content than to the size of its fat globules. This report also discusses the observation of writers touching infant feeding and the testimony of pediatricians concerning broad principles which may be laid down.

Recent reports of nutrition experts both in this country[2] and in Great Britain[3] lay considerable emphasis on mineral elements in the diet. Milk is the best protein food for children and is an important source of calcium and vitamins. As stated in last year's report, the low iron content of milk is its most marked deficiency, and consequently a child should not be confined too long to milk as its sole food.

It is recognized that a young, growing, active animal requires a larger proportion of protein in its food than does an older animal. Several studies have been made of the protein requirements of farm animals. These have shown that certain vegetable proteins, such as are found in the maize kernel, fail to promote growth effectively unless supplemented by added nutrients.

In studies of the relative value of certain proteins and protein concentrates as supplements to corn gluten in an otherwise adequate ration for rats, Osborne and Mendel utilized various proteins, including casein, lactalbumin,

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[1] Washburn, R. M., and Jones, C. H. Studies of the Values of Different Grades of Milk in Infant Feeding. Bulletin 195, Vermont Agricultural Experiment Station, Burlington, Vt., 1916.

[2] Report of Committee on Nutritional Problems, Am. Jour. P.H., *14*, 513-517, 1924.

[3] Special Report No. 38, revised 1924, Medical Research Council, London, England.

edestin, cotton seed protein, cotton seed flour, soy bean flour, and "milk albumin," beef tissue, fish meat meal, corn meal cake, "vegetable albumin flour," brewer's grains, distiller's grains, pea meal and peanut meal. The authors note that "the efficiency of these supplements presumably depends essentially upon their relative content of lysine and tryptophane; for the addition of amino acids, either as such or in the form of proteins yielding them, renders corn gluten suitable for growth." Of the various proteins employed to supplement the inefficient corn gluten, lactalbumin was found to be the most effective. Lactalbumin, as ordinarily employed, is a mixture of the coagulable proteins, including both the albumin and globulin that remain in milk after removal of the fats and casein by precipitation with acid.[4]

In view of certain questions [5] raised concerning the experiments above reported, Osborne and Mendel [6] recently extended their observations by experiments which attempted to exclude as far as possible any extraneous sources of protein that might act to supplement the milk protein used. The growth result of a number of feeding trials furnishes additional evidence to indicate that lactalbumin is a protein of comparatively good nutrient quality under dietary conditions in which the supply is adequate.

The Committee on Nutritional Problems of the American Public Health Association, in its last report, called attention to the lack of calcium in the various forms and products of grains and other seeds which constitute so large a part of the food intake of man in the temperate regions. This is true of all fats, meats, and nearly all sweets. It was

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[4] Osborne, T. B., and Mendel, L. B. The Relative Value of Certain Proteins and Protein Concentrates as Supplements to Corn Gluten. Jour. Biol. Chem. *29*, 69-92, 1917.

[5] McCollum, E. V. The Newer Knowledge of Nutrition, New York, 2nd edition, 1922, p. 70; and McCollum, E. V., Simonds, N. and Parsons, H. T. Jour. Biol. Chem., *37*, 289, 1919.

[6] Osborne, T. B., and Mendel, L. B. The Nutritive Value of Lactalbumin. Jour. Biol. Chem., *59*, 339-345, 1924.

stated in the report of this committee that the calcium requirement is a little over one one-hundredth of the protein requirement, and the need for a margin over actual requirement as a "factor of safety" would seem to be at least as great in the case of calcium as of protein. A study of American dietaries, however, indicates that most Americans "carry a much larger insurance as regards protein than as regards calcium."

Milk is unique in furnishing more calcium than any other common food. The studies of Sherman and Hawley [7] have shown significantly that on an ordinary diet containing daily 750 grams of milk and furnishing a total of from .74 to 1.02 grams of calcium a day, children from 3 to 13 years of age secured from 0.15 to 0.62 grams of calcium a day, the amount being approximately proportional to the size of the child and averaging 0.01 grams of calcium per kilogram of body weight daily. When the daily allowance of milk was increased to 1,000 grams, the storage of calcium was increased. The results obtained indicate that optimal storage of calcium is made when the diet contains one quart of milk a day for each child.

Previous reports of this committee and of other committees on nutrition give ample evidence that the benefit of a liberal allowance of milk is not due to the calcium alone but to its well-balanced proportions of calcium, phosphorus, and other growth essentials.[8]

That milk is an important source of vitamins is now generally recognized, and last year's report of this committee contained a somewhat extensive review of the literature. It has also been clearly demonstrated that the presence of these elements in the diet is absolutely necessary

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[7] Sherman, H. C., and Hawley, Edith. Calcium and Phosphorus Metabolism in Childhood. Jour. Biol. Chem., *53*, 375, 1922.

[8] Sherman, H. C., and Crocker, J. Growth and Reproduction upon Simplified Food Supply. III. The efficiency of growth as influenced by the proportion of milk in the diet. Jour. Biol. Chem., *53*, 49-52, 1922.

for growth, proper functioning and maintenance of health.[9] In diets deficient in vitamins, certain "deficiency" diseases have been known to develop, such as scurvy, beri beri, a severe nervous and intestinal disorder, and zerophthalmia, a severe eye inflammation.

The effect of diet on changes in flow of milk and its composition have been extensively studied. In a careful review of the literature, Meigs [10] has stated that both the milk yield and the composition may be considerably influenced by changes in the ration. With regard to the vitamins, Mendel states [11] that "there is more or less evidence tending to indicate that changes in the vitamin content of the diet influence directly the concentration of the vitamins in milk." Apparently in this respect feed may be quite as important as breed for the quality of the milk secreted. Particularly does this seem to be true for the antiscorbutic potency and the content of vitamin A in cow's milk. These important conclusions should be recognized, especially in regulating the diet of children in order that possible deficiencies may be supplemented. For example, in the case of infant feeding consideration should be given to the value of fruit and vegetable juices to supplement the antiscorbutic vitamin present in milk in variable amounts, whether or not the milk be pasteurized.

The problem of stability of vitamins A, B and C in milk to heat treatment has been studied extensively by various workers. This question is of such importance that a summary table of results and sources of these data has been prepared, and is included for those interested in studying the subject further, as an appendix to this report. It

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[9] McCollum, E. V., The Newer Knowledge of Nutrition, New York, 1918. Osborne, T. B., and Mendel, L. B., Ophthalmia and Diet Jour. A.M.A., 76, 905, 1921. Sherman, H. C., The Fat-soluble Vitamin in Relation to Health. Nation's Health, 5, 682, 1923.

[10] Meigs, E. V., Milk Secretion as Related to Diet. Physiological Review, 2, 204, 1922.

[11] Mendel, L. B. Nutrition; The Chemistry of Life. Yale University Press, New Haven, 1923, p. 109.

should be pointed out, however, that information on this subject is still incomplete and that this table gives only a partial list of studies which have been undertaken.

PASTEURIZED MILK

Inasmuch as milk is a vital food for which there is no adequate substitute, it is imperative that safe milk be at all times available for the public. Milk is also an excellent medium for bacterial growth and must, therefore, be produced and handled under the most favorable conditions of modern sanitation. Pasteurization by the holding process is the most reliable safeguard at present available for practical use in communities. Realizing that the production of clean, safe milk is essential, the dairy industry is cooperating with various agencies to improve the milk supply and to safeguard further this essential food by proper pasteurization. The National Dairy Council has published a summary of the opinions of many leading scientists, physicians and welfare organizations on this subject. It is generally considered that pasteurization is not a substitute for sanitation but should be coupled with adequate supervision at the source and at the milk plant. No epidemic of disease has ever been traced to properly pasteurized milk.

A recent editorial in the American Journal of Public Health [12] deals so effectively with certain aspects of this subject that it is quoted somewhat in detail.

"The discovery of vitamins and the alleged injurious effect of heat on these accessory food substances has given another point for argument to the objectors, and the danger of scurvy from heated milk is being used as an argument against the pasteurization of milk. The growth-promoting vitamin is not affected by ordinary pasteurization, and there is much difference of opinion on the effect which pasteurization has in lessening the antiscorbutic factor. There are instances which cannot be doubted of what might be called

[12] Am. Jour. P. H., *14*, 700, 1924.

epidemics of subacute infantile scurvy in children fed on their mother's breast who suffered from scurvy. It is also to be borne in mind that at best cow's milk is classed amongst those food stuffs which have a low antiscorbutic value, and there are outbreaks recorded by reliable authorities of widespread scurvy occurring in children who had for at least six months prior to the outbreak taken one pint of fresh milk per day, but whose diet otherwise was deficient in fresh meat and vegetables. Recent work in England and in this country has shown that the essential factor in destruction of vitamin C is oxidation and not heat. At any rate, the prevention of scurvy by orange juice, tomatoes, or certain other products is so cheap and easy and so sure in action, that the certain risk of tuberculosis or diarrheal diseases from unpasteurized milk cannot be balanced against the possible danger of scurvy through heated milk. At the Lister Institute, Dr. Zilva has succeeded in separating and concentrating the antiscorbutic factor of lemon juice to such an extent that it is now possible to reduce the total solids from about 9 per cent to about 0.04 per cent without appreciably diminishing the antiscorbutic activity. It is now possible to store concentrated antiscorbutic preparations for considerable periods without any loss in potency. The most recent publication on the matter gives exactly the same vitamin content for pasteurized milk as for fresh cow's milk in summer. It must be borne in mind, as is pointed out in this same publication, that cow's milk in winter may be low in vitamin A, and very low in vitamin C, and it is well known that cows may be fed on a diet which seems perfectly satisfactory to them, and which maintains their health, yet produces milk which is practically free from vitamin A."

"The study made by the New York City Board of Health on children fed at the fifty-five municipal milk stations in that city demonstrated the tremendous value of pasteurization in combating diarrheal diseases of infants, and

showed also that these children gained weight regularly. It has also been demonstrated that pasteurization kills the tubercle bacillus and makes a milk which would otherwise be dangerous a safe food for infants and children."

BOILED MILK

Many pediatricians recommend for infant feeding that a high grade of raw milk be secured and boiled at home. The practice of boiling milk is a common form of treatment utilized in England. Milk properly treated in this way is said to be readily digestible by infants.

DRIED MILK

Milk powder consists of either whole or skim milk which has been deprived of its water. The value of dried milk powder as food for adults and older children as well as infants was discussed somewhat in detail in last year's report. Reference should also be made to the valuable report of the Committee on Nutritional Problems of the American Public Health Association.[13] Supplee has studied the progress of the powdered milk industry and reports that in 1914, the per capita consumption of dried milk was the equivalent of 1.1 quarts of normal fluid product; in 1918,

[13] Am. Jour. P. H., *12*, 113-116, 1922; and the following studies on dry milk products:

Redfield, H. W. Special report, "Remade Milk and Cream," contributed at special conference, International Association of Dairy and Milk Inspectors, April 26, 1919.

Reports to the Local Government Board on Public Health and Medical Subjects, New Series No. 116, H. M. Stationery Office, London, 1918.

Hess, A. F., and Unger, I. J. Factors Affecting the Antiscorbutic Value of Foods. Am. Jour. Dis. of Children, *17*, 221-240, 1919.

Hart, E. B., Steenbock, H. and Ellis, N. R. Antiscorbutic Potency of Milk Powders. Jour. Biol. Chem., *46*, 309-318, 1921.

Hess, A. F., Unger, L. J., and Supplee, G. C. Relation of Fodder to the Antiscorbutic Potency and Salt Content of Milk. Jour. Biol. Chem., 45, 229-235, 1920.

Supplee, G. C., and Ashbaugh, V. J. Bacterial Content of Milk Powder. Jour. Dairy Science, *5*, 216-228, 1922.

Kennedy, Cornelia. Vitamins in Preserved Milk. Abstract presented, World's Dairy Congress, Syracuse, N. Y., 1923.

it was 1.4 quarts, and in 1920, it had increased to 2.4 quarts. The actual increase in quantity may be relatively small, but the increase of over 100 per cent in seven years is most significant.[14] Blackham also states that during the past fifteen years a remarkable increase in the use of dried milk for infant feeding has taken place in the United Kingdom.[15]

The research department of the Dry Milk Company has recently completed a nutrition project with school children wherein the object was to determine the value of dry milk (Dryco brand, a dry milk with reduced fat content manufactured by the Just double-roller process) as a corrective for malnutrition. A search of the literature reveals no instance where dry milk has been used very extensively for this purpose among children of school age. While the results of this work have not yet been published,* preliminary observations indicate that reconstituted dry milk made by the Just process is suitable and highly satisfactory as a corrective for malnutrition of the younger school ages.

FILLED MILK

Filled milk is skim milk emulsified with some vegetable oil, usually coconut oil. While it is equal in energy or caloric value to ordinary milk, it lacks the growth vitamins of cream and is not advised for babies and children. The recent passage of the Voigt bill is a measure of considerable importance in reducing the production and sale of filled milk.

EVAPORATED MILK

Canned milk is a milk of which part of the water has been evaporated, and is of two types: sweetened and unsweet-

[14] Supplee, G. C. Progress of the Powdered Milk Industry. Am. Food Jour., March, 1923.

[15] Blackham, R. I. The Development of Dried Milk as a Food. Abstract presented at World's Dairy Congress, Syracuse, N. Y., 1923.

*A report of these studies will appear in an early number of *The Nation's Health*.

ened. The antiscorbutic and antineuritic vitamins and some of the mineral elements of the original milk are lessened, but it may be used as a food if fresh milk cannot be obtained. Its use is not recommended if an abundant supply of fresh cow's milk is available.

PROTEIN MILK

Since the introduction of eiweissmilch by Finkelstein, the use of some form of protein milk in digestive disturbances of infancy and early childhood is becoming more and more generalized, particularly in Europe. In America its adoption has been somewhat slow. Protein milk is essentially a calcium caseinate, produced from the milk by precipitating the casein therefrom by means of rennet or other protein coagulant, and rendered soluble by neutralization with calcium hydroxide and subsequent evaporation to dryness. [16] Benefits derived are due essentially to its high protein and low fat and sugar content, and the presence, in some, of lactic acid organisms.

However, protein milk is not a permanent food, and while its use is said to be beneficial for the period of the disturbance, it is not to be continued longer than necessary, usually not more than five or six weeks. Since its food value is but small, having a caloric value of only about 12 calories to the ounce, some forms of carbohydrate should be added as soon as feasible. It is said to be dangerous to continue the protein milk more than one or two days without the addition of some sugar, for while the intestinal symptoms may improve under its use, the harm done to the nutritional status of the child would more than overbalance the benefit upon the symptoms.

The percentage of fat in protein milk depends upon the quality of the milk used in its preparation. If a lower fat content is desired, skimmed milk or buttermilk may be used

[16] Blau, Arthur I. The Use of Protein Milk in Pediatrics, N. Y. Med. Jour. and Rec., April 2, 1924.

in part, or instead of the milk. The use of buttermilk is considered particularly advisable in some cases, where a stronger lactic acid bacterial content is desired.

"Protein milk is indicated wherever there is a favorable medium in the intestinal canal for the work of acid-producing bacteria, as is found in fermentative diarrheas"

BUTTER

Butter is made from the cream or fat of the milk and it also contains a small per cent of the other constituents of the milk. It is a superior form of fat, because it is made from milk which has valuable growth and antiophthalmic vitamins in it. Reports from Denmark [17] have shown that a disease, keratomalacia, which chiefly affects children, and xerosis of the conjunctiva without keratomalacia, attributed to a diet poor in the fat soluble vitamin A, are due to the substitution of margarine for butter and of skimmed milk for whole milk. This committee, in accord with the Committee on Pasteurization of Milk and Milk Products, desires to emphasize the importance of the pasteurization of all cream used to make butter.

BUTTERMILK

Buttermilk and artificially soured milks are wholesome foods and are more easily digested by some than plain milk. Buttermilk, which is the product left from the cream after it has been churned to butter, lacks the fat with its growth-promoting vitamins and has not the energy or caloric value of whole milk.[18] A large portion of the buttermilk sold to the consuming public at the present time is made from skim milk to which a "starter" has been added. The energy value and the vitamin value of fermented milks depend upon whether they are made of whole or skimmed milk.

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[17] The Lancet, June, 1924, p. 1218.

[18] Peters, L. H. Diet for Children, Dodd, Mead and Company, Inc., New York, 1924.

Much of the buttermilk left after churning butter is now dried and used in that state. Calves fed on condensed and powdered buttermilk in place of skimmed milk have been shown to make satisfactory growth,[19] and during the experiment to be unsually free from sickness or digestion troubles.

ACIDIFIED MILK

One of the important additions to infant feeding during the last year seems to be the more extensive use of lactic acid milk and corn syrup.[20] The value of milk acidified with lemon juice has been studied by Hess and Matzner,[21] but space does not permit an adequate discussion of this question here.

ACIDOPHILUS MILK

Considerable interest has been manifested within the past six years in acidophilus milk, chiefly because of the favorable therapeutic results obtained by different observers.[22] It has been demonstrated that the amount of lactose or dextrin required to cause practically complete simplification of the fecal flora could be reduced by one half, provided living cultures or suspensions of *B. acidophilus* were given along with the carbohydrate. To quote from a recent paper by Professor Rettger:

"Acidophilus milk, when properly prepared, is especially appropriate as an agent involving the acidophilus principle—that is, for curative and therapeutic purposes in connection with intestinal and related ailments.

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[19] Eckles, C. H., and Gullickson, T. W. Condensed and Powdered Buttermilk for Dairy Calves. Jour. Dairy Science, *7*, 213-221, 1924.

[20] Moffett, Rudolph Duryea. Progress in Pediatrics. Review of the literature for 1923 on infant feeding. Amer. Jour. Dis. of Children, *27*, 618-632, 1924.

[21] Hess, A. F. and Matzner, M. J. The Value of Milk Acidified with Lemon Juice. J. A. M. A., *82*, 604, 1924.

[22] Rettger, L. F., and Cheplin, H. A. (a) A Treatise on the Transformation of the Intestinal Flora. Yale University Press, 1921. (b) Bacillus acidophilus and its Therapeutic Application. Archives of Inter. Med., *29*, 357, 1922.

"Because of its smooth, creamy character, and pleasant odor and taste, it should also establish itself as a valuable beverage. The chief obstacles lie in the difficulty of preparation. However, these difficulties have been successfully overcome by the use of proper facilities, including a careful and able operator, and by close supervision of a trained bacteriologist.

"Unless these proper facilities are available, attempts to produce satisfactory acidophilus milk will certainly result in failure. The manufacture of this product should be limited to those who are able and prepared to undertake it, since unsuccessful production of the milk—that is, an acidophilus milk which has "off" tastes and odors due to contaminating bacteria, will of necessity prejudice the consumer against the product and do the acidophilus principle irreparable harm.

"The successful commercial production of acidophilus milk on a large scale as a beverage and therapeutic agent will be of practical significance to the dairy industry. It should establish an outlet for skim milk and dessicated milk, the economic disposal of which has always been, and still is, a very serious problem. That a satisfactory uniform acidophilus milk can be produced commercially has been already thoroughly established. The widespread use of lactose for regulating bacterial conditions in the intestinal tract also has an important bearing on dairying. Lactose is one of the most valuable foods for man, and anything that will bring it into prominence as a food alone, like ordinary table sugar, or as a therapeutic agent, can not but be of value to those who are financially interested in the production of milk and other dairy products."[23]

BUTTER FLOUR MIXTURE

All over Europe where there has been a deficiency of milk, the Czerny-Kleinschmidt butter flour feeding has

[23] Rettger, L. F. Lactic Acid Bacteria with Special Reference to the *Bacillus acidophilus* Type. World's Dairy Congress, 1923.

gained in popularity. Articles by Gismondi, Lecoq, Ernberg, Lowenburg, Hamburger, Schwartz, Kasteele, Poulsen, and Becking describe methods [24] of preparing butter flour, as laid down by Czerny-Kleinschmidt in their article in 1918. In reviewing the literature on this type of feeding, however, one is inclined to feel that in this country the necessity for the use of this preparation is not as urgent as in Germany, where the butterfat content of milk is usually so low that the addition of butter becomes a necessity.

CHEESE

Cheese is a good food because it is a concentrated product of milk, and therefore very high in complete proteins and the valuable mineral elements, especially lime.

ICE CREAM

Ice cream today is classified as a food instead of a luxury, and legal standards exist for its composition, purity and the sanitary conditions under which it is to be manufactured. The importance of pasteurization of milk and cream used in the manufacture of ice cream should be emphasized. It is wholesome if made from clean milk and cream and other ingredients. Ice cream varies so much in its proportion of cream that its food value varies accordingly. If eaten in moderation and eaten slowly enough so that it is melted before it reaches the stomach, it is an excellent food and may be eaten by invalids.

DESIRABLE PER CAPITA CONSUMPTION OF MILK FOR A COMMUNITY

Reference has been made in an earlier section of this report to the interesting studies of Sherman and his co-

[24] Hamburger, R. Further Experiments with Butter-flour Feedings. Monatschr. f.Kinderh., *25*, 254, 1923.
Schwartz, A. B. The Present Status of Infant Feeding with the Butter-flour Mixture of Czerny-Kleinschmidt, Wisconsin Med. Jour., *21*, 539, 1923.

workers to ascertain what is the ideal daily milk consumption for American people. It may be appropriate at this time to quote from the recent report of the Committee on Nutritional Problems of the American Public Health Association, of which Professor Sherman is chairman:

"In view of the fact that most physicians who have given careful attention to the subject recommend a quart of milk per day for every child, while some believe that a pint per day may do as well, the New York Association for Improving the Condition of the Poor undertook, with the cooperation of the Department of Chemistry of Columbia University, an extended series of carefully controlled experiments upon normal children of various ages for the optimum storage of calcium and phosphorus in the body of the growing child, and therefore, presumably, for the best development of bones and teeth, and, second, to what extent the needed calcium can be obtained from vegetables as well as from milk. The results of these experiments lead to the conclusion that throughout the entire time of rapid growth, that is, up to at least the age of thirteen years, the child should receive in some form the equivalent of a full quart of milk per day in order to provide for an optimum storage of calcium as well as of phosphorus. Equally good results could not be secured in any of the many experiments in which one-half of this milk was replaced by vegetables furnishing an equal amount of calcium. A liberal allowance of vegetables in the dietary is desirable for other reasons, but does not diminish the importance of a quart of milk per day for every child."

How far is the American people from realizing the ideal daily milk consumption? Data supplied by the Department of Agriculture indicate that in 1900, the urban and suburban population of the United States purchased about 0.5 pint of milk per capita daily. In 1920 the amount had risen, according to the same authority, to 0.9 pint daily, and in 1923 to over one pint. Reports compiled by organi-

APPENDIX—TABLE

Summary of A Partial List of Observations on the Effect of Heat on Vitamins in Milk and Milk Products

A. Stability of Vitamin A in Milk and Butter Fat

Heat Treatment	Substance	Results	Authors	
Live steam passed through 2½ hours	B. F.	No loss of Vit. A indicated in rats	Osborne & Mendel	Journal Biological Chem. 1915-20-379
Aerated 12 hours at 212°	B. F.	Total loss of Vit. A	Steenbock, Boutwell & Kent	Journal Biol. Chem. 1918-35-517
Heated ¼ hour at 212°	B. F.	Vit. A. destroyed	Drummond	Biochemical Journal 1919-13-81
Live steam passed through 6 hours	B. F.	No loss of Vit. A.	Drummond & Coward	Biochemical Journal 1920-14-734
Commercially canned	Evaporated and sweetened cond. milk	Retained the Vit. A. in almost its original potency	McCollum	Boston Medical and Surgical Journal, May 5, 1921
Commercially dried	Milk	Vitamin A was undiminished	Hume	Biochemical Journal 1921-15-20

B. Stability of Vitamin B in Milk

Heat Treatment	Substance	Results	Authors	
Heated 2 hours at 257°	Fresh milk	Fowls fed on this and polished rice all gained in weight as on fresh milk	Gibson & Conception	Journal Science, Series B, 11, 119
Boiled 1, 10 and 45 minutes at 237° F.	Fresh milk	Rats grow slowly and do not reproduce	Daniels & Stuessy	American Journal, Diseases of Children, 1916-11-45

Heated quickly to boiling, boiled 1 minute	Fresh milk	Rats grew normally and reproduced	Daniels & Laughlin	Journal Biol. Chem. 1920-44-381
Brought to boiling in 35 minutes, boiled 1 minute	Fresh milk	Rats grew only half normally and did not reproduce	Daniels & Laughlin	Journal Biol. Chem. 1920-44-381
Heated 30-40 minutes at 149-180° F.	Fresh milk	Rats grew poorly	Daniels & Laughlin	Journal Biol. Chem. 1920-44-381
Commercially canned	Evap. and sweetened cond. milk	Vitamin B is retained in almost the original amount	Rosenau	Boston Med. & Surg. Jour., May 5, 1921

C. Stability of Vitamin C in Milk

Heat Treatment	Substance	Results	Authors	
Heated ½ hour at 145° F. Past. in laboratory	Milk	Of six infants fed upon it, none developed scurvy; one child was cured of scurvy after changing to this milk.	Hess	American Journal, Diseases of Children, 1917-14-337
Heating to boiling or higher in hermetically sealed bottles	Milk	Children's specialists in France have reported thousands of babies fed on hundreds of bottles of this milk over course of years with not a case of scurvy.	Hess	Jour. Ind. Eng. Chem. 1921-13-1115
Commercially canned	Sweetened condensed	May retain much of its anti-scorbutic vitamin and be able to cure infantile scurvy.	Hess	Jour. Ind. Eng. Chem. 1921-13-1115
Commercially canned	Nestlé's sweetened condensed	No loss of vitamin evident from feeding monkeys.	Hume	Biochemical Journal 1921-15-163

zations interested in public health indicate considerable variation on this point and the figures for many of the municipalities suggest a much smaller consumption. As stated in a recent editorial of the Journal of the American Medical Association,[25] "these figures will suffice to lend some assurance that there still is abundant occasion for the promotion of public health policies in this direction."

That the nation needs to increase its milk consumption no one can doubt after consideration of such figures as those presented in this report. The fact has been fully established that the average American food supply is one-sided through liberal if not excessive use of meats and sweets and insufficient use of milk, fruits and vegetables in the diet. While it is true that a few persons have an undeniable idiosyncrasy or a fancied dietary grievance against milk, they do not make up the mass of the population. The members of this organization are urged to continue their activities to stimulate the larger use of milk, vegetables and fruit in the American dietary.

The milk inspector's task includes more than supervision of production, for three fundamental truths must be impressed upon the public, namely, (1) the importance of increased milk consumption to reach the desired standard of one quart of milk per person per day; (2) the value of pasteurized milk; and (3) the need for proper care of milk in the home. Practical measures for educating the public along these lines include the use of the press, circulars, bulletins, pamphlets, lectures, exhibits, pageants, essays, posters, special contests, and special activities through nutrition classes and well-directed campaigns.

From data available in a few cities it would seem that per capita milk consumption increases with improved quality of milk supplies. In looking forward to possible lines of activity for this committee during the coming year it has seemed to some of the members that it would be helpful to

[25] Jour. A. M. A., *82*, 2122, 1924.

study further certain factors, such as the cost and the quality of milk distributed in various cities of this country, Canada and Mexico, and the relation of these factors to milk consumption. This should include a study of both standards and results. Information on this subject is already available for many of the large cities.

Those who have not prepared data on bacterial content and butter fat content of raw and pasteurized milk should do so, in order that they may know the quality of their milk. Such data would serve to stimulate interest in this subject and would make the work of our committee educational in its influence.

"Such blessings Nature pours,
O'erstocked mankind enjoy but half her stores."

A SUMMARY OF THE WORK OF THE NATIONAL DAIRY COUNCIL

M. O. MAUGHAN, *Secretary*, National Dairy Council, Chicago, Ill.

No doubt all of you know that during the past five years the National Dairy Council has been quite active. While the Council was organized back in 1915, our activities were held up on account of the war coming on, and the Council did not do active work until approximately five years ago.

Starting with only three of us in the organization, the president, myself, and one stenographer, the work of the Council has grown to a point where we now have 105 people engaged in our educational work. Milk consumption has increased during the past three years from 43 to 53 gallons per person per year.

The work of the National Dairy Council is two-fold: First, educational work to increase the consumption of dairy products, and second, educational work to improve the quality of milk and other dairy products.

We feel that it is equally as important, if not more so, to see that a high quality of milk and dairy products is produced, as it is to educate the people to appreciate the value of these products. We recognize full well that it would be a waste of time to tell of the wonderful qualities of dairy products and at the same time to find that the people are being served with milk of poor quality.

In several of our territories we now have well-established Quality Control Departments to attend to the improvement of quality. In Pittsburgh, for example, of the sixteen workers who are active there, four devote their entire time to work among the farmers and in the receiving stations checking up on the quality of milk produced and teaching the farmer better methods of production.

In Philadelphia there is now a staff of ten men who devote their entire time to this work. Branches of the Dairy

Council in other places are contemplating taking up similar work very shortly.

When we started on quality control we took sediment tests because it was simple and quick and the farmer could see for himself there was nothing mysterious about it. Later on, however, we adopted other tests of quality, principally the methylene blue test and in some cases the plate method of counting bacteria. We are strong for the methylene blue test and find it is working very satisfactorily.

We have been very fortunate in getting wonderful cooperation from the milk dealers in this quality control work. They recognize that they cannot afford to buy poor milk and they will not take the farmer's milk if he persists after he has been given an opportunity to clean up. The farmer is given a certain time in which to improve the quality of his milk and during this period he is given a temporary permit.

The larger percentage of our staff is engaged in educational work among the school children and women's clubs and through the public press. We feel if we can reach the children of this nation, the mothers in their various clubs and meetings, and also get our message in the public press, that we will have accomplished much good.

The Dairy Councils have adopted a very broad program in which we feature the eight fundamental rules of health. One of the rules relates to the brushing of the teeth regularly; another rule—sleep many hours with the windows open; third, take a bath oftener than once a week; fourth, exercise part of every day out of doors; fifth, drink at least four glasses of water each day; sixth, eat some vegetable besides potato every day; seventh, eat fruit every day; eighth, drink milk and eat cereal and milk every day.

We recognize fully that milk will not do everything and we have felt that if we were to go ahead on a purely milk and dairy products program, decidedly selfish in its nature, that we would not get very far. We recognize fully that

there is only one way to succeed—and that is to render a real service. We decided that the only way to render a real service was to tell the whole truth and to teach health through the entire eight rules.

We feel, and in fact know, that we are doing the right thing when we do this.

As a result of our broad program of health, we are receiving a most wonderful response from organizations through which we wish to work. The schools are recognizing that the National Dairy Council is not a commercial organization—far from that—but that it is an educational institution with a wonderful program.

When one stops to realize that approximately one third of the boys and girls are undernourished and that their condition is largely due to an improper supply and kind of food, then one recognizes the wonderful field ahead for the dairy industry. When we recognize that the average consumption of milk in the United States is far below a pint per person, and when the scientific world says it should be a quart, we realize more than ever the wonderful opportunities for service.

Dr. Sherman, of Columbia University, has very carefully outlined the expenditures which the American people now make for food, and furthermore he stipulates very definitely how our money should be spent for better results. He states that the American people are now spending approximately only 20 per cent of their food money for milk and dairy products, while it should, instead, be 44 per cent. The outline is as follows:

The expenditure for food now is:		The expenditure for food should be:	
Meat and fish	35%	Meat and fish	12%
Milk and its products	20	Milk and its products	44
Bread and cereals	15	Bread and cereals	13
Fruits and vegetables	13	Fruits and vegetables	17
Eggs	6	Eggs	6
Sugar	5	Sugar	3
Miscellaneous	6	Miscellaneous	5
	100%		100%

The dairy industry has a most wonderful opportunity for growth, and there is every reason to believe the next few years will see the dairy industry make the most of this opportunity for effective service.

There is a health wave going over the country and people are talking as never before of health and how to acquire it. Even the Rotary Clubs, Kiwanis Clubs, and other clubs are discussing this all-important and very popular question at the present time. Many of these clubs are raising funds to buy milk for the poor children and others are working along other lines. Mothers' clubs, as never before, are becoming enthusiastic over this health work and are learning the "how's and why's."

But most important of all, to my way of thinking, is the changed attitude of the schools. Only a few years ago the schools confined their work to teaching the three R's and a few allied subjects; now, however, the major portion of the schools in the United States are recognizing the importance of teaching health along with the three R's, and they recognize that no child can attain successful mental development without having a sound physical development as well. Most of the schools are adopting health education and are devoting regular periods throughout each day to the discussion of this important topic.

Schools throughout the land are providing scales so that the children can be weighed and measured. Many schools have already adopted the serving of milk to all the children, while others only serve milk to the undernourished children. I have felt since the serving of milk in schools began that this activity was the biggest possible boost for education, for health, and, for the dairy industry. Incidentally it was a long-delayed but a most wonderful public recognition of the value of milk.

The National Dairy Council is doing everything within its power to promote this educational work in the schools and for that purpose we have a vast amount of literature

and other helps. We have something over a dozen milk and health plays, all featuring the importance of milk and other dairy products, as well as other good foods in the diet and their relationship to health. I wish all of you could have seen the "Health Circus" which was put on at the Dairy Show this year. It compares well with any show which you might pay $2.00 or $3.00 to see.

In addition to our health plays, we have developed a large number of interesting stories, games, and demonstrations. One of our demonstrations is called the "American Girl Beauty Products" and in this demonstration all good foods are featured, as well as tooth brushes and other symbols of health habits, and the demonstrator proceeds to tell the audience how to attain beauty in rich abundance. Milk is spoken of as being "Cow's Vanishing Cream." One of the interesting games is the one in which the milk bottle finally chases the coffee pot out of the school room. This provides a lot of fun and is educational as well.

We have a large supply of films, now numbering fifteen, which are ideal for use in the schools, before mothers' clubs, and even before the movie crowds in the cities and towns. One of our films was shown in the great Egyptian Theatre of Los Angeles, which is supposed to be the greatest movie theatre in the world, for a period of seven days free of charge. Sometimes we find it necessary to pay a slight fee to get films shown in the large movie houses, while at other times the movie people are glad to use these films because of the desire of their patrons for occasional pictures which relate to health.

Our display department has assumed large proportions. We receive calls every week, sometimes every day, for some of our mechanical devices and other material to be used in fairs, food shows, etc. Two years ago we built a most marvelous exhibit called "The Land of Health." It was a little over 60 feet in length and about 20 feet in width, and depicted a great land in which were located eight villages,

each village representing a rule of health, to which I referred above. One village was "Tooth Brush Heights," another one "Play Meadows," and the capital city of this great land was "Milk City." This exhibit was shown to hundreds of thousands of people in each of the six leading cities in the United States, including New York City, Chicago, Philadelphia, Detroit, St. Louis, and others.

We receive at our office upwards of fifty letters each day from various schools throughout the country asking for our material to be used in teaching health to boys and girls.

Just a word about how we are financed. The milk producers in our organized territories ordinarily pay one cent on each 100 lbs. of milk which they sell and the milk dealers pay a like amount. The butter men pay 60 cents on each 1,000 lbs. of butter produced and the ice cream men, cheese men, and others proportionately.

Our organized territories now include the following places:

California, Oregon, Iowa, St. Louis territory, El Paso, Texas, territory, Twin Cities territory, Central Ohio territory, Pittsburgh district, Philadelphia territory, Boston territory.

The Council will spend this year, 1924, a little over $500,000.

We solicit your cooperation and support. We want your advice. We want you to feel free to offer suggestions. Whenever the people in your territory are ready for educational work of an intensive nature, we will be very glad to hear from you along this line, and if possible start dairy council work in such territories.

The National Dairy Council renders a service to milk dealers throughout the country in the way of supplying them with pamphlets, booklets, etc., for their individual use to their customers. We also supply them with copy for newspaper ads. We feel that we are rendering quite an extensive service along this line because of the vast amount

of material that we are putting out for them and also because we believe it is material of the right character.

If we are going to increase the consumption of milk we must first of all see that the quality of milk is good, and this should be strictly supervised by the Health Department. Then the dairy industry should tell the public about the wonderful qualities of this most marvelous food. I think you will agree with me on this.

Time will not permit of my going into further detail, but in conclusion I want to say that the work of the National Dairy Council is growing at a tremendous rate and the public is rallying to our support as never before.

"The true joy of living is not in idle leisure,
but in active creation."

A STUDY OF CONTINUOUS-FLOW MACHINES

PART I

C. H. CHILSON, *Director of Dairy and Food Inspection,*
Detroit, Michigan

The necessity for pasteurization of milk supplies has brought into the industry different devices and means for meeting the requirements of this process. The demand of the large dealer for a machine that would pasteurize his supply other than in batches resulted in the use of the continuous-flow types of machines. In some instances the operating principles of the machine made them questionable as to their positive holding, due to a natual condition that accompanies the flow of liquids. In others the operations from a mechanical standpoint have not justified their use. Of the former, there are two types that have come under the writer's observation. One is known as the "long-flow tubular type." It consists of a series of large-size tubes arranged in a boxlike structure. These tubes are connected one with the other at the ends by suitable hinged hoods, so that the milk which enters the top tube of the series flows forward and backward through all of them and is discharged from the lower tube. In this type of holder the flow of milk through the apparatus is quite rapid and this rapid flow tends to prevent diffusion, thus approaching a nearly perfect holding. The other type of this class of holder is known as the "upright-tank holder." The milk enters the top of the holder, flows to the bottom and escapes through a pipe near the top of the holder. In one type of this holder the milk comes up from the bottom through a pipe; in another type the milk comes up on the outside of a core or drum. Two and three tanks are used, milk flowing from one to the other by gravity.

The other types of holders are those automatically operated with gears and valves. If these valves and gears would operate as they are theoretically supposed to, milk could be held the proper time, but in many instances the valves and gears get out of order and the machine will not function properly. Thus there will be by-passing and leakage.

In the last-mentioned type of machines, the faults can generally be detected with the eye. In the other types this cannot be done and some test must be applied to determine their actual holding time. A test * in which water, inoculated with harmless bacteria, is passed through the pasteurizing system seems to give the information wanted. Following the suggestions of the Dairy Division of the United States Department of Agriculture, various continuous-flow holders were checked by this method, which, briefly, is as follows:

The pasteurizing system was filled with water and about two liters of a water emulsion of Prodigiosus (red) organisms were added at the intake of the system. Samples were collected at the outlet at intervals, varying from five to two minutes. These samples were then plated and the growth watched. The results of these tests are shown in the following table:

Kind of Pasteurizer	Time of Holding Indicated by Growth of Organisms on Plates (In Minutes)													
	5	10	12	14	16	18	20	22	24	26	28	30	32	34
Long-flow tubular	—	—	—	—	—	—	—	—	—	—	—	—	+	+
Upright Tanks, gravity flow, 2 tanks	—	—	—	—	+	+								
do (2 tanks)	—	—	—	—	+	+								
do (3 tanks)	—	—	—	—	—	+	+							
do (2 tanks)	—	—	+	+										
do (2 tanks)	—	—	+	+										
do (3 tanks)	—	+	+											
do (2 tanks)	—	—	—	—	—	+	+							
do (3 tanks)	—	—	—	—	+	+								
Vat compartment with automatic poppet valve system.	—	—	+	+	—	—	—							
	—	—	+	+	—	—	—							

This bacteriological test shows that thirty-minute holding is not accomplished with some of the continuous-flow holders. The reason for this is discussed in Part II of this paper, which will be presented by Professor C. O. Wisler, Engineering Department, University of Michigan.

A STUDY OF CONTINUOUS-FLOW MACHINES

PART II

PROF. C. O. WISLER, *Engineering Department,* University of Michigan.

REASONS FOR SHORT HOLDING PERIOD IN UPRIGHT TANK HOLDERS

This paper deals briefly with the cause for the short holding period frequently found in the operation of the "upright tank holder." It is believed that there can be but one cause for this short holding period, viz., short circulating.

By short circulating is meant that the milk upon entering the holder, instead of spreading out and flowing with a uniform velocity over the entire cross sectional area of the tank, seeks the path of least resistance and follows that path at a relatively high velocity, leaving the milk that fills the surrounding space virtually stagnant.

In consequence of this action the cross-sectional area of the moving milk may easily be but a third or a fourth of the cross sectional area of the tank, with the result that the velocity is multiplied three or four times and the time of holding reduced to one third or one fourth of the expected time.

When the design of these tanks is considered, it is apparent that this action is not a phenomenon but is rather what should be expected.

With a velocity of one to three feet per second the milk enters the holder, whose cross-sectional area is usually from one hundred to three hundred times as great as the area of the supply line. Instead of the velocity of the entering stream being reduced to a fraction of one per cent of its original value, the stream impinges against the baffle plate

with nearly the same velocity with which it enters. A considerable portion of the milk passes through the openings near the center of the baffle at only a slightly reduced velocity. That portion passing through the adjacent openings also has a relatively high velocity.

The result is that there is very likely to be a central core or column of milk moving downward with a velocity much higher than that of the surrounding milk. This tendency is further accelerated by the manner in which the milk is drawn off and conducted to the next holder.

In case of the single cylindrical tank, from which the milk is drawn off through a pipe whose inlet is at the bottom of the tank and near the center, it is at once apparent that the shortest path as well as the path of least resistance is straight down the center of the tank.

In the type of holder having a central core from which the flow is outward and upward, with discharge through a small pipe connected at one side and near the top, the tendency is for the lower end of the downward-moving central column to be drawn over to the discharge side of the holder, rising through the outer tank practically only on that side.

This explanation of the short holding period at times found in this class of holders is based upon two of the fundamental laws of the mechanics of liquid; viz.

1. *Any body of liquid in motion at a given velocity will continue at the same velocity until acted upon by some external force.* The type of baffle at present used is not sufficient to break up a velocity of one to three feet per second.

2. *A liquid flowing between two points seeks the path of least resistance.* This path is along the shortest line between the two points and also along that line farthest removed from frictional surfaces.

It is believed these two laws constitute a sufficient and satisfactory reason for the short holding period encountered.

DISCUSSION

Dr. Price: We know practically that such apparatus does not hold the pasteurizing temperature for the proper time. For this reason I feel it better to abandon rather than attempt to correct this type of pasteurizing apparatus, especially in view of other apparatus that is preferable.

Prof. Wisler: Variation in temperature of a liquid would produce a different rate of flow through the apparatus.

Mr. Ralph E. Irwin, Harrisburg, Pa.: Tests were made in Pennsylvania with water at a low temperature. The same apparatus was later used with milk with the color test. We found with either water or milk that liquids were held only a short and variable time. There are so many variations in the results in the use of such apparatus that I would be sorry to see any manufacturer putting out this type of apparatus.

Dr. Grim: Variations in temperature have a marked effect on the flow of liquid. No milk can properly be called pasteurized unless it is held at pasteurizing temperature for not less than thirty minutes and so recorded.

Dr. Harding: I believe we should discourage the installation and use of this type of apparatus wherever we can do so.

"Every absurdity has a champion to defend it, for error is always talkative."

TESTS OF CERTIFIED AND PASTEURIZED MILK FOR B. COLI-LIKE COLONIES ON ENDO MEDIUM

F. O. ADAMS, Laboratory, Detroit Department of Health

AND

ARCHIBALD R. WARD, Dairy Research Division, The Frederick C. Mathews Company, Detroit, Michigan.

The use of *B. coli* tests in connection with efforts to improve milk supplies first came into prominent notice in connection with the administration of the Federal Pure Food Law. Extensive effort was made to prove that certain samples of milk and ice cream were adulterated in that they were composed in whole or in part of filthy, putrid and decomposed animal or vegetable matter. Effort was made about a decade ago to secure convictions under this act by evidence establishing the fact of such technical adulteration by means of results of total bacterial counts and results of *B. coli* tests. The evidence submitted by the prosecution endeavored to show that the presence of *B. coli* conclusively proved that fecal contamination of the product had occurred.

This in turn was followed by an intensive study by the Dairy Division [1] of [2] the Department of Agriculture which confirmed the conclusions of Professor S. C. Prescott [3] and others that germs reacting to the ordinary tests for *B. coli* are very widely distributed in nature, and are in nowise restricted to the intestinal tract of animals. In connection

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[1] L. A. Rogers, William Mansfield Clark and Alice C. Evans. The Characteristics of Bacteria of the Colon Type Occurring on Grains. J. Inf. Dis., Vol. 17, 1915, p. 137.

[2] S. Henry Ayers and Paul W. Clemmer. The Significance of the Colon Count in Raw Milk. U. S. Dept. Agr. Bul. 739, 1918.

[3] S. C. Prescott. The Source and Significance of *Bacillus Coli* in Milk. Proc. Sixth Ann. Convention, Int'l Milk Dealers Assoc., 1913, p. 36.

with these same studies it was shown [4] that many of the *B. coli* strains are sufficiently heat resistant to survive milk pasteurization.

In connection with many other studies it was shown that *B. coli* is almost universally present in milk and other food substances.

It is quite natural that in the light of these findings interest in the presence of *B. coli* in milk as an index of carelessness declined, and for some years *B. coli* tests of milk were rarely mentioned.

About a year ago Brown and Gott,[5] of the Kentucky Public Service Laboratory, published on the use of Endo's medium for making *B. coli* tests of milk. They concluded that "milk does not necessarily contain *B. coli* and can be produced free from such contamination."

Their conclusions and data suggested the desirability of our studying the occurrence of *B. coli* in high-grade milk. The details of this work will be given elsewhere, and only a bare summary of results will be given here.

Of 39 samples of pasteurized milk collected by the Detroit Milk Inspection service, 56 per cent showed *B. coli* on Endo plates when one cubic centimeter of the milk was plated direct. Similarly, of 42 samples of certified milk collected by the same agency, 33 per cent showed *B. coli* colonies on Endo with one cubic centimeter plated direct.

This percentage of samples of pasteurized milk showing *B. coli* is, as would be expected, considerably lower than results reported by Vance [6] for raw milk in Kentucky. The samples showed total bacterial plate counts varying from 100,000 to 1,000,000 per cubic centimeter, with cor-

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[4] S. Henry Ayers. The Present Status of the Pasteurization of Milk. U. S. Dept. Agr. Bul. 342, p. 20.

[5] Linwood A. Brown and Edwin J. Gott. Use of Endo's Medium in Locating Milk Contamination. Am. Food Jour., Vol. 18, 1923, No. 6, p. 295.

[6] Sarah H. Vance. A Clean Milk Supply for a Small Town. Twelfth Ann. Rep't, Int. Assoc. Dairy and Milk Inspectors, 1923, p. 231.

responding percentage of positive *B. coli* counts that varied from 64 to 100 per cent.

When our samples of milk were incubated 24 hours at 37.5° C., and one cubic centimeter added to the Endo plates, B. coli-like colonies appeared in 97 per cent of the certified milks. From these results it would seem that B. coli-like organisms are practically always present in the Detroit milk supply. Evidently whether we find *B. coli* in milk or not depends primarily upon the laboratory technic employed.

Therefore, whether or not a sample is to be condemned depends upon selection of the method of testing. This involves setting a standard under circumstances singularly void of evidence showing that the presence or absence of *B. coli* corresponds to significant differences in amount of manure present, if at all.

The destructively weak point in the so-called *B. coli* count is that it does not indicate the presence of *Bacillus coli* of fecal origin alone, but the presence of any member of a large group of germs, some of which are positively known to be widely distributed in nature and not necessarily of fecal origin.

These facts have been generally known for a decade; so long, that discussion of the subject has practically ceased. The younger generation of bacteriologists, only, includes an occasional individual who is unaware of the discredited status of *B. coli* determinations.

"Truth is afraid of nothing but concealment."

THE FUNCTION OF THE STATE IN MILK SANITATION

LESLIE C. FRANK, *Associate Sanitary Engineer,* U. S. Public Health Service, Montgomery, Alabama.

In September, 1922, the State Health Officer of Alabama, becoming convinced of the need for better milk sanitation in the various cities of that State, requested the United States Public Health Service to formulate a milk sanitation program for the State. The Surgeon General consented and the State of Alabama is now carrying out the program formulated.

An inspection of the existing conditions in the cities of the State of Alabama disclosed the fact that a number of the cities had no milk legislation of any kind; that of the ordinances which were in effect no two were alike; that only one or two cities were really enforcing milk legislation; that in the several cities which were really enforcing milk legislation the dairy industry and the health authorities were in almost constant conflict; and that in one of these cities the friction had become so great that the dairymen had taken the health officer to the woods and beaten him unmercifully.

Certainly not an encouraging picture! There could be no question as to the need for an adequate remedy. Why was it that so few of the cities attempted proper milk sanitation? What was the cause for the great variation in types of milk legislation? Why was there so much friction between the health departments and the dairy industry when the former attempted to enforce milk control?

It soon became apparent that one of the principal factors responsible for these conditions was the absence of any coordinating and directing agency in the State. The majority of smaller and middle-sized and some of the larger

communities in most States have failed to reach an adequate standard of milk sanitation partly, at least, because the health and other officials are bewildered by the different kinds of milk legislation now extant in this country. Very few local health officers have special training in milk sanitation and it is accordingly not to be wondered at that, observing so many different practices, they hesitate and in most cases fail to act.

Where local health officers have conceived the necessity of some kind of control, the lack of any expressed unity of thought among authorities in general has engendered the practice of creating patchwork ordinances. They have each independently brought together the ordinances from a number of cities and chosen sections here and there to suit the individual taste. The result has been, of course, a hodge-podge of milk legislation.

This great diversity of methods of milk control has naturally led dairymen to resist milk legislation because they considered that legislation to be the invention of their particular health officer and hence a menace aimed at them by an individual rather than a rule of dairy conduct accepted and enforced by health officers in general throughout the State or country, and it has resulted in an unfortunately large number of court decisions unfavorable to Health Departments.

This state of affairs seems bound to continue until some coordinating agency arises to correct it. So long as most city health departments are forced to confess to the dairy industry and to the courts that the practice of milk sanitation is anything but uniform in the United States, so long will the dairy industry and the courts conceive that among all of the varying practices some must be wrong, and that very possibly their own city may be wrong.

It seems reasonable to believe that if the milk legislation and control of a given State, or, better still, of the United States, could be unified; if some agency could begin to

operate whose function it was to gradually bring health officers to think alike in milk sanitation, then would the dairy industry in a given city begin to feel that the restrictions with which it is surrounded are valid restrictions, arrived at through group judgment, and not lightly to be attacked. Then it is believed court cases would be far less numerous and be freed of the disturbing element of conflicting evidence as between health authorities.

If, for example, the practice of grading milk and of requiring the grade to appear upon the bottle cap were universal throughout the United States, and a dairyman should then refuse to comply with this requirement, he would meet with short shrift from the courts. In fact, it is extremely unlikely that a dairyman would permit a court case to occur under these circumstances.

To sum up, then, it appears that the shortcomings of the present include lack of effort in many cities, the existence of very dissimilar types of legislation and control in cities which attempt control, conflict between the dairy industry and the health department, and the all too frequent failure to prosecute court cases successfully. Most of these shortcomings would seem to be the result of the lack of unity of thought among health officers.

What coordinating agency is best fitted and most likely to bring about this much desired unity of thought? It seems logical to believe that as between the individual cities of a State the logical coordinating agency is the State health department, and as between the individual States of the Union the logical coordinating agency is the United States Public Health Service. It is practically always the health departments of cities which have charge of milk control, and it is for this reason that it is believed that the State and Federal health authorities constitute the logical coordinating agencies.

In this paper it is intended to confine the discussion to the problem of the individual State; and the next inquiry must

therefore be: In what manner can the State health department best form its coordinating function?

The question at once arises whether or not the proper solution is a State law. For some states it may be, particularly such States as have already established the precedent of milk control through State law. In many States, however, (and this is true of Alabama) this precedent has not been established, and under these circumstances it is to be doubted whether the wisest solution, in the beginning, at least, is State law.

With this decision reached for Alabama, the only other method of carrying out the State coordinating function seems to be the formulation of a standard milk ordinance, the promotion of its passage by the various cities of the State, the guidance of its enforcement and the measurement of its results. This, in brief, is the program which the State of Alabama was advised to adopt and which it has since put into effect.

The first problem was the formulation of the Standard Ordinance, but before this could be done it was necessary to be clear as to the precise function of the proposed standard. Briefly, it was determined that the proper function of a good milk ordinance is to promote the production of safe milk without shrinking the supply. In this connection it seems clear that one of the greatest sins a health officer can commit is to write and enforce such regulations as will discourage dairymen from producing milk and will thus reduce the amount of milk available. All things considered, milk has done far more good than harm. It is true that hundreds and probably thousands of milk-borne epidemics have occurred since the distribution of milk became a sizable business, but on the other hand it is easy to conceive that entire withdrawal of milk from a city would do far more damage than all the epidemics which that milk, uncontrolled, might cause in that city. It seems to be just as much the health officer's duty to encourage the consumption of

enough milk as it is his duty to encourage the production of safe milk. Both of these objects, and they are not conflicting, should therefore be kept clearly in mind in designing milk-control legislation.

Again, before proceeding to the detailed work of formulating the Standard Ordinance it was necessary to be quite clear as to what was meant by "safe milk." The question was, therefore: "Is the highest grade of raw milk which it is possible to produce safe milk?" After much consideration the final answer was a decided negative. This decision was reached for the following reasons:

(1) Tuberculin testing, while valuable and to be regarded as an advisable precaution in the production of milk, whether raw or pasteurized, cannot be depended upon to keep all milk from tuberculous cows off the market. Very few years elapse in which reactors are not found among herds which are tested annually. The question must always be answered: "What of the milk from these reactors during the interval between tests?"

(2) Employees at dairies cannot be depended upon to recognize and report the first symptoms of infective conditions early enough to insure that they may not infect the milk. Personal experience recalls a case of diarrhea upon a certified dairy which was not reported by the employee for twenty-four hours after it had begun.

(3) Employees can be in an infective condition for forty-eight hours preceding the first symptoms of certain acute infectious diseases. No possible extent of vigilance can safeguard against infecting milk in this way.

(4) The search for healthy carriers, particularly of typhoid fever, while important and to be considered a desirable safeguard for all milk, can not be depended upon to disclose every carrier. It has hitherto been assumed that the percentage of healthy typhoid carriers among the general population was probably not on the average above one half

per cent. Improved technic, however, will probably show the incidence of carriers to be much higher than this.

If we remember also that healthy typhoid carriers are almost always intermittent in the discharge of *B. typhosus,* it will be clear that no reasonable amount of search can disclose every carrier. As before stated, the search should be made and all carriers found eliminated from the industry, but this should be regarded as one factor of safety only and not as a complete protection against typhoid fever.

The above reasoning applies to certified milk, Grade "A" raw milk, or to any other "highest grade" of raw milk.

For the above reasons, the conclusion was inevitable that the highest grade of raw milk it is possible to produce can not be considered sufficiently safe. It was impossible, therefore, for the Service to recommend to the Alabama State Board of Health any other than the following policy, namely, that while the safety of raw milk undoubtedly increases as the precautions surrounding it increase, no milk, however carefully safeguarded, can be considered entirely safe in its raw state, and that ultimately, therefore, all milk should be properly pasteurized.

Attention is called here to the term "properly pasteurized." Much damage has been done to the reputation of scientific pasteurization by the practice of slipshod and unintelligent pasteurization. Pasteurization cannot be considered to deserve its name unless it is correct pasteurization. Again, milk must be pasteurized not only intelligently but also in apparatus properly designed for correct pasteurization.

The definition of safe milk as adopted under the present studies, was, therefore, as follows: "Safe milk is high-grade raw milk, properly pasteurized or boiled."

It is now possible to approach the problem of designing the proposed Standard Ordinance.

Among the many ordinances in use in the United States there seem to be three general trends: (1) A type of ordinance which boldly and simply requires that all milk be

pasteurized: (2) An ordinance which divides milk into two classes, raw and pasteurized, imposes certain conditions of production and distribution upon each, but does not grade either; (3) A type of ordinance which divides milk into two classes, raw and pasteurized, and then further divides each class into grades according to the care with which the milk has been produced, processed and distributed.

It was natural, in view of the definition of safe milk which had been determined, to consider immediately the adoption of the first type of ordinance mentioned, namely, the one which flatly requires all milk to be pasteurized. This type of ordinance was, however, quickly discarded as a possible State standard. It should be kept in mind that in order to achieve the maximum result, the State Standard Ordinance must be one which the communities of the State can be expected to enact, and if one thing has been learned beyond a doubt in this work it is that the majority of cities in a State *will not pass a universal pasteurization ordinance.* This, of course, is stated as being true of today only. It may not be true ten years hence.

Now it cannot be denied that raw milk does become safer as it becomes better safeguarded. Does it not seem clear that that State is unwise which assumes the position of negotiating with and assisting only such cities as will pass a universal pasteurization ordinance? On the contrary, from the standpoint of the greatest good for the greatest number, must it not be admitted that the State's function, where it cannot secure universal pasteurization, is to encourage the maximum percentage of pasteurized milk and the maximum safeguard for that part of the milk which is sold raw?

For the above reasons the universal pasteurization type of ordinance was discarded as a possible State standard. In this connection the distinction should be noted between the term "Standard Ordinance" and the term "model ordinance." A "model ordinance" might very well be a

universal pasteurization ordinance. It is a model, an ideal to be striven for, whereas a "standard ordinance" is here interpreted to mean an ordinance which will accomplish the greatest good in the shortest time.

Attention was next directed to the second type of milk legislation, namely, the type which divides all milk into two classes, raw and pasteurized, surrounds each with certain requirements, but does not grade either.

If there is any type of milk legislation which is more widely used than any other it is this type, and for this reason it was very carefully considered as a possible State standard. It was finally discarded, however, for two principal reasons.

The first is that it assumes, if adopted as a State standard, that no cities in the State could be convinced as to the desirability of requiring all milk to be pasteurized. The ordinance provides at once for the sale of some raw milk and defines the character of raw milk which will be permitted to be sold raw. It was believed that it would be just as unwise for the State to assume that no cities would pass a law requiring all milk to be pasteurized, as it would be for the State to assume that many cities would pass an ordinance requiring all milk to be pasteurized.

The second reason for discarding this type of ordinance as a State standard was that it does not provide sufficient incentive for the production of a high grade of raw milk for pasteurization purposes. Because of the fact that only one grade of pasteurized milk is provided for in such an ordinance, the requirements for the raw milk permitted to be used for pasteurization must be absolutely minimum requirements below which the raw milk is forbidden the market entirely. Accordingly, most of the ordinances of this type require that no milk may be pasteurized which contains more than 1,000,000 bacteria per cubic centimeter, and no credit whatever is given the producer whose bacterial count is less than this. Hence, producers have no incentive

to keep their average bacterial counts much below a million, and in point of fact, in most cities operating under this type of ordinance, the bacterial count of the milk which is pasteurized is only too frequently above 500,000 and often above a million.

For the above reasons, much more favorable consideration was given to the third, or grading, type of ordinance. This type of ordinance provides for both raw and pasteurized milk and grades both according to the conditions under which they are produced, handled, pasteurized, and distributed and according to the results of laboratory analyses of the milk. Under this type of ordinance the pasteurized milk must carry a grade mark which is partly dependent upon the quality of the milk which is pasteurized. Hence, the pasteurization plant has an immediate incentive to pay more for high-quality raw milk than for low-quality raw milk. Under these conditions the producer feels that he is being paid a price commensurate with the care he has taken in producing his milk.

There were several features of the type of grading ordinance usually employed which were not considered advisable. The first of these is the fact that the ordinary type of grading ordinance, similar to the nongrading ordinance previously referred to, assumes that all cities will permit some milk to be sold raw.

One well-known State standard ordinance, for example, states that all milk sold shall be of one of the following grades: Certified, Grade "A" Raw, Grade "A" Pasteurized, Grade "B" Pasteurized. This ordinance assumes that all cities in the State will permit Certified and Grade "A" Raw Milk to be sold to the final consumer without pasteurization.

Another characteristic of the usual type of grading ordinance is that it bases the grading of milk partly upon the score of the dairy, and provides that Grade "A" Raw Milk, for example, shall come from dairies scoring at least 75

per cent, or in other cases, 85 per cent. Inasmuch as the items of sanitation with which a dairy should comply number at least twenty-five or more on any reputable score card, no one item can be assigned very many points in a possible total of one hundred. Hence, a dairy may omit one or more important items of sanitation and still attain a score of 75 per cent or 85 per cent, and thus be entitled to a Grade "A" rating, unless all important items are specifically mentioned in the ordinance as being required in the production of all milk. In the latter case the ordinance becomes rather awkward and difficult to understand on the part of the producer. It is easy for him to understand that if he attains a score of 85 per cent he is entitled to a Grade "A" rating, but when, despite this fact, he is told that the violation of certain specific requirements has robbed him of his grade, his immediate question is: "Well, then, what is the use of the score?"

In order to correct the above shortcomings, the usual type of grading ordinance was modified and given the following form:

The ordinance requires that all raw milk, whether it is to be pasteurized or not, is to be graded in accordance with certain requirements. Instead of the grade being based partly upon a numerical score card, Grade "A" Raw Milk is defined as milk which meets *every one* of a certain definite list of requirements. Grade "B" Raw Milk is defined as milk in which one or more of certain of these requirements have been found to be omitted or modified, the omissions or modifications being minor in degree. Grade "C" Raw Milk is defined as milk which has failed to meet any one of a certain group of additional requirements, some of which are major in degree. Grade "D" Raw Milk is defined as all other milk. This avoids altogether the numerical score and causes Grade "A" Raw Milk to be a definite, known quantity.

The Standard Ordinance next contains a section which

is left blank but which is intended to designate the grades of raw milk which shall be pasteurized. The foreword to the ordinance contains a recommendation that in all cities where the pasteurization facilities are or can be made adequate, this section should require that within twelve months of the date of passage of the ordinance all grades of milk shall be pasteurized. The foreword further states, however, that if insistence upon complete pasteurization should threaten to result in failure to pass *any* milk ordinance, the section be written to permit Grade "A" Raw Milk to be sold raw. It is believed further that an intermediate attempt should be made to limit the sale of raw milk to certified milk.

By this means the objections to the usual type of grading ordinance were overcome.

The Standard Ordinance adopted requires that all bottles and other containers of milk show the grade mark and that all restaurants, soda fountains, and similar establishments display a placard indicating the grade of milk sold therein.

The next part of the program was to bring about the passage of the Standard Ordinance by the various municipalities of the State. Thus far, eight Alabama municipalities have enacted the Standard Ordinance. Experience in securing the passage of the standard legislation in these cities has indicated a number of items of policy.

In the first place, it was found to be wise for the health officer to take the dairy industry into his confidence in proposing the passage of the Standard Ordinance. Otherwise the industry is apt to develop a resentful attitude which will later make enforcement difficult.

On the other hand, it was found unwise to make the passage of the Standard Ordinance entirely dependent upon the will of the dairy industry. This would make the dairy industry the dictator of the kind of milk which would be served to a community, whereas as a matter of fact it is the consumers, represented by their health officer, who should

have the final decision as to the quality of milk which will be tolerated by a community.

Again, great care should be taken to make clear at the outset the attitude of the health department as to the relative safety of the raw and pasteurized grades. Otherwise the dairy industry is apt to assume that the health department will recommend equally Grade "A" Raw and Grade "A" Pasteurized Milk, and if they find that this is not the case after the ordinance goes into effect they will conclude that the health department has misled them and will thus develop a spirit of resentment which should by all means be avoided.

The final item of policy which it was found advisable to observe in securing the passage of milk legislation was that it should not be attempted to begin a campaign for better milk and the passage of the State Standard Milk Ordinance without first having discussed the matter with the highest city officials. Sometimes a local health officer, after having been approached by the State Health Department, will in his enthusiasm begin immediately to develop public opinion in favor of the Standard Ordinance and overlook consulting the Mayor and other officials first. This may seem to be a small matter, but in one instance, at least,the city administration believed an attempt was being made by the State and Local Health Departments to force a favorable decision and resentfully delayed the passage of the ordinance for many months.

In general, the best policy to adopt in securing the passage of the Standard Milk Ordinance would seem to be to have the local health officer advise the Mayor and other city officials: first, that after a conference with the State Health Department he has decided to recommend officially that the city adopt the Standard Ordinance, and recite the advantages, both to the dairy industry and to the consuming public; second, that if the city officials think there would be any likelihood of political embarrassment in passing the

ordinance, he, the health officer, will be glad to develop public opinion in favor of the ordinance. In the majority of cases this will prove unnecessary.

Then with regard to the dairymen a wise plan seems to be to call them together in meeting and advise them of the definite intention of the health department to recommend the Standard Ordinance to the city authorities. The dairymen should be clearly informed why such regulation is necessary and that its impartial enforcement will be to the advantage of the industry by increasing the confidence of the public in milk as a food and thus increasing the consumption of milk, by eliminating unfair competition through the grading principle, and by reducing milk-borne epidemics, which are always disastrous to the industry.

The attitude of the Health Department on pasteurization should then be carefully explained. The dairymen should be advised that if the city insists on allowing raw milk to be sold the Health Department will be forced as a matter of duty to advise the public repeatedly of the greater safety of properly pasteurized milk, and that this advice will be constantly before the public on the grade placards which the Standard Ordinance requires all restaurants, soda fountains, etc., to carry.

Having now formulated the State Standard Ordinance and secured its enactment in a number of the cities of the State, the next problem was to insure its enforcement. Unfortunately, enforcement does not follow as a matter of course. Political interference, lack of proper special training of the health officer and his inspectors, lack of sufficient funds and personnel, sometimes even indifference on the part of the local health officer or the other city officials—one or more of these factors are apt to result in poor milk control. The statement is regretted, but it is nevertheless believed, that if a State health department were merely to formulate a standard ordinance and secure its local adoption not more than half the cities of the State would benefit.

The State cannot stop there. It must not merely secure the general adoption of a method as standard. It has another function: it must see to it that the method is carried out. It seems difficult, and it is probable that no State will succeed entirely, but the State can study the various causes of nonenforcement and attempt to overcome them.

One of these possible causes, as has been indicated, is the lack of sufficient funds and personnel. This cause is usually operative only in the smaller municipalities. These do not usually have a well-trained milk inspector and practically never have a bacteriological and chemical laboratory. How can the State help here? In the case of Alabama a simple remedy has been employed. The State Health Department has added carefully trained dairy inspectors to its staff and has arranged to have the milk analyses done in the central or in one of the branch State laboratories.

Each State Dairy Inspector is responsible for a group of municipalities. (Experience thus far indicates that one inspector can handle about five or six small towns.) His duties are:

(1) To train the local inspectors in the inspection of dairies and pasteurization plants, in the routine collection of milk samples, in the determination and announcement of grades, and in the general enforcement of the ordinance.

(2) To supplement the work of local inspectors when necessary.

(3) To determine periodically the municipal milk sanitation ratings of the group of towns for which he is responsible.

The above plan has proved quite satisfactory in Alabama, although the problem of the reimbursement of the State by the local communities has not as yet been attacked. It is possible that ultimately each town should reimburse the State on a pro rata basis, but the policy has been adopted in Alabama of deferring the consideration of this question until some time in the future when the consumers of the

cities will have had a sufficiently long experience with milk control to make it quite certain that they will support a request for reimbursement. It is obvious, of course, that the cost to each small community under this group plan will be much less than under a plan whereby each community established its own laboratory and complete inspection service.

Another factor frequently resulting in unsatisfactory local milk control is the lack of special training of the health officer and his inspectors. The employment of specially trained inspectors by the State Department of Health also helps to solve this problem inasmuch as one of the duties of these inspectors and of their Bureau chief, as above stated, is to acquaint the local health officials with such special knowledge of modern milk control methods as they may not already possess.

The two other factors sometimes resulting in unsatisfactory local milk control are political interference and occasional indifference on the part of the local health officer. After careful consideration the Public Health Service decided to recommend to the Alabama State Department of Health that one good plan for reducing these causes would be to have the State Department of Health grade the milk sanitation of cities just as the municipal department of health grades the milk sanitation condition of individual dairies. It was believed that if this could be done, political interference would be somewhat less apt to occur, as a resultant low rating of the city by the State would be apt to meet with criticism on the part of the citizens and on the part of special organizations, such as the Chamber of Commerce, men's luncheon clubs, and women's organizations. It was further believed that the routine announcement of such municipal milk ratings by the State would tend to discourage indifference on the part of the health officer for the same reasons.

The above recommendation made it necessary to devise

a method for measuring the milk sanitation status of cities, and this was the final problem to be solved. It is impossible in this paper to include a detailed discussion of the rating plan which was finally recommended, but, briefly, the method involves the determination of the percentage of the city's milk supply which complies with each of the items of sanitation required in the ordinance for the ideal milk supply. Each item of sanitation is assigned a maximum possible credit. Then the maximum possible credit for each item is multiplied by the percentage compliance previously determined, which gives the earned credit for each item. The sum of all earned credits, divided by the sum of all maximum possible credits, gives the municipal milk sanitation rating.

As previously stated, the periodic determination of the milk sanitation ratings of the cities of the State is a further function of the State milk inspectors.

In closing it will be observed that a State which adopts the program above outlined has accomplished the four objects originally determined upon as necessary, namely: It has formulated a Standard Ordinance designed to promote the production of safe milk and the consumption of enough milk; it has secured the adoption of the Standard Ordinance by local communities under a carefully thought-out plan; it has stimulated and supervised the enforcement of the Standard Ordinance; and it has measured its results.

"It seems to be just as much the health officer's duty to encourage the consumption of enough milk as it is his duty to encourage the production of safe milk."

THE STANDARDIZATION OF THE METHYLENE BLUE REDUCTION TEST FOR MILK CONTROL WORK*

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The quality of milk is something in which all are interested, for everyone is a consumer of milk or of its products. The various factors that enter into the determination of the quality of milk may be summarized as follows:

1. Nutritive value.
2. Taste and odor.
3. Keeping quality.
4. Value for manufacturing purposes.
5. Healthfulness.

The first involves the composition of the milk and is determined by the individual animal producing the milk. The remainder are almost completely determined by the number and kind of bacteria in the milk. The last factor, "healthfulness," is determined largely by specific bacteria, as those causing tuberculosis and typhoid fever. It will be excluded from the following discussion, since keeping milk free or freeing it from living disease-producing bacteria involves methods and processes quite foreign to those used in the control of keeping quality or of the other factors above mentioned.

It is certain that no one will disagree with the statement that the best milk is that which is perfectly clean because no foreign matter has been allowed to enter, not because it has been cleaned; and that which is perfectly fresh, or, in other words, milk in which no bacteria have ever grown

* A report presented to the American Public Health Association, October, 1924, by Dr. R. S. Breed, Referee in "Methods of Milk Analysis."

and which, therefore, possesses its original composition. It is, of course, impossible to obtain the ideal milk except on the farm where it is produced. All of the milk delivered to milk-distributing depots, to milk consumers and to the various plants in which dairy products are made is a more or less remote approximation to the ideal. In order to gradually approach the ideal milk supply it is essential to govern its bacterial content both from the quantitative and qualitative points of view. In other words, methods must be available by which the number of the various kinds of bacteria can be determined in order that those producing, distributing or using poor milk may be discovered and their methods corrected to their own advantage and to the advantage of their customers. This is practically what is involved in milk control.

Milk control is a far more inclusive phrase than most consider. There is a tendency to think of it solely in connection with that portion of the milk destined for consumption as fluid milk. It is evident that if the quality of dairy products is dependent on the quality of the milk, the control of quality is as important to the ice cream maker, the manufacturer of evaporated milk or milk powder, and to the butter and cheese maker as it is to the distributor of fluid milk or to the public official entrusted with milk control.

Up to the present time the quantitative methods of bacteriological analysis have completely overshadowed the qualitative, and will continue to do so for some time, although in certain relations the relative importance is the reverse, and a knowledge of the kinds of bacteria present is of more value than of the number alone.

The need of milk control is as great, relatively, in the village, in the individual condensing plant and cheese factory as in the city. The conditions under which the work must be done as regards accuracy and expense, both of time and money and of trained help, will be quite different than in the municipal laboratory or in that of a large milk-distrib-

uting company. The need of more simple methods of determining the number of bacteria is self-evident to one who recognizes the importance of milk control.

The methylene blue reduction test, or the reductase test, is the most simple and inexpensive method yet suggested for determining the number of bacteria in milk. The time required for the blue color to disappear from a sample of milk to which a fixed amount of the dye has been added and which is kept at a definite temperature is dependent on the reducing power of the various kinds of bacteria therein and on the number thereof.

The different groups of milk bacteria vary in reducing action, but not to such an extent as to destroy the value of the test as a measure of the total number of bacteria in the milk.

The reductase test has made little headway in this country, chiefly, the writer believes, because all studying it have insisted on attempting to make the results obtained therewith check with those supplied by plate cultures. The non-agreement in many cases led them to consider it incorrect, although there was as much reason for considering the colony count inaccurate.

The recognition that as valuable results can be obtained with the reductase method as with the more complicated and expensive methods has led its wide use in the Scandinavian countries, especially in Denmark under the advice of Dr. Orla-Jensen, and in Sweden under the direction of Dr. Barthel.

In order to make the preparation of the reagent easy and constant in content of methylene blue, tablets were prepared by the firm of Blauenfeldt and Tvede, of Copenhagen. As these tablets have not been available in this country, those using or studying the test have employed crystalline methylene blue of varied origin. Recent investigations by Dr. H. J. Conn and his collaborators have shown that the content of methylene blue in commercial dyes varies

widely, due to the presence of inert material. In order to overcome this difficulty it was suggested to the National Aniline & Chemical Co. that they undertake the preparation of tablets for use in the reductase test. The company assented, and working under the guidance of Dr. Conn have prepared and are distributing such tablets. In their use certain questions have arisen which it seems should be studied. Among these questions were the influence on the results of the volume of milk used in making the test; the variation in strength of different tablets from the same source; the practical importance of the variations found; and the comparative strength of tablets from the two available sources, Danish and American.

In making the test it is desirable to use such volumes of milk and dye as can be easily measured with the apparatus available in any laboratory. In Denmark, 40 c. c. of milk is used, to which is added 1 c. c. of a solution obtained by dissolving one tablet in 200 c. c. of water. There was apparently no reason why a smaller volume of milk would not give the same results as the larger amount and with certain advantages when a considerable number of tests are to be made at one time. It was thought that the preparation of a smaller volume of the test solution would have advantages, since it would be used up more quickly and troubles due to deterioration on standing would thus be avoided to some extent.

Two batches of American tablets were made. The first, designated as full-strength, were supposed to duplicate the Danish; the second were supposed to be one-fourth as strong as the Danish. A study of the relative strength of the Danish and of the two batches of American tablets was made by dissolving the tablets in the required amount of water and comparing the color in the Duboscq colorimeter. Two samples of Danish tablets were available. We have no information as to whether they represent the same or different batches. They were supplied to us by visitors from

Denmark and Sweden. A period of several years elapsed between the receipt of the first and second supply. In the work of determining the relative content in dye of the tablets from different sources, one sample of the Danish was taken as the base, and its strength expressed as 100. Table I is a summary of the results.

TABLE I.

RELATIVE STRENGTH OF METHYLENE BLUE SOLUTIONS WHEN THESE WERE PREPARED ACCORDING TO DIRECTION

	Relative Strength
Sample No. 1 Danish	100
" No. 2 "	70
" American Full Strength	67
" " ¼ Strength	43
" " "	42

It will be seen that the two samples of Danish tablets are not of the same content in methylene blue, and that the American tablets first prepared, designated as full-strength, were practically identical with the weaker Danish tablets. The effort of the American manufacturers to prepare a tablet containing one-fourth the methylene blue found in the original American tablets was not entirely successful; the tablets proved to be considerably weaker, having a relative strength of 42.5.

It might seem at first as though this failure to prepare a tablet one-fourth as strong as the stronger Danish tablet would destroy the value of the present supply of American tablets. The writer is not of this opinion. In our study of the factors influencing the reductase test, the influence of the varying concentrations of the dye was studied. The Danish tablets gave a color which was practically identical with one containing one part of the crystalline dye in 200,000 parts of milk. When the concentration was decreased so that one part of the dye was present in 300,000 or 400,000 parts of milk, the reduction time was so close to that obtained with 1 to 200,000 parts that the differences were of no importance and would be completely overshadowed by other factors.

Again it would seem that there is but little point in using, in this country, a solution identical with that used abroad. The more important thing is that all using the method in this country should be employing a test solution of approximately the same strength. This will be secured by using the tablets now on the market of this country.

Another point studied was the variation in strength between different tablets from the same batch. It is probably impossible to prepare tablets which will not vary in weight and therefore in content of the active agent. Again, in actual use crumbling of tablets is encountered, due to shaking of the tablets in the bottle and to handling. This may, in many cases, far overshadow variation in weights of the tablets as prepared. The American-made tablets crumble less than the Danish, as they are prepared with a lactose binder while the Danish appear to have common salt as a binder.

Table II presents the variations in relative strength of perfect tablets of different origins.

TABLE II.

VARIATIONS IN STRENGTH OF SOLUTIONS PREPARED FROM PERFECT TABLETS

	Relative Strength
Danish, Sample 2	
Tablet 1	76
" 2	67
" 3	68
American Full Strength	
Tablet 1	76
" 2	67
" 3	61
" 4	68
American One-fourth Strength	
Tablet 1	40
" 2	43
" 3	46
" 4	45
American One-fourth Strength	
Tablet 1	41
" 2	40
" 3	41
" 4	45

These variations are of no practical importance, as is shown in the following data.

TABLE III.

COMPARATIVE REDUCTION TIME OF SOLUTIONS PREPARED FROM SIX DIFFERENT AMERICAN TABLETS

Tablet	Relative Strength	Milk No. 1 Min.	Milk No. 2 Min.	Milk No. 3 Min.	Milk No. 4 Min.	Milk No. 5 Min.
1	46	54	210	225	225	805
2	43	55	205	223	255	805
3	41	54	202	223	255	787
4	41	55	208	223	257	795
5	40	52	206	220	257	787
6	40	52	209	220	255	785

In the use of the reductase test one can, of course, divide the milk into as large a number of classes as desired. The number of classes will depend on the frequency of observation during the incubation period. In the Scandinavian countries the following classification as to reduction time is used:

Class I Reduction time over 5-1/2 hours.
Class II Reduction time 2—5-1/2 hours.
Class III Reduction time 20 mins. to 2 hours.
Class IV Reduction time less than 20 mins.

Even with observations much more frequent than demanded by the above classification, the variation in strength of tablets and in reduction time caused thereby is of no importance.

The other point studied in detail was the influence of different volumes of milk on reduction time. The custom in Europe is to use 40 c. c. and in this country 10 c. c. The result of a long series of comparative tests was to show that there was no difference in reduction time when 10- and 40- c. c. samples were used.

In view of the work done the following recommendations are made:

1. That the present supply of American tablets be considered as yielding the standard solution to be used in the

reductase test when *one perfect* tablet is dissolved in 200 c. c. of water and 1 c. c. of the resulting solution is used for each 10 c. c. of milk.

2. That in preparing additional supplies of tablets care shall be taken to make them identical in content of methylene blue with the present supply, and that the tablets shall be placed on the market only after they have been passed by the Commission on Standardization of Stains of the Society of American Bacteriologists and affiliated societies.

3. That 10 c. c. be considered the standard volume of milk to be used in the reductase test.

"The men who try to do something and fail are infinitely better than those who try to do nothing and succeed."

REPORT OF COMMITTEE ON METHODS OF BACTERIAL ANALYSIS OF MILK AND MILK PRODUCTS

GEORGE E. BOLLING, *Chairman*

The work of the committee this year has been limited to a trial of the "Reductase Test," given as a provisional method in the 1923 Edition of "Standard Methods of Milk Analysis" of the American Public Health Association and the Association of Official Agricultural Chemists.

The method of conducting the test is extremely simple, all the apparatus required being 1-c. c. and 10-c. c. pipettes, thick-walled test tubes of the size commonly used in bacteriological work, and a water bath capable of being maintained at a temperature of 37°. If economy of apparatus is desirable, but one 1-c. c. pipette, one 10-c. c. graduated cylinder, the water bath and the requisite number of test tubes are necessary. The tubes used for the test may be placed in a wire rack ready for immersion in the water bath and the 10-c. c. amounts of milk added from the cylinder, rinsing the latter several times in running tap water between samples and once with the milk itself. By marking with a file or etching with acid the 10-c. c. mark on the test tubes used, all such measurings may be dispensed with.

The reagent is the methylene blue tablet supplied by the National Aniline and Chemical Company of New York. These tablets are marketed in bottles of 100 at a cost of $2.00 per bottle. As some 200 tests may be made from the 200-c. c. solution of each tablet, the cost per test is brought down to the reasonably low figure of 1/100 of a cent.

After ten cubic centimeters of the sample have been placed in the test tube, one cubic centimeter of the solution of methylene blue is added. It is not necessary to blow the

dye from the pipette into the milk to secure an adequate mixture, as a slight shaking or quick rotary motion of the tube will suffice. If this method of mixing is used, but one 1-c. c. pipette is required for each lot of samples.

The rack of tubes is placed in the water bath and observed at intervals to note any diminution in color. The end point is reached when the blue color has disappeared and the milk regained its normal color.

A scheme of classification as used in the Scandinavian countries is given in the Standard Methods report as follows:

Class I. Good milk, not decolorized in 5½ hours, containing, as a rule, less than 500,000 bacteria per cubic centimeter.

Class II. Milk of fair average quality, decolorized in less than 5½ hours but not less than 2 hours, containing, as a rule, 500,000 to 4,000,000 bacteria per cubic centimeter.

Class III. Bad milk, decolorized in less than two hours, but not less than 20 minutes, containing, as a rule, 4,000,000 to 20,000,000 bacteria per cubic centimeter.

Class IV. Very bad milk, decolorized in 20 minutes or less, containing, as a rule, over 20,000,000 bacteria per cubic centimeter.

Our work has been to ascertain whether these figures as given approximated those obtained by plate counts in representative American milk control laboratories. Four members of the committee collaborated in this work. For the plate counts, two used meat infusion agar, one the present standard meat extract agar and one the Bacto product, eliminating thereby the undesirability of having to judge the method under consideration when tested against but one medium.

Without going into the detailed data afforded by hundreds of samples examined, it may be stated that only about one

per cent of the samples failed to place itself by the reductase test in the class, as shown by the plate count, in which it belonged.

A short summary of the findings of four laboratories follows:

Laboratory	Class I. Below 500,000	Class II. 500,000 to 4,000,000	Class III. 4,000,000 to 20,000,000	Class IV. Over 20,000,000
A.....	112,000	.....	.....	.....
B.....	136,000	1,920,000	6,000,000	.....
C.....	33,000	2,440,000	8,800,000	44,000,000
D.....	176,000	1,740,000	6,670,000	93,580,000
Average	114,000	1,520,000	7,180,000	68,000,000

As a method for rapidly ascertaining the quality of milk, the reductase test should be of much value, but cannot supplant the plate count method in official control laboratories.

As a verification method, also, it has a distinct application. In laboratories where direct microscopic examinations are relied upon, it should prove useful, particularly in the case of pasteurized milk, where the results obtained by microscopic examination may but very remotely indicate the viability of the bacteria present.

As empowered by this Association at its 1923 meeting, your committee has secured samples of such prepared or dehydrated media, intended for use in plate counts of milk, as were on sale. The product of one manufacturer has been found to yield results so closely in accord with those obtained by standard media as to warrant our approval for its use for such purpose.

The product was examined by four laboratories and all concurred in pronouncing it acceptable. The manufacturer proposes to employ the following label:

Approved

BACTO-NUTRIENT AGAR

1%

This lot of Bacto-Nutrient Agar 1% Dehydrated has been examined by the committee on "Methods of Bacterial Analysis" of the International Association of Dairy and Milk Inspectors, and has been approved for use in making bacterial counts of milk.

The formula for this medium conforms to that included in "Standard Methods of Milk Analysis 1923," and the pH of the finished medium, when prepared in accordance with the directions on the label, meets its requirements, and approximates "The most desirable reaction—."

This medium is recommended for general cultural purposes.

Samples from all additional batches of such media are to be sent to designated laboratories for examination before being offered for sale.

"If you have knowledge, let others light their candles by it."

THE RELATION OF PREPASTEURIZED MILK TO CERTAIN FORMS OF GASTRO-ENTERITIS IN INFANTS

J. H. SHRADER, Ph. D., *Director,* Bureau of Chemistry and Food, City Health Department, Baltimore, Md.

Some years ago the New York Milk Commission stated: "Milk with a high bacteria count is not necessarily harmful, but when used as a food, particularly for children, is a hazard too great to be warranted." A recent circular by Kelly and Leete, of the United States Department of Agriculture, contains this statement: "Digestive disturbances are often associated with milk of high bacterial count due to dirt or age; and these disturbances may be serious if the digestion is weak, as in the case of infants and invalids."

In spite of such generally recognized ideas, there has gradually developed the belief that since the bulk of the milk of the average city is pasteurized, there is little need to consider the bacterial flora of the raw milk prior to such pasteurization. Many health and food officials do have a laudable desire to keep down the prepasteurization counts, but their procedure is based more upon aesthetic considerations than upon belief that a public health matter is involved. Such a point of view is prejudicial to the good cause of pasteurization. That the public health aspect of the quality of the supply before it is pasteurized should not be unduly minimized but given its due consideration, the following observations are presented.

As long ago as 1903, Doctors Park and Holt (Studies from the Rockefeller Institute for Medical Research, Reprints, Vol. 2, 1904; Archives of Pediatrics, December, 1903) in New York City reported that as a result of observations of several hundred bottle-fed infants, they found that the primary factors in producing summer diar-

rheas were heat and improper care, and that the bacterial quality of the milk exerts a secondary effect, except that when the bacterial contamination is extreme or when pathogenic organisms are present, the deleterious effect is more marked. They found that the use of milk which contained from 1,000,000 to 25,000,000 organisms per cubic centimeter and then was pasteurized, was accompanied by a distinct increase in the amount of diarrheal disease. Among their conclusions, they state that with milk which is taken raw, the fewer the number of bacteria present, the better the results. When milk is heated above 170 degrees F., most of the bacteria and apparently some of the poisonous products are destroyed. Bacteria present to the extent of many millions before heating were decidedly deleterious.

Since then, Schölberg and Wallis (Chemical changes produced in milk by bacteria and their relation to the epidemic diarrhea of infants. Local Gov. Board. Medical Officer's Report 1909-10, vol. 39, pp. 504-43; Chemical Abstracts, vol. 6, p. 2645. Note: The abstractor's volume reference is incorrect) have thrown light on the biochemistry involved in the mixed bacterial contamination of market milk. They found that such milk when tested with the biuret reaction showed the presence of peptones and albumoses and some intermediate transitory unidentified product, whereas milk of low bacteria counts reacted negative thereto. They isolated several strains, notably atypical coli and some spore-formers, and found that these organisms when inoculated into milk gave rise to intermediate products which reacted specifically to the biuret test. Moreover, they showed that this intermediate decomposition product exerted a deleterious effect on the pancreas, which resulted thereby in a disturbed metabolism with attendant diarrhea. One of their most striking contributions was the announcement of the *transitory* character of the intermediate decomposition product, which disappears after about forty-eight hours and hence is not present in the finished

products of bacterial action on milk. Their investigation was quite complete and was carried all the way through from tests on the milk to autopsy findings on infants who succumbed to summer diarrhea.

From the above, it is clear that the clinical work of Park and Holt, limited as it was in the number of cases, served to place the emphasis on the secondary but nevertheless real relation of milk to summer diarrhea in infants. Moreover, the work of Schölberg and Wallis gave experimental demonstrations of the biochemistry involved.

In the summer of 1922, it was noticed that the average bacterial count of milk entering Baltimore and destined for pasteurization was much greater than in the immediately preceding years and a little later our attention was called to the great increase in the mortality of infants under two years of age from gastro-enteritis and dysentery. The city pasteurized milk constituted about 98 per cent of the supply and was under better regulatory control than formerly. Plotting the bacterial counts, temperature and infant mortality from gastro-enteritis and dysentery on co-ordinate paper, it was noted that the peaks all lay in July, while the peak of the bacterial content of the city pasteurized milk bore no relation to the other three.

During the summer of 1923, particular effort was exerted to improve the bacterial content of the milk. However, certain legal restrictions written into our basic law operated to so handicap us in regulatory control that the final results of our endeavor to improve the milk were not as striking as the effort warranted, but salutary nevertheless. (We believe that the improvement in the milk supply during the summer of 1923 was greater than that indicated for the reason that regulatory pressure always is accompanied by an improvement in performance, not noticeable in the figures presented because the milk samples were all taken at railroad and truck delivery platforms and before the city dairies could exert their influence in favor of a lower final

count by means of a more expeditious handling and closer supervision of the milk before the actual application of the pasteurization process.) Concomitantly, there was a marked improvement in the infantile mortality rates as regularly reported.

Profiting by the experience of the summer of 1923, we planned a campaign for 1924 that was to be really effective in greatly lowering the bacteria content of the milk. Accordingly, we inaugurated an educational campaign over the entire Baltimore milk shed, beginning early in March. With this as a background, we applied certain regulatory pressure when the occasion warranted, with the result that a very marked improvement in the prepasteurized milk was effected. This improvement was in parallel to a marked improvement in the gastro-enteritis rate during all of the early part of the summer, but toward the end of July, the gastro-enteritis and dysentery mortality rates rose to such an extent that the gains were wiped out and the peak simulated that of the preceding year, 1923.

Maximum Monthly Averages.

Prepasteurized bacteria count.

1922	5,000,000*	(peak month, July)
1923	4,000,000*	(peak month, August)
1924	2,200,000	(peak month, June)

Mortality.

1922	133	(peak month, July)
1923	71	(peak month, August)
1924	81	(peak month, August)

* Samples taken at points of entry into city, whereas in 1924 the samples were taken from the vats in the pasteurizing plants just prior to heating. Accordingly, the maximum bacterial counts in the prepasteurized milk in 1922 and 1923 were materially more than what the figures show, some tests indicating that the count doubled in the interim between entry in Baltimore and the application of the pasteurizing process.

Maximum Monthly Averages—*Continued*

Temperature.

1922 78° (peak month, July)
1923 78° (peak months, June-July)
1924 77° (peak months, July-August)

City Pasteurized unit.

1922 18,000 (peak month, September)
1923 20,000 (peak month, June)
1924 22,000 (peak month, June)

The relative position and height of the mortality peaks are unchanged even when all cases which are not fed on liquid fresh cows' milk are eliminated.

In the summer of 1924, we were able for the first time to collect the full history of each mortality case. From such, the department epidemiologist grouped the cases into diarrhea (gastro-enteritis) and bacillary dysentery. Such data enabled us to compare the dates of onset of illness. During the past season, we were also able to make bacterial counts in the milk with milk powder agar as well as plain agar, so that counts could be made of the peptonizers, acid formers and alkali formers and also *B. coli* and anaerobic spores.

On the basis of the grouping of onset of illness in infantile deaths as determined by the case histories, it appears that both types of bowel disease have two well-defined peaks: the gastro-intestinal type predominates overwhelmingly in the early summer, while the bacillary type comes on not only somewhat later but is about equally divided in its peaks. Coincident with this grouping, it has been observed that the alkali and acid-forming organisms together with the peptonizers predominate in the prepasteurized milk early in the summer, while *B. coli* ascendancy comes on later. Thus we see that the two peaks of onset of illness coincide with the earlier grouping of acid and alkali formers, peptonizers and some *B. coli,* while the later grouping coincides with an overwhelming increase in *B. coli.* This observation is in con-

formity with the findings of Schölberg and Wallis (loc. cit.) and will be discussed more in detail in a separate publication. (Comprehensive bacteriological study of milk supply of Baltimore. J. C. Swenarton and J. H. Shrader.)

Fully recognizing that the above observations do not by any means prove a causal relationship between the pre-pasteurization bacterial flora of milk and infantile illness, they do serve to call attention again to the work of Park and Holt, and that of Schölberg and Wallis, and serve as a basis to direct further studies on the significance of bacteria counts and the biochemical changes thereby engendered in the milk. Nothing herein presented is antagonistic, to say the least, to the idea that milk should be produced and handled so as to keep the germ life reduced to a minimum, and only then is this high-grade product to be pasteurized.

"Business can never be well done that is not well understood."

AN OBSERVATION

BY

J. H. SHRADER, PH. D., *Director,* Bureau of Chemistry and Food, City Health Department, Baltimore, Md.

One of the sanitary requirements in the production for sale in Baltimore of unpasteurized milk (about 2 per cent of the supply is not pasteurized) provides that all employees who handle the milk must be medically examined by nose and throat as well as by urinary and fecal cultures.

On a given date, every culture from the workers in a certified milk dairy farm was reported negative by the State Board of Health. About five days later, one of the employees on the farm was feeling indisposed and since he was running a little fever, he was ordered by the management to a hospital, and the city Health Department was immediately notified. The boarding-house keeper was also not well. All the milk was then ordered to be pasteurized. Before long, the search for the cause disclosed the fact that the keeper of the boarding-house where many of the men boarded was a typhoid carrier. If it had not been for the high personal integrity of the manager, whereby the reporting of the slightest indisposition on the part of his workmen is encouraged, undoubtedly a milk-borne outbreak of typhoid would have occurred. Accordingly, it behooves health officers to fully appreciate the limitations of medical examination as the only safeguard to the healthfulness of a milk supply and to again realize the effectiveness of pasteurization as a public health measure.

"Castles in the air cost a vast deal to keep up."

SOME OBSERVATIONS ON THE SCIENTIFIC CONTROL OF MILK PLANTS FROM THE STANDPOINT OF BACTERIA

GEORGE B. TAYLOR, Washington, D. C.

In the bacteriological control of milk supplied by pasteurizing plants, there are three important conditions to be desired:

1. A good raw milk supply.
2. Proper pasteurization.
3. A low bacterial count in the pasteurized product.

Without a good raw milk supply, it is difficult to obtain a pasteurized product low in bacteria. Without proper pasteurization, the safety and healthfulness of the product cannot be guaranteed. In this connection it is needless to add that there cannot be real scientific control of a milk supply without adequate sanitary observance. While a low bacterial count in the pasteurized product is not absolutely essential to a safe milk supply, it follows, nevertheless, that under ordinary conditions a good raw milk supply and proper pasteurization will give a low count in the pasteurized product.

In considering an apparent exception to the rule stated above, it might be well to define such terms as "a good raw milk supply," "proper pasteurization," and "a low bacterial count." "A good raw milk supply" is one which has been produced and handled under well-recognized sanitary supervision and which has a bacterial count averaging not more than 100,000 colonies per cubic centimeter. "Proper pasteurization" means the heating of the milk to 143°—145° Fahrenheit, and holding at that temperature for 30 minutes, followed by immediate cooling below 40° Fahrenheit. "A low bacterial count" means a count under 10,000 on plain agar, pH 6.4 to 7.0.

The average milk plant sanitarian has found that on occasions the bacterial count of routine samples of pasteurized milk has increased to several times the normal amount. There is a type of bacteria sometimes found in milk which resists pasteurization temperature and holding time. Experience has shown that where such a condition exists, it is due to lack of proper sterilization of milk contact surfaces either in the plant or on the farm. If the trouble is in the plant, all of a day's routine samples will show abnormally high counts. If one or several shippers are responsible for the high counts, this will be indicated when milk from these producers is represented in the pasteurized sample. The placing of the blame for resistant-type bacteria is much easier when the vat or batch system of pasteurization is used than when the system is continuous flow. For example, in the vat system, if the milk from one vat has run high in bacteria and the bacterial count of the other vats has remained normal, the trouble is due to milk from certain shippers in that vat. Moreover, if the shippers whose milk is in this vat are known, it is easy to determine the individual whose milk is at fault. Samples of milk from each producer whose product enters this vat are pasteurized separately in the laboratory. The pasteurized products are plated on extract agar and incubated at 37° Centigrade. Within 24 hours, as a rule, the plates will show colonies which, in turn, indicate where the trouble lies. In this way it is easy to find the guilty producer. Immediate steps should be taken to correct the conditions causing the contamination. Among the causes for the resistant type of bacteria are:

1. Sterilizer not working properly.
2. Neglect in properly caring for milking machines.
3. Milk cans not cleaned and resterilized after return from milk plant.
4. Lack of sterilization of other milk contact utensils.

Whenever proper sterilizing methods are applied, the trouble is checked.

The following are typical instances of contamination by resistant-type bacteria and results after the remedy had been applied.

Shipper	Date	Bacterial Counts, Extract Agar, 37.5° C. for 48 hours	
		Raw	Pasteurized in laboratory
A	3/6	530,000	240,000
	3/12	120,000	1,000
	3/20	50,000	6,000
	3/28	100,000	2,600
B	3/12	130,000	68,000
	3/17	28,000	700
	3/28	300,000	300
C	3/5	500,000	210,000
	3/12	140,000	55,000
	3/19	28,000	6,000
	3/28	13,000	900

Experience with the resistant-type bacteria as indicated above shows:

1. That proper sterilization of milk contact surfaces will remove the trouble.
2. That there is a tendency for a recurrence of the trouble. It has been shown repeatedly that when the resistant-type bacteria occur in the pasteurized milk, the trouble is frequently caused by milk from farms where this contamination has existed before.
3. It happens that a pasteurized sample may show more bacteria than the same sample in the raw state.

In making the foregoing observations, it is important to know that all counts were made on plain agar prepared from commercial powdered agar, although it has been proved that the counts of milk from individual shippers are comparable to the above when other extract agars are used.

In this connection it might be well to speak of comparative bacterial counts of milk made by using two kinds of plain agar media. It is now generally admitted, as stated at a conference on the ingredients of bacteriological media, that "later studies have shown that particularly in the case of pasteurized milk, the use of various commercial brands of peptone and beef extract bring about marked variations in the resulting bacterial count."

It has been found in the comparison of two media, one extract agar made according to methods of the American Public Health Association, and the other a powdered agar, made by a commercial firm, plating both raw and pasteurized milk, that:

1. With raw milk samples, counts made by both media compare fairly closely.
2. With pasteurized samples, counts made from the manufactured powdered agar are in many instances enormously higher, with typical "pin-point" colonies, presumably indicating gross contamination.
3. With milk pasteurized in large quantities in the plant, and samples of this same milk pasteurized in the laboratory, using both plain agar medium and powdered agar medium in each instance, that milk pasteurized in the plant shows a much higher deviation in the counts than that pasteurized in the laboratory.

There are apparent inconsistencies in the above statements, but that such conditions do obtain is shown by comparing these media under like conditions in different milk plants.

SUMMARY

1. There is a type of bacteria which resists the temperature of pasteurization, 143°-145° F., which grows equally well on powdered nutrient agar and on Liebig's extract agar. This resistant type is the result of improper sterilization of milk contact surfaces either on the farm or in the milk plant. Proper sterilization will destroy this type of

bacteria, although there is a tendency for a recurrence.

2. There is another type of bacteria which increases greatly at the temperature of pasteurization. This type does not grow on Liebig's extract agar made according to methods of the American Public Health Association, but is shown as "pin-point" or very small round colonies on powdered nutrient agar, using other makes of beef extract. This type seems to be generally distributed and appears erratically even in milk plants recognized as conducting operations under the most careful sanitary and scientific control. Even under the best of conditions there seems to be contamination either in the pasteurization vats or an accumulative inoculation found when large quantities of bulk milk are undergoing pasteurization without intermediate sterilization of contact surfaces.

"Persistency is the best known form of perpetual motion that produces success."

Application for Membership

To the Officers and Members of the International Association of Dairy and Milk Inspectors.

GENTLEMEN:

I desire to aid in developing and improving the methods of dairy and milk inspection, and I hereby respectfully apply for membership, and all the privileges of membership, in your Association. Should my application be granted, I promise a faithful compliance with all regulations. I enclose herewith five dollars for membership dues for one year, the same to be returned to me if my application is not accepted.

My present position is that of.....

.....

I have held the position.....years.....months.

Positions previously held by me.....

.....

.....

.....

For further information regarding my character or work you are respectfully referred to (Give two references).

Name Address

.....

.....

Respectfully

(Signature) .....

Applicant

Date.....192..... Address.....

The objects of the International Association of Dairy and Milk Inspectors are 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; to perfect efficient methods for the bacteriological and chemical testing of milk and milk products; to develop and encourage the consumption of milk and its products, and to educate consumers in the matter of their more extended use; to hold meetings annually for the discussion of pertinent issues relating to milk and its products, and to consider the progress of events with reference to these commodities.

The membership of the Association is composed of those who now are, or who have been, officially engaged in dairy or milk inspection. This includes official laboratory workers examining or investigating milk or milk products, as well as those making sanitary inspections of the conditions under which milk is produced or handled.

Please read both sides of this leaf, and if eligible for membership remove this leaf and apply for membership.