SIXTEENTH ANNUAL REPORT

OF THE

International Association of Dairy and Milk Inspectors

INCLUDING PAPERS READ AT THE ANNUAL
CONVENTION IN TORONTO, ONTARIO
OCTOBER 24, 25 AND 26, 1927

*"Our own success comes as
we help the other fellow
and as he helps us."*

COMPILED BY
IVAN C. WELD, Secretary-Treasurer
PENNSYLVANIA AVENUE AT 26th STREET
WASHINGTON, D. C.

Price Two Dollars

International Association of Dairy and Milk Inspectors

CONSTITUTION AND BY-LAWS

CONSTITUTION

ADOPTED OCTOBER 16, 1911

NAME

This Association shall be known as the International Association of Dairy and Milk Inspectors.

OBJECT

The object of this Association shall be to develop uniform and efficient inspection of dairy farms, milk establishments, milk and milk products, and to place the inspection of the same in the hands of men who have a thorough knowledge of dairy work.

MEMBERSHIP

The membership of this Association shall be composed of men who now are or who have been actively engaged in dairy or milk inspection. Any person who now is or who has been so engaged may make application to the Secretary-Treasurer and if application is accepted by the Membership Committee, said applicant may become a member of the Association upon payment of the annual dues of five dollars ($5.00).

OFFICERS

The officers of this Association shall be a President, three Vice-Presidents, a Secretary-Treasurer, and two Auditors, who shall be elected by a majority ballot at the Annual Meeting of the Association, and shall hold office for one year or until their successors are elected. An Executive Board, 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 Association, and perform such other duties as usually devolve upon a presiding officer, or are required of him by the Association.

[1] Adopted October 29, 1915

SECTION 2. The Vice-Presidents, in the order of their selection, shall perform the duties of the President in his absence.

SECTION 3. The Secretary-Treasurer shall record the proceedings of the Association. He shall keep a list of members, and collect all moneys due the Association, giving his receipt therefor. He shall record the amount of each payment, with the name and address of the person so paying. He shall faithfully care for all moneys entrusted to his keeping, paying out the same only with the approval of the President, and taking a receipt therefor. He shall, immediately after his election to office, file with the President of the Association a bond in the sum of five hundred dollars, the expense of which shall be borne by the Association. He shall, at the annual meeting, make a detailed statement of the financial condition of the Association.

It shall also be the duty of the Secretary-Treasurer to assist in making arrangements and preparing a program for the annual meeting, and to compile and prepare for publication all papers, addresses, discussions and other matter worthy of publication, as soon as possible after the annual meeting.

SECTION 4. The full management of the affairs of the Association when the Association is not in session shall be in the hands of the Executive Board, as provided in the Constitution.

SECTION 5. It shall be the duty of the Auditors to examine and audit the accounts of the Secretary-Treasurer and all other financial accounts of the Association, and to make a full report of the condition of the same at the annual meeting.

ARTICLE 4

MEETINGS

SECTION 1. The annual meeting of the Association shall be held at such time and place during the month of

October of each year or at such other time as shall be designated by the Executive Board.

SECTION 2. Special meetings of the Association may be called by the Executive Board, of which due notice shall be given to the members by the Secretary.

SECTION 3. Quorum.—Twenty-five per cent of the membership shall constitute a quorum for transaction of business at any annual meeting. Voting by proxy shall not be permitted.

ARTICLE 5

These By-Laws may be altered or amended at any annual meeting of the Association. Any member proposing amendments must seasonably submit the same in writing to the Secretary-Treasurer, who shall then give notice of the proposed amendments by mail to each member of the Association at least thirty days previous to the date of the annual meeting.

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

International Association of Dairy and Milk Inspectors

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First Vice-President, I. V. HISCOCK..........New Haven, Conn.
Second Vice-President, HOWARD R. ESTES, New York, N.Y.
Third Vice-President, RALPH E. IRWIN......Harrisburg, Pa.
Secretary-Treasurer, IVAN C. WELD..........Washington, D. C.
Auditors: THOMAS HOLT..........Hartford, Conn.
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METHODS OF BACTERIAL ANALYSIS OF MILK AND MILK PRODUCTS.

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Shain, Dr. Chas.....Chief Food Inspector........Hamilton, Ontario

Shoults, Dr. W. A...Director of Food Division, Provincial Board of Health.Winnipeg, Manitoba

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Shroat, H. E.......Assistant, Division of Milk Control, State Department of Health ....28 Evergreen St., Harrisburg, Pa.

Shull, Dr. Hubert...Food and Dairy Inspector...414 W. Third St., Texarkana, Ark.

Sibbald, A. D......Assistant Dairy and Food Commissioner ....Old Capitol, St. Paul, Minn.

Smith, D. R........Hampton Roads Creamery, Inc. ....Newport News, Va.

Smith, Edwin J.....Chief Milk Inspector........Detroit, Mich.

Smith, Dr. George..Chief Food and Drug Inspector ....Division of Health, Toledo, O.

Smith, Howell A....Carlson-Frink Co. ....Denver, Colo.

Smith, Russell S....U. S. Public Health Service..519 Dexter Ave., Montgomery, Ala.

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Strauch, Thos. J....Chief Dairy Inspector, Bureau of Health ....Richmond, Va.

Supplee, Dr. G. C... Director of Research Laboratory, The Dry Milk Company ....Bainbridge, N. Y.

Tiedeman, Walter v.D........Assistant Sanitarian, Division of Sanitation, State Department of Health ....Elsmere, N. Y.

Tingle, John T......Municipal Milk and Dairy Inspector ....Meridian, Miss.

Tobey, Dr. James A..Scientific Consultant, The Borden Company ....350 Madison Ave., New York City

Tobin, Michael F...Inspector of Pasteurization..245 Canal St., Providence, R. I.

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Wallis, Wm. H.....Dairy Inspector ....City Hall, Somerville, Mass.

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Ward, Willard E...Agent, Board of Health, for Food and Milk Inspection.14 Town Hall, Brookline, Mass.

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White, W. W.......Assistant, Division of Milk Control, State Department of Health ....Harrisburg, Pa.

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Yale, Maurice W....Chief of Sanitation Department, Pittsburgh District Dairy Council ....451 Century Bldg., Pittsburgh, Pa.

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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.

Hastings, Dr. C. J. Medical Officer of Health...Toronto, Ontario

Pearson, Dr. Raymond A...President, University of Maryland ....College Park, Md.

Van Norman, Prof. H. E........President, American Dry Milk Institute ....160 N. La Salle St., Chicago, Ill.

Woodward, Dr. Wm. C.......American Medical Association, Bureau of Legal Medicine and Legislation ....535 N. Dearborn St., Chicago, Ill.

Sixteenth Annual Convention

KING EDWARD HOTEL
TORONTO, ONTARIO

MONDAY, OCTOBER 24, 1927

FIRST SESSION

The Sixteenth Annual Convention of the International Association of Dairy and Milk Inspectors was called to order by President W. A. Shoults in the Blue Room of the King Edward Hotel, Toronto, on Monday morning, October 24, at 11 o'clock.

Thomas Foster, mayor of Toronto, extended greetings and welcomed the Association to the city. His Worship the Mayor also expressed the hope that the work of the convention would be helpful to all, and that each member and visitor would thoroughly enjoy the days spent in Toronto. First Vice-President Ira V. Hiscock, of New Haven, Conn., responding for the Association, expressed to His Worship the Mayor the appreciation of the Association for the greetings and welcome extended.

Dr. W. A. Shoults, president of the Association, delivered the presidential address. Following the presidential address, Dr. A. E. Berry, of the Provincial Board of Health of Ontario, addressed the Association, expressing the satisfaction and pleasure in the Association's decision to hold this convention in Ontario, and expressed the hope that the members of the Association would visit the offices of the Provincial Board of Health while in Toronto.

Dr. A. R. B. Richmond, Director, Division of Food Control, Department of Public Health, Toronto, gave a most interesting talk on the subject "The Milk Supply of

Toronto." The last paper of the morning session, "Some Economic Factors in the Distribution of Milk in Ontario Cities," was read by Mr. J. B. Hoodless, of the Ontario Agricultural College, Guelph.

SECOND SESSION

The second session of the convention was called to order at 2 o'clock, and Dr. Paul B. Brooks, State Deputy Health Commissioner, of Albany, N. Y., read a paper, "The Recently Revised New York State Milk Code."

"Record Forms for Use in Milk Supervision" was the subject of a paper read by Prof. Ira V. Hiscock, School of Medicine, Yale University. Dr. J. W. Vanderslice, of Chicago, Ill., presented a paper, "The Place and Purpose of Certified Milk."

The committee appointed to report on communicable diseases affecting man, their relation to the milk supply and to the public health—Horatio N. Parker, Jacksonville, Fla., Chairman—in the absence of Mr. Parker presented its report through Vice-President Ralph E. Irwin. Dr. C. D. Pearce, New York City, Chairman, presented the report of the Committee on Bovine Diseases—Their Relation to the Milk Supply and to the Public Health.

Following the report of Dr. Pearce, a recess was taken. During the recess, a majority of the members enjoyed an informal dinner together, which was followed by speeches by members, none of which exceeded one minute.

THIRD SESSION

The evening session was called to order at 8 o'clock. Mr. Russell I. Prentiss, Milk Inspector of Lexington, Mass., presented a paper. The report of the Committee on Serving Milk in Schools, Factories, and Office Buildings was presented by Mr. M. O. Maughan, Executive Secretary of the Milk Council, Inc., Chicago.

"A Year's Work on Positive Pasteurization" was the subject of a paper read by Mr. A. R. Tolland, Supervisor of Pasteurization, Health Department, Boston, Mass. Dr. H. A. Harding and Dr. A. R. Ward, of Detroit, Mich., presented a paper, "What are the Sources of High Bacterial Counts in Pasteurized Milk?"

"The Use of Blood Agar in Milk Control Work" was the subject of a paper prepared by Dr. S. C. Prescott, of the Massachusetts Institute of Technology, and Mr. M. E. Parker, of the Walker-Gordon Laboratory, Princeton, N. J. In the absence of the authors, the paper was read by Dr. H. C. Lawton, of Pennsylvania. Following this paper, the convention took a recess.

Tuesday, October 25

Fourth Session

Doctor Shoults, President, called the Association to order at 10 o'clock. Dr. Charles J. Hastings, Medical Officer of Health of Toronto, was introduced and addressed the Association. The report of the Committee on Food Value of Milk and Milk Products was presented by Prof. Ira V. Hiscock, of New Haven.

Three brief papers were read by Dr. J. H. Shrader, Director, Bureau of Chemistry and Food, Health Department, Baltimore, Md. The papers were as follows: (a) "The Catalase Test in Milk Control." (b) "The Quantitative Limitations of the Reductase Test." (c) "Further Studies on the Relation of Biochemical Constituents of Media to Bacteria Counts."

The report of the Committee on Educational Aspects of Dairy and Milk Inspection, of which Prof. C. L. Roadhouse, of the University of California, was Chairman, was read by Prof. J. D. Brew, of Ithaca, N. Y. Dr. James G. McAlpine and Dr. Charles A. Slanetz presented a paper on the subject *"Bacterium abortum* Infection in Man and its Relation to Milk Consumption." The paper was read by Doctor Slanetz.

Mr. Leslie C. Frank, of the United States Public Health Service, was recognized, and addressed the Association briefly on the subject of the "standard ordinance" for the control of milk supplies suggested by the United States Public Health Service. The convention then took a recess.

FIFTH SESSION

The convention was again called to order by President Shoults. The first paper of the afternoon was on the subject "The Practical Sanitary and Economic Advantages of Concentrated Milk," by Dr. James A. Tobey, Scientific Consultant, Borden Sales Co., Inc., New York City.

"The Appraisal of Milk Control Activities" was the subject of a paper prepared by Dr. W. F. Walker, Field Director, Committee on Administrative Practice, American Public Health Association, New York City. Dr. M. J. Prucha, Dairy Bacteriologist, University of Illinois, read a paper on the subject "Chemical Sterilization."

Mr. Paul F. Krueger, Milk Sanitarian, Department of Public Health, State of Illinois, gave an interesting illustrated address on the work of the Department as carried on by means of the traveling bacteriological laboratory.

The report of the Committee on Score Cards and the Score Card System of Dairy Inspection, of which Mr. C. Sidney Leete, of the Bureau of Dairy Industry, United States Department of Agriculture, was chairman, in Mr. Leete's absence was read by Mr. Ernest Kelly, also of the Bureau of Dairy Industry of the United States Department of Agriculture.

SIXTH SESSION

The evening session was called to order by First Vice-President Ira V. Hiscock, who presided during the evening. A paper prepared by Dr. John L. Rice, Health Officer, and Chas. H. Amerman, also of the Health Department of New Haven, Conn., and having as its subject "The New Haven Milk Bottle Exchange," was read by Mr. Chas. H. Amerman.

Mr. Ernest Kelly, Bureau of Dairy Industry, United States Department of Agriculture, Washington, D. C., read a paper entitled "Is Dairy Inspection an Exact Science?" Dr. W. G. Hollingworth, City Veterinarian of Utica, N. Y., read the final paper of the evening. The subject of Dr. Hollingworth's paper was "Education is Surer than Legislation."

Wednesday, October 26

SEVENTH SESSION

President Shoults called the convention to order at 10 o'clock. Dr. Ralph F. Lockwood, Health Officer and Milk Inspector of Lakewood, R. I., contributed a paper, "The Physician's Duty in Teaching the Public the Value of Milk." The report of the Committee on Remade Milk, of which Dr. J. H. Shrader, of Baltimore, was chairman, was read by Doctor Shrader.

Mr. W. D. Dotterrer, of Chicago, Ill., Chairman, reported for the Committee on Methods of Obtaining a Satisfactory Quality of Raw Milk for Pasteurization. Mr. George W. Putnam, Chief, Bureau of Dairy Products, Chicago Department of Health, Chairman, presented the report of his Committee on Dairy and Milk Plant Equipment. The report of the Committee on Milk Plant Practice was presented by Dr. H. A. Harding, Chairman, of Detroit.

The report of the Committee on Methods of Bacterial Analysis of Milk and Milk Products, of which Mr. George E. Bolling, of Brockton, Mass., was chairman, was in the absence of the chairman presented by Dr. Wm. H. Price, of Detroit.

EIGHTH SESSION

The afternoon session was called to order at 2 o'clock by President Shoults. The first paper of the afternoon was on the subject "The Use of the Direct Microscopic Count in Quality Control," by Mr. M. W. Yale, Chief, Sanitation Department, Pittsburgh District Dairy Council, Pittsburgh, Pa. Prof. T. J. McInerney, of Cornell University, Ithaca, N. Y., read a paper, "The Relation of the Hydrogen Ion Concentration to the Titratable Acidity of Milk."

Dr. Floyd C. Rath, Dairy and Food Inspector, Madison, Wis., read a paper on "Grade A Milk in Wisconsin." "Statistical Analysis of Bacteria Counts Made by the Direct Microscopic and Agar Plate Methods" was the subject of a paper presented by Prof. James D. Brew, of Cornell University. "Cincinnati's Milk Supply and the Regulations which Govern It" was the subject of a paper contributed by Dr. S. T. Pyper, Chief Food Inspector, Board of Health, Cincinnati, O.

Business Session

The business session of the Association was called to order by President Shoults at 3.35 o'clock. The report of the auditors was received, as was also the report of the Secretary-Treasurer.

In the absence of Dr. G. C. Supplee, Chairman, the report of the Committee on Resolutions was made by Mr. Thos. J. Strauch, and resolutions were adopted as follows:

1. Whereas, This Association has been enlightened and greatly benefited by contribution of papers by friends of our organization; therefore be it

Resolved, That the International Association of Dairy and Milk Inspectors express its appreciation and thanks to Dr. C. J. Hastings, Dr. A. E. Berry, Mr. J. B. Hoodless, Dr. J. W. Vanderslice, Dr. S. C. Prescott, Mr. M. E. Parker, Dr. James G. McAlpine, Dr. Charles A. Slanetz, Dr. M. J. Prucha, and Prof. A. Leitch, for papers presented.

2. WHEREAS, His Worship, Mayor Foster, has officially welcomed the International Association of Dairy and Milk Inspectors to Toronto on the occasion of its sixteenth annual convention; therefore be it

Resolved, That this Association express to His Worship the Mayor our thanks for the welcome and courtesies extended.

First Vice-President Hiscock spoke of the activities of Dr. Charles J. Hastings, Medical Officer of Health of Toronto, and on behalf of the Membership Committee placed his name in nomination for election as an honorary member of the Association. This motion was seconded by Mr. Ralph E. Irwin, and Dr. Charles J. Hastings, of Toronto, was unanimously elected by the Association as an honorary member.

The following were elected as officers for the ensuing year:

President, Prof. Ira V. Hiscock, New Haven, Conn.
First Vice-President, Howard R. Estes, New York City.
Second Vice-President, Ralph E. Irwin, Harrisburg, Pa.
Third Vice-President, Dr. A. R. B. Richmond, Toronto, Ontario.
Secretary-Treasurer, Ivan C. Weld, Washington, D. C.
Auditors, Thomas Holt, Hartford, Conn.; Dr. F. D. Holford, New York City.

An interesting discussion regarding various phases of the Association's activities was participated in by many of the members.

NINTH SESSION

A final session of the convention was called to order by President Shoults at 8 o'clock. "Some Results of the Reductase Test as Used in Routine Milk Analyses" was the subject of a paper contributed by Mr. E. B. Johnson, Milk Inspector of Framingham, Mass. In the absence of Mr. Johnson, the paper was read by Dr. H. C. Lawton, of Pennsylvania.

Prof. A. Leitch, Department of Agricultural Economics, Ontario Agricultural College, gave a most interesting address on the subject of producers' organizations and price adjustments. Mr. Benjamin Vener, Long Island City, N. Y., contributed a paper on the subject "Ice Cream in the Balance." The report of the Committee on Sanitary Control of Ice Cream was read by its chairman, Mr. Ralph E. Irwin, Chief of Division of Milk Control, State Department of Health, Harrisburg, Pa. Mr. Wm. B. Palmer, of Orange, N. J., chairman of the Committee on Milk Ordinances, presented the report of the committee.

Secretary Weld expressed the appreciation so frequently voiced by members of the Association during the convention of the helpful cooperation given by the officials of Ontario and of Toronto which had contributed in so large degree to the success of the convention. He particularly referred to the helpfulness of Dr. Richmond, of the Toronto Health Department, and to the representatives of the Agricultural College and others.

In bringing the sixteenth annual convention to a close, President Shoults voiced the satisfaction and pleasure which he as president of the organization and as a Canadian had experienced as a result of the holding of this convention in his country.

ADDRESS OF WELCOME

His Worship, the Mayor of Toronto

Mayor Foster said in part:

It is an opportunity I appreciate to welcome the International Association of Dairy and Milk Inspectors to the City of Toronto. You realize the importance of your work and your responsibility to the public, and it is most commendable that you should meet together from time to time to compare notes and experiences and to give and gain information that will be helpful to you and the people whom you serve in your various localities.

The public depends upon you and your alertness in attending to the things that make for health. Toronto has been free from outbreaks of disease. Because of constant alertness, epidemics which might have been most costly have been averted and consequent illness and loss of life have been prevented. The conditions under which milk is produced and distributed have been greatly improved, and the people of Toronto are today being served with milk that is both safe and wholesome.

In this, the Queen City of Ontario, within 50 miles of which there is a population of 50,000,000 people, we are happy to welcome this Association. We hope your convention will be a profitable one for you and that you may remain an extra day and see our city and its surroundings. We have fine modern dairies, some of which are pronounced to be among the finest on the continent and which attract visitors from many countries. We have one of the largest department stores. The University of Toronto with affiliated colleges is the second largest in the British Empire and ranks among the ten largest universities in the world, having between six and seven thousand students representing every country in the world, as well as several thousand other students in the technical schools.

Bordering on the lake front we have a thirty-million-dollar development which is designed to make it safe for the enjoyment of our people. Our water supply is furnished by the city, and our street railways, electric light, heat, and power plants are also owned and conducted by the city. We have not less than 2,000 acres devoted to parks.

We hope you will become acquainted with our city and that you will always be ready to say a good word for Toronto. If arrested by our police and lodged in jail, call on me and I will secure for you your liberty. We have pleasure in helping you and hope that you will so enjoy your stay here that you will want to come again.

"Few were their words, but, if you look, you'll much in little see."

RESPONSE TO ADDRESS OF WELCOME

PROF. IRA V. HISCOCK,
First Vice-President,
New Haven, Conn.

The members of the International Association of Dairy and Milk Inspectors are glad to have this opportunity to meet in Canada for their sixteenth annual convention. They deeply appreciate the cordial greetings of Your Worship, and the hospitality already shown them in Toronto.

This Association stands for service to the people. Our members are primarily concerned with the supervision of milk supplies, and they are mindful of the relation of safe milk to public health. They are leaders in this important work in their respective communities, and they recognize the responsibility which rests upon them. Emphasis is repeatedly given in our meetings to the importance of high standards of milk supervision, administered by trained workers who are secure in tenure. These are sound principles. As the Association is international in scope and its membership is drawn from many sections of the land, there is offered a unique opportunity for service to mankind.

It is fitting that this Association should hold its convention in the Queen City of Canada. For many years, public health workers throughout America have followed with admiration the accomplishments of this great city in improving the health conditions of its people. Toronto has a most able commissioner of health, who years ago began a campaign for an adequate and safe milk supply. His efforts were rewarded, so that today Toronto has one of the best milk supplies on the continent. Nearly 100 per cent of the supply is pasteurized. While these activities have been going on, Toronto has developed a department of health of the first rank, which students, educators, and administrators from many lands have come to visit. It is a great privilege to be able to visit this city and to see the results of such an excellent health program.

"Giving credit where credit is due is a great producer of ambition; and ambition produces results."

PRESIDENTIAL ADDRESS

Dr. W. A. Shoults, Winnipeg, Manitoba

I deem it an honor and a privilege, and to me as a Canadian it is a great pleasure, to preside at this, our first convention to be held in Canada. It is fitting that this meeting should be held in Toronto, the Queen City of the leading province in this Dominion. We hope the proceedings will be of a character that will enable you who come from the United States to carry away the most pleasant and kindly recollections of your visit to this side of the imaginary line which divides this continent. Since our organization is probably not so well known in Canada as on the American side, I will take the liberty of making some reference to the early history of the Association.

Prior to 1911 our Secretary-Treasurer, Mr. Weld, as a representative of the United States Department of Agriculture, had for several years been travelling among and working with officials engaged in the improvement of public milk supplies. Observing the work at that time was more or less a matter of individual enterprise, it occurred to him that if there were better opportunities for the interchange of opinions among officials, a better medium for making public the findings of those engaged in research, and a more concerted effort on the part of those engaged on the problem of cleaner and safer milk supplies, much more could be accomplished; and so the idea of forming an organization was conceived.

The International Dairy Show of 1911 was held at the city of Milwaukee, and Mr. Weld took this opportunity of discussing the project with officials who happened to be present. Immediate organization was agreed upon, and in a room in the auditorium in Milwaukee, after much travail, a lusty infant, the International Association of Dairy and Milk Inspectors, was born on October 16, 1911. The offspring of that meeting has thriven and grown until its influence has been felt over the entire continent, and even beyond the seas. The records show that nine members were enrolled at the organization meeting, and the following officers were elected: President, C. J. Steffen; First Vice-President, A. N. Henderson; Secretary-Treasurer, I. C. Weld.

Within the next year five applicants were accepted to membership. The first annual meeting was held in connection with the International Dairy Show in the auditorium in Milwaukee, October 25, 1912. At 16 years of age the Association has an active membership of about 180. Fifteen annual reports have been published. These fifteen volumes contain 483 papers. About 7,500 copies of the reports have been distributed throughout the United States and Canada, and many also have been sent to European, Asiatic, and South American countries.

I do not flatter our Secretary, Mr. Weld, but merely pay him a well-earned tribute when I say that not only did he play a leading part in bringing this organization into being, but what has been accomplished by the Association throughout its entire history has been in large measure due to his untiring efforts.

The more efficient supervision and control of milk and dairy products during the last 25 years have been important factors in extending the span of human life. This has been called the age of disease prevention. In the sixteenth century the expectancy of human life in England was said to be 21 years. This time has been gradually extended until the expectancy of life is now estimated at from 56 to 58 years, no less than nine of which have been added during the first quarter of the present century. The remarkable strides of the last sixty years have been largely due to the advancement in surgery, and to the more efficient control and prevention of communicable disease. It is in this latter field that the work with which we are concerned plays an essential part. Prominently associated with the achievements of the nineteenth century are the names of Lord Lister, Pasteur, Von Behring, and Koch. To Pasteur we owe the credit for the process of treating milk which bears the name "pasteurization" and which, when properly and efficiently carried out, is the most valuable single agency yet developed for the safeguarding of public milk supplies. The improvement in the quality and safety of milk and dairy products has been accomplished in two principal ways; namely, cleaner methods of handling, and pasteurization.

Certified Milk has set a standard for the production and handling of milk that has influenced the entire industry. Pasteurization is the other great factor in improvement. Within the last couple of years commercial pasteurization has been submitted to a more searching scrutiny on the part of public health officials. In some cases a wide gap was found between technical pasteurization and the commercial so-called pasteurization practised. The net result of these investigations will undoubtedly be the more efficient application of this valuable safeguard. Coupled with this improvement in the general quality and wholesomeness of public milk supplies, there has been an increasing appreciation of the nutritive value of this important food, and the per capita consumption of milk and dairy products on this continent is daily increasing. In times past, owing to the distance from the source of supply, the perishable nature of the product, and the risk of contamination in transit, the great problem lay in supplying the larger cities with a safe milk supply. The application of modern methods now makes this possible. But while in the prevention of milk-borne diseases much has been accomplished in the larger cities, little has been done to protect milk consumers in the rural districts and the smaller urban centers. Because the possibilities of handling milk in a large way are so limited, and because the cost of efficient supervision is relatively high, the safeguarding of milk supplies in the smaller urban centers is a difficult problem, and one which calls for serious and thoughtful consideration.

"Success consists not so much in sitting up nights as being awake in the daytime."

SOME ECONOMIC FACTORS IN THE DISTRIBUTION OF MILK IN ONTARIO CITIES

J. B. HOODLESS, *Research Assistant in Marketing,*
Department of Agricultural Economics,
Ontario Agricultural College,
Guelph, Ontario.

In studying the various essential services that have to be rendered in the marketing of almost any product, there is a tendency to stop the study with the producing and marketing of the raw bulk product. Perhaps no better example of this can be given than milk. Most farmers consider that their efforts are the really essential ones, and rarely stop to consider the many important and vital steps that must be completed to place their raw milk in the hands of the ultimate consumer, and the consumers are in many cases lax in understanding and appreciating the services involved. While not attempting in this paper to cover the many points that could be dealt with, I will try to discuss some that may be of particular interest to this Convention.

The growth of our towns and cities and the economic changes that are occurring tend to build up the distribution of fluid milk into a highly specialized business. Problems of transportation, processing, and distribution have arisen, until now the distributors perform services as necessary as production itself. They are also, in most cases, the salesmen of the producers, and with large investments of capital and experience at stake are highly efficient.

In many of our smaller places, lack of enforcement of the modern requirements of purity and standards permits the peddling of milk by small producers and distributors. It renders a sufficient volume of business on which to operate a modern plant impossible or, as in some cases, possible during part of the year only. It permits unscrupulous dealers to sell an inferior quality. It leads to dissatisfied consumers and decreased consumption. It tends to lower the standard of health in the producing herds. It has almost invariably resulted in a low price to the producer and a high cost to the consumer. Wherever lax standards prevailed, an unsatisfactory condition was found.

A few years ago, in the course of our studies, we visited two cities. I will call them "A" and "B." They were similar in size and centered in equally good producing areas, with almost identical facilities in every way.

"A" in 1924 had three efficient pasteurizing plants. No ordinary raw milk or cream was permitted to be sold, under a very thorough and effective municipal inspection.

"B" had at least five so-called pasteurizing plants, and ten or more peddlers of raw milk. Stores and market were supplied direct by farmers. A lax system of municipal inspection existed.

	Price to Producer	Retail Price	"Spread"
City A	6c per qt.	11.75c per qt.	5.5c per qt.
City B	5.7c per qt.	12c per qt.	6.3c per qt.

One had a safe high-quality food, the other a doubtful one.

There is a decided tendency toward the elimination of the small milk distributors, and as volume of business is the all-important factor in the cost of the services rendered by the distributors, this is to be expected. With this factor is closely associated strict enforcement of standards.

Toronto in 1917 had 85 dairies in operation and in 1927 this number had been reduced to 52.

In ten years there has been a decrease of 33 dairies, and at the same time a very large increase in population to be served. In the city proper this increase has amounted to over 82,000. The retail price of milk has remained practically stable.

The larger the distributor the better able he is to cope with the many problems that arise in the cost of distribution. His plant can be strategically placed, both for receiving and distributing his merchandise, and can be built large enough to handle economically the pasteurizing or manufacture of his products. The unit of cost of pasteurizing largely depends upon the volume and the adaptability of the plant for efficient handling. The pasteurizing plant should be large enough to take care of the total retail trade from that plant in about six hours. If the plant is too small, longer hours must be taken to handle the perishable product, and cleanliness is harder and more costly to maintain.

Most of our modern plants have been overbuilt for the handling of fluid milk alone. Opportunity is frequently offered to combine some other product of the dairy business and, with little additional expense in labor and equipment, increase the volume of business and lower plant expense. The vexatious problem of surplus is frequently helped, too, by the ability to manufacture.

The heaviest proportionate expense in the distribution of fluid milk is the conveying of the product from the plant to the consumer.

Perhaps the most important factor in this service, both from the standpoint of economy and efficient service to the consumer, is keeping the milk sales on the retail wagon. The store trade has little to be said in its favor and much to its detriment. Briefly, it acts as a convenient supplementary source of supply to the wagon, and in some cases it provides refrigeration. On the other hand, if properly equipped to handle milk, the capital investment is an additional expense on the cost of distribution. Bottle losses are much greater through the stores and they are frequently the cause of bitter and destructive competition among the distributors. There is the liability of milk being held too long before reaching the consumer, and the storekeeper has not the pride in his product the distributor has. They lengthen wagon routes and decrease loads. The use of a universal exchangeable bottle for stores has been found to effect a marked saving in the loss of bottles. These bottles are used by all distributors and on return to any store are exchanged without charge.

I have often heard it remarked that there are too many milk wagons on our streets. Where a community has too many distributors, that is nearly always true; but where there is a proper balance, the fact that two or three wagons may cover the same ground does not necessarily mean waste. When two or three reliable dealers are covering the same route, the consumer has the benefit of choosing the one she prefers, and the expense is about as low as though there were only one dealer. A driver can deliver only a certain amount at any one time and must return to his wagon to refill his carrier, during which time his horse moves him along to his next stop, the only difference being that in the thickly populated sections, the wagon is moved instead of standing still. The competition, if reasonable, is good for both consumers and distributors.

There should be proper milk receptacles built into every house. After all the inspection and care taken to deliver the milk, it should have some protection on the part of the consumer. It means economy to the distributor in saving replacements by protecting the quality and purity of milk, in summer from heat and in winter from freezing. Some distributors are providing small insulated cabinets, placed in a convenient place, and they answer very well. Such service is also appreciated by the intelligent consumer.

Drivers of milk routes must be salesmen as well. Many distributors are now making special efforts to educate their drivers in the business they are engaged in, as in many cases the drivers are the point of personal contact with the consumers. They can be a source of much useful information, and the more they know about the product they are handling, the more valuable they are.

There are two factors that always have a bad reaction on the milk business as a whole:

1. Accusations of profiteering, dishonesty, inefficiency, etc., based on hearsay evidence, and lacking real knowledge of the conditions. These frequently arise about election time and only succeed in unsettling the minds of the public. Here in Ontario, we have yet to find justification for these attacks.

2. Price wars. There can hardly be anything more disastrous to the whole community so far as milk consumption is concerned. The consumers are lead to believe as the price drops that they were being robbed, but the drop does not increase consumption materially. The distributor looks around to try to cut his expenses. Reduction of wages or staff leads to disorganization and inefficient service. Cutting the purchase price or reduction of quality is bad business for all, yet the loss the war entails must be made up some way, or ruin stares many a distributor in the face. Where is there any gain? When it is over the consumers have become accustomed to the lower price that can't be maintained, and when the price goes back to normal, consumption falls off.

Desiring to know something about the per capita consumption of fluid milk in our cities in cooperation with distributors in various centers, we had the milk route drivers take a census of their routes. We provided cards on which the drivers filled out the number in the family, both adults and children, and quantity taken. Where possible, the routes were divided into "well-to-do," "medium," and "poor" sections. The assumption was taken that adults in families with children, and adults in families without children, in the same social class, consumed a similar quantity of milk, and while this may not be exactly true, for purposes of comparison between classes it is essentially correct. We did not include cream, as it is most largely used in the wealthier sections, wagons in the poorer sections carrying very little.

The city of Hamilton, with a population of over 120,000, was very thoroughly covered, the figures used being the weighted average of over eighty milk routes. Being especially a manufacturing center and having very distinctly divided residential sections, it lent itself to a fairly definite classification into the various divisions made.

Consumption of Fluid Milk in the City of Hamilton

	Well-to-do	Moderate	Poor
Daily per capita consumption	.70 pts.	.59 pts.	.51 pts.
Daily consumption per child	.90 pts.	.65 pts.	.42 pts.

Comparing the families of the "well-to-do" class and the "poor" class, the addition of children to the former increased the per capita consumption, while it decreased it in the latter.

Families with Children

Well-to-do	.75 pts. per capita
Poor	.50 pts. per capita

Families without Children

Well-to-do	.66 pts. per capita
Poor	.57 pts. per capita

Division of Costs

When the consumer in the City of Toronto paid $1.00 for milk in 1924, it was divided up as follows:

Net profit	2.4c
Office expense	5.9
Delivery expense	18.6
Plant expense	14.9
Cost of material	58.2
Total	100.0

Ontario may be divided into three rough geographical areas, with material differences affecting the cost of milk distribution in each. These areas are as follows:

1. Ottawa.
2. Toronto and Hamilton.
3. Border Cities (Windsor, Walkerville, etc.).

Ottawa, occupying the unique position of the only large city in the whole of Eastern Ontario, is located in a district where dairying has been for years the most prominent branch of farming. This makes somewhat easier the question of volume of supply within a reasonable distance of the consuming center, though there are the same difficulties respecting the quality and steadiness of supply as are found in other districts. Moreover, the volume of milk consumed in Ottawa is just about that amount that makes it possible to combine its distribution in the most profitable degree with the ice cream business of the city itself, and of the large surrounding territory of villages and towns in the extremely well-balanced and efficient business that distributes a large part of Ottawa's milk.

Toronto and Hamilton are located in an area which has not been generally devoted to dairying. As a consequence, the type of dairy farming that has been evolved in the tributary district is the kind well adapted to producing market milk and cream. As the type of farming in any district naturally changes very slowly, the distributors in Toronto especially have had to reach out for a part of their supply into the established dairy districts of Oxford on the west, and the Bay of Quinte counties on the east. Moreover, there is not the same happy balance between volume of milk and volume of ice cream in Toronto and Hamilton as in Ottawa, since a large part of the ice cream produced in dairy plants is consumed within these cities, where there are also large separate ice cream plants which, with the great number of local ice cream plants in the moderate-sized cities near Hamilton and Toronto, compete keenly for the ice cream trade in this section of Ontario. There is, therefore, a smaller proportion of the costs of milk distribution borne by the inclusion of ice cream in joint business than in Ottawa.

The Border Cities are quite differently situated. They have grown very recently and rapidly from small isolated towns into a large consuming center. They are located in a district where dairy farming has been until recently practically unknown. Their local supply of milk has the serious handicaps in quantity, quality, and unevenness of supply that are only to be expected in such a situation. The cities are very much spread out and labor costs are high, due to their unique industries and to the contact with Detroit. These cities are in the process of learning to supply themselves with a good milk supply.

In 1924, Ottawa's retail "spread" was 3.9 cents per quart, retail price 10 to 11 cents; Toronto's retail "spread" was 6.4 cents per quart, retail price 11¾ to 13 cents; and in the Border Cities, the retail "spread" was 7.33 cents per quart, retail price 13 to 15 cents.

In comparing the price of milk in various areas, it is therefore important to know the economic differences that affect them and have important influences on the costs and conditions of milk distribution.

In conclusion, let me again emphasize the fact that we found the greatest factor in an economical and efficient milk supply in our cities to be the strict enforcement of the modern requirements of purity.

"Man's worst ill is stubbornness of heart."

THE REVISED NEW YORK STATE MILK CODE

PAUL B. BROOKS, M. D.,
Deputy State Commissioner of Health
Albany, N. Y.

In New York State supervision of milk supplies is carried on jointly by the State Department of Agriculture and Markets and the health authorities, State and local. The Agriculture and Markets law contains a chapter relating to dairy products, while Chapter III of the State sanitary code, effective except in New York City, relates to the sale of milk and cream. The local health authorities also have power to enact local regulations not inconsistent with the State code.

Considering the fact that both the State Department of Agriculture and Markets and the Department of Health have rather broad powers in relation to milk control, it is conceivable that there might be considerable overlapping and some possibilities of friction. Fortunately, however, the relation between the two departments has been one of understanding and cooperation. I have in my files a copy of a letter from Commissioner Pyrke, head of the Department of Agriculture and Markets, to a milk company official who was evidently concerned lest with the enactment of a revised State milk code his business was going to be interfered with by two State departments acting independently. Two or three extracts from this letter will indicate Commissioner Pyrke's attitude. He said:

> "The changes in the sanitary code are not revolutionary. I think there is no reason why dairymen or dealers should be apprehensive as to new burdens being placed upon them. * * * * * This department's regulation of the milk industry is more particularly on the side of the nutritional qualities of milk, while the Department of Health approaches the problem

from the standpoint of the public health. * * * we place our chief emphasis on insuring that milk will reach the consumer in exactly the condition in which it was drawn from the cow. * * * * *

"The sanitary code * * * is a guide * * * for the local health officials, and these officials plainly have a very important place in the safeguarding of the people's milk supply. In a state so intensively developed in dairying * * * it is not practicable for the State to maintain a constant supervision of the thousands of dairies which furnish the State's milk supply. This intimate supervision necessarily must come principally from the officials of the municipalities where milk is sold.

"This department maintains a constant supervision of milk plants, and with the small force of men it is at such points of concentration that the most effective supervision can be set up."

Commissioner Pyrke expressed the opinion that the Agriculture and Markets Law imposed upon his department the power to establish grades of milk, but added:

"We have not attempted to exercise this power, as the subject has been well covered by the sanitary code and it is our purpose to prevent duplication and overlapping."

In short, there is a general understanding that the health authorities will concern themselves primarily with prevention of the spread of disease through milk, and the agricultural authorities primarily with the economic aspects, including the prevention of adulteration and misbranding and the protection of the interests of milk producers.

For some time the Public Health Council has realized that the present milk code, enacted in 1914, was being outgrown, and about a year and a half ago it appointed a committee to prepare a revision. This committee, consisting of H. N. Ogden, Professor of Sanitary Engineering at Cornell and a member of the Council, J. D. Brew, Extension Professor of Dairy Industry at Cornell, S. W. Bateson, Superintendent of Milk and Food Inspection, Buffalo, Mr. Holmquist, and myself, devoted over a year to the undertaking. Some of you will recall that we were in the midst of it when this organization met last year. After making a study of many State and municipal codes we prepared a preliminary draft which was sent to about a hundred milk "authorities" of various kinds, including a number of large and small milk dealers and dairymen, with requests for criticisms and comments. Many suggestions were received and considered, and we prepared a second draft, invited more criticisms, and held a number of personal conferences with representatives of the larger milk companies and others. Eventually we finished our undertaking, and on May 6th the Public Health Council adopted the revision which we recommended, making only a few minor changes, and making it effective July 1, 1928. Health Commissioner Harris of New York City worked with us, and when the revised code was adopted it was with the understanding that he would recommend revision of the New York City milk code to make it identical in all essential features.

In preparing the revision the committee adhered as closely as possible to three general aims: to establish only such requirements as were necessary to prevent the spread of communicable disease through milk; to establish reasonable standards, leaving the methods of attaining them so far as practicable to the producers and dealers; and to impose upon the latter no unnecessary or unreasonable restrictions.

The following is a summary of the more important changes from the present code:

1. The grade designations in the order in which they appear are: Pasteurized Grade A, Certified, Pasteurized Grade B, Unpasteurized Tuberculin Tested, and Unpasteurized Not Tuberculin Tested. It was the intent to emphasize

pasteurization or the lack of it and to make it readily apparent whether herds were or were not tuberculin tested.

2. Bacteria counts are universally required for grading and control, and in general the bacterial standards are somewhat higher than those in the present code. The revised code includes a provision that the local health officer shall "cause" such counts to be made in laboratories approved for the purpose by the State Commissioner of Health. The intent is to place the responsibility upon the municipality rather than upon the producer or dealer. At present in some localities the milkmen are required by local ordinances to assume this burden. We feel that the bacterial examinations, and the examinations of dairy cattle as well, are primarily in the interest of the public health rather than in the interest of the producer or dealer.

Although local laboratory service is provided more extensively in New York State than in many other States, we are not so optimistic as to believe that there will be an immediate 100 per cent compliance with these requirements. We feel, however, that the difficulties are by no means insurmountable and we are already beginning systematic efforts, through our district State health officers and otherwise, to bring about the establishment of local milk laboratory service where it is at present lacking or inadequate.

3. Milk which is not pasteurized must be from tuberculin-tested herds, except that the health officer, if all other requirements are met, may permit the sale of milk from untested herds if the owners have made formal application to the Department of Agriculture and Markets for tests. The exception was incorporated because we recognized the practical impossibility of having all herds immediately tested. The Department of Agriculture and Markets is actively engaged in promoting the accredited herd plan and the

exception is looked upon as a temporary expedient which will ultimately become unnecessary.

4. Pasteurizing plants, in order to handle Pasteurized Grade A, must have been inspected by an authorized representative of the State Commissioner of Health and approved in writing as to type and efficiency. We have been asked whether we believe that a plant so defective that it can not be approved for the handling of Grade A can safely be permitted to pasteurize Grade B. Our answer has been that a plant so defective as to be dangerous should not be permitted to pasteurize milk of any grade; on the other hand, it is well recognized that so many plants are defective in some respects that immediate perfection is out of the question and that corrections will have to be brought about gradually. To require approval for handling Grade A will provide an added safeguard, warranting the higher price, and at the same time stimulate correction of defects.

5. All persons engaged in handling unpasteurized milk or in handling Pasteurized Grade A during or following pasteurization are required to submit such samples of bodily discharges as the health officers may prescribe. This we regard as essential for the raw milk and as providing a safeguard for Pasteurized Grade A.

6. No plant is permitted to pasteurize more than one grade of milk unless separate pasteurizing apparatus is used. Whether or not this requirement will be difficult to enforce remains to be seen. The intent, of course, is to prevent the fraud so frequently perpetrated when milk bearing different grade designations is sold from a plant having but one set of apparatus.

7. Milk may be sold in bottles only, with the exception that under certain prescribed conditions it may be sold in cans to camps, hospitals, restaurants, etc., and at the place of production, bottling, or pasteurization in quantities of four quarts or less in the customer's own containers. The

intent is to eliminate the sale of dipped milk in stores and on the street.

8. County medical milk commissions must be registered with the State Department of Health and a copy of the commission's certificate must be filed with the health officer of each place where Certified Milk is sold. Each commission is required to report to the health officer monthly the results of all bacterial counts, health examinations of milk handlers, tuberculin tests and physical examinations of dairy cattle. At the suggestion of Doctor Moak, we probably will agree to have these reports made through our district State health officers.

Failure on the part of a commission to comply with the requirements of the American Association of Medical Milk Commissions or of the State code is declared to be ground for refusal, on the part of the health officer, to issue a permit for the sale of Certified Milk.

9. The numerical dairy score has been abandoned, and a "yes and no" inspection substituted.

The *Rural New-Yorker,* a well-known farm journal, recently published a *resumé* of our revised code and concluded its article with the statement that the enforcement of the code undoubtedly will mean an increase in the cost of production of milk and that in the present temper of milk producers the increased cost will be passed on to the consumer. Assuming enforcement with reason and discretion, we see no good reason why production costs should be increased. The three features which seemed to excite most concern were the requirement as to bacterial examinations, the requirement regarding the tuberculin test, and the elimination of dipped milk. As already noted, under this code many producers will be relieved of a burden they are now carrying—that of paying for bacteria counts—the responsibility being placed upon the municipality. Because of the growth of the accredited herd plan, universal tuberculin testing will soon be an accomplished fact in New York State, irrespective of the requirements of this code. People now buying loose milk will no doubt have to pay a little more for milk in bottles, but unsafe milk is expensive at any price and in the aggregate we believe it will mean economy. This requirement imposes no new burden upon the producer.

As has often been pointed out, there is another side to this question of price. If we consider relative values it becomes evident that whereas many of the articles and substances in common use are sold at prices representing many times the production cost, the greater part of the price representing the cost of advertising and salesmanship, milk is sold at prices very little above the actual cost of production and handling. The dealer receives the fair profit to which he is entitled, but the farmer on whom we depend for our milk supply is sometimes fortunate if he closes a year without actual loss. He of all persons is entitled to a reasonable return for his effort and assurance of such a return should mean increased production and, indirectly, stabilization of prices. I believe it is a duty of health officials and others interested in the production, sale, or sanitary control of milk to educate the consumer to an appreciation of the value of good milk and to the idea of paying a reasonable price for it.

In conclusion, we know that enforcement of this new code will not be without its difficulties and that there will be obstacles to overcome. However, we consider the effort warranted and well worth while. In the past, although there has been a progressive improvement, we have been by no means satisfied with the enforcement of our milk regulations. Within the past year two events have emphasized the importance of efficient enforcement. Preceding the last annual election a candidate for an important State office based his campaign largely on milk. Perhaps fortunately for us, New York City absorbed his attention. From our standpoint this campaign had a beneficial effect in that it stimulated official activity and excited interest in milk control in people who had given no thought to it before. The other and more important event was the Montreal epidemic in which milk from one plant was said to be responsible for twice as many cases of typhoid as we have had in our jurisdiction in New York State in any recent year and exceeding the number of cases of diphtheria in any one of the last three years. We believe that a majority of the thinking people in our State are now ready to lend their support and cooperation in bringing about an efficient enforcement of this new code and we intend to make this one of our principal objectives in the coming year.

"Even dynamite cannot demonstrate its power unless you give it a chance to explode."

RECORD FORMS FOR USE IN THE SUPERVISION OF MILK SUPPLIES

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The effectiveness of milk supervision programs depends upon many important factors, such as the ability and personality of the milk inspectors, the support received from official bodies in providing adequate ordinances, funds, and personnel, and the interest and cooperation received from milk producers. The nature and extent of the task of milk supervision naturally vary with local conditions, as, for example, the size and characteristics of a community, the geographical location, and the length of haul. Consequently, the administrative problems concerned with milk control are likely to multiply in direct proportion with the increase in complexity of this important task. There is likewise bound to be a lack of uniformity of procedure in various sections of the country and under different conditions.

In an effort to aid, within practicable limits, the standardization of certain phases of community health practice, the committee on administrative practice of the American Public Health Association has created several subcommittees. One of these subcommittees is engaged in the preparation of standard record forms for various purposes. Reports have already been presented on record forms for communicable disease control, for public health laboratories, and for public health nursing. As a member of this committee, the writer is at present engaged in a study of record forms for use in the supervision of milk supplies. It therefore has seemed appropriate to bring this subject before such a highly representative group of milk inspectors in the hope that mutual benefit may be derived from a free discussion of the problem. Suggestions as to the types of forms and data to be included will be appreciated.

The maintenance of careful records of the results of inspections and of analyses and the prompt reporting of results is fundamental for the fullest success of a milk supervision bureau. The use of special forms appropriate to different phases of activity facilitates the work and affords valuable permanent records for administrative purposes. Simplicity of records, however, is to be sought so far as possible. The record forms needed by large and small cities are for the most part quite similar in make-up, although the variety of forms required in small cities is not as great as in large ones.

The various types of record forms used commonly in milk control work may be listed under the following headings:

1. Application for milk permit or license
2. Milk permit or license (to sell milk and milk products)
3. Dairy farm and plant score cards
4. Inspectors' records
5. Inspection reports
6. Veterinarians' reports
7. Laboratory records and reports

I. *Application for milk permit or license.*

Before a milk plant starts operation or before milk can be sold either from stores, other depots, or restaurants or dairies, it is becoming more and more common to require that an application be made in writing to the Department of Health or other appropriate body for a permit or a license. Regular form blanks are used for this purpose, and while varying in detail in different places, usually indicate (a) the grades of milk to be sold and methods of distribution (as from wagons, stores, etc., and number of same), (b) number of quarts of milk to be sold, and (c) the sources of supply. Agreement to comply with legal requirements precedes the signature of applicant. A convenient size is

8½ x 11 inches, and 16- or 20-pound bond paper may be used.

II. *Milk Permit or License.*

The types of milk permit issued also vary, some being attractive in design and displayed prominently in a frame by the possessor. By means of a stub (or of a carbon copy), a record of the permit number, name, address, and date issued may be kept on file in a health department or other licensing office. In a few cities, the licenses or permits are issued by a special license bureau rather than by the health department. In such cases additional form blanks of approval of license or permit issue must be obtained from the health department for the information and guidance of the license clerk. It is customary for permits to be issued by the health department in accordance with an established ordinance or regulations that usually include the power to revoke any permit or to suspend or discontinue the sale of milk that does not meet the requirements of health department regulations. The permit usually indicates that the owner is granted permission to sell milk and milk products in the city of ———, under and in accordance with the ordinances of said city, and subject to the rules and regulations of the health department. In accepting the permit the holder agrees to permit samples of milk and milk products to be taken for analysis by inspectors of the department, and further agrees to permit inspections of his dairy or premises whenever such inspections may be deemed necessary. Permits are not transferable. A size of 6¼ x 7½ inches is convenient, with 6¼ x 3¼ inches for the stub.

A survey of municipal health department practice in 1923* revealed that producers' permits were required in 45 of the 100 largest United States cities. There appears to be a tendency for the larger cities to be less concerned in the requirement of producers' permits than the smaller cities. In all these cities, however, it was found that each distrib-

* P. H. Bulletin, No. 164, 1926, U. S. P. H. S.

utor was required to obtain a permit for the sale of milk or milk products.

III. *Dairy Farm and Plant Scores.*

In his survey report on 1923 conditions in the largest cities, Frank and his associates* calculated that the average population served per producing dairy farm was 130, and that there were 768 producing farms per 100,000 population. These figures indicate a problem of considerable magnitude in supervision at the source. The average number of distributors serving milk to each 100,000 population was found to increase from 10 for the larger cities (500,000 and over) to 75 for the smaller cities of 70,000 to 100,000. In these larger cities the bulk of the supply is handled by pasteurization plants serving a relatively large number of consumers as compared to the average distributor in the smaller cities.

Score cards for dairy farm inspection were found to be in use in 1923 in nearly 90 per cent of all cities of over 250,000 population and by approximately 62 per cent of the cities of 70,000 to 250,000 population. The forms in use by the United States Department of Agriculture are most commonly employed. For city milk-plant inspection, 47 of the 100 cities reported the use of score cards, 28 of them using the Federal department form. Two cities did not score milk plants and 49 were not heard from on this point. To quote from the survey report: "The use of scoring devices primarily adapts itself to the recording of estimates of methods used in the production and handling of milk. Credits or penalties for high temperatures, sediment, or other physical irregularities, and for bacterial counts exceeding the maximum contamination permitted by milk ordinances give greater weight to the milk score." Score cards may be effectively used for farms, milk receiving stations, and city milk plants. They serve the purpose of checking

* P. H. Bulletin, No. 164, 1926, U. S. P. H. S.

up in detail the equipment and methods used in handling and procuring the product.

IV. *Inspectors' Records.*

It is the normal practice for dairy and milk inspectors to make a daily record of all their work, and a special form is useful for this purpose. It is likewise important to keep a daily record of findings in different plants. A dairy inspectors' weekly report may contain, for each day of the week, information as to the dairies and milk plants scored, number passed, applications received and approved, new barns, new milk houses, data regarding new equipment installed during the week, permits suspended or revoked, et cetera.

In a somewhat similar manner a milk inspector's report may be maintained on a weekly card, divided into daily columns, showing the number of collected samples of various products for different kinds of analyses, temperature readings, and vehicles and cans inspected, notices served, and gallons of milk condemned. A card 6 x 9 inches, 16- or 20-pound bond paper, or slightly heavier, is adequate for this purpose.

Additional forms are sometimes used for routine collection of milk samples for tests for preservative, sediment, bacteria, skimming, cream, buttermilk, or sweet whole milk. Many inspectors are also equipped with seals so arranged as to give space for recording sample number, inspection number, inspector's name, and the date.

V. *Inspection Reports.*

Special report cards save the time of inspectors and encourage uniformity of reports. Periodically, dairies and milk plants are scored, and reports of results are made to producers or distributors, as the case may be, a carbon being maintained in the office.

In order to handle the communicable disease situation in the country, it is the frequent practice to equip receiving stations with forms which are given out to the health officer when a case is reported. These may be filled out by the health officer and returned to the department. Gradually, regulations are being adopted requiring the physical examination, periodically, of milk handlers, and a physician's certificate is a necessary record under such circumstances. The physician's record form should include space for recording the results of laboratory examinations of cultures and specimens.

Whenever an inspector excludes a producer because of violation of health department rules, he will find it is good practice to leave a card with the farmer relative to changes desired. When the changes are made as required, the farmer fills out the card and mails it to the office. The larger cities also keep record sheets for complete records of dairies, tuberculin tests, inspections, scores, milk analyses, and the like. One large sheet is used for each dairy. These sheets are filed alphabetically, the retail dealers in one group and the wholesale dealers in another group.

VI. *Veterinarians' Reports*

If a herd is to be tested by a veterinarian, a form card may be sent by the director of the milk division to the veterinarian, indicating the location, name of owner, size of herd, and other important facts. The veterinarian in turn reports results, and also files a detailed report, monthly or at other appropriate intervals, showing the name and location of owner, day test was applied, test used, herds tested, number tested and number reacting, as well as number passed.

In many cities tuberculin testing is compulsory for all farms shipping raw milk not intended for pasteurization into a city. In Detroit, for example, such milk is classed either as certified or as Class A. The cattle on these farms are tested once or twice a year or every 60 days, depending upon conditions. Triplicate records of these tests are kept in Detroit.

VII. *Laboratory Records and Reports.*

Samples of milk for laboratory purposes are regularly collected by inspectors. A receipt card may be given by the inspector to the driver or person from whom the sample was obtained. Special identification tags accompany the sample.

As the daily sample reports come from the laboratory, a clerk may transfer the results to a milk analysis record sheet. Simple record forms for reporting the results to producers and distributors are also commonly used. A special report on laboratory record forms, which includes cards for this purpose, has recently been published.* If the data are properly interpreted, and the inspector is a real educator, such reports may serve a useful purpose in maintaining contacts with milk producers and improving milk supplies. The laboratory may be one of the most useful tools of the health officer and milk inspector in improving milk supplies.

The effective use of record forms, adapted to local conditions, is an application of good business methods. Such use is likely to encourage uniform inspection methods as well as afford an opportunity for the measurement of results. If conservatively applied, in a manner not to remove too completely the sympathetic personal contact between inspector and producer, a carefully developed record system is an aid in the adequate supervision of milk supplies.

*** Record Forms for Public Health Work (For Experimental Use), published by the American Public Health Association, 1927.**

"Habit is a cable. We weave a thread of it every day."

THE PLACE AND PURPOSE OF CERTIFIED MILK

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The advance in dairy hygiene and sanitation during the past 35 years is such that had anyone had the temerity to predict in the early nineties the quality of milk which would be demanded when sold commercially today, he would have been considered abnormally minded.

At that time the death rate of infants was such that only 70 of every 100 babies reached their first birthday. Milk-borne epidemics were the rule rather than the exception. On the other hand, the water supply of many of the large cities was such that comparison with their milk supply did not put the milk to shame.

There had been more or less agitation from time to time in several of the cities of the United States over the quality of milk delivered to the consumers. The Health Officer of the City of Rochester, N. Y., made a very definite and sustained effort to improve the milk supply of that city. The teachers of diseases of children in the various medical schools emphasized the milk used in the feeding of infants as the one great cause for the enormous number of diarrheal disorders seen among children during the heated months.

The necessity for a clean milk for the feeding of infants and invalids crystallized in the mind of Dr. Henry L. Coit, of Newark, N. J., in the year 1888. Dr. Coit developed a working system for the production of a safe, clean raw milk produced in commercial quantities. He had the confidence and cooperation of the entire medical profession. The profession at large recognized the urgent need for such a clinical product.

It was decided early in the experiment that it was necessary that a definite organization of medical men be established. The committee elected for this purpose was known as the Milk Commission. The first Milk Commission was formed in and known as the Essex County (N. J.) Medical Milk Commission. Following the lead of this first commission, similar organizations were formed in the larger cities of the country, Philadelphia and New York being in the vanguard.

The Milk Commission is a committee of physicians elected by a county medical society. The personnel of the Milk Commission is usually composed of such medical practitioners as are especially interested in the care of children. In the roster of Medical Milk Commissions are found the names of many eminent pediatricians. The members of the various commissions serve without pay and gladly give much of their time and effort to the supervision and safeguarding of the production of Certified Milk.

The Milk Commissions were federated into a national organization in 1906. In this national organization the methods and standards for the production of Certified Milk were unified. The methods and standards for the production of Certified Milk are designed to guarantee as nearly as possible a product whose safety and purity insure its adaptability for the feeding of infants and invalids.

Certified Milk has a unique place, for as a commercial commodity it is the product of the medical profession and developed from an altruistic motive of preventive medicine. An idea conceived by the pain and sorrow of large numbers of mothers and fathers whose offspring were being lost to society by the lack of a proper food made this product possible.

The intense desire for this food as a baby food finds expression in the contracts with the producers of Certified

Milk. There you will find this clause: "In case of shortage of Certified Milk, the babies shall be first supplied."

Certified Milk was the pioneer of much of the "social welfare" movement. Certified Milk has been the leader in the advance of dairy hygiene. It is within the memory of many of those present when it was beyond belief that a milk with a bacteria count below ten thousand could be produced day after day, winter and summer.

Certified Milk, the product of the idealist, by the enthusiasm, ability, and integrity of its originators, was at once placed among the articles of commerce bearing the hall mark of purity. This reputation for excellence of product has been maintained for upward of 35 years. In all this period, the leader of the dairy industry has been and is Certified Milk.

That the idealism of the founders of Certified Milk was founded upon a scientific basis is readily proved now, when after this long interval the rules and recommendations of the original commission are with but slight modifications the methods and standards of the American Association of Medical Milk Commissions of 1927.

A great deal of time and money has been and is now being spent upon the scientific investigation of the various phases of Certified Milk. Qualified investigators, such as Professor W. E. Frost, of the University of Wisconsin, Professor J. Howard Brown, of Johns Hopkins, and Professor Jones, of the Rockefeller Foundation, are each working upon some problem of the subject. The results of many of these investigations have been published from time to time and add no small part to the scientific literature of sanitary milk production.

There are many definitions for Certified Milk, but none which better defines the product than does that of the founder, Dr. Henry L. Coit, which is:

"Milk from a lower animal which has been certified by a

Medical Milk Commission appointed by a medical society and which certification is the monthly authorization for the commercial use of the term and which certificate is based upon the Commission's investigations relative to the production of Certified Milk showing that it conforms to the standards of quality and purity for Certified Milk and the methods and regulations for the production of Certified Milk, which standards of quality consist of a fresh milk, unchanged by either heat or cold, delivered to the consumer at the earliest possible moment, and which contains not less than 12 per cent of total solids with not less than 3.5 nor more than 5.5 per cent of fat, to which has not been added any other food principle, chemical substance or preservative, which standards of purity for the milk consist of the lowest possible bacterial and dust-dropping content, consistent with the highest possible practice of dairy hygiene, provided that the average numerical bacterial contamination is not above an average weekly count of 10,000 bacteria per cubic centimeter and from which milk every known method has been employed to exclude pathogenic microörganisms and which standards of purity are safeguarded by a medical guarantee of the health and personal hygiene of every employe handling the milk and by a veterinary guarantee that the milk herd will not be a carrier of any disease to those using the milk for food, which method and regulations for the production of Certified Milk are carried on in conformity with those adopted by the American Association of Medical Milk Commissions and are changed from time to time as the action of this association modifies the technique for the attainment of the standards of quality and purity for Certified Milk growing out of improved methods and regulations for its production."

The legal definition is:

"Certified Milk is a milk produced under the supervision and certification of a regularly appointed Milk Commission of a county Medical Society."

Early in the production of Certified Milk, it established for itself a place in the dairy industry as the pioneer in the clean milk movement—a position it has maintained for a third of a century.

The influence that certified milk has exerted over the dairy husbandry of this country can not be estimated. That it has been an enviable example to all who produce or handle milk there is no question.

In the districts where certified milk is produced there is continually found the effect of this better milk movement. The dairy companies are well acquainted with the fact that special milks for particular kinds of trade can more readily be had in such a community. The proneness of the human being to imitate may account for much of this; however, the more laudable ambition to do just as well as the other fellow appears the more obvious reason.

If it were possible to visualize the place of Certified Milk with its relationship to market milk for the past third of a century, who is brave enough to speak of the possibilities of the next third of a century?

In the beginning of the period there was not produced and sold a milk which could be marketed in any of the large cities today. Certified Milk rallied together many agencies to make the milk supply of today what it is. The certified milk industry has produced a milk which was believed impossible. It was produced in commercial quantities. The milk distributors became interested in a better product. Competition had forced them to view milk not just as milk, but milk as graded in the wholesale if not in the retail trade. Milk was tested at receiving stations for visible dirt. Bacteria counts were made. Soon it was found that the large companies were sending inspectors to see the conditions under which their milk was produced.

The consumer reaped the reward, but the health officer most of all reaped the benefit of this new order of things. The reply of milk producers or of milk distributors, "It can't be done," was answered "But it is done."

That it was possible for the health officer to enforce new laws, and further still, that it was possible for the many laws aiding the health officer in his work for prevention of disease to be written upon the statute books at all, may in a large way be attributed to this banner-bearer of the milk industry, Certified Milk. The enforcement officer of today has a very easy task compared to those who preceded him but yesterday.

In the vicinity of every large city there are to be found Certified Milk farms whose example is of the utmost aid in teaching the market milk producers.

Certified Milk is a quality product; it is an extra-priced special product, produced under the certification of the medical profession for the definite purpose of supplying a milk that is as safe and pure as it is humanly possible to produce, a milk that is best suited for the needs of the infant and the invalid.

The fact that for a few years there has been a vogue among many of the pediatricians in favor of boiled milk is no negation to the value of this food. Those who are advocating the boiling of milk are just as emphatically demanding a clean milk to be boiled.

The new vista that is opening to the scientific world of a better and greater knowledge of nutrition has already definitely established the value of clean raw cow's milk, milked from clean, healthy cows by clean, healthy milkers and kept clean and cool from the cow to the consumer.

Every experiment, every evaluation that has been made has demonstrated beyond peradventure that there is in clean, pure, raw milk some quality that beneficially affects nutrition, especially in growing animals. These experiments have been made not by those interested financially in the product, but in the great institutions of learning throughout the country.

The purpose of the sponsors of Certified Milk is to place around that product every scientific safeguard, that it may be the best milk possible to produce. The Milk

Commissions throughout the country are expending no small amount of money upon original investigations for the benefit of dairy husbandry and also for any light upon preventive medicine.

The question of absolute safety is one that is more or less continually asked of the Milk Commissions. Absolute safety in food products is an impossibility. The question of relative safety may be answered without hesitation in the affirmative.

It would seem that the question of milk-borne epidemics were a little out of style. In no city with an adequate department of health has there been a milk-borne epidemic within the memory of the younger members present. In the city of Chicago, which city has had a very enviable department of health for some years, there has not been a milk-borne epidemic in the course of a dozen years. That a milk-borne epidemic may occur is not doubted. Eternal vigilance is the price of safety.

Accidents, seemingly trivial, may allow the ingress of pathogenic bacteria into any food product. The history of illnesses caused by ingested food are without number.

Certified Milk is a milk product for which there is an established demand. Certified Milk has made for itself a reputation for high quality which is almost household. The fact that Certified Milk is so widely known and highly considered is of extreme interest when it is remembered that this commodity has never had any general advertising. Never a campaign of national advertising, but yet recognized by all as an article of exceeding merit.

Certified Milk deserves a place in the health officer's manual by reason of its effect upon all milk products.

Certified Milk deserves a place in all milk ordinances by reason of its high standard of purity, its nutritional value, and as a lodestar for all food producers to emulate.

"I have had many troubles, but most of them never happened."

REPORT OF COMMITTEE ON COMMUNICABLE DISEASES AFFECTING MAN—THEIR RELATION TO THE MILK SUPPLY AND TO THE PUBLIC HEALTH

HORATIO N. PARKER, *Chairman*

The excellence of milk as a food is an established fact which is inculcated by nutritional experts and is utilized by dietitians. Health officers have been quick to grasp its importance and have earnestly tried to persuade the public to use milk liberally, with the result that regular use of milk is much more common than it was. With school children, thanks to the efforts of school authorities, parent-teacher associations, physicians, and nurses, the response has been particularly good. Business men are learning that a glass of milk, supplemented by various light foods, satisfies hunger and leaves them alert and keen instead of with the lazy feeling that follows a heavy lunch. Thus, in Jacksonville, Florida, for instance, milk is served in all the schools, many business men patronize dairy lunches, and at the noon hour laborers may be seen making a break for the nearest store which sells milk. In hotels and restaurants the use of milk as a beverage, while not as common as it should be, nevertheless is on the increase. The colored population, which a few years ago used almost no milk, now is using it more generally, and the colored nurses report that the negro school children are spending their pennies for milk instead of "pop." Other cities would tell a similar tale. So the criticism of milk supplies that is offered in constructive effort to improve them should deter no one from using milk. Such comment is necessary to secure the best milk for the public and is not intended to frighten.

Of course, infants and children must have milk, and most people know that it is recommended for invalids and for milk diets, but its importance in fending off and as a curative for certain diseases is new. Thus, Goldberger has pointed out that its liberal use is helpful in preventing pellagra and in restoring those who have contracted the disease. Indeed, the omission of milk from institutional dietaries is far too common and is often attended with deplorable results.

All this is said to emphasize the fact that this Committee believes in the liberal use of good milk and that the presentation of the facts that follow regarding the transmission of disease by milk does not in the least shake the belief of this Committee in the wisdom of using milk liberally. On the contrary, it is of the opinion the more milk used the better. The fact is that of the tons and tons of milk consumed, but a trifling amount is infected, and that of the diseases that may be transmitted in milk, but a small percentage that actually occur are milk-borne. Indeed, were it not for the suffering and tragedy entailed by milk epidemics and the possibility of their establishing new foci of infection, they might be ignored, but they are highly important and they must be made much less frequent than they are.

This year several important studies of milk epidemics have been published, and two of these will be considered. One of them is a continuation by Bigelow and Fosbeck of the study of milk-borne diseases in Massachusetts which was begun by Kelley in 1916. Their study is based on the replies by 44 cities of 10,000 population and over, constituting 70 per cent of the total population of the State, to a questionnaire. The diseases considered were typhoid fever, septic sore throat, scarlet fever, and diphtheria. Bovine tuberculosis was not included because of the obvious difficulty in tracing such infection, but the disease is recognized as of considerable importance. It is pointed out, too, that the possibility of poliomyelitis and undulant fever featuring in milk-borne disease investigations of the future must be considered.

TABLE I

PROPORTION OF CASES OF TYPHOID FEVER, SEPTIC SORE THROAT, SCARLET FEVER AND DIPHTHERIA TRACED TO MILK

Disease:	Cases Reported	Traced to Milk	Per Cent
1907-1914			
Typhoid Fever	23,482	2,215	9.43
Septic Sore Throat	*	(2,512)	....
Scarlet Fever	70,569	2,747	3.89
Diphtheria	69,646	131	0.18
Total	163,697	5,093	3.11
Yearly Average	20,462	637	3.11
1915-1918			
Typhoid Fever	6,331	496	7.83
Septic Sore Throat	1,401	867	61.88
Scarlet Fever	25,328	140	0.55
Diphtheria	33,807	30	0.08
Total	66,867	1,533	2.29
Yearly Average	16,717	384	2.29
1919-1923			
Typhoid Fever	4,105	297	7.23
Septic Sore Throat	829	118	14.23
Scarlet Fever	46,777	53	0.11
Diphtheria	42,386	8	0.018
Total	94,097	476	0.505
Yearly Average	18,819	95	0.505
1924-1926			
Typhoid Fever	1,705	81	4.10
Septic Sore Throat	415	0	0.00
Scarlet Fever	36,052	56	0.16
Diphtheria..	15,173	25	0.16
Total	53,345	162	0.31
Yearly Average	17,782	54	0.31

* Not reported until 1915.
Sum does not include Septic Sore Throat.

In the summary it is stated:

1. The per cent of milk-borne typhoid fever, septic sore throat, scarlet fever, and diphtheria has steadily decreased over a period of 20 years.

2. There have been no epidemics of septic sore throat in the last three years.

3. The average number of milk-borne outbreaks per year

continues to decrease, but at a much slower rate than the decrease in cases.

4. Apparently there has been a 10 per cent increase in the per capita consumption of milk, but a further 25 per cent increase is desirable.

5. Eighty-three per cent of the milk is pasteurized, as compared with 74 per cent in 1923 and 34 per cent in 1919.

6. About one-half per cent of the milk is certified.

7. Over 95 per cent of the towns have milk inspection.

8. Milk standards vary greatly.

9. About ten chemical and twenty bacteriological examinations are made per 100,000 quarts of milk. There is a wide variation in different towns.

For the State as a whole:

1. About 61 per cent of the population is protected against possible infection with bovine tuberculosis. About 42 per cent live in communities where the entire population is so protected through the requirement that the milk be either pasteurized or from tuberculosis-free herds.

2. At least 58 per cent of the population of the State is protected by pasteurization from typhoid fever, septic sore throat, scarlet fever, and diphtheria.

3. There is one pasteurizing plant to about every 10,000 individuals. It is stressed that the vulnerability of a milk supply is more accurately estimated by the number of outbreaks for which it is responsible than by the total number of cases.

The study also mentions that the adequacy of pasteurization will be more generally assured in the future by recent legislation regarding licensing of pasteurization plants.

The other study, which is by Armstrong and Parran, is entitled "Further Studies on the Importance of Milk and Milk Products as a Factor in the Causation of Outbreaks of Disease in the United States," and completes the data for the United States from 1908 to January 1, 1927.

The summary states that:

1. In addition to 179 milk-borne outbreaks in the United

States collected by various authors prior to 1908, there is herewith reported a compilation of 612 additional epidemics traced to milk or its products to 1927.

2. Ordinary raw milk or its products was incriminated in 179 outbreaks; pasteurized milk or its products was incriminated in 29 outbreaks, and Certified Milk in three, while in 356 the character of the incriminated supply was not stated. Ice cream was incriminated in 36 outbreaks, butter in three, and cheese in four.

3. Incomplete records of cases and deaths for the 612 reported milk-borne outbreaks indicate the following:

SUMMARY OF 612 MILK-BORNE OUTBREAKS

Diseases	Number of Outbreaks	Number of Cases (Incomplete)	Number of Deaths (Incomplete)
Typhoid Fever	479	14,968	219
Paratyphoid	7	434	15
Diarrhea and Dysentery	6	92	5
Septic Sore Throat	42	21,045	139
Scarlet Fever	40	3,939	20
Diphtheria	26	971	7
Miscellaneous Diseases	12	878	5
Totals	612	42,327	410

4. A gradual increase in the reported number of milk-borne epidemics in the United States is noted from 1881 to 1914, following which year a decrease is noted.

5. Carriers, active cases, and exchange of infected bottles, in the order named, are noted as the most prolific source of milk infection by typhoid bacilli.

6. A markedly increased prevalence of milk-borne typhoid outbreaks is noted in August and September.

7. Those outbreaks attributed to carriers reached their greatest incidence of onset during August, while in those traced to active cases the highest occurrence was in September.

For this toll of disease science has a remedy, viz.: pasteurization. Thus the late Prof. George C. Whipple noted in studying the curve of typhoid fever death rates of

Massachusetts that there was a marked change in the trend in the period of 1908-10 which "coincided with the period when improvements in milk supplies were being actively pushed, when pasteurization was being put into practice. A like curve for New Jersey shows the same break in 1910 as that of Massachusetts; in fact, the two curves are surprisingly alike throughout, showing direct relation of improvements in the water and milk supply to the typhoid fever situation. If similar plottings are made for large cities, it will almost invariably be found that the downward slopes of the plotted typhoid rates began to accelerate somewhere between 1908 and 1910. The change of rate about this time was so marked, was so general over the country and applied to so many cities where the water supply did not change in character during these years, that the cumulative evidence makes it seem almost certain that the great decline in typhoid fever in the United States during the past decade was due very largely to the pasteurization of milk supplies."

Despite the fact that it is known that pasteurization will greatly reduce the amount of milk-borne infection, indeed almost stamp it out, the remedy is not adopted with anything like the rapidity that it should be. Pasteurization has been put in practice in the largest cities of the country, but it has not gone over as it should in the smaller cities, especially those producing a sufficient supply of milk near at hand. Citizens have remained apathetic or have been actually hostile to it, and the dairymen are opposed to it.

For this situation there appear to be two reasons. In the first place, enough dealers have put out pasteurized milk that has been fortified with condensed milk or has been otherwise monkeyed with to give the product a bad name in the local market, and there are enough cases on record of carelessly pasteurized milk having caused epidemics to make the public skeptical about it.

In the second place, pasteurized milk has not yet been convincingly presented either to the public or to the medical profession. The former still believes, to a certain extent, that pasteurized milk is a medicated product or one materially different from raw milk, and the latter that milk is pasteurized at such high temperatures that the lactic bacteria are killed off and the surviving spore-formers shortly "rot" it. For this belief there is some reason, for pasteurization at different times has been done differently. At least one textbook that is commonly found in doctors' offices states that pasteurization is done at 160° to 165° F., with the result above stated. Its readers do not know that pasteurization is now done at 145° F. and that enough lactic bacteria survive to sour milk naturally.

Is it not time for this Association to join with others in a determined campaign to put pasteurization across everywhere in the United States, and not leave it to a few courageous health officers who jeopardize their jobs every time they attempt to get a pasteurization ordinance adopted?

References

Pellagra; Its Nature and Prevention. Goldberger, J. Public Health Reports, V. 42, No. 35, p. 2193, Sept. 2, 1927.

Milk-Borne Disease in Massachusetts. Bigelow, G. H., and Fosbeck, P. C.
American Jour. Pub. Health, V. 17, No. 10, p. 1019, October, 1927.

Further Studies on the Importance of Milk and Milk Products as a Factor in the Causation of Outbreaks of Disease in the United States. Armstrong, C., and Parran, T.
Suppl. 62, Public Health Reports, 1927.

Cause of Decrease in Typhoid Rate in the United States. Whipple, G. C.
Eng. News Record, V. 89, No. 19, p. 794, Nov. 9, 1922.

"Genius begins great works; labor finishes them."

REPORT OF COMMITTEE ON BOVINE DISEASES

THEIR RELATION TO THE MILK SUPPLY AND TO THE PUBLIC HEALTH

DR. C. D. PEARCE, *Chairman*

In reviewing the subject of bovine diseases during the past year, there seems little to report. This, no doubt, is brought about by the methods employed in keeping our herds in health. For years, the Federal, State, and other agencies have devoted their time and energy to disease prevention. That they have not worked in vain is shown by the absence of foot-and-mouth disease on this continent north of the Mexican border; the monumental work of freeing the Southern States from the cattle tick; the control of anthrax and black leg; and the progress that is being made to control if not to eradicate bovine tuberculosis from our herds. These efforts have saved and are saving the livestock interests of the country millions of dollars.

The growth of pasteurization has greatly held in check the transmission of bovine diseases from animal to man through milk. Where milk is properly pasteurized, bovine diseases can be eliminated as communicable diseases. Certified milk can also be classified with pasteurized milk, as the controls thrown around these raw milk supplies leave little chance indeed of any danger from bovine diseases.

There are two bovine diseases, however, which are widespread; namely, tuberculosis and contagious abortion. Bovine tuberculosis is transmissible from animal to animal and from animal to man, and the efforts now being made to eradicate this disease are producing nation-wide results. There is less known about contagious abortion, and future investigations are apt to reveal many facts in the control of this disease that will be of interest to all of us.

Tuberculosis

The tuberculin testing of cattle has grown apace. At first, individual herds were tested, but since the accredited herd plan has been put into effect, we now see scattered throughout our land townships and counties that are either accredited or modified accredited areas, with many large cities demanding that their milk supplies be not only pasteurized but that the herds supplying these cities be tuberculin tested.

The campaign for eradicating tuberculosis in domestic live-stock made exceptional progress during the fiscal year ended June 30, 1927. Records of the Bureau of Animal Industry show that 347 counties have completed the necessary official tests and have qualified for recognition as tuberculosis-free areas. This number constitutes more than eleven per cent of the total number of counties in the United States. In addition, 945 counties were actively engaged in the area project at the beginning of the current fiscal year.

The amount of money that has been made available for the carrying on of tuberculosis eradication is an indication of the interest the various States are showing toward controlling this disease. According to reports issued by the Bureau of Animal Industry, $18,500,000 will be available this coming year for tuberculosis control. This includes $6,000,000 appropriated by Congress.

Contagious Abortion

Contagious abortion, caused by *Brucella abortus* (Bang's bacillus), is a contagious disease of cattle that is widespread. This disease has been studied for years. Its control is an economic problem to the live-stock interests, as it has caused untold losses in our dairy herds. This organism is frequently found in milk, but little attention has been paid to it from a public health standpoint, as until very recently there has been but little clinical evidence that it was anything but a cattle disease.

Since Evans and others have pointed out that there was a very close relation between *Brucella abortus,* which has been closely associated with contagious abortion in cattle, and *Brucella melitensis,* which causes Malta or undulant fever in man and goats, bacteriologists have taken an interest in studying these two microörganisms. They are very closely related and belong to the same group or family.

Recent developments suggest that possibly *Brucella abortus,* with all its mysterious ways of causing havoc in cattle, may yet become the cause of a disease in human beings from a bovine source. Medical literature for the past year or so has reported febrile states in men where an organism similar to or indistinguishable from that of *Brucella abortus* has been identified from blood tests.

Two interesting cases are given in an article by Dr. Moore and Dr. Carpenter in the *Cornell Veterinarian,* April, 1926. An organism indistinguishable from that of *Brucella abortus* was not only isolated by Dr. Carpenter from the blood of two students at Ithaca suffering from an unidentified fever, but cultures made therefrom produced abortion in two pregnant heifers. Bacteria identical with the ones injected were recovered from the fetuses, placenta, and the milk in each case.

The milk consumed by one patient was heavily infected with a strain of *Brucella abortus* which is very virulent for guinea pigs. The patient had not come in contact with goats or drunk goat's milk. The other patient had spent the summer on a dairy farm where contagious abortion existed. Although milk is suspected as being the carrying agent, sufficient study has not been given to prove this definitely.

Since these two cases were reported there have been a considerable number of other cases where undulant fever has been diagnosed or suspected. Work is now being done upon the source of the infection to see if other foods besides raw milk will harbor the infection. Apparently there are various strains of *Brucella abortus,* some of which are more virulent than others.

Until future researches definitely prove beyond any shadow of doubt that *Brucella abortus* is pathogenic to humans, all evidence should be weighed very carefully, as the dairy industry as a whole must be considered, as well as the stock owners and the public health.

Foot-and-Mouth Disease

At present, there are no known cases of foot-and-mouth disease in the United States or Canada. To guard against the possible introduction of this disease, the United States Department of Agriculture has added an amendment to its already rigid quarantine measure that no susceptible animals and no hay, straw, or other feeding material originating in the southern part of Mexico where the disease is suspected to exist shall be admitted into the United States. This amendment further orders that no hides, skins, or other animal by-products originating in or unloaded within the designated portion of Mexico shall be admitted, unless disinfected under the supervision of a United States Bureau of Animal Industry inspector. We sincerely trust this disease will never again find its way to any of our herds.

Poisonous Weeds

The close relation betwen the disease known as "trembles" in cattle and "milk sickness" in man has been the subject of scientific investigation for many years. Although there have been no cases coming to our attention recently, last year there was an outbreak in Illinois resulting in the death of several people. Dr. James F. Couch, of the United States Bureau of Animal Industry, in his investigations throws new light on this malady. His experiments, supplementing those of other investigators, show conclusively that poisonous plants cause trembles in cattle, sheep, and other animals; that animals may be poisoned without showing symptoms of trembles, and that milk and butter from cows so poisoned are dangerous to the consuming public.

Two plants seem to be responsible for trembles in livestock. These plants are the white snakeroot, which grows in the East and Central West, and the rayless goldenrod, found in Texas and New Mexico, where the malady is called "alkali disease."

Animals may be poisoned by the dry white snakeroot, found in the hay, during the winter, and the rayless goldenrod likewise is dangerous when the plant is either green or dry. Many farmers have been skeptical about the white snakeroot being the cause of trembles, as this disease appears at times during the winter when the poisonous plants are dormant.

Three poisonous substances were found in white snakeroot, only one of which caused symptoms of trembles. This poison is a complex alcohol named "tremotol." The other two poisons are a resinous acid and a volatile oil.

When milk sickness is not fatal to man, there is generally a long period of illness and a weakened vitality. The control of this disease is accomplished by destroying the plant itself. During the fall when our pastures are apt to be dry, cattle should be kept out of pastures infested with poisonous plants.

This report would not be complete without at least mentioning various inflammations of the udders which are constantly with us. With the exception of the hemolytic streptococcus causing septic sore throat, these are not specific infections, and the harm they do is not known. Milk, however, is universally used as an infant food and every precaution should be taken to see that the udders of cows are healthy. This condition is best controlled through education and a physical examination by competent veterinarians. Cows suffering from acute inflammation of the udder should be quarantined and milk from such cows should not be included in deliveries to any milk station where milk is bought until recovery has taken place. Cows with chronic inflammations of the udder should be condemned for milk purposes.

With the exception of a diseased condition from poisonous weeds, the infections mentioned are easily controlled through a proper pasteurization of milk. Therefore, in controlling the transmission of bovine diseases from animal to man, we should first see that the cows are healthy, and then supervise our milk supplies so that milk is well cared for from the time it is produced until it is delivered to the consumer. In addition to this, and as a further safeguard, it should be pasteurized.

"Health is the vital principle of bliss."

THE MASSACHUSETTS MILK INSPECTORS' ASSOCIATION: ITS HISTORY AND ACHIEVEMENTS

RUSSELL I. PRENTISS, *Secretary*
Massachusetts Milk Inspectors' Association,
Boston, Mass.

As early as 1907, it became apparent that an association of milk inspectors of Massachusetts was necessary to improve conditions in the production and sale of milk and milk products. Accordingly, on April 9, 1907, eleven of the twenty milk inspectors of the metropolitan district of Boston met at the Quincy House and formed what is now known as the Massachusetts Milk Inspectors' Association. Dr. J. E. Richardson, of Somerville, was elected the first president and served to the time of his death in 1909.

Each inspector had been working more or less in the dark prior to this important meeting, and the bringing together of these men was in itself an important factor in developing a more uniform procedure among the milk inspectors. Members passed on to each other the best methods then employed in handling the milk question, and the organization during these years proved to be of benefit to each and every man in the Association. The effectiveness of the work of members of the Association tempted others to join, and each year the annual banquet of the Association brought new members.

Much consideration was given in the early meetings of this organization to the exposure of fraudulent dealers in milk products in each community. Effective methods of dealing with the milk dealer who was distributing an inferior product or an adulterated product to the consumer were discussed at length at each meeting, and the milk inspector who was faithful in his attendance was soon able to handle the fraudulent milk dealer in his community. Not only the fraudulent commissions, but the negligent omissions of producers and dealers in the care and handling of milk, were given important consideration by this group of milk inspectors.

The foremost authorities on the question of producing and distributing wholesome milk under sanitary conditions were invited to these meetings and the information and instruction obtained were passed on by the milk inspectors to different control agencies.

Legislative changes in milk standards and sanitation were discussed at the meetings of the Association in an endeavor to work in unison for the public good and to bring into cooperation every local board of health, to the end that uniform ordinances to secure the production and sale of healthful, clean milk might be enacted.

When the influence of the Association became apparent through the special activities of its members in connection with a wholesale war on adulterated and dirty milk, certain bills were presented to the Legislature attempting to curtail the inspector's power or to have State inspectors appointed to carry on the milk inspection work. It required the united effort of all members of the Association to oppose successfully the passage of legislation of this type.

One of the greatest victories that the Association won was the defeat of the Ellis Milk Bill, introduced into the Legislature in 1912. This was a bill to create State supervision of milk inspectors. This bill was substituted and redrafted on several occasions until finally, in 1915, the bill passed both branches of the Government but was vetoed by Governor Walsh, who wisely considered at that time the advice and counsel of G. S. Berg, of Worcester, and other milk inspectors, who produced the strongest kind of evidence to show that the milk inspectors of Massachusetts were handling the milk problem in an efficient and effective manner.

It might be said in passing that the meeting together of members of the Association was not always for strict business purposes. The Association held its first outing in 1909, and the records of the Secretary would tend to indicate that a good time was enjoyed. The annual outing thereafter continued to effect a greater friendship between the members of the group.

The Association was indeed fortunate during the first years of its history to have as a secretary and treasurer Dr. Sparrow, who had always given unstintingly of his time to the furtherance of the ideals for which the Association was organized. The death of this faithful officer in 1912 was greatly regretted by the entire membership.

The Executive Committee, in 1916, extended an invitation to the International Association of Dairy and Milk Inspectors to meet jointly at Springfield, Massachusetts, the scene of the National Dairy Show. This organization did meet in Massachusetts in 1916, and the Massachusetts Milk Inspectors' Association presented a one-hundred-percent attendance on this occasion. There is no question but that the Association derived great benefit from this meeting and from the association with national authorities on the questions pertaining to a better milk supply.

Mr. A. W. Lombard, one of the pioneer milk inspectors of Massachusetts, and at that time a representative of the Department of Agriculture, presided at the joint sessions of both Associations, this occasion being the fifth annual convention of the International Association and the twenty-sixth meeting of the Massachusetts Association.

The event of the World War checked temporarily the steady increase in the membership. At the close of the war, however, special attention was given to increased enrollment and the Association reached out to include inspectors from all parts of the Commonwealth.

One of the special features during more recent years has been the milk surveys or clean milk contests sponsored by the Association in cooperation with the State Department of Agriculture and the State Department of Health. Suitable prizes were awarded to cities and towns having the best milk supplies, and the resulting interest as shown by a large number of municipalities more than repaid the agencies instrumental in instituting this campaign for better quality milk.

Our records indicate that 46 per cent of the population of Massachusetts are using either pasteurized milk or milk from tuberculin-tested cows. This achievement can probably be traced directly to the influence and active endeavor of the Milk Inspectors' Association. It is the purpose of the Association to continue along this line until 100 per cent of the milk used in Massachusetts is either pasteurized or from tuberculin-tested cows. It is the further purpose of the Association to continue its policy of rigid enforcement of all laws and regulations affecting a clean supply of wholesome milk to the consuming population.

In closing I might say that the group of eleven members has grown to a State-wide organization of 65 members, all imbued with the one thought of pure, clean, and safe milk for Massachusetts.

"We need a fuller realization of our utter dependence one upon the other, and a further realization as to what a large percentage of our problems are mutual."

A YEAR'S WORK ON POSITIVE PASTEURIZATION

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Section 4 of our amended milk regulations states that no pasteurizing equipment shall be used for the pasteurization of milk that is not approved by the Health Commissioner or his authorized agent. Upon my return from our convention of a year ago, the Health Commissioner, who heard Chicago's report at the American Public Health Association convention, questioned me regarding the existence of similar equipment defects in Boston. After learning that our equipment here was in about the same condition, he ordered these defects remedied.

I then started a check-up of each plant, showing the dealer the defects in his equipment and in what manner they could be remedied. Results have been very satisfactory. All of our smaller dealers using the vat system have installed flush valves and indicating thermometers, and the new 12-hour chart with a one-degree scale division has been installed in many plants.

We placed the responsibility of showing the temperature and holding time of continuous-flow holders on the dealers, and six dealers using continuous-flow holders of the Park type installed approved equipment.

From the time that milk sanitarians at Endicott, N. Y., had shown the questionable holding time of this equipment, we had refused to allow the installation of this type in Boston and had waged a campaign against it. Over two years ago one dealer had installed four baffle plates in each holder, but according to his own tests the milk was held approximately 20 minutes. We originally had 12 plants using this type of holder. As stated above, six plants had changed to proper equipment, and four others have ordered approved equipment, which must be installed by December 15, 1927. The two remaining dealers are using a temporary outfit. One of the dealers was anxious to use these upright cylindrical holders as vats. We agreed to this, provided he could meet the requirements. He purchased two more of these holders, making four in all, and used them as a battery of vats. We insisted that the inlet pipe from the heater be carried to the bottom of the vat to avoid foam and that the outlet pipe be carried to the bottom of the vat and the milk, after 30 minutes' holding period, be pumped from vats over the cooler to the filler. These tanks were equipped with indicating and recording thermometers and insulated covers. This equipment, while only a makeshift, has worked out well; it will eventually be supplanted by other equipment. Six dealers were using pocket types of such construction that it was impossible to find any remedy for them. Two dealers sold out, two more have installed approved equipment, and the other two have ordered proper equipment.

This appears to be the revolutionary period in pasteurizing equipment, the tendency being to get away from valves. At present I believe there are at least three valveless holders on the market.

Boston defines pasteurization as the process of holding milk for 30 minutes at a temperature never below 140 degrees nor above 145 degrees F. Some vats are so constructed that it is impossible to get valves flush with the inside of the vat, making it necessary to use a valve leaving a pocket of about two inches in which the temperature drops from one to two degrees. Thirty-seven of our dealers were using 67 vats of the coil, spray, and glass-lined type. All of these vats are now equipped with flush valves of leak-protector type. Some vats have automatic steaming connections; others are steamed by the use of hand-operated valves. Boston insists on flush valves on all equipment and does not believe in disconnecting the outlet pipe, as we are not quite sure it will be done and we haven't the working force to take care of all our plants located in and within 30 miles of Boston.

Our regulations call for indicating thermometers to be accurate within one degree. Thermometer manufacturers state that they will guarantee thermometers to be accurate within one per cent of their scale range; that is, a 200-degree scale range would be accurate within two degrees. To meet these requirements they have manufactured a thermometer with a 100-degree range from 60 to 160 F., with an enlarged bore at the top to allow for mercury expansion to protect against sterilization temperature.

We are shifting our recorders as fast as possible, working into a one-degree scale. The operators and the inspectors find them very convenient, due to the easy reading, as one can read within one-half a degree, the pen of the older type covering a two-degree space.

Foam is introduced into the milk before processing. This is commonly caused by entrained air or by the dropping of the milk for some distance, causing foam and splash. By using long inlets into the vats and a proper pump, practically all foam is eliminated, but some of our large holders still show foam. Chicago suggests heating the foam, and this is now being tried out. Most of our plants no longer clarify in an effort to eliminate foam.

In May, 1927, a bill fostered by the State Department of Health, calling for the licensing of pasteurizing plants, was passed by the Massachusetts Legislature. Immediately after the passage of this bill, the State Health Commissioner appointed committees composed of milk dealers and milk inspectors to draft the regulations for the enforcement of this act. The Milk Inspector, Chief of the Dairy Division, and the writer were members of this committee. The following regulations were finally adopted:

Regulations Relative to Establishments for the Pasteurization of Milk

Made Under the Provisions of Chapter 259 of the Acts of 1927.

Regulation No. 1

All persons desiring a license to maintain an establishment for the pasteurization of milk shall make in duplicate application to the Board of Health of the town where the establishment is to be located. This application shall be in the following form:

To be Filled Out in Duplicate

..............., Mass., ...19..

To the Board of Health of..........................

Application is hereby made for a LICENSE to maintain an establishment for the PASTEURIZATION OF MILK under the name of................................

Situated at....................................

Make of Heater.................................

Make of Holder.................................

Type of building construction......................

Number of rooms for handling and
processing milk...............................

Estimated quantity of milk to be
pasteurized daily...............................

Estimated number of employees
engaged in the establishment....................

Number of employees who have
had Typhoid Fever.........................

This is to certify that this establishment is in compliance with the copy of the Regulations of the Massachusetts

Department of Public Health Relative to Establishments for the PASTEURIZATION OF MILK and otherwise in accordance with the provisions of Chapter 259, of the Acts of 1927.

....
Signature of Applicant.

Persons not previously licensed shall file with the application a sketch indicating the construction of the building and the installation of machinery. Persons desiring a renewal of a license shall file a sketch indicating any changes in such construction and installation since the license was issued.

REGULATION NO. 2

Upon receipt of an application for a license, the Board of Health shall cause an examination of the building and equipment to be made, and if the establishment is found to be in conformance with these regulations and otherwise complies with the regulations issued by the Board under the provisions of Sections 41 and 43 of Chapter 94 of the General Laws, a license shall be issued for twelve calendar months. One copy of the application shall be retained by the Board and the other copy bearing a statement of the Board's action thereon shall be sent to the department.

REGULATION NO. 3

The license may be issued in the following form:

..................., Mass., ...19..

The Board of Health of..............................

Hereby grants a LICENSE to

....

of ....

to maintain an establishment for the PASTEURIZATION OF MILK at..

for a period of twelve calendar months from this date, subject to the Rules and Regulations of the Massachusetts Department of Public Health Relative to Establishments for the PASTEURIZATION OF MILK, and to the provisions of Chapter 259 of the Acts of 1927.

....
....
....

Number..................
Board of Health of.............................

REGULATION No. 4

No license shall be granted, and any license granted may be revoked if the pasteurization apparatus is not constructed or operated in accordance with the following specifications:

Vat Type Apparatus

(a) The apparatus shall be so designed that the milk will be agitated during the entire heating period.

(b) The vat shall be either disconnected entirely during the holding period from any influent piping, and during the filling, heating and holding period from the effluent piping and fittings or provided with leak-escape valves which will not permit any unpasteurized milk to enter the vat during the holding period or any incompletely pasteurized milk to escape into the effluent piping and fittings.

(c) The lids of vats shall be kept closed during the holding period, and be so designed that when opened nothing on top thereof will drop into the vat.

(d) Every vat shall be provided with an indicating mercury in glass thermometer, as well as a recording thermometer. The indicating thermometer shall be accurate within 1° F. The recording thermometer shall be checked daily by the plant operator. The indicating, and not the recording, thermometer shall be used as an index of temperature by the plant operator.

(e) All effluent piping and fittings referred to in (b) above, shall be sterilized by hot water or steam, either manually or automatically, shortly before discharge of the pasteurized milk.

(f) Designs which permit foam formation shall be equipped with a device which will keep the atmosphere above the body of the milk to at least pasteurizing temperature during the holding period.

Pocket Type Apparatus

(a) The apparatus shall be so designed as to be free from "cold pockets" or pipe sections, the milk in which will drop below the temperature of pasteurization before discharge from the pocket.

(b) Influent as well as effluent manifolds shall be provided with both recording mercury in glass thermometers and indicating thermometers. Indicating thermometers shall be accurate within 1° F. The indicating, and not the recording, thermometers shall be used as an index of temperature by the plant operator. Recording thermometers shall be checked daily by the plant operator.

(c) All influent and effluent fittings shall be so designed as not to permit any unpasteurized milk to enter the pocket during the holding period, or incompletely pasteurized milk to enter the effluent manifold.

(d) Lids of pockets shall be kept closed during the holding period, and be so designed that when opened nothing on top thereof will drop into the pocket.

(e) Designs which permit foam formation shall be equipped with a device which will keep the atmosphere above the body of the milk to at least pasteurizing temperature during the holding period.

(f) All effluent fittings shall be sterilized by hot water or steam, either manually or automatically, shortly before the discharge of the pasteurized milk.

Continuous-Flow-Type Apparatus

(a) Each continuous-flow-type apparatus shall be tested by the applicant for a license to the satisfaction of the Board of Health, to determine the operating conditions, which must be observed in order to insure the uniform application of the desired time and temperature.

(b) Influent as well as effluent piping shall be provided with both recording mercury in glass thermometers and indicating thermometers. Indicating thermometers shall be accurate within 1° F. The indicating, and not the recording, thermometers shall be used as an index of temperature by the plant operator. Recording thermometers shall be checked daily by the plant operator.

(c) All continuous-flow apparatus shall be provided with thermostatic control, properly designed to maintain a uniform temperature in the milk.

(d) The holder shall be free of any "cold pockets" or pipe line sections, the milk in which will drop below the pasteurizing temperature before discharge.

Pasteurization in the Final Container

Pasteurization in the final container shall be carried on so that the entire contents of the container are heated to the legal temperature for the legal length of time.

REGULATION NO. 5

Each licensee shall cause a chart which has not previously been used, and dated with the year, month, and day of the month to be placed upon each recording thermometer upon each day when milk is to be pasteurized. Each licensee shall keep each thermogram of pasteurization temperature on file for a period of not less than twelve months at the premises covered by the license.

Regulation No. 6

Each licensee shall cause the establishment covered by the license to be maintained and operated in a clean, healthful, and sanitary manner.

Regulation No. 7

Each establishment shall be adequately lighted and ventilated. All floors shall be water-tight, properly graded and drained so as to discharge into a public sewer, a properly constructed cesspool or septic tank, or be conveyed by drains to a point at least five hundred feet from the building. Such disposal of waste shall in addition conform to regulations of the town where the establishment is located. All walls and ceilings shall be tight and shall be kept clean by the licensee. The licensee shall take measures to exclude flies from rooms where milk is handled or processed. No stable, nor any room used for living or domestic purposes shall communicate directly with any room in which milk is processed or in which utensils are washed.

Regulation No. 8

Each licensee shall provide suitable toilet facilities for the use of employees, but no such toilet shall communicate directly with any room used for handling milk or milk products, or with any room in which utensils are washed. Privies or earth closets must be situated at least one hundred feet from the building and must be equipped with fly-proof vaults and self-closing seat covers. Each licensee shall provide a suitable washroom, separate from the pasteurizing room, with running water, soap and towels, for employees. The water must be either from a public water supply or from a private water supply subject to the approval of the Department of Public Health.

Regulation No. 9

All apparatus used in pasteurization of milk must be so constructed that it can be easily taken apart for cleaning, and adequate facilities for the sterilization of such apparatus and of all containers used in the handling and storage of milk must be provided by the licensee.

Regulation No. 10

Each licensee shall clean and sterilize, insofar as practicable, all weigh cans, storage vats, pumps, filters, clarifiers, pipes and all other apparatus for the handling of milk, after being used. Each licensee shall sterilize, insofar as practicable, all bottles and cans used for holding pasteurized milk and protect them from contamination between the time of such sterilization and the time when they are filled.

Regulation No. 11

Each licensee shall, upon the premises where the milk is pasteurized, cause all pasteurized milk to be put into containers sterilized and protected as provided in Regulation No. 10, and such containers shall be immediately capped, and in the case of bottles, by a machine capper. All bottle caps must be purchased and stored in tubes, and each cap shall bear the word "pasteurized." This requirement relating to labelling of caps shall go into effect upon the first day of January, 1928.

Regulation No. 12

All pasteurized milk shall, until the time of delivery from the licensed establishment, show a count of not more than one hundred thousand colonies per cubic centimeter as determined by the standard plate methods of the American Public Health Association in use at the time the examination is made, and in the case of cream not more than 500,000 colonies. Each count shall be the median of not less than three nor more than seven samples taken from different containers at substantially the same time.

Regulation No. 13

Licenses may be granted to persons engaged on July 14, 1927, in the business of pasteurizing milk if either the establishment or the machinery is not in strict accordance with these regulations and a reasonable time for necessary changes not exceeding five months shall be given the licensee prior to revocation of the license, provided that the establishment is operated in a clean, healthful, and sanitary manner, and provided further that the licensee shall, prior to September 1, 1927, in good faith contract for such necessary changes in construction and for such new machinery as will cause the establishment to conform with these regulations.

"It's what we learn after we think we know it all that counts."

WHAT ARE THE SOURCES OF HIGH BACTERIAL COUNTS IN PASTEURIZED MILK?

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Much of the confusion regarding the significance of high bacterial counts in pasteurized milk arises from the fact that these counts may be produced by a number of different causes.

VARIATIONS IN BACTERIAL PLATE COUNTS

The fact is almost universally recognized that bacterial plate counts do vary, and there is a growing appreciation that this variation is large enough to be important. We have been charged with saying unkind things regarding the reliability of bacterial plate counts, and wishing to avoid controversial questions we will merely call attention to the statement in the fifth edition of the Standard Methods of Milk Analysis of the American Public Health Association. We all accept the Standard Methods as our Bible in milk matters, but it is possible that some of us do not read it as frequently as would be desirable.

In discussing the reporting of bacterial plate counts the following statements are made: "Specific data showing the actual percentage error in these counts have been difficult to obtain, and have only recently been obtained by means of comparisons made between microscopic and agar plate counts. The conclusions reached by Breed and Stocking are that the margin between two plate counts made from similar samples of market milk must be as great as one to five before it becomes a practical certainty that the larger count actually represents the larger number of bacteria.

"It is, however, self-evident that between any two samples the one having the higher count probably contains the greater number of bacteria, and this probability can be made a practical certainty by the examination of a series of samples."

Translated into numerical terms, this means that when we are considering the germ content of samples of milk from two dairies, one of which gives a bacterial plate count of 50,000 per cubic centimeter, we can not say with certainty that the sample from the second dairy contains a larger germ content unless its bacterial plate count is at least 250,000 per cubic centimeter.

Put into terms of grading under the Standard Ordinance which is being advocated by the United States Public Health Service, if one sample of milk gave a bacterial plate count at the upper limit of Grade A Pasteurized, the other might have a bacterial plate count which would place it in Grade C Pasteurized, and yet one could not be certain that it really had a larger germ content than the sample placed in Grade A.

If milk ordinances in which the grades were to be limited by bacterial plate counts were drawn in accordance with the statement of the Standard Methods above quoted, there would be provision for a neutral zone between the limiting counts for each grade, and this zone between Grade A and Grade B would be wider than the present provision for Grade B in the Standard Ordinance as referred to above.

Enough has been said to indicate that variations in the laboratory may account for many of the high and of the low bacterial plate counts observed in milk supply supervision. While the actual range of these variations is considerably wider than the statement in the Standard Methods would indicate, it should be remembered that such statements are expected to be phrased in a conservative manner.

Influence of Germ Content of Raw Milk

The available information indicates that raw milk as it reaches the milk plants in the larger cities has an average bacterial plate count of somewhat under one million during the colder months and considerably above one million during the hot weather. The annual average is below or above a million depending largely upon the relative number of hot and of cold months.

Where the average bacterial plate count of the raw milk is approximately one million per cubic centimeter, the average count of the pasteurized milk will ordinarily be about 50,000 per cubic centimeter. This indicates a bacterial plate count reduction due to the plant processes of approximately 95 per cent. Given a high count in the raw milk, it is practicable to get a larger percentage reduction, but the actual count per cubic centimeter in the resulting pasteurized milk will ordinarily be higher. Likewise, the actual keeping quality of a milk which has had a high bacterial content before pasteurization will be less than one in which bacteria have not developed.

Largely because of a desire to deliver a milk with finer keeping quality than his competitor, the wide-awake milk dealer has been exerting himself to obtain a raw milk supply of lower germ content. He has found that putting the milk into dry cans and cooling it to approximately 50° F. are two of the most important steps in such production.

Until comparatively recently, facilities have not been available to the milk inspector or to the milk dealer for detecting the high-count milk as it reaches the milk plant. The development of the methylene blue test has changed all this. By the use of this test it is economically possible to determine the keeping quality of the milk as delivered and to do this at sufficiently frequent intervals to form a satisfactory basis for modifying the payment on the basis of the methylene blue results.

Not infrequently we encounter official counts of pasteurized milk of 5,000 or less. Disregarding the cases where such counts are due to laboratory variations and to civic pride, such dairies are commonly fortunate in having a low-count raw milk supply. Likewise, high counts at pasteurization plants are not infrequently due to the necessity of processing milk which is heavily seeded with germ life.

Unfortunately, perhaps, the influence of the raw germ content is not purely quantitative. Ayers and Johnson showed long since that the relative proportion of acid-forming germs was greater in pasteurized than in raw milk. This is due to the fact that on the average the acid forms are better able to withstand the heating process than the other bacteria. Occasionally a given milk supply is well seeded with germs which are even more resistant to heat than are the acid forms. Under such conditions the bacterial reduction due to pasteurization will not be 95 per cent, and in extreme cases it may not be 50 per cent.

Accordingly, both the total number and the kinds of bacteria present in the raw milk have an appreciable influence upon the bacterial count of the pasteurized product.

Little work has yet been done to locate the sources from which the heat-resistant germs enter the milk. There is some evidence that the germ life from poorly cared-for milking machines may at times be of a kind which largely resists pasteurizing temperatures, but this is probably not always the case.

While we agree that all germ life growing in milk is undesirable and should be kept to the lowest practicable limits, it would be helpful if we knew more regarding the sources from which the especially heat-resistant germs are commonly derived. We might then lay especial stress upon the necessity of keeping them out of the milk.

Germ Life From Plant Equipment

The washing of all machinery coming into contact with the milk, after the work of the day, is a practically universal custom in milk plants. It is also common practice to follow this washing with an application of hot water or steam, with the object of destroying a large proportion of the germs remaining in the apparatus.

However, during the warm weather a marked development of germ life takes place upon the moist surfaces during the night, so that on the following morning the equipment is fairly heavily seeded. It is now almost universally recognized as standard plant practice to flush out the milk line with steam, or hot water, or both, immediately before beginning the treatment of the milk. The completeness of this treatment varies with the different apparatus and the proper flushing of the horizontal cooler and of the bottler are beset with especial difficulties.

The lower portion of the cooler is filled with brine or contains some ammonia, depending upon the cooling system, and this material markedly reduces the temperature of the heating medium.

The success of this heat treatment of the milk line can best be judged by making a bacterial count of the first bottle of milk over the line. Cases have been observed where the bacterial count of this first bottle of milk was a million per cubic centimeter, when that of a bottle after 200 gallons of milk had been bottled was only 20,000 per cubic centimeter.

While neglect to properly flush the milk line before beginning the work of the day may result in an extremely high count of the first milk, the influence of this neglect is soon removed by the flow of the milk. In other words, if the bacterial life is not washed away by hot water before handling the milk, it will soon be removed by the milk itself.

In the light of this fact it will be seen that the bacterial count which may be given to the product of any plant may depend largely upon the stage in the work of the day represented by the bottle which is taken as a sample. If it chances to be the first bottle filled, the count may be high, while if the bottle comes from a later stage in the work the count may be low.

Any serious attempt to determine what is taking place in the plant so far as the germ life in the pasteurized milk is concerned should include the examination of samples from the first, the middle, and from the last of the run. If the first bottle gives a very high count, one might suspect that the apparatus had not been properly prepared to receive the milk. If the sample at the end of the run is high the trouble is of another kind.

Growth of Germ Life in the Pasteurizer

When one remembers that, in their structure, bacteria closely resemble minute fragments of jelly, it is difficult to understand how they are able to grow in milk which is so hot as to scald the hand. However, if one desires to convince himself of the reality of this ability, all that is necessary is to obtain a sample of milk from a mixture of the product from a number of dairies, hold it at pasteurizing temperature, and note the changes in the germ life in it. Quite uniformly the first change is the destruction of a large part of the germ life present. Soon there begins a multiplication of the remaining forms, and in a few hours the germ life in the milk held at 145° F. is much more numerous than before it was heated. Germs possessing this ability to grow at pasteurizing temperatures are present in much of the ordinary raw milk supply. While they have the ability to grow at pasteurizing temperatures, they do not grow with sufficient rapidity to become a serious problem in ordinary pasteurization.

However, there are kinds of bacteria which seem much better prepared to grow in the pasteurizer. Fortunately, they are not so widely distributed and they appear in the finished product of practically all pasteurizing plants for short periods and with irregular intervals. When they get into the pasteurizers of a plant where this process continues for some hours they build up so that the finished product toward the end of the run will have a bacterial plate count of a half million to several millions per cubic centimeter.

This growth takes place when the routine care of the plant is carried on in accord with what is considered the best of plant practice and no determinable reason can be demonstrated for the appearance of the growth nor for its failure to grow. The cause for its disappearance is quite as unknown as the cause for its coming.

While these germs grow with unusual rapidity at the pasteurizing temperature, as soon as the milk goes over the cooler it passes out of their growth range and the flavor, keeping quality, and apparent desirability of this milk with a bacterial plate count of a million per cubic centimeter is quite as satisfactory as though it had a count of only a few thousand.

Not only does the cooling of the milk check the growth of these germs, but holding it cold markedly decreases their ability to form observable colonies on the agar plates. When as many as a million per cubic centimeter develop from samples plated immediately after pasteurization, holding the milk cold for 24 hours may result in a 90-per-cent decrease in the bacterial plate count. This is one of the reasons why milk samples taken from delivery wagons so rarely yield these high counts.

Another surprising characteristic appears when one attempts to transfer colonies from the agar plate to a slope of the same agar. Quite uniformly the colony fails to develop when thus transferred.

It is very probable that these forms have not been successfully cultivated from raw milk. A period of heating seems to be necessary before they will develop noticeable colonies on agar plates.

Oddly enough, studies have shown that germs with this ability to grow at pasteurizing temperatures are fairly abundant in certified milk, having been found in practically half of the samples which have been examined. Commercially these germs seem to be more inclined to cause high counts in pasteurized milks which have been prepared with special regard to cleanliness of handling.

During the present summer one of us had the good fortune to spend some weeks in the study of a pasteurized milk supply which was produced on two farms with unusual regard to the cleanliness of the cows and milk utensils and with care to cool the milk immediately with iced water and hold it cold until delivered.

The two milkings from these two farms were placed in a carefully washed vat which was thoroughly scalded immediately before use. The milk was pasteurized at slightly below 145° F. for 30 minutes and then bottled, using a cooler and bottler which had been freshly scalded after thorough washing.

When everything went as it should, the bacterial plate count of the finished milk was well under 10,000 per cubic centimeter. On other days, when everything had been well handled, under so far as could be determined the same conditions, the count of the finished milk would be some hundred thousand per cubic centimeter. The observations covered the details of operations at the farms as well as the details of preparation at the plant.

In connection with this same study, bacterial plates were prepared from a certified milk which had quite uniformly been showing a bacterial count of only a few thousand. The plates made from the cold raw milk gave a count of approximately 3,000. A sample was immediately heated in a sterile test tube to 145° F. for 30 minutes, cooled and plated. The plates from the sample of certified milk which had thus been pasteurized gave a count of approximately 140,000. Scarcely an hour elapsed between the making of the plates which gave a count of 3,000 for the raw and those which gave a count of 140,000 for the pasteurized, and except for the time when the sample was being pasteurized or plated it was in a Kelvinator at low temperature.

While the germs which are able to grow at pasteurizing temperatures may enter the milk at various points in its journey from the cow to the pasteurizer, the observations mentioned suggest that at least some of them enter the milk in connection with the best conditions for milk production with which we are at present familiar. Since every known point of entrance for germ life outside of the udder was protected in connection with the preparation of these supplies, there seems to be ground for believing that at least under some conditions the udder of the cow may be the source of some of the germs which are responsible for high counts in pasteurized milk.

Summary

The sources from which come the high bacterial counts of pasteurized milk may be briefly summarized as follows:

1. The bacterial content of the raw milk exerts a more important influence upon the bacterial count and keeping quality of the same milk after pasteurization than was earlier appreciated. A raw milk supply of fine keeping quality is a necessary prerequisite for a pasteurized milk of fine keeping quality.

2. The milk line, especially in warm weather, should be flushed out with steam or very hot water shortly before use, or the accumulated germ growth on the surfaces of the metal will raise the bacterial plate count of the first milk very markedly. However, this germ life is fairly rapidly removed by the flowing milk, so that this influence affects only a small portion of the first milk.

3. Under conditions which are not yet understood, the pasteurizing apparatus becomes seeded with germ life which grows rapidly at pasteurizing temperature, so that at the end of the run for the day the pasteurized milk may have a very high bacterial plate count. Under such conditions

the milk does not seem to be the worse for the presence of this unusual amount of germ life.

So far as observations have gone, this phenomenon occurs in all pasteurizing plants, but at very irregular intervals.

"Knowledge breeds more doubt than ignorance."

USE OF BLOOD AGAR IN CONTROL OF MILK SUPPLIES

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Not infrequently, raw milk supplies prove to be the source of serious epidemics of septic sore throat or other infections. This potential danger is well recognized, and because of this, many of the leading Certified Milk producers are placing an increasing reliance upon the blood agar plate as a means of detecting the invasion of *Streptococcus epidemicus* within their herds. This is based on the fact that the blood agar plate supplies a means of detecting hemolytic streptococcus.

The presence of hemolytic streptococci in raw milk freshly drawn from the udder has always led to discussion regarding their significance and possible relation to human diseases. According to Smith, Brown, and others (1), (2), (3), the streptococcus causing septic sore throat is of human origin and it may reach the milk either directly or indirectly from human case or carrier. On the other hand, hemolytic streptococci, nonpathogenic for humans, are found in the milk of many clinically normal cows and probably in the mixed milk of all herds of more than a few animals. Fortunately, udder infection with the human organism is relatively uncommon; nevertheless, such infections are possible at any time. However, the streptococci infections of apparently normal udders are not confined to the hemolytic types. Jones, in his studies of mastitis (4), (5), has found practically twice as many cases associated with nonhemolytic as were associated with hemolytic types. In an analysis of the laboratory records of 749 individual cows, it was indicated that practically twice as many animals were infected with nonhemolytic streptococci as were infected with the hemolytic type (6). The incidence of udder infections with hemolytic streptococci seems to be approximately the same in large herds as indicated by published findings (6), (7).

In view of these facts concerning the presence of streptococci in apparently normal udders and the possible danger from infection with the human types, the value of the blood agar plate in the sanitary control of raw milk supplies becomes evident. Young and Crooks (8) have also demonstrated the utility of the blood agar plate as a practical control procedure to permit laboratory diagnosis in septic sore throat and to serve as a control on diphtheria diagnosis. In addition, an extensive quantitative application involving comparable blood and nutrient agar plate counts was suggested in the observations noted by one of us (9).

In applying the blood agar plate to routine control work, certain procedures were evolved that proved of practical value. It was found in comparing comparable blood and nutrient agar plate counts upon samples drawn under as nearly aseptic conditions as production practice permitted, that the blood agar count almost invariably exceeded the nutrient agar count. Repeated observations seemed to indicate that such was the case whenever reasonable aseptic precautions were observed in drawing the milk. Experiments with samples collected under insanitary conditions most often gave results with the nutrient agar count exceeding that of the blood agar.

It is to be noted that in making these comparisons, the blood agar counts were made after incubating the inoculated plates at 37° C. for 18-20 hours, while the nutrient agar counts were made after incubation at the same temperature *for 48 hours.* The nutrient agar used in all these observations was prepared from Difco Bacto-Nutrient Agar prepared according to Standard Methods Formula, and approved by the Committee on Methods of Bacterial Analysis of the International Association of Dairy and Milk Inspectors. 0.8 per cent NaCl was added in preparing the nutrient agar. The blood agar used in all these observations was prepared by adding 0.8 per cent NaCl to the Difco product mentioned above, and then just before pouring the plates 5 per cent sterile defibrinated horse blood was added and well mixed. The terms "blood agar" and "nutrient agar" hereafter used in this report refer to the media described above.

An interpretation of the results of these observations seemed to indicate that blood agar had a depressing effect upon the types of organisms having their source outside the udder, but probably favored the growth of the udder micro-organisms, particularly the udder streptococci. On the other hand, it was assumed that the nutrient agar probably had a depressing effect upon the growth of those types having their sources within the udder, but a favorable effect upon the types found outside the udder. It was the desire to test the accuracy of such an opinion that caused the present investigation to be undertaken.

Experimental

Various cultures of organisms common to and isolated from milk having their sources within or outside of the udder were collected. Comparative plate counts were then made of salt suspensions of these various cultures prepared in suitable dilutions from 24-hour broth or 24-hour agar slant cultures. With each culture, 20 plates were poured (10 of nutrient and 10 of blood agar) using the same pipette and identical sample dilution throughout. Each suspension in suitable dilution was shaken thoroughly, glass beads being used to insure the breaking up of clumps. The plates were incubated at 37° C. in stacks four high and counts were made at 18 and 48 hours. The 72-hour and 5-day counts were made only when indicated. (A history of the various cultures is presented in the Appendix.)

The results of the comparative plate counts are given in Table I. The figures given represent the means of the individual plate counts. The maximum deviations from the mean among each series of individual plate counts at 48 hours are also given.

TABLE I

MEAN VALUES OF COMPARATIVE PLATE COUNTS MADE UPON BLOOD AND NUTRIENT AGARS AT 37° C.

	Blood Agar			Nutrient Agar		
Culture	18 hours	48 hours	Maximum deviation %	18 hours	48 hours	Maximum deviation %
Bovine streptococci:						
Nonhemolytic	...	...	...	...	106†	...
No. 14	88	123	24	*	*	8†
No. 13	70	123	16	*	95	22
No. 9	45	59	40	*	48	30
Alpha hemolytic						
No. C136	7	15	20	1	9 11†	36
Beta hemolytic						
No. 17	41	47	15	25	49	12
No. 11	28	31	26	*	15 18†	39
Staphylococcus aureus No. 23	348	348	3	320	320	6
Serratia marcescens No. 19	133	135	26	134	134	15
Serratia lactica No. 21	416	416	9	423	423	8
Escherichia coli No. 18	17	23	56	14	17	83
Escherichia coli No. 8	141	143	15	126	127	24
Aerobacter aerogenes No. 20	39	44	36	44	48	17
Bacillus subtilis No. 15	22	27 27‡	30	21	32 32‡	53
Sarcina lutea No. 22	*	*	36	*	23	50

* Colonies not visible with hand lens. † 72-hour counts. ‡ 5-day counts.

The figures given in Table I serve to indicate again that the plate method of comparing the growth of the various organisms is subject to considerable inaccuracy. Aside from *Sarcina lutea,* blood agar does not appear to inhibit the growth of any of the cultures studied. On the other hand, the nutrient agar apparently has a depressing effect upon the growth of the udder streptococci, notably the non-hemolytic variety and those streptococci producing alpha hemolysis, but less marked with streptococci producing beta hemolysis. It is interesting to note that the blood agar plate does permit *detecting the presence of the hemolytic strains* of udder streptococci within eighteen hours, and often in 8-12 hours (Jones), whereas the nutrient agar does *not* possess such utility at all. However, the presence of other types of organisms which produce the punctiform colony are readily confused with the nonhemolytic streptococci, and therefore caution must be exercised.

In view of the results obtained by these culture studies, experiments were then conducted upon freshly drawn milk. Three series of samples were drawn from each of six cows. The animals were prepared by cleaning the udder of any superficial material and then rejecting a few streams of milk from each quarter. A composite sample representing the product of all four quarters was then collected under aseptic conditions by means of sterile milking tubes and container. Immediately following this sample, another was taken by milking a few streams directly into a clean milk bottle, reasonable sanitary precautions being observed in so doing. Another sample was then drawn similarly, excepting that at the end, the milker wiped his hand over the outer surfaces of the udder and then contaminated the sample by dipping his fingers into the milk. In Table II, these different samples collected in series from each of six animals are designated, first, by the ear tag number of the cow; second, by the letter "C" suffixed to the ear tag number, and third, the letter "S" suffixed to the ear tag number and corresponding to the order in which the samples were taken as stated above. The plating technique complied with the requirements of the Standard Methods of Milk Analysis. The 1:100 dilution was used throughout and counts were made at 18 and 48 hours, 37° C. being the incubation temperature. With each sample, 10 plates were poured (five in nutrient and five in blood agar) using the same pipette and identical dilution throughout.

The results of the comparative plate counts are given in Table II. The figures given represent the means of the individual plate counts. The maximum deviations from the means among each series of counts at the 48-hour counting are also given.

TABLE II

MEAN VALUES OF COMPARATIVE PLATE COUNTS OF MILK SAMPLES MADE UPON BLOOD AND NUTRIENT AGARS AT 37° C.

	Blood Agar			Nutrient Agar			
Sample	18 hrs. No. of colonies (00 omitted)	48 hrs. No. of colonies (00 omitted)	Maximum deviation %	18 hrs. No. of colonies (00 omitted)	48 hrs. No. of colonies (00 omitted)	Maximum deviation %	Type of predominating organisms
136	22	48	40	*	47	33	Streptococci
136C	57	94	11	*	80	20	producing alpha
136S	53	137	31	24	138	7	hemolysis
212	*	114	18	...	106	3	Staphylococcus
212C	139	160	19	134	169	30	
212S	209	267	16	216	267	8	
884	182	204	9	114	152	9	Staphylococcus
884C	119	129	15	86	101	19	
884S†	47	92	16	34	94	28	
89	84	103	17	98	110	8	Streptococci
89C	124	129	15	114	121	14	producing beta
89S	294	510‡	..	336	510‡	..	hemolysis
309	154	172	22	169	174	10	Staphylococci
309C	146	157	9	162	168	11	Nonhemolytic streptococci
309S	232	400‡	..	274	400‡	..	Alpha strep.
926	15	15	21	14	15	20	Staphylococci
926C	23	24	30	16	21	33	
926S	132	224	25	126	209	8	

* Colonies not visible with hand lens.
† Sample not contaminated.
‡ Counts estimated.

According to the results given in Table II, there appears to be an inhibition of the udder streptococci producing alpha hemolysis by the nutrient agar after 18 hours' incubation, but apparently none at 48 hours. The results of the analyses of the other samples do not indicate any inhibition of bacterial growth by either agar. In samples of the series No. 309, the predominence of staphylococci apparently confused the relations noted for nonhemolytic and alpha hemolytic streptococci in Table I. In passing, mention should be made of the fact that in the contaminated samples there was noticeable a considerable crowding out of the hemolytic streptococci by the contaminating organisms. Where the streptococci would normally constitute 80 to 90 per cent of the udder flora, doubling or tripling the count by contamination was not accompanied by a *proportional* decrease of the udder streptococci, but instead they were reduced almost to a negligible quantity. This indicates the necessity of applying the blood agar plate to the examination of milk freshly drawn and free from any considerable outside contamination.

A final experiment was conducted upon the various cultures by noting the growth effects upon the surfaces of agar slants. In addition to blood and nutrient agar, serum agar was also used in preparing the slants. The serum agar was prepared similarly to the blood agar described elsewhere in this paper, excepting that the clear serum of the defibrinated blood was used in place of the blood itself. After the slants were prepared they were incubated for 48 hours at 37° C. for sterility. Eighteen-hour broth cultures of various pure cultures were transferred to the surfaces of the agar slants and incubated for 24 hours at 37° C., when the growth effects were noted. The results are tabulated in Table III below:

TABLE III

24-HOUR CULTURE GROWTHS ON AGAR SLANTS INCUBATED AT 37° C.

Culture		Nutrient Agar	Blood Agar	Serum Agar
Bovine streptococci				
Nonhemolytic	No. 9	2	3	3
	No. 10	2	3	3
	No. 13	2	3	3
	No. 14	2	3	3
Beta hemolytic	No. 11	3	3	3
	No. 17	3	3	3
Alpha hemolytic	No. C136	2	3	3
	No. C309	2	3	3
Staphylococci				
Staph. aureus	No. 23	4	4	4
	No. C982	4	4	4
	No. C309	4	4	4
	No. C884	4	4	4
	No. C926	4	4	4
Serratia				
marcescens	No. 19	4	4	4
lactica	No. 21	4	4	4
Escherichia				
coli	No. 8	4	4	4
coli	No. 28	4	4	4
grunthali	No. 24	4	4	4
vekanda	No. 25	4	4	4
Aerobacter				
aerogenes	No. 20	4	4	4
Bacillus				
subtilis	No. 15	4	4	4
Sarcina				
lutea	No. 22	4†	1†	1†

1 scant growth (1 or 2 colonies)
2 appreciable growth
3 moderate growth
4 luxuriant growth

† 72 hours incubation at 20° C.

The results of Table III compare well with the results noted in Table I. The nutrient agar apparently produces a slight inhibition in the growth of the udder streptococci, more particularly among the nonhemolytic variety and those streptococci producing alpha hemolysis, with apparently no real difference among the streptococci producing beta hemolysis.

DISCUSSION

There is no evidence in the data of this investigation that blood agar inhibits the growth of any of the microörganisms that usually constitute the flora of milk freshly drawn from the udder and having their origin either within or outside of the udder. The only exception noted was that of *Sarcina lutea*, which was definitely inhibited by both blood and serum agar. On the other hand, nutrient agar does appreciably delay the growth of the udder streptococci, notably those producing alpha hemolysis and the nonhemolytic strains. This delay apparently does not extend in most instances beyond 48 hours' incubation at 37° C. While the blood agar plate does permit the ready detection within eighteen hours of the presence of hemolytic streptococci such as are likely to occur, the presence of nonhemolytic streptococci must be carefully demonstrated, due to the resemblance in colony formation to those cultures not originating in the udder.

There is positively no evidence that a basis of comparison between an 18-20-hour count on blood agar and a 48-hour count on nutrient agar is warranted. In view of the results of this investigation, the observations that unclean milk will give a greater count on nutrient agar after 48 hours' incubation than on blood agar after 18-20 hours' incubation is true, but it is also true that the maximum count of the udder streptococci is not reached on blood agar in the shorter incubation period, just as the maximum count is not reached on nutrient agar until after 48 hours' incubation. Earlier observation that milk drawn under reasonably aseptic conditions will give an 18-20-hour blood agar count either equal to or greater than a comparable nutrient agar count at 48 hours is subject to considerable revision, as it is not always true.

It is possible, however, that the extensive incidence of nonhemolytic streptococcic infections of the udder in the herd in which the original observations were made (6) might account for some of the differences noted in the greater counts in blood agar after 18-20 hours' incubation. On the other hand, the differences noted with greater counts in nutrient agar are not necessarily due to a flora originating in outside contaminations. The inherent inaccuracy that any plate method of bacterial enumeration is subject to makes any such comparisons erroneous. Therefore, in view of the results of this investigation, it appears that any differences noted in the comparative counts upon blood and nutrient agars under the conditions described were more apparent than real.

Summary

A study of the effects of blood and nutrient agars upon the growth of a number of bacteria of the types usually encountered in milk freshly drawn from the udder has been made. Of the various cultures studied, there was no inhibition of growth traceable to blood agar with the exception of *Sarcina lutea* (an unimportant organism). On the other hand, there appeared to be an inhibition of certain of the udder streptococci by nutrient agar, notably among the alpha hemolytic and nonhemolytic strains. In most instances, this inhibition did not extend beyond the 48-hour incubation period at 37° C. The blood agar plate does, however, permit the ready detection of hemolytic streptococci in 18 hours.

The results of this investigation indicate that no reliance can be placed upon any apparent differences of counts appearing in blood and nutrient agars as a basis of administrative laboratory control. The inherent inaccuracy of any plate method of bacterial enumeration alone makes this impossible.

The utility of the blood agar plate, as a differential medium and presumptive test, for use in the sanitary control of raw milk supplies against the invasion of *Streptococcus epidemicus* is not affected when the milk to be examined is freshly drawn and free from any considerable contamination. The presence of nonhemolytic streptococci must be

carefully determined, due to the punctiform colony formation produced by other organisms that might readily be confused with those of streptococci.

Bibliography

1. Smith and Brown, J. Med. Res. xxxi, 445, 1915.
2. Brown, Frost, and Shaw, J. Inf. Dis. xxxviii, 5; 381-388 (May, 1926).
3. Frost and Carr, A. J. P. H. xvii, 2; (Feb., 1927).
4. Jones, J. Exp. Med. xxviii, 9; 735 (1918).
5. Jones, Proc. World's Dairy Con. II, 1923.
6. Parker, J. Bact. xii, 1; 61 (Jan., 1927).
7. Frost, Gumm, and Thomas, J. Bact. xiii, 1; 61 (Jan., 1927).
8. Young and Crooks, Mich. Dept. Health Reprint Series No. 48 and No. 49, (Jan., 1926).
9. Parker, *The Nation's Health*, ix, 8; 42-43 (Aug. 15, 1927).

Appendix

Bovine streptococci:

Nonhemolytic

No. 9—Isolated from milk 5/12/27

No. 10—Isolated from milk 5/12/27

No. 13—Cow 55 VI-23 R. I. M. R.

No. 14—Woodstock Mastitis VI-23 R. I. M. R.

Beta hemolytic

No. 11—Cow 67 VI-23 R. I. M. R.

No. 17—Streptococcus mastitidis
No. 342 A. T. C. C.

Alpha hemolytic

No. C136—Cow 136 9/25/27

No. C309—Cow 309 9/31/27

Staphylococci:

aureus No. 23—Stock culture M. I. T.

No. C982—Cow 982 9/31/27

No. C309—Cow 309 9/31/27

No. C884—Cow 884 9/31/27

No. C926—Cow 926 9/31/27

Serratia

marcescens No. 19—No. 247 A. T. C. C.
lactica No. 21—Stock culture M. I. T.

Escherichia

coli No. 8—Isolated from calf R. I. M. R.
coli No. 28—A. T. C. C. No. 600
vekanda No. 25—A. T. C. C. No. 964
grunthali No. 24—A. T. C. C. No. 963

Aerobacter aerogenes No. 20—A. T. C. C. No. 211

Bacillus subtilis No. 15—A. T. C. C. No. 243

Sarcina lutea—Stock culture M. I. T.

"Such help as we can give to each other in this world is a debt we owe to each other."

REPORT OF COMMITTEE ON FOOD VALUE OF MILK AND MILK PRODUCTS

IRA V. HISCOCK,* *Chairman*

This report aims to direct attention to some of the most important information which has been assembled during the past year concerning the food value of milk and milk products. Sources of data are included in the bibliography for the benefit of members who wish to study the subject in greater detail than the limits of this report provide.

Milk is not merely a palatable drink but our most important food. Milk furnishes some of all the material necessary for growth, as well as energy for work and play and warmth. It supplies protein for body building, minerals for bloods, bone, and teeth; vitamins for health and growth; fat and sugar for fuel for the body processes.

The Children's Bureau of the U. S. Department of Labor has recently issued a publication[1] entitled "Milk, the Indispensable Food for Children." This booklet of 43 pages lists 198 useful references, and contains an immense amount of valuable information concerning the nature and value of milk as a food, substitutes for breast milk, the purchasing and preparation of milk for infants, liquid milk, canned milk, and milk for the older child.

The summary of this publication seems worthy of quotation here because in most respects it covers admirably the major factors to be emphasized.

> "Milk is the indispensable food for children. Whole milk in some form must be furnished them if nutrition is to be adequately maintained and if normal growth in height and weight and normal bone and tooth formation are to be assured.
>
> "The proper nourishment of children is the first

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[1] Bureau Publication No. 163, 1926.

duty of the Nation. Every child from 1 year to 16 years of age is better for having a quart of milk in his daily diet. The minimum allowance for any growing child is 1½ pints daily; an adult needs 1 pint daily. Milk can be used in the cooking of food and so disguised for those who do not like it as a drink.

"Since milk and milk products are a vital necessity for growing children, for pregnant and nursing mothers, and for the sick, a supply of good-quality clean milk should be available in every locality under strict sanitary supervision.

"Clean, fresh cow's milk is the best available form of milk for infants after they are weaned, but it may have to be treated or modified to adapt it to the digestion of some infants. Pasteurized milk has become more and more generally used in this country because safe raw milk is difficult to obtain. Milk powder or evaporated milk (unsweetened condensed) may safely be substituted when good raw or pasteurized milk can not be had.

"Goat's milk is equally digestible and nourishing.

"Milk has no adequate substitute in the diet of the child. Milk is the chief calcium (lime) food. Milk is the cheapest source of high-grade protein. Milk is rich in the growth-promoting vitamin—vitamin A. Milk is the chief of the 'protective' foods that compensate for the inadequacies of the American diet and keep the people well.

"There is a real relation between milk and health and growth. Impaired nutrition means decreased vitality and lowered resistance to disease. The future of the Nation depends upon the stamina of the children. The Nation can not afford to permit any child to be deprived of his daily allowance of milk."

As members of the International Association of Dairy and Milk Inspectors, we are interested not only in an adequate milk supply, but also in a safe milk supply. We recognize, as Tobey has well stated,[2] that the value of milk lies in the fact that it is the only single article of diet which

[2] **Tobey, James A., M.S., Dr.P.H. The Public Health Value of Concentrated Milk. American Medical Journal and Record. August 17, 1927.**

contains practically every one of the elements which are necessary to human nutrition. Its danger comes from the ease with which pathogenic bacteria may gain access to milk and spread disease. The fourth paragraph of the above summary may be somewhat misleading. While clean, fresh cow's milk is recognized as the best available form of milk for infants after they are weaned, public health workers and the majority of leading pediatricians[3] also emphasize that milk for infant and child feeding should be boiled or properly pasteurized as an added safeguard against communicable diseases which may be transmitted by raw milk. Most pediatricians now agree that boiling of milk also renders the product more digestible for infants. It is vital for the welfare of our milk-consuming public that milk production be carefully supervised throughout the entire process, from the dairy farm to the consumer. The best guarantee of safety, especially for large milk supplies, is pasteurization.

It should be stated in this connection that the booklet of the Children's Bureau does contain the following important sentences on the subject of pasteurization: "Pasteurization should be regarded as an additional factor of safety in caring for clean milk and not as a cloak to cover dirty milk. Pasteurization is the best method at present available for obtaining safe milk on a large commercial scale. Most public health authorities consider pasteurization necessary in order to prevent milk-borne epidemics of disease."

A very interesting publication from the Medical Research Council, London, England,[4] has recently appeared which seems worthy of summary. This report is the result of what seems to be a careful study of the diets for boys during the school age. Adequate nutrition in this report is taken to mean that which allows the full unfolding in growth of the best potential qualities, physical and mental, inherent in the child at birth.

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[3] See report of this committee in 1926, p. 229.
[4] Special report series No. 105, 1926.

The observations reported were made upon the nutrition of boys of school age who were living in an institution a few miles outside of London. The housing conditions were excellent and quite modern, the "villa" system allowing for a total of 30 to 35 boys in each house, with a low rate of sickness. During a period of four years, records were made of the diet which was actually consumed at table by weighing sample rations as served at table, daily, for each of the three meals, thus obtaining minimum and maximum helpings—for smaller and larger boys—and deducting waste. The basic diet thus supervised varied between 1,679 and 2,154 calories daily—the average of 7 weekdays; it provided 37.3 calories per pound of body weight for a boy of 45 pounds' weight, and 35.9 calories per pound of body weight for a boy of 60 pounds' weight. The average diet for a boy of 52.5 pounds' weight had a value of 1,916 calories, containing protein 13 per cent of calories, fat 18 per cent of calories, and carbohydrate 68 per cent of calories. This diet was steady during four years.

Healthy boys whose weights were between 45 and 60 pounds were drafted into different cottages, as far as possible with a similar number of the same age and body weight in each cottage. These batches of boys were then fed in different ways, the minimum period of observation being one year, the maximum period extending in some instances to three years. Frequent records were kept of weight and height increments and a constant supervision of physical fitness and general health. The results were as follows:

Average Gains Per Boy in One Year

Ration	Number of Boys	Gains in Weight	Gains in Height
Basic Diet	61	3.85 lbs.	1.84 in.
Plus Water-cress	26	5.42 lbs.	1.70 in.
Plus Sugar*	20	4.93 lbs.	1.94 in.
Plus Milk*	41	6.98 lbs.	2.63 in.
Plus Casein	30	4.01 lbs.	1.76 in.
Plus Butter N.Z.*	26	6.30 lbs.	2.22 in.
Plus Veget. Marg.*	16	5.21 lbs.	1.84 in.

* Equivalent calories.

It was found that there was almost invariably rather more growth during the summer period and usually more gain in weight also during that season, although there were noticeable exceptions. It is noteworthy that the addition of one pint of milk a day to a diet which by itself satisfied the appetite of growing boys fed upon it, could convert an average annual gain of weight of 3.85 pounds per boy into one of 6.98 pounds, and an annual average increase of height from 1.84 inches to 2.63 inches. In this institution where there was no deficiency either of fresh air or sunshine, an immediate improvement in physique is reported to have followed an alteration in the quality of the diet which was adequate from a physiological standpoint. This improvement was most successful when fresh cow's milk, recently pasteurized, from a clean and reliable source, formed the additional item of food, and such improvement both in the weight and height increments was not a temporary phase but was maintained over a period of one, two, and three years.

The value of milk of adequate butter-fat content is recognized by nutrition workers. Too frequently, however, is the fact overlooked that regulations provide only for minimum limits, and too frequently does a milk supply merely conform to these limits. One aspect of this problem has been recently reported upon by Platon as a result of experimental feeding of rats.[5] These findings seem to warrant the conclusion that if any part of the vitamin A in milk is in combination with other elements than the fat, such combination must be in a very insignificant amount.

In considering the various aspects of the food value of milk, it is important to bear in mind that milk is somewhat low in iron content. Because of this deficiency, a child should not be confined too long to milk as its sole food. Leafy vegetables (such as spinach), egg yolk, and beef

[5] Biochem. Zeit. 185: 238 (June, 1927).

supplement milk in regard to iron, and can be used even for infants. A recent editorial calls attention to the fact[6] that the concentration of iron in milk approximates only 0.0002 per cent. It has been shown that adult rabbits and certain other adult species can be made anemic by a diet of cow's milk alone. Experiments at the Wisconsin Experiment Station showed further that evidently milk cannot be converted by regulating the diet of lactating animals into a conspicuous source of iron.

Conflicting reports of previous investigators as to the possibility of increasing iron in milk by feeding iron compounds have led to the conduct of very careful experiments.[7] Two goats used were mature lactating animals which had been fed on a basal ration one week prior to experiments. The animals were milked twice daily and the milk analyzed for iron. It was found impossible to increase the iron content of the milk by feeding Fe_2O_3 or the soluble salt $FeSO_4 \cdot 7H_2O$. There was no noticeable change in iron content even when the addition of iron increased the original iron content of the ration fivefold. The addition of Fe_2O_3, or Fe_2O_3 plus fresh green cabbage, to the ration of a goat brought about no changes in the milk which would prevent the development of nutritional anemia when fed to young growing rabbits. Cows fed on rations of alfalfa hay and of timothy showed no difference in iron content of milk, although alfalfa contained twice as much iron as timothy.

Several important studies have been reported dealing with irradiation. Wieland[8] has recently reported that ultraviolet light or irradiated milk powder cures the bone changes in rickets, but is without influence on the anemia. Hess, in

[6] Editorial, Jour. A.M.A., April 16, 1927. See also Hart, E. B., Steenbock, H.; Elvehjem, C. A., and Waddell, J.: J. Biol. Chem. 65:67 (Aug.) 1925.

[7] C. A. Elvehjem, R. C. Herrin, and E. B. Hart; J. Biol. Chem., 71:255 (Jan.), 1927.

[8] E. Wieland, "Direct and Indirect Phototherapy of Rickets": Schweizerische medizinische Wochenschrift, Basel, 57:169-192, Feb. 19, 1927.

a recent article,[9] states that the most practical application of an irradiated food is the use of irradiated dried milk for infant feeding. It is the unanimous opinion that dried milk treated in this way prevents or cures infantile rickets and tetany. The specific activity of the milk is maintained for a period of at least six months.

After exhaustive studies of the antirachitic properties of irradiated dry milk, Supplee and Dow report[10] that the favorable results obtained with ultraviolet rays from the standpoint of laboratory studies indicate that nutritive and therapeutic properties of the product are enhanced to an appreciable degree. It appears that the beneficial results known to accrue to food products exposed to ultraviolet rays can be attained without measurable destruction of the readily oxidizable vitamins A and C, provided that a suitable technic of irradiation is used. Critical studies of the product under consideration have shown that there is no evidence of a disagreeable flavor and odor commonly found in milk products that are exposed to the ultraviolet rays for long periods of time. Furthermore, the usual keeping qualities of the product are apparently unimpaired. The irradiated product has been found to keep satisfactorily and apparently in its original condition for a period of several months. The comparative studies which have been made indicate that the process of activation as applied does not accelerate oxidation of the fatty constituents to a degree that impairs the nutritive value in any way to induce changes of a detrimental character.

The relation between the vitamin C content of a cow's ration and of its milk has received considerable attention. Most workers have indicated that the vitamin C content of milk varies with the content of this vitamin in the feed.

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[9] Hess, Alfred F., M.D.: Jour. A.M.A., Vol. 89, No. 5, July 30, 1927, p. 337.

[10] Supplee, G. C., Ph.D., and Dow. Odessa D., M.S., Amer. Jour. Dis. Children, Vol. 34, No. 3, Sept. 27, 1927, p. 364.

Hughes, Fitch, Cave, and Riddell[11] have reported the results of a study of the influence of the vitamin content of the diet on the vitamin content of milk in dairy cows. A number of feeding rations were tried, all of which are recorded, as well as graphs showing the growth of the various animals. The results of all of these experiments indicate the vitamin C content of a cow's ration has little if any influence on the vitamin C content of the milk. In the case of one cow, at least, there is evidence to indicate an ability on the part of the animal to synthesize this vitamin. These results indicate that there are still unsolved problems even in regard to milk.

CONCENTRATED MILK[12]

The concentrated milks, including condensed, evaporated, and dried, have a wide scope of usefulness. Some of the advantages of these concentrated milk products are that (a) if properly handled and from proven sources, they should be clean and safe; (b) they may usually be kept as prepared for long periods of time (recently there has been discovered the development of mold in cases of canned milk); (c) they may be uniform in composition (not necessarily so under the definitions promulgated by the Secretary of Agriculture); (d) they are convenient and inexpensive. The nutritional qualities of the concentrated milks are apparently not impaired by the manufacturing process. The value and uses of dried milk and of various milk products not included in this report have been discussed in detail in previous reports of this committee.

ICE CREAM

The value of ice cream as a food is becoming more and more clearly recognized. Up to a few years ago, ice cream

[11] J. Biol. Chem., 71:309 (Jan.), 1927.

[12] For a more complete discussion of concentrated milk, read "The Public Health Value of Concentrated Milk," American Medical Record, Aug. 17, 1927.

was considered more as a luxury than as a valuable food. It is now even popularly called health in frozen form.[11] Ice cream has come to be considered a valuable nutriment. The chief ingredients are milk solids, cream, and sugar. There is need, however, for the adoption of more uniform standards for ice cream. The Food Standards Committee has recognized modern commercial practice in a tentative definition for ice cream, which, however, has not been adopted by the Secretary of Agriculture. In this definition, skimmed milk, evaporated milk, condensed milk, butter-fat, and water are recognized ingredients, as are cream, sugar, and milk. Certain States have recognized ice cream of 8 per cent butter-fat content, and fruit and nut ice cream of 6 per cent butter-fat.

Athletes recognize ice cream as one of the desirable sweets found at the training table, and hospitals serve it as a part of their regular fare. In certain types of throat cases, for example, as following tonsil operations, ice cream is often one of the first foods given the patient. It is not merely a food for athletes and invalids, however, as Tobey has well stated, for it may be eaten by all except a small minority, as sufferers from diabetes who are usually forbidden to eat sugar, and those whose obesity makes it desirable to abstain.

Ice cream contains vitamins, calcium, and other minerals, being a concentrated and refined form of milk, and these contribute to proper building of teeth and bones. It is to be desired in winter as well as in summer, as a part of a regular meal. Properly eaten (slow consumption), ice cream, in spite of its coldness, has no deleterious effect on digestion. Fruits and flavors may add to its value. Pasteurization does not affect vitamins A and B, but may reduce the antiscorbutic vitamin C. Such fruits as oranges and pineapples should restore this vitamin C. Fruits also contribute more carbohydrates, although in a different form.

[11] Tobey, James A., Hygeia, April, 1927. See also Nation's Health, May, 1926, p. 356, and October, 1926, p. 683.

Nuts add protein. Emphasis should be given, however, to the importance of richness and quality, proper blending of constituents, and cleanliness and safety of the product; for supervision of the production and delivery of ice cream is as important as the care in handling of other milk products.

"Men do less than they ought unless they do all that they can."

ADDRESS

DR. CHARLES J. HASTINGS, *Medical Officer of Health,*
Toronto, Ontario

Dr. Hastings said in part:

It is a great pleasure to us for this Association to come to Toronto for its annual convention. We realize the good work you are doing, and we all appreciate greatly the early work of research men and others who have helped to make possible the progress that has been made in supplying our cities with safe and wholesome milk. The conservativeness and reliability of the workers for a better milk supply are qualities that have helped greatly.

The field of research in the dairy industry has not only been well cultivated, but is possible of further development. The food value of milk, from the standpoint of nutrition as well as from the standpoint of health, has become generally recognized, and the producers and distributors of milk are really nation builders, as they provide and safeguard the most important of all foods. Milk, formerly a fruitful source of disease, is now one of the safest foods.

Education constitutes 99.99 per cent of the qualities essential for success. Our job is to see that the people want what they should have. One of the jobs of the politicians is to give people what they want. In our work we show the people what they paid for water when they thought they were buying milk. Let the politicians alone. Let the people know what they should have, and the people will look out for the politicians. We still have a few in our City Council who were members of the City Council 17 years ago, but for several years they have been using as a plank for their reelection "adequate appropriations for the protection of the public health."

The politician will give any amount of money the people want the Health Department to use in the performance of its work.

Money used in health protection is important; in fact, the highest-paying investment that can be made. Show the people what should, could, and would happen with sufficient funds for health work, and the funds will be provided.

Producers and distributors of milk have worked with us in a most complete harmony in securing clean milk plus scientific pasteurization. Occasionally a medical man will object to pasteurized milk, but he does not know what he is doing. Mother's milk may not, and neither may cow's milk, contain the vitamins affected by heat, and all well-informed medical men are using orange juice; but no amount of orange juice will guarantee against typhoid, septic sore throat, and other communicable diseases that are absolutely prevented by proper pasteurization.

We are glad you have come here for your convention. We hope you will enjoy your stay in our city and that you will return to us again in the near future.

"The world's a great book, and they that never stir from home read only a page."

THE CATALASE TEST IN MILK CONTROL

J. H. SHRADER, *Director*, and F. A. KORFF, *Chief*,
Division of Chemistry, Bureau of Chemistry and Food,
Baltimore City Health Department.

LITERATURE

Burnet (1) has stated that catalase is an enzyme which is a normal constituent of the cell itself. Its function is to catalyze organic peroxides, liberating molecular oxygen and thus protecting the tissues from the harmful effects of the accumulation of these peroxides.

In 1910, Kostler (2) stated that a high catalase test in freshly drawn milk indicates diseased milk. Likewise Barthel (3) in 1910 assembled some of the earlier information and showed further that it is the innumerable white blood corpuscles, the so-called leucocytes, in the milk which are the carriers of the enzymes that decompose hydrogen peroxide and give color reactions with guaiacum. Heineman (4) states that the enzyme is present in cow's milk in excessive quantity when the udder is diseased. A test for catalase has therefore been used to indicate mastitis.

Race (5) declares that fresh milk usually evolves 1 to 3 c.c. of oxygen, and that higher results are indicative of bacterial contamination or of excessive amounts of cellular elements produced by physiological or pathological irritations of the udder. Orla-Jensen (6) states that cows with diseased udders or cows approaching the end of the lactation period will liberate large amounts of oxygen from hydrogen peroxide, and that there will be no more than 2.5 c.c. of oxygen liberated in six hours from hydrogen peroxide by the catalase of fresh milk.

Northrup (7) showed that the rate of formation of oxygen is independent of the hydrogen peroxide concentration if the latter is greater than 0.1 M (0.3 per cent), that the rate of decomposition of the hydrogen peroxide is proportional to the catalase present, and that the catalase undergoes spontaneous monomolecular decomposition during the reaction.

Bazin (8) used the catalase reaction for appraising the hygienic value of milk. He measured the amount of oxygen liberated from 10 c.c. of hydrogen peroxide by 10 c.c. of milk. Three hours after milking this was found to be 0.6-0.7 c.c. He states that for milk kept under proper conditions and handled properly, the amount should not exceed 1.5-2.0 after 12 hours. He further states that the rate of formation of catalase runs parallel with the increase in acidity after the first 17 hours, after which the catalase increases the more rapidly.

Ohtsubo (9) states that the exposure of catalase to a temperature of 72° C. for thirty minutes, to acids, alkalies, and a number of other chemicals, inhibits or destroys its activity. Catalase action is said to be complete in one hour. An incubation of 24 hours weakens it, which a number of authors confirm.

Local Needs for Tests

In the course of our milk control work, we occasionally encountered bacteria counts which were tremendously in excess of what had been the general run of counts for the respective milk pasteurizing plants. These counts came through in from 48 to 72 hours after the sample was taken, depending on whether or not a Sunday or holiday intervened. The unusually high count indicated that something was wrong. Accordingly, one of our milk plant inspectors would make an inspection several days subsequent to the event, with the result that he would usually find little or nothing that would explain the count.

Moreover, we frequently found cattle with inflamed udders in the herds of our several raw milk dealers (furnishing about 0.9 per cent of our total milk supply). Our staff was not large enough to allow us to pay weekly visits to each of these raw milk plants.

It is clear that if we could find some good laboratory method that would help in solving the cause of sporadic high counts or the presence of diseased animals in a herd, we could not only solve some inexplicable or difficultly diagnosed situations, but could increase the intensity of our control by covering the dairies much more frequently through sampling their milk.

The so-called catalase test was one of the biochemical methods studied. This test depends on the decomposition of a weak solution of hydrogen peroxide by the catalase in the milk.

Extensive search brought to light the following types of so-called catalase tubes, illustrated in Figures I to VI. In each case, the test depends on the quantitative liberation of oxygen and its estimation by reading directly the equal quantity of displaced milk.

In all of our earlier regulatory work, we used the Fucoma tube (Fig. I), but this has been gradually superseded by other types more efficient. It is extremely difficult to insure that there are no leaks around the rubber stopper. To insure tight fits, the analyst would frequently break the tube and cut his hand.

The Fucoma tube (Fig. I) consists of a glass jacket or jar, inside of which is a graduated pipette, the lower end dipping below the milk. Milk and hydrogen peroxide are placed in the outer tube, the inner pipette placed in this tube, and the rubber stopper put in place. The level of the liquid is adjusted to the zero mark on the pipette and the whole apparatus placed in a water bath at 25° C. As the oxygen is liberated, it sets up a positive pressure

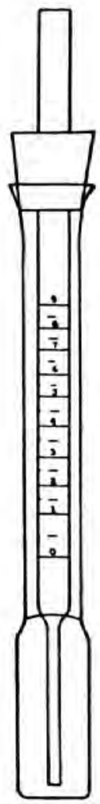

Figure I

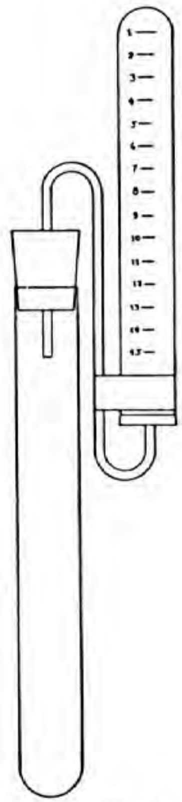

Figure II

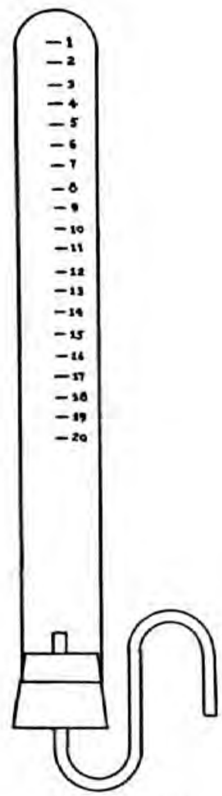

Figure III

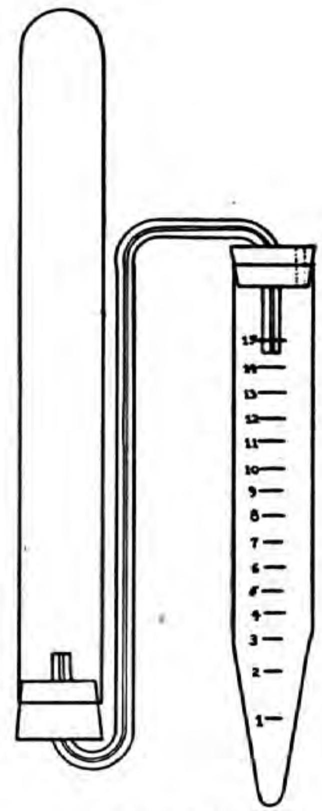

Figure IV

in the outer tube and forces the milk into the inner tube, and causes it to rise therein to the extent of the number of c.c. of gas which is liberated. This is determined by reading the height of the milk column in the inner tube.

The Christiansen tube (Fig. II) consists of two separate tubes, one of which holds the milk and peroxide, the other inverted tube containing water. The two tubes are connected by means of a metal S-tube. As the oxygen is liberated, it collects in the inverted tube and is read off directly.

The Jensen tube (Fig. III) consists simply of a graduated tube with an S-tube through a rubber stopper. The milk and peroxide is displaced by the oxygen and the level of the liquid is read off.

The Ellis tube (Fig. IV) is similar to the Christiansen tube, but instead of the gas being read, the milk and peroxide displaced by the oxygen is read. In later models of this tube, the whole tube containing milk and hydrogen peroxide is immersed in the water bath, which does away with any change of temperature affecting the liberated oxygen.

The Lobeck tube (Fig. V) is similar in operation to the Christiansen tube, but is built as one piece of apparatus. Water is placed in the upper portion and this is displaced by the oxygen liberated and the level of the water read off.

The other tube (Fig. VI) is a modification of the Lasser-Cohn saccharimeter which can be used for the determination of catalase. This tube does away with all rubber stoppers and connections, a possible source of leakage in the other tubes.

Virtanen and Karström (10) state that the optimal reaction for bacterial catalase is pH 7.5-8.0, and the limiting reactions are pH 9.1 and pH 3.1.

As will be seen later on, it is clear that a small amount of peroxide is decomposed in pasteurized milk.

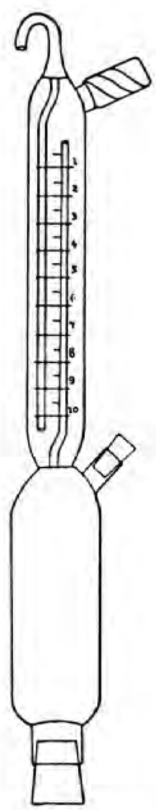

Figure V

Figure Va

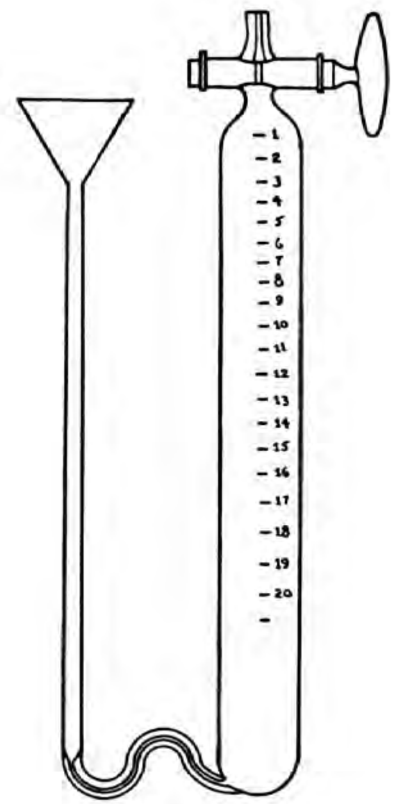

Figure VI

Foussier (11) states that the disappearance of hydrogen peroxide from pasteurized milk is due to the presence of peptonizers which resisted pasteurization.

Experimental Determinations

In order for the above data to be of diagnostic value, this information must be placed on a definite qualitative and quantitative basis, and must be shown to be effective under practical conditions. In the following experiments the Fucoma tube (Fig. I) was used and the samples were incubated at 25° C. Our procedure in making the test was as follows:

To 15 c.c. of milk there is added 5 c.c. of a one per cent solution of hydrogen peroxide, neutralized to phenolphthalein. This is placed in a catalase tube, immersed in a water bath at 25° C. and held there for two hours, at which time the reading is taken and recorded. This is called the catalase index. The peroxide strength does not have to be exact.

In order to ascertain what might be the order of magnitude of the leucocyte count in relation to the catalase reading, the following catalase determinations were made of samples of milk with varying leucocyte content:

TABLE I

Relation Between Catalase Reading and Leucocyte Count

Catalase	Leucocyte per c.c.	Catalase	Leucocyte per c.c.
10	32,000,000	9	30,000,000
10	20,000,000	9	7,200,000
9	30,000,000	9.5	1,900,000
9	8,500,000	9.0	4,200,000
9	26,000,000	8.5	2,100,000
9	1,500,000	8.1	14,100,000
9	7,000,000	8.1	5,400,000
9	18,000,000	8.0	1,400,000
9	19,000,000	7.5	2,800,000
9	7,500,000	7.0	2,400,000
9	90,000	6.5	2,100,000
9	2,800,000	6.1	1,100,000
9	2,000,000	6.0	1,700,000
9	30,000,000	6.0	6,000,000

TABLE I—Cont'd.

RELATION BETWEEN CATALASE READING AND LEUCOCYTE COUNT

Catalase	Leucocyte per c.c.	Catalase	Leucocyte per c.c.
9	5,400,000	6.0	1,900,000
5.9	1,400,000	2.4	240,000
5.6	4,100,000	2.4	166,000
5.6	2,000,000	2.4	1,200,000
5.2	2,700,000	2.3	350,000
5.1	300,000	2.1	800,000
4.9	2,200,000	2.1	2,200,000
4.8	3,500,000	2.0	250,000
4.7	4,700,000	2.0	330,000
4.6	7,600,000	2.0	130,000
4.5	5,100,000	1.8	1,400,000
4.5	4,500,000	1.7	600,000
4.4	4,800,000	1.7	2,000,000
4.4	4,100,000	1.6	990,000
4.2	3,700,000	1.5	1,400,000
3.8	4,400,000	1.4	1,000,000
3.6	20,000,000	1.3	1,700,000
3.5	3,800,000	1.0	5,100,000
3.5	3,900,000	1.0	400,000
3.4	80,000	0.8	1,000,000
3.3	1,100,000	0.7	600,000
3.3	4,300,000	0.7	1,000,000
3.1	1,800,000	0.7	400,000
3.1	1,700,000	0.6	200,000
3.0	2,200,000	0.4	300,000
2.8	1,500,000	0.3	500,000
2.6	200,000	0.1	1,400,000
2.5	1,700,000	0.0	300,000
2.5	110,000		

It is clear that a reading of above 3.0 c.c. indicates that in 80 per cent of the cases studied, the leucocytes exceed two million per c.c. of milk.

In view of the fact that sometimes the milk whose catalase content is being tested contains large numbers of bacteria, with their accompanying content of lactic acid, some tests were made to determine the effect of the pH reaction on the catalase activity. In each experiment, a given milk was subdivided into a number of samples, each of which was adjusted to a different pH by the addition of acid or alkali. These data are presented in Table II.

TABLE II

EFFECT OF PH ON CATALASE ACTIVITY

Methylene Blue Reduction	pH reading 5.7	5.8	6.0	6.2	6.3	6.4	6.5	6.6	6.8	6.9	7.0	7.2	7.3	7.4
5 hours	..	0.5	0.7	0.8	..	2.0	..	2.1	2.4	..	2.8	4.5	..	3.5
Immediately	..	9	9	9	..	9	..	9	9	..	9	9	..	9
2½ hrs. (2,200,000 Breed)	..	2.7	3.5	3.2	..	4.4	..	4.0	4.2	..	4.5	4.6	..	4.6
2½ hrs.—5½ hrs.	..	2.3	..	..	3.4	..	..	3.6	2.8	..	..	..	..	3.3
2 hrs. 45 mins. to 3 hrs. 20 mins.	..	1.7	2.8	..	2.5	..	..	..	2.6	..	..	2.4	..	..
Not red. 6½ hrs.	2.6	..	2.6	3.1	..	3.2	..	3.4	4.0	..	3.8	..	3.6	..
Not red. 4½ hrs.	1.5	..	1.0	1.4	..	1.7	..	2.1	..	2.4	..	2.5	..	..
Not red. 5¾ hrs.	..	0.6	0.7	0.9	..	..	0.8	..	0.9	..	1.0	..	..	1.0
Not red. 4¾ hrs.	..	..	0.6	..	..	..	0.9	..	0.9	..	0.8	..	..	0.9
Reduced 5 min. (over 5,000,000 bact. per cc.)	..	..	..	..	..	9	..	..	9	..	..	9	..	9

Bacteria per c.c.—Breed method approximate plate.

In actual dairy farm inspection control, it is rare that all the animals in the herd are infected, but it is quite common for one or more to be so affected. The milk of these sick cows is very frequently mixed with that of well ones, thus diluting the pathological milk. To ascertain the extent to which this dilution serves to limit the sensitiveness of the test, a number of samples of milk from mastitis cows were diluted with increasing quantities of normal raw milk and the catalase reading made on the mixed milk, as the following Table III shows:

TABLE III

EFFECT OF DILUTION ON CATALASE READING

Dilution		Catalase index of samples					
Infected milk	Normal milk	A	B	C	D	E	F
0	15	1.0	1.0	1.0	1.0	1.0	1.0
1	30	..	..	..	3.4	1.4	1.0
1	15	1.4	2.8	1.1	6.5	4.2	1.0
2	15	2.1	6.5	2.8	7.2	..	1.0
3	15	2.6	9	2.9	10	9	1.2
4	15	3.4	9	2.8	10	9	..
5	15	3.4	9	3.4	10	..	..
6	15	3.9	9	..	..	..	..
15	0	9	9	7.0	10	9	7.2

This data shows that the dilution of pathological milk with about five times the quantity of good milk is about the dilution limit of sensitiveness of the method.

The literature states that the heating of milk destroys its catalase activity. This was tested as illustrated in Table IV:

TABLE IV

EFFECT OF HEATING IN CATALASE READING

Raw Milk	4.0	1.8	1.7
Same milk heated at 138° F. for ½ hr.	0.4	0.1	0.1

If the above is correct, then the catalase readings on the average milk being delivered to the pasteurizing plants may show a catalase reading of several c.c., whereas the pasteurized milk from the same plants should show a very low catalase reading. Accordingly, determinations on the catalase reading were made of the incoming and outgoing milk of a large number of dairies in Baltimore, with the following results listed in Table V:

TABLE V

CATALASE READING ON PREPASTEURIZED AND PASTEURIZED MILK

Dairy	Prepasteurized	Pasteurized	Dairy	Prepasteurized	Pasteurized
No. 1	2.0	0	No. 11	1.8	1.5
	0.5	0		0.5	0
	1.8	0	No. 12	1.1	0
	2.0	0		1.6	0
	2.8	0		2.0	1.1
	4.5	0		0.4	0.4
No. 2	0.2	0	No. 13	2.0	0.3
	2.1	0		0.1	0
	1.2	0	No. 14	2.5	0
	2.0	0		2.2	0
	2.8	0		2.2	0.8
No. 3	2.0	0.4		1.6	0
No. 4	2.8	0	No. 15	2.4	0.4
	1.3	0.4		1.1	0
	0.5	0	No. 16	0.6	0.2
	2.4	0.4		0.7	0.2
	2.5	0		1.7	0.2
No. 5	1.4	0.8	No. 17	2.0	0
	1.6	0.0		2.0	0
No. 6	2.0	0	No. 18	0.4	0
	1.6	0	No. 19	2.0	0
	1.0	0		0.9	0
	1.1	0.1		2.7	0
	1.0	0.1	No. 20	1.5	0
No. 7	1.3	1.1		0.9	0
	3.1	0.9		2.1	0
	3.5	0.0	No. 21	3.0	0
	0.5	0		1.9	0
No. 8	0.8	0	No. 22	1.0	0.3
	2.7	0.2		0.6	0
No. 9	2.4	0.0	No. 23	3.0	0
	1.0	0		0.7	0.2
	1.1	0	No. 24	1.5	0
No. 10	1.0	0.2		1.4	0.1
	1.5	0.2	No. 25	0.2	0
	2.3	1.2		0.6	0
	2.1	0	No. 26	1.7	0
				1.0	0
			Average	1.6	0.15

Some of the above pasteurized milk came from pasteurizing plants which were small and irregularly conducted, several of whose permits were subsequently revoked and several of which went out of business under increasing regulatory pressure and several sold out voluntarily. Nevertheless, the data shows clearly what might be expected as a high average catalase reading for satisfactorily pasteurized milk.

In Table VI are listed catalase readings of several dairies which sold unpasteurized milk, such milk corresponding to the generally recognized Grade A raw milk:

TABLE VI

CATALASE READING OF UNPASTEURIZED MILK

Dairy No. 1	3.5	Dairy No. 4	0.5
	0.6		0.3
	0.9		0.8
	0.4		0.8
	1.2		1.4
Dairy No. 2	1.5		0.6
	2.1	Dairy No. 5	0.1
	1.3		0.6
	1.5		1.7
Dairy No. 3	2.0		2.0
	1.0	Dairy No. 6	2.1
	0.9	(Certified)	0.5
	2.0		1.0
			1.5
			1.0
			1.5

Our regular procedure is to sample the milk which is delivered to the pasteurizing plants (comprising over 99 per cent of the supply) and sample again after pasteurizing and from the wagons on the streets. We also sample the relatively small amount of raw milk from the wagons on the streets. We have used the catalase test regularly since November, 1926. We believe that like all other biological information of a regulatory character, the data is not quantitative enough to be depended upon by itself alone for regulatory action. However, we believe that it is dependable enough to serve as a very good lead to direct the attention of the inspection staff to certain conditions at the farms or plants which should be corrected. For example, a catalase test on raw milk of over 3.0 c.c. would indicate that there is a condition on the farm which requires the attention of the inspector and that probably the trouble is in the herd. Moreover, if the catalase reading is in excess of 1.0 c.c. in pasteurized milk, there is an indication that the pasteurizing plant is not performing satisfactorily in one way or another; *e. g.*, mixing raw milk with the pasteurized milk, inadequately pasteurizing the milk, ineffectively cooling the milk after pasteurization, and other such practices.

Indicative of the regulatory value of the test, we present the following examples of its usefulness:

Dairy No. 1. Dairy retailed raw milk. Catalase reading started rising to 4.0, 5.0, and up. On inspection at the farm, the majority of cows were found to be suffering from mastitis. The remainder of the milk was ordered to be pasteurized. The catalase on such bottled milk was found to be 0.5 or below for several months. Suddenly catalase jumped to 2.1 c.c. On being summoned for a hearing to explain conditions, the dealer admitted that he had omitted to pasteurize his milk.

Dairy No. 2. Pasteurizing dairy. Catalase readings running regularly below 0.5 suddenly jumped to 2.4 c.c. On inspection of the pasteurizing charts these were found to be faked. Irregular pasteurization practice was confirmed by inspection.

Dairy No. 3. An out-of-state creamery, shipping milk for pasteurization to a local plant. The prepasteurized bacteria counts were excessive. The management was warned that the milk must be improved. Offense repeated and was warned finally. Subsequent shipments arrived with very low bacteria counts. The previous readings had been above 2.0 c.c., but the last shipment had a reading below 0.5 c.c. Upon investigation, the permittee was found to have been surreptitiously pasteurizing his milk because he could not comply with the city's requirement for prepasteurized quality.

Dairy No. 4. Pasteurizing dairy with a normal catalase reading. A bottled sample jumped to 2.4 c.c. and the same sample showed a bacteria count of 2,400,000 bacteria, indicating faulty pasteurization procedure or faulty handling subsequent thereto.

Dairy No. 5. Pasteurizing dairy with normal catalase readings which suddenly jumped to 1.5 c.c. On investigation there was found some evidence that raw milk had been mixed with pasteurized milk (but this could not be proved).

It is not to be inferred from the above discussion that in all instances of high catalase index, we found evidence of a pathological condition in a herd or pasteurization irregularities. We have noted a number of instances where the catalase indices of the pasteurized milk of several of our better controlled plants have run unexpectedly high (0.7-1.5) in individual instances and we have found no explanation for such. On the other hand, the catalase indices of our best controlled pasteurizing plants, whose milk is uniformly low in bacteria counts, in no instance have exceeded 0.8. It is clear that the best quality of milk produced under intensive supervision and pasteurized with the greatest care gives an index not to exceed 0.8. All we claim is that the test serves admirably to direct attention of the inspection service to certain lines of investigation, and in this we have been signally successful.

Conclusions

From the above discussion, the following conclusions are warranted:

1. Under practical conditions of the milk supply for a

large city, the catalase test should not be above 3.0 c.c. for unpasteurized milk.

2. Milk which is pasteurized under the best care and which runs uniformly low in bacteria count never exceeds 1.0 c.c.
3. Catalase readings in excess of these are indicative that an intensive inspection of the premises or of the plant procedure is warranted.

References

1. Burnett: N. Cal. Pub. Physiol., Vol 5, p. 167.
2. Kostler: Jahresb. Bern. Molkereischule, 1910, 24; Through Milchwirtsch. Zentr., Vol. 41, pp. 44-6; C. A. Vol. 6, 1640, 1912.
3. Barthel: Milk and Dairy Products, 1910, p. 98.
4. Heineman: Milk, 1919, p. 234.
5. Race: The Examination of Milk, 1918, p. 98.
6. Orla-Jensen: Dairy Bacteriology, 1921, p. 159.
7. Northrup: J. Gen. Physiol., Vol. 7, p. 373.
8. Bazin: Bull. Soc. Pharm. Bordeaux, Vol. 60, p. 54, 1922.
9. Ohtsubo: Kitasato Arch. Exptl. Med., 1923, Vol. 6, p. 61.
10. Virtanen and Karström: Biochem. Z., 1925,, Vol. 161, 9-46.
11. Foussier: Le Lait, 1921, Vol. 1, p. 171.

"What cannot art and industry perform,
When science plans the progress of their toil!"

THE QUANTITATIVE LIMITATIONS OF THE REDUCTASE TEST

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Bureau of Chemistry and Food,
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Within the last few years there have appeared a number of papers on the use of the reductase test as a measure of the bacterial contamination of market milk. It is regrettable that a larger number of them do not contain more facts in contradistinction to a plethora of opinion. This ranges all the way from that of ardent advocates who claim that the reductase test strictly parallels the agar plate counts, to that of those (and there recently have been several more in the literature) who claim that the reductase test has absolutely no such value and is utterly undependable.

Passing over the earlier work done in Europe, historically reviewed by Simmons (1), we are well acquainted particularly with the work of Hastings and his collaborators (2), (3), and (4), in this country, together with the number of papers that have been presented to this Association at the 1924, 1925, and 1926 meetings.

Recently a valuable contribution to this subject has been made from the laboratory of the Vermont Agricultural Experiment Station by Ellenberger and co-workers (5), which states that "the methylene blue reduction test proved to be a more accurate measure of milk quality than the agar plate count."

In the past four years we have made determinations of the bacterial content of milk by means of the methylene blue reduction test and agar plate counts and Breed direct counts to the extent of several thousand samples of market milk extending over several years. When we attempted to plot the methylene blue reduction times against the bacteria counts, we failed to find any correlation which was strong enough to be used for regulatory purposes. However, we did find that when we applied the reductase test to the milk of all our shippers for the purpose of ascertaining those milks whose agar plate counts exceeded one and a half million and later those which exceeded one million (regulatory standards), we found that the methylene blue test was very helpful. As a result of compiling all of our data over a year in order to ascertain the degree of compliance of the two methods, we found that classification of the milk by the reductase test accorded better with that of the agar colony counts than when the correlation was made in only the warm months, as is evidenced by the following table:

	May-September		Whole Year	
	No. of samples	Percentage compliance	No. of samples	Percentage compliance
1925......	630	72%	....	....
1926......	1671	76%	2578	84% (agar plates)
1927......	675	75% (agar plate)	1349	82% (Breeds)
	320	64% (Breed)	....	....

The above table indicates, for example, that during the summer months of 1925, 72 per cent of our samples were shown by the reductase test in the period of two and one-half hours to be in excess of 1,000,000 organisms when the latter are determined by the agar plate count. During the summer period in 1926 there was 76 per cent of such compliance, but when all of the non-reductions of samples in the winter months were added in, the general average of compliance was raised to 84 per cent.

A recalculation of the data submitted in the article by Ellenberger and his co-workers (5) shows that compliance of the reductase test with the agar plate count method occurs in 87½ per cent of the cases when the comparison is restricted to those samples whose germ-life is in excess of 1,000,000 as determined by the agar plate count.

In other words, Ellenberger's data and our own agree in that we can expect the reductase method to classify approximately 85 per cent of those milks whose germ-life by the agar plate method is in excess of 1,000,000 per c.c. Control officers must recognize this degree of difference before taking any action of a regulatory character based on an assumption that both methods classify the same.

At first impression, it might be disappointing to consider that the two methods do not agree any closer than this, but we consider that this discrepancy is in favor of the dependability of the reductase method. Ellenberger shows clearly that when the reductase test is compared with the agar plate method as to the keeping quality of the milk, the reductase method "correlates much more closely than does the agar plate count." Furthermore, he finds that the reductase test shows one seventh of the variability between check or duplicate tests that is shown by the agar plate method.

In our laboratory we have run 368 reduction tests in duplicate (368 pairs) and measured the reduction time from a minimum of 35 minutes to a maximum of four hours. In all of these tests, the reduction times coincided exactly within the reading period of five-minute intervals, except in one case when the reduction times were one hour and thirty minutes and one hour and forty-five minutes, respectively. Moreover, 1,200 samples agreed exactly to the extent that they did not reduce within the period for which they were examined, namely, two hours in some instances and two and a half hours in others.

The above considerations indicate that the reductase test affords a better basis of dependability and duplicatability than has been shown in numerous recent publications (6) to be the case with agar plate counts, and that the discrepancy between the two should by no means be adjudged as detrimental to the reductase test but should be considered strictly on the basis of the facts, namely, that the reductase test agrees with 85 per cent of the agar plate counts. However, it must be remembered that the agar plate method itself is subject to the influence of factors which are so great that unless early methods are taken to improve it, it will be increasingly discounted as a quantitative measure of sanitation.

REFERENCES

1. Simmons: Jour. of Infec. Dis., 1919, Vol. 24, p. 322.
2. Hastings: Jour. of Dairy Sci., 1919, Vol. 2, No. 5, p. 293.
3. Hastings and Davenport: J. Dairy Sci., 1920, Vol. 3, p. 353-66.
4. Hastings, Davenport, and Wright: Jour. Dairy Sci., September, 1922, Vol. 5, p. 438.
5. Ellenberger, Bond, Robertson, and Moody: Bulletin 264, February, 1927, Vermont Agricultural Experiment Station.
6. Ward: Bacterial Plate Counts of Milk. A research publication from the Frederick C. Mathews Company, Detroit.

"Infinite is the help man can yield to man."

FURTHER STUDIES ON THE RELATION OF BIOCHEMICAL CONSTITUENTS OF MEDIA TO BACTERIA COUNTS

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At the 1926 meeting of this Association (Fifteenth Annual Report of the International Association of Dairy and Milk Inspectors, 1926, p. 208), Shrader reported that the composition of bacteriological culture media was an important factor in estimating the number of bacteria colonies in a given sample of milk by the official agar plate method. The literature stated and his experimental work indicated that the percentage of amino acids were determining nitrogenous factors in bacterial colony development.

Since then, some further work of a similar character has been prosecuted, using different peptones for the purpose not only of further study but also of including other factors, such as the use of the formol titration method versus the Van Slyke gasometric method for amino-acid determination, the further determination of the relation of the nitrogenous constituents to the agar plate counts, and the effect of total solids on the agar plate counts.

EXPERIMENTAL DATA

The media were made up according to the standard methods and were similar in every respect with the exception that different commercial peptones were used. In two cases, No. 7351 and No. 7352, no peptone at all was included. In sample No. 7351, extra agar was added. One sample of milk was used, but the counts were made in triplicate.

In Tables I and II are tabulations of the analyses and agar plate counts with the different media:

TABLE I

BACTERIOLOGICAL MEDIA DATA

Agar	Raw Milk	(Breed—1,100,000)	
Sample No. 7343	950,000 750,000 700,000	Average 800,000	A
Sample No. 7344	600,000 650,000 680,000	Average 650,000	B
Sample No. 7345	620,000 400,000 500,000	Average 510,000	E
Sample No. 7346	350,000 400,000 300,000	Average 350,000	F
Sample No. 7347	300,000 400,000 250,000	Average 310,000	H
Sample No. 7348	200,000 360,000 370,000	Average 310,000	H
Sample No. 7349	300,000 320,000 380,000	Average 340,000	G
Sample No. 7350	280,000 250,000 230,000	Average 260,000	I
Sample No. 7351	250,000 200,000 100,000	Average 190,000	K
Sample No. 7352	150,000 240,000 200,000	Average 200,000	J
Sample No. 7353	500,000 560,000 600,000	Average 560,000	D
Sample No. 7354	600,000 620,000 650,000	Average 630,000	C
Sample No. 7355	460,000 200,000 350,000	Average 340,000	G

TABLE II

Chemical Analytical Data

Sample No.	Actual Per Cent Amino Acid N		Per Cent Amino Acid N of Total N		Actual Per Cent Ammoniacal N	Per Cent Ammoniacal N of Total N	Per Cent Protein N of Total N	Total Solids	pH
	Formol	Van Slyke	Formol	Van Slyke					
7343	.03164	.0303	30.0	28.6	.00252	2.26	35.95	2.59	6.9
7344	.01174	.02207	12.8	24.1	.00275	3.0	50.33	2.64	7.1
7345	.01179	.00884	11.7	9.6	.00291	3.16	59.37	2.41	7.2
7346	.0104	.00859	11.92	10.0	.002707	3.15	66.65	2.48	7.1
7347	.01424	.0192	13.16	17.8	.00309	2.88	29.8	2.50	7.1
7348	.02133	.0191	20.88	18.2	.00737	7.22	43.9	2.74	6.9
7349	.0205	.0191	20.5	19.6	.00360	3.65	59.7	2.37	6.7
7350	.01496	.0191	15.35	19.55	.00144	1.47	35.7	2.35	7.1
7351	.00371	.0026	14.7	10.2	.00114	4.49	18.7	2.48	7.0
7352	.00522	.00249	15.1	7.36	.00191	5.6	45.5	1.86	6.7
7353	.01711	.0139	21.0	18.4	.00329	4.0	41.4	2.39	6.8
7354	.01705	.0181	15.5	16.5	.00254	2.3	55.2	2.63	7.0
7355	.01891	.0204	32.9	35.5	.00349	5.6	51.8	2.64	6.9

Using the data in Tables I and II, the bacteria counts were plotted against the percentage content of amino acids determined by both the formol and Van Slyke methods. One set is calculated as the percentage of the amino-acid nitrogen of the total nitrogen, and the other is calculated as the percentage of amino-acid nitrogen of the agar itself.

It is clear that there is a relation between the bacteria colony count and the amino-acid content when the latter is determined by either of the two analytical methods, or when their nitrogen is calculated as percentage of total nitrogen or as percentage of the culture medium itself. From the appreciable content of amino acid and ammoniacal nitrogen in samples No. 7351 and No. 7352 (which contained no peptone) and the relative regularity with which these points appear and their relation to other points, it follows that the composition of the *beef extract* must receive just as much consideration as that of the peptones. This is further brought out by reference to the curves, where the curve of Series II, starting out the same as that of Series I, when the ingredients of both sets of media were the same, falls off as the concentrations of all the ingredients except the peptone decline, but with the peptone constant.

The presence of ammonia has some effect on the colony counts, but it is relatively minor. Protein nitrogen is certainly indifferent in its effect.

Collaborative work between a number of the various educational, industrial, and control milk laboratories of Baltimore shows that samples of their culture media have differed greatly in composition, as indicated in Table III:

TABLE III

VARIATION OF COMPOSITION OF MEDIA FROM VARIOUS LABORATORIES

	Highest	Lowest	Average
Number of laboratories............7			
Percentage of Ammoniacal Nitrogen of Total Nitrogen................	10.0	0.48	2.95
Percentage Amino-Acid Nitrogen of Total Nitrogen................	31.0	8.2	19.3
Percentage Total Solids..............	4.29	1.87	2.45

The following experiments were planned to ascertain the extent to which the percentage of total solids affects the plate count when (a) the media are made to be of approximately double strength and then diluted down by regular steps with water, and (b) same as the above except that the peptone is kept constant by adding equal quantities to the various diluted fractions in order to keep the amount of peptone constant, but to widely vary the percentage of solids. We used three different peptones and four kinds of milk, namely, certified milk, unpasteurized milk, and two samples of pasteurized milk.

In Table IV is presented a tabulation of the agar plate bacteria colony counts of the several milks used. Series I contains the counts on media of regularly decreasing concentration of each constituent, while Series II contains a similarly decreasing percentage of solids except that the peptone is kept constant. Each count presented is the average of three.

TABLE IV

RELATION OF BACTERIA COUNTS TO PERCENTAGE OF SOLIDS IN CULTURE MEDIUM

	Series I				Series II			
	Certified	Prepast.	Past.	Past.	Certified	Prepast.	Past.	Past.
Peptone Number 1	3,000	450,000	7,400	19,000	1,700	54,000	3,000	55,000
	1,700	920,000	6,900	41,000	2,200	450,000	7,400	54,000
	2,400	880,000	11,000	66,000	1,600	110,000	2,900	45,000
	2,000	790,000	8,400	71,000	1,900	250,000	11,000	48,000
	1,600	1,200,000	12,000	92,000	2,600	790,000	10,000	47,000
	1,600	170,000	14,000	46,000	1,900	720,000	8,500	53,000
	1,300	450,000	7,500	45,000	900	340,000	.....	43,000
Peptone Number 2	1,400	770,000	2,200	49,000	1,400	560,000	5,300	119,000
	1,100	820,000	3,600	60,000	1,800	410,000	6,500	54,000
	1,500	750,000	4,700	49,000	1,400	340,000	4,000	49,000
	1,800	240,000	4,100	48,000	1,600	380,000	5,100	47,000
	1,600	540,000	7,300	40,000	1,400	400,000	4,300	33,000
	2,100	770,000	3,800	69,000	2,000	......	3,300	35,000
	1,600	600,000	6,300	58,000	500	150,000	.....	42,000
Peptone Number 3	....	....	.....	.....	1,600	210,000	8,800	51,000
	2,100	550,000	9,700	49,000	2,100	450,000	7,700	37,000
	2,400	700,000	7,800	72,000	1,400	440,000	6,800	28,000
	1,800	....	7,900	59,000	1,900	660,000	7,400	36,000
	1,400	550,000	13,000	59,000	2,200	440,000	9,600	36,000
	2,000	370,000	13,000	42,000	1,900	840,000	.....	33,000
	1,000	260,000	4,400	52,000	1,000	......	.....	.....

In Table V is presented a tabulation of the percentage of total solids of the respective agar media:

TABLE V

TOTAL SOLID CONTENT OF AGARS

	Series I				Series II			
	Certified	Prepasteurized	Pasteurized	Pasteurized	Certified	Prepasteurized	Pasteurized	Pasteurized
P_1A	...	3.74	3.71	3.61	3.45	4.21	3.89	3.72
P_1B	3.46	3.33	3.38	3.56	...	3.69	3.48	2.81
P_1C	2.84	2.96	2.85	2.76	3.00	2.84	3.06	2.775
P_1D	2.71	2.53	2.54	2.39	2.55	2.43	2.50	2.46
P_1E	1.98	1.99	1.92	1.88	2.05	2.00	2.22	2.04
P_1F	1.51	1.48	1.46	1.44	1.87	1.81	1.81	1.89
P_1G	1.19	1.07	0.947	0.92	1.03	1,005	1.04	1.018
P_2A	...	4.11	4.22	4.17	3.21	3.96	3.725	3.71
P_2B	...	3.78	3.85	3.807	3.48	3.49	3.46	3.35
P_2C	3.36	3.26	3.28	3.12	2.96	2.91	2.98	3.04
P_2D	2.67	2.81	2.78	2.68	2.47	2.52	2.49	2.36
P_2E	1.98	2.09	2.08	1.999	2.06	2.08	1.97	2.05
P_2F	1.51	1.74	1.61	....	1.53	1.52	1.49	1.49
P_2G	1.19	2.16	1.17	....	1.05	1.05	0.994	0.950
P_3A	...	...	....	....	4.33	3.86	3.97	3.92
P_3B	3.54	3.62	3.67	3.75	3.53	4.05	3.57	2.70
P_3C	3.10	3.19	3.10	3.04	3.13	3.11	3.13	3.08
P_3D	2.55	2.69	2.60	2.645	2.50	2.61	2.57	2.57
P_3E	2.06	1.99	1.904	2.07	1.93	2.02	2.02	2.008
P_3F	1.58	1.55	....	1.54	1.59	1.54	1.57	1.42
P_3G	0.710	0.777	....	0.735	1.28	0.89	0.928	0.859

In order to smooth out the irregularities caused by individual differences between successive samples, the bacteria counts of all four milks were averaged for a given dilution. In order to place all the samples on a comparable basis and eliminate the overbalanced effect of the high count samples, the counts of the prepasteurized milk were all divided by 100, and those of the second sample of pasteurized milk were divided by 10. This data is tabulated in Table VI on the effect of dilution on counts. The bacterial averages of each dilution were plotted against the dilution calculated of percentage of total solids.

TABLE VI

EFFECT OF DILUTION ON COUNTS

Sample	Series I Average Bacteria Count	Series I Average Per Cent Solids	Series II Average Bacteria Count	Series II Average Per Cent Solids
A	4,100	4.0	4,300	3.8
B	5,100	3.6	4,600	3.4
C	6,000	3.1	3,300	3.0
D	5,000	2.6	4,600	2.5
E	6,500	2.0	4,800	2.0
F	5,400	1.5	4,400	1.6
G	4,200	1.1	2,900	1.0

It is clear that Series I gives higher counts than Series II, and that generally speaking, the concentration of about 2.5 per cent total solids is the optimum one. Study of the individual curves of each medium with the respective peptone used showed that one peptone medium (No. 1) has a decidedly "cocked hat" shape, another (No. 3) is much flatter but with a well-defined, rounded maximum, while No. 2 is quite flat in Series I but sloping sharply downward in Series II. This shows how greatly the peptone affects the medium.

Reference to Table III shows that the range of percentage of total solids is from 1.87 to 4.29. Applying this to the averaged data, it is clear that bacteria counts may vary as much as about 2:1 merely on account of differences in concentration of ingredients in culture media as they are encountered in practice.

SUMMARY

Discussion. Further experimental data has been presented which shows that the amino-acid content of bacteria culture media greatly affects the colony counts, in the direction that the larger the amino-acid content, the higher the count. This relationship seems to obtain whether or not the amino acids are determined by the formol titration method or the Van Slyke gasometric method.

The peptones are not the only ingredients which contain

amino acids. The media which contained no peptones at all did contain beef extract, and the amino-acid and ammonia content were appreciable. Moreover, the results indicate that the influence of the amino acids is exercised independent of its source. However, the data on the influence of the beef extract is quite meager and must be repeated on a larger scale before the hypothesis of the dominating influence of amino acids in peptones can be extended to the beef extract.

Ammonia seems to exert a slight effect in some cases, but the data is more or less contradictory. The protein content seems to exercise no influence on the colony counts.

Detailed analyses of about thirty-five samples of culture media used by bacteriological laboratories in collaborative work in Baltimore showed that the media varied greatly in composition. This fact alone constitutes a large factor in the variability of colony counts. By reference to Table III, it is seen that the range of variation in percentage of amino-acid nitrogen of total nitrogen, in the media of collaborative laboratories, would introduce a factor of about 3.8. That is to say, a laboratory using a culture medium of the highest amino-acid content reported could expect a colony count about 3.8 times greater than one whose amino-acid content was the lowest.

Moreover, by reference again to Table III, it is seen that the range of variation in percentage of total solids would introduce a factor of about 1.9.

The maximum difference which is possible between counts on account of differences in content of amino acids and in percentage of total solids would therefore result in one count being 7.2 times higher than the other count.

Conclusions. The amino-acid content of a bacteria culture medium greatly affects the bacteria colony count in almost direct proportion.

The composition of bacteria culture media should be studied from the standpoint of the variability in composition of the beef extracts, as has been done with the peptones.

The percentage of total solids affects the colony count.

The composition of bacteria culture media as encountered in collaborative work in Baltimore varies over a wide range.

The maximum difference which may be expected between colony counts made on media whose range of variable composition is reported is about 700 per cent, when the only variable is such media composition.

"Science loses nothing once gained."

REPORT OF COMMITEE ON EDUCATIONAL ASPECTS OF DAIRY AND MILK INSPECTION

PROF. C. L. ROADHOUSE, *Chairman*

To understand the need for recommendations in the field of educational requirements for dairy and milk inspectors, it is necessary that we inform ourselves concerning the present situation. Accordingly, the number of inspectors, the provisions for civil service, and educational requirements for the several types of political subdivisions (cities, counties, States, etc.) are tabulated.

There are many instances where dairy and milk inspectors are employed without experience or technical knowledge of dairying. Where such men are employed, the committee believes that dairy inspection is largely of police control type, unsympathetic in its policies, and in too many instances inefficient in its accomplishments. Where a minimum educational requirement is established, it is believed that constant progress will be made in the improvement of the quality of milk and in establishing public confidence in inspection.

Dairy inspectors must meet dairy farmers of all degrees of educational training; the health officer and his assistants and other members of the medical profession; the courts and members of the legal profession; the representative citizens of the community who are interested in important community problems, of which an adequate, safe milk supply is one of the most important; the leaders in community enterprises; chambers of commerce; public welfare organizations, such as the Red Cross, women's clubs, and the Parent-Teacher Association; city and village officials; business men, and operators of dairy plants.

The dairy inspector should be able to meet the individual or the group. He should understand their point of view, and in his work get results without making enemies. This demands, in addition to technical training, both tact and a pleasing personality.

Educational Requirements Recommended

The Committee believes that if progress along the lines described is to continue, the man selected as dairy control official should be graduated from an agricultural college or from an accredited veterinary college. The subjects recommended for the curriculum should include dairy chemistry, bacteriology, physics, dairy sanitation, economics. The inspector should have some knowledge, either by experience or otherwise, of the principles of the manufacture of butter, cheese, ice cream, and other dairy products, the production and handling of market milk, and the operation of dairy machinery.

Dairy chemistry should include not only a thorough training in the testing of dairy products, but some fundamental knowledge at least of organic and bio-chemistry. Bacteriology should include general instruction in the principles of bacteriology and a specialized course in the bacteriology of dairy products and in pathogenic bacteriology.

Experience

In addition to a complete course of instruction as described, the candidate should have had at least two years of experience or contact with some branch of the dairy industry.

Age Limits

Although the age at which a man may do the most effective work in dairy inspection cannot be definitely stated, it is believed advisable to restrict the age of an applicant to the period of twenty-one to forty-five. Men older than the maximum given may be efficient as dairy control officials, but it is believed that their work in later years will be more satisfactory if they decide to follow this line of work earlier in life.

Residence

Some civil service commissions have required that candidates for civil service examination be residents of the city or territory in which the work is to be done. The Committee believes that this requirement should be waived in the case of the dairy inspector, since the work calls for special qualifications. Such a restriction often works detrimentally, in that some municipalities would be forced to select from an unproperly qualified list of applicants. It is recommended, therefore, that the residence requirement be waived in order that all well-qualified men may be given an opportunity to compete in the civil service examination and to qualify for the position.

Titles for Inspectors

The Committee is of the opinion that the title of "dairy and milk inspector" is open to criticism. It does not properly indicate the dignity or responsibility of this profession, nor is the title descriptive of the knowledge and training necessary for modern control work in order to stimulate the interest of the best trained and higher type of men.

With a view of a possible selection of a more appropriate title by the Association, the Committee recommends for consideration the following titles: "Dairy Supervisor," "Dairy Control Officer," "Chief Dairy Control Officer," "Chief of the Division of Milk Control," or "Chief of the Division of Milk and Dairy Sanitation." The titles of assistants should be the same except for substituting the term "Assistant."

Reservations

The Committee realizes that there are instances where men are available for dairy control work who have had unusual training and experience, and who are, therefore, well qualified to carry on effective dairy control work, although they have no degree from an agricultural or veterinary college. To cover such cases, a city or State civil service board may include under "education" a statement to the effect that equivalent training, including a knowledge of dairying, together with some college training, may be accepted in lieu of a college degree.

General Summary of Replies to Questionnaire Sent Out to States and Cities

1. Number of States replying 42
   Number of States not replying 7
   (Georgia, Louisiana, Mississippi, North Carolina, North Dakota, Oregon, Texas)
2. Uniform State-wide system of market milk inspection.
   a. Number reporting Yes 5
   b. Number reporting No 37
3. Correlating agencies.
   a. State agricultural or dairy departments reported by 27
   b. State department of health reported by 12
   c. Others (as State college, etc.) reported by 1
   d. Gave no answer 2
4. Civil service requirements (reported by States.)
   a. Number of States requiring civil service 9
   b. Number of States not requiring civil service 25
   c. Number of counties requiring civil service 1
   d. Number of counties not requiring civil service 22
5. Educational requirements (reported by States).
   a. Number of States which demand special educational qualifications 7
   b. Number of States which do not demand special educational qualifications 26

c. Number of counties which demand special educational qualifications 0

d. Number of counties which do not demand special educational qualifications 25

e. Number of cities which demand special educational qualifications 1

f. Number of cities which do not demand special educational qualifications 22

6. Report from city health departments.

Number of replies 51

a. Civil service required by 26

Civil service not required by 24

Gave no answer 1

b. Special educational requirements specified by 11

No special educational requirements specified by 38

Gave no answer 2

It should be recognized that it is always difficult to compile such a report and at the same time have it absolutely free of discrepancies, primarily because of the vagueness of the replies in some of the questionnaires. Some States reported a uniform State-wide system of market milk inspection, but the balance of the information submitted indicated so clearly that they did not have a uniform system that these cases were recorded as "No."

There is apparently a conflict in some of the answers to the questions regarding the educational and civil service requirements. In a few instances it was stated that prospective candidates had to pass civil service examination, but gave a negative answer in their replies to the questions regarding the educational requirements demanded. Civil service implies a certain amount of educational training. The Committee had in mind primarily a more special training, such as a college degree in agriculture or veterinary medicine, or, in occasional instances, a training based upon a few years of successful experience.

REPLIES TO QUESTIONNAIRE

Although information was not received from all States, yet a considerable number of replies to the Committee's questionnaire were received, and although obviously not complete, the following information was obtained.

With the exception of Minnesota, Nebraska, and Connecticut, no State has a uniform State-wide system of market milk inspection.

Alabama.

Correlating agency, State Board of Health. State inspectors, 5; county inspectors, 7; city inspectors, 12. No civil service requirements. State inspectors' salary, $200 monthly. County inspectors' salary, $100-200 monthly. No educational requirements.

Arizona.

Correlating agency, State Dairy Department. Two State inspectors, 15 city inspectors. No civil service requirements. Educational requirements for State inspectors: practical and technical knowledge of dairy products. No educational requirements for city inspectors.

Arkansas.

Correlating agency, State Department of Agriculture. Six city inspectors. No civil service requirements. No educational requirements.

California.

Correlating agency, State Department of Agriculture. Twenty-nine State inspectors, 23 county inspectors, 67 city inspectors. Civil service requirements for all. Salary: State inspectors, $150-333 per month; county, $150-350; city, $150-350 per month. Educational requirements for State inspectors, college degree plus two years' experience. No educational requirements for county or city inspectors. Among the California cities, Los Angeles has 14 inspectors; San Francisco, 12; Oakland, 5. In each of these three cities, the inspectors are under civil service. In these three cities, salaries range from $145 to $300 per month.

Colorado.

Correlating agency, State Dairy Commissioner. Four dairy inspectors employed by the State. Twelve city inspectors within the State. State inspectors are under civil service. Salary for State inspectors is $100 to $150 per month. Educational requirements for State inspectors: graduate of agricultural college. Among the Colorado cities, Colorado Springs and Pueblo have one inspector each. Denver has five inspectors. In Denver there are no civil service requirements. In Colorado Springs and Pueblo, inspectors are under civil service, and at Pueblo it is required that the inspector shall be a veterinarian.

Connecticut.

Correlating agency, State Department of Health. Number of State inspectors employed, 10. No civil service requirements. Salary of State inspectors, $150-200 per month. No educational requirements. New Haven has four inspectors under civil service. Bridgeport has one, not under civil service. No educational requirements in either city.

Delaware.

Correlating agency, State Board of Health. One State inspector, two city inspectors. There are no civil service requirements. Salaries: State inspector, $125 per month; city inspector, $122 per month. No educational or training requirements.

District of Columbia.

Correlating agency, District Health Department. District Government has 10 inspectors. No civil service requirements. Salaries range from $175 to $200 per month. Educational and training requirements: must be graduate veterinarian.

Florida.

No correlating agency. No State inspectors. The city of Jacksonville has three inspectors; Miami has three. No civil service requirements and no educational or training requirements for either city.

Idaho.

Correlating agency, State Department of Public Welfare. Two State inspectors, eight city inspectors. No civil service requirements. Salary of State inspector, $200 per month; city inspector, $125-175 per month. No educational requirements.

Illinois.

Correlating agency, State Department of Agriculture. Forty-four State inspectors. Civil service requirements. Salary of State inspectors, $150-250 per month. Peoria has one inspector, not under civil service. Salary, $150 per month. No educational or training requirements. Chicago has 62 inspectors, under civil service. Salaries, $125-417 per month. No educational or training requirements.

Indiana.

Correlating agency, State Board of Health. No State inspectors. Eight city inspectors. No civil service requirements. Salary of city inspectors, $100-200 monthly. No educational or training requirements. South Bend has one inspector, not under civil service. Salary, $200 monthly. No educational or training requirements. Terre Haute has one inspector, not under civil service. Educational and training requirements: must be graduate veterinarian. Indianapolis has six inspectors, not under civil service. No educational or training requirements.

Iowa.

Correlating agency, State Department of Agriculture. Thirty State inspectors. Salaries, $150-192 monthly.

Kansas.

Correlating agency, State Board of Agriculture. Four State inspectors, not under civil service requirements. Salary, $150-175 per month. Topeka has two inspectors, not under civil service. Educational and training requirements: must be veterinarian.

Kentucky.

Correlating agency, State Board of Health. Two State inspectors, three county inspectors, five city inspectors, none under civil service requirements. Salary of State inspectors, $125-200 per month; city inspectors, $100-200 per month.

Maine.

Correlating agency, State Department of Agriculture. Two State inspectors. No county inspectors. Twenty-five city inspectors. None under civil service requirements. No educational or training requirements.

Maryland.

Correlating agency, State Department of Health. Two State inspectors, 24 city inspectors. State inspectors under civil service requirements. Salary: State inspectors, $134-150 per month; city inspectors, $125-200 per month. No educational or training requirements. Baltimore has 24 inspectors, under civil service, with salaries ranging from $125 to $208 per month. No educational or training requirements.

Massachusetts.

Correlating agency, State Department of Public Health. Civil service requirements in cities. Boston has 12 inspectors, under civil service requirements, with salaries ranging from $142 to $292 per month. No educational or training requirements. Cambridge has two inspectors, under civil service, with salaries ranging from $167 to $292 per month. No educational requirements.

Michigan.

Correlating agency, State Department of Agriculture. State inspectors, 11; county inspectors, 2; city inspectors, 100. No civil service requirements. Salary of State inspectors, $125-184 per month; county inspectors, $150 per month; city inspectors, $100-250 per month. Detroit has 16 inspectors, not under civil service. No educational or training requirements.

Minnesota.

Correlating agency, Department of Dairy and Food. Sixteen State inspectors, under civil service requirements. Salaries, $125-175 per month. No educational or training requirements. Duluth has four inspectors, under civil service. Salaries range from $145-225 per month. No educational or training requirements. Minneapolis has three inspectors, under civil service. Salaries, $135-200 per month. No educational requirements.

Missouri.

Correlating agency, State Board of Agriculture. One State inspector, 30 city inspectors. No civil service requirements. Salary of State inspectors, $125-200 per month. No educational or training requirements. St. Joseph has two inspectors, not under civil service; salary, $150 monthly. No educational or training requirements. St. Louis has nine inspectors, under civil service. No educational or training requirements. Kansas City has six inspectors, not under civil service, at $150-200 per month salary. No educational or training requirements.

Montana.

Correlating agency, State Department of Agriculture. Three State inspectors. No civil service requirements. Salary, $175 monthly. No educational or training requirements.

Nebraska.

Correlating agency, State Department of Agriculture. Fourteen State inspectors. No civil service requirement. No educational or training requirement. Omaha has three inspectors, not under civil service; no educational or training requirement.

Nevada.

Correlating agency, University of Nevada. Six State inspectors, not under civil service requirements. Salary, $125-275 per month. No educational or training requirement.

New Hampshire.

Correlating agency, State Board of Health. Two State inspectors, six city inspectors, not under civil service requirements. Salary of State inspectors, $155 monthly. No educational or training requirement.

New Jersey.

Correlating agency, State Department of Health. Eight State inspectors, 16 city inspectors. State inspectors, civil service requirement. City inspectors, no civil service requirement. Salary: State inspectors, $115-250 per month; city inspectors, $175-200 per month. Educational and training requirements for both State and city inspectors, high school.

New Mexico.

Correlating agency, State Department of Health. One county inspector. No civil service requirements. Salary, $125 per month. No educational or training requirements.

New York.

Correlating agency, State Department of Agriculture. Thirty-eight State inspectors, under civil service requirements. Salary, $125-225 per month. No educational or training requirements. Rochester has 11 inspectors, not under civil service. Salary, $150-200 per month. No educational or training requirements. Albany has three inspectors, under civil service. Salary, $100-184 per month. No educational requirements. Buffalo has eight inspectors. Civil Service requirements. Salary, $137-188 per month. New York City has 63 inspectors. Civil service requirements. Salary, $130-230 per month. Educational and training requirements, college graduate; experience.

Ohio.

Correlating agency, State Department of Agriculture. Two State inspectors, 10 county inspectors, 75 city inspectors. Civil service requirements for State inspectors. Salary of State inspectors, $125 per month. Educational and training requirements, one year experience. Cleveland has 22 inspectors under civil service. Salaries, $135-230 per month. Educational and training requirement, high school education. Cincinnati has five inspectors, under civil service. Salary, $150 per month. Educational and training requirement, graduate agricultural college. Columbus has five inspectors, under civil service. Salary, $150-185 per month. Educational and training requirements, high school; two years' experience.

Oklahoma.

Correlating agency, State Board of Agriculture. Fifty city inspectors. Educational and training requirements, graduate agricultural college or equivalent.

Pennsylvania.

Correlating agencies, State Department of Health and State Department of Agriculture. Five State inspectors, 62 city inspectors. Civil service requirements, none. Salary State inspectors, $167-375 monthly. Salary city inspectors, $167-375 monthly. Educational and training requirements, none. Philadelphia has 17 inspectors, under civil service. Salary, $120 per month. No educational or training requirements.

Rhode Island.

Correlating agency, State Board of Agriculture. No civil service requirements. No educational or training requirements.

South Carolina.

Correlating agency, State Department of Agriculture. No civil service requirements. No educational or training requirements. Charleston has four inspectors, not under civil service. No educational or training requirements.

South Dakota

Correlating agency, State Department of Agriculture. Eight State inspectors. Civil service requirements, none. Salary, $125-150 per month. Educational or training requirements, none.

Tennessee.

Correlating agency, State Department of Agriculture. One county inspector, 12 city inspectors. Memphis has three inspectors, under civil service. Salaries, $125-135 per month. No educational or training requirements.

Texas.

Dallas has five inspectors, not under civil service. No educational or training requirements. Fort Worth has two inspectors, under civil service. Salaries, $150-167 per month. Educational and training requirements, high school. Houston has five inspectors, not under civil service. Salary, $135-185 per month. No educational or training requirements.

Utah.

Correlating agency, State Board of Agriculture. Three State inspectors, eight city inspectors. No civil service requirements. Salary of State inspectors, $135-250 per month. Educational and training requirements, none. Salt Lake City has three inspectors, not under civil service. Salary, $135-250 per month. No educational or training requirements.

Vermont.

Correlating agency, State Department of Agriculture. Three State inspectors, two city inspectors. No civil service requirements. Salary of State inspectors, $133 per month. Salary of city inspectors, $50-125 per month, part time. No educational or training requirements.

Virginia.

Correlating agency, State Department of Agriculture. Five State inspectors. No civil service requirements. Salary, $150-250 per month. No educational or training requirement. Richmond has three inspectors, not under civil service. No educational or training requirement.

Washington.

Correlating agency, State Department of Agriculture. Ten State inspectors, one county inspector, 14 city inspectors. State and county inspectors under civil service requirement. Two cities have civil service requirement. Salary of State inspectors, $200-250 per month. Salary of city inspectors, $200-250 per month. No educational or training requirements. Tacoma has one inspector, under civil service. No educational or training requirements. Seattle has four inspectors, under civil service. Salary, $150-250 per month. Educational and training requirements, graduate of dairy school.

West Virginia.

Correlating agency, State Department of Agriculture. Charleston has two inspectors, not under civil service. Salaries, $150-250 per month. No educational or training requirement.

Wisconsin.

Correlating agency, State Dairy and Food Department. Twelve State inspectors. Civil service requirements. Salary $150-195 per month. Education and training requirements, five years' practical experience; high school. Milwaukee has seven inspectors, under civil service. Salary, $150-250 per month. Educational and training requirement: Agricultural short course, three years' experience. Madison has one inspector, not under civil service. Salary, $275 per month. Educational and training requirements, B. S. degree.

Wyoming.

State Department of Agriculture. Three State inspectors, three city inspectors. No civil service requirements. Salary, State inspectors, $175-200 per month; city inspectors, $150-200 per month. No educational or training requirements.

"He clarified his notions by filtering them through other minds."

BACT. ABORTUS INFECTION IN MAN AND ITS RELATION TO MILK CONSUMPTION

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I. INTRODUCTION

During the last few years there has been an accumulation of data showing the infectivity of *Bact. abortus* for man. This disease is indistinguishable from the clinical standpoint from the undulant or Malta fever which is so prevalent in Mediterranean countries. There the disease has been traced to the consumption of infected milk or cheese from goats harboring the organism. In this country it has been assumed that the milk of infected cows plays a large rôle in the causation of remittent fever.

The investigations of Evans (1918) have shown the very close relationship both serologically and morphologically of all types of *Bact. abortus* to *Bact. melitensis*. The ordinary cultural tests and cross-agglutination studies failed to differentiate between these types, and it is possible to separate them only by means of the agglutinin absorption method. Using this technique, she has in a later work (1925) been able to separate the organisms, regardless of their source, into eight varieties, and it would seem from her observations that man is susceptible to practically all of them.

II. HISTORICAL

Schroeder and Cotton (1911) were the first to demonstrate the presence of *Bact. abortus* in market milk by guinea pig injection. Zwick and Krage (1913) by cultural methods showed that *Bact. abortus* was present in the milk of aborting cows, even as long as thirteen months after the premature expulsion of the fetus. Cotton (1913) made an extensive investigation on the persistence of *Bact. abortus* in infected animals. The supra-mammary glands contained the bacteria, and the udder was the latent focus of infection. These results have been amply corroborated by other workers in this field.

The general consensus of opinion before 1920 was that the bovine type of *Bact. abortus* is not pathogenic for human beings. Mohler and Traum (1911), by the examination of human sera with the complement fixation and agglutination tests, could obtain no positive results when they used *Bact. abortus* as an antigen. Nicoll and Pratt (1915) obtained positive agglutination reactions in the blood sera of some children, but could draw no definite conclusions from these results. Cooledge (1916) fed raw milk from infected cows to human subjects and came to the following conclusions: First, that there was no proof that *Bact. abortus* (bovine) is pathogenic for human beings; second, that the appearance of *Bact. abortus* antibodies in the blood serum of adults fed on infected milk might possibly indicate a passive immunity due to the absorption in the intestine of the preformed antibodies present in the infected milk. Since 1920, there has been a large number of cases reported in the United States of *Bact. abortus* infection in man. These have been summarized by Evans (1927). All of the persons affected had either partaken of the raw milk from infected herds or had been in close contact with swine. In all of the subjects reported by her, the organism was isolated from the blood and was classified by the agglutinin absorption method.

III. Differences Between Bact. Abortus Strains from Swine and Bovine Sources

It has been shown by workers in this field that swine strains are always more pathogenic for experimental animals than those obtained from bovine sources. Good and Smith (1916) also noted a difference in gas requirements between these two varieties. *Bact. abortus* (bovine) in almost all cases requires the addition of carbon dioxide for its initial growth, but *Bact. abortus* from swine will grow under ordinary aerobic conditions. The number of transfers necessary to acclimate bovine strains to aerobic conditions varies with the strains themselves.

The present authors, believing that these various gas requirements indicate a fundamental metabolic difference, have made a rather extensive study of the metabolism of the different types and varieties in this group. Strains of *Bact. melitensis* from human and caprine sources and *Bact. abortus* from human, bovine, and porcine sources were included in these studies. The *Bact. abortus* cultures classified as human were isolated from the blood of infected persons and had been previously classified by Miss Evans as the *Bact. abortus* variety. The work up to date indicates that upon the basis of metabolic activities alone it is possible to divide these organisms into two main groups: the first of these includes *Bact. melitensis* and *Bact. abortus* from swine and human sources, and the second, only the strains of bovine origin. It was found that there was a marked difference in the nitrogen metabolism of different members of this general group in the presence of glucose. Contrary to general opinion, *Bact. melitensis* and *Bact. abortus* of human and porcine origin utilized from four to 20 per cent of this carbohydrate.

It was also proved that the growth of bovine strains was always stimulated by the addition of 10 per cent carbon dioxide gas, even though these strains had been growing under aerobic conditions in the laboratory for years. The addition of this amount of gas had no beneficial effect upon the growth of the organisms of porcine and human *Bact.*

abortus and *Bact. melitensis,* and generally caused partial inhibition.

From the data given above it would seem as if it were possible to definitely separate *Bact. abortus* of bovine origin from those isolated from swine. There was an extensive number of strains employed in our studies, and in no case were we unable to classify them by the utilization of glucose. The fact that all strains which we were able to obtain from human sources fell in the swine group is significant.

IV. Discussion

This work must be considered as merely a preliminary report, but the results point very strongly to swine as the causative factor in the spread of *Bact. abortus* infection in man. The history and distribution of the various human cases in the United States also lends some support to this theory.

McAlpine and Mickle (1927) tested over 10,000 human sera by the agglutination method in the State of Connecticut, and found only about 0.6 per cent to react when *Bact. abortus* was used as the antigen. Preliminary testing of the dairy herds in this State have shown approximately 90 per cent to harbor *Bact. abortus*. Roughly, only 60 per cent of the milk is pasteurized. Therefore, we would expect a much higher incidence of infection if the bovine type of the organism is pathogenic for human beings. The number of swine grown in Connecticut is small when compared with western States or even with New York. In such States as Michigan and New York, where extensive studies have been made upon this disease, the incidence of cases has appeared much higher than in Connecticut.

There is a possibility that cows when closely associated with swine can contract the porcine form of infection. Carpenter (1927) injected a small number of pregnant heifers with strains isolated from human sources. In all cases his reactions were much more severe than those which we have had the opportunity to observe in this State, where the bovine variety of the organism was used. The infected persons had partaken of milk from herds in which a very violent type of the disease had been rampant. It is very probable that in some sections of the country the porcine type has been spread to adjacent dairy herds, which in turn infect man through the milk.

Therefore, in the present state of our knowledge it would be advisable, until further data are forthcoming, to rigidly separate swine from dairy cattle. The pasteurization of milk from herds in which a violent form of the abortion disease is present would be an additional safeguard to the public. We do not mean to say that the compulsory pasteurization of all milk from abortion-infected herds is warranted.

V. Summary

1. Through metabolic studies it has been proved that the porcine type of *Bact. abortus* is different from the true bovine variety of *Bact. abortus*.

2. *Bact. abortus* which has been isolated from man has in all cases studied by this laboratory fallen into the porcine group.

3. The incidence of *Bact. abortus* infection in man appears to be higher in States where the swine industry is large, and presumptive evidence points to the porcine type as the causative organism.

4. It is possible that cows may become infected with the porcine variety should they come in close contact with swine.

Bibliography

Carpenter, C. M., 1927.......**Results of injecting pregnant heifers with *Brucella abortus* isolated from man.**
J.A.V.M.A., *70*, N.S. 23, No. 4, 459–468.

Cooledge, L. H., 1916........**A study of the presence of *Bact. abortus* (Bang) in milk.**
Tech. Bul. No. 33, Mich. Agri. College, East Lansing.

Cotton, W. E., 1913..........The persistence of the bacillus of infectious abortion in the tissues of animals.
Am. Vet. Rev., *44*, 307–318.

Evans, Alice C., 1918........Further studies on *Bact. abortus* and related bacteria. II. A comparison of *Bact. abortus* with *Bact. bronchisepticus* and with the organism which causes Malta fever.
J. Infect. Dis., *22*, 580–593.

Evans, Alice C., 1925........Studies on *Brucella (Alkaligenes) Melitensis.*
Hyg. Lab. Bul., No. 143.

Evans, Alice C., 1927........Human infections with organism of contagious abortion of cattle and hogs.
J. A. M. A., *88*, 630–632.

Good, E. S., and Smith, W. V., 1916 ....*Bacillus abortus* (Bang) as an etiological factor in infectious abortion in swine.
J. Bact., *1*, 415–422.

Larsen, W. P., and Sedgwick, J. P., 1913..........The complement fixation reaction of the blood of children and infants using *Bact. abortus* as antigen.
7th Annual Report of the American Association of Medical Milk Commissions.

McAlpine, J. G., and Mickle, Friend Lee, 1927.........*Bact. abortus* infection in man. The results of the agglutination test applied to more than 10,000 human sera.
Am. Publ. Health Assoc. meeting, Cincinnati, October, 1927.

Mohler, J. A., and Traum, J., 1911..................Infectious abortion of cattle.
28th Annual Report, B. A. I.

Nicoll, M., and Pratt, J. B., 1915 ....Does the *Bacillus abortus* (Bang) infect man?
Am. Jour. of Dis. of Children, *10*, No. 2, 203–205.

Schroeder, E. C., and Cotton, W. E., 1911...........The bacillus of contagious abortion found in milk.
Annual Report, B. A. I., 1911, 139.

Zwick and Krage, 1913......Ueber des Ausscheidung von Abortusbazellen mit der Milch infezierter Tier.
Berlin Tier. Woch., 1913, *29*, 41.

"Good counsel has no price."

THE PRACTICAL SANITARY AND ECONOMIC ADVANTAGES OF CONCENTRATED MILK

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Opinions as to the first essential of a milk supply will differ among interested persons in various walks of life. The general physician and the dietitian look upon the nutritive properties of milk as of primary importance, but the pediatrician considers a certain well-balanced chemical composition to be the most necessary element. The dairyman thinks largely in terms of abundance and demand, the grocer and restaurant keeper are concerned with profits, while the consumer desires richness and taste at minimum expense. All of these attributes of a milk supply are indeed important, as dairy and milk officials realize, but the true first essential is that which concerns the sanitarian. It is safety.

Security from the possibility of disease is the most significant factor in milk production and milk promotion, an obvious proposition which needs no argument to sustain. The purity and safety of milk is, moreover, an economic as well as a public health problem of fundamental importance. A milk supply may have a most excellent record for fat and vitamin content, and it may even be generally low in bacteria, but if among the organisms present are a few typhoid bacilli, all of the other advantages are at once rendered worthless.

Due to the valiant efforts of health and dairy officials, modern milk supplies are somewhat of an improvement over those of several years ago. Except in a few of the larger cities, such as New York, Chicago, Boston, and Washington, where the milk of certain dealers may be consumed by almost any one with impunity, a vast amount of sanitary work still remains to be accomplished. There are yet some parts of the country where it is wiser to get your milk from a small sealed tin receptacle and dilute it with boiled water, than it is to take a chance with the whole milk which is offered.

Confirmation of the danger of improperly supervised milk supplies is contained in the reports of the "clean and safe milk" campaign conducted for several years by the American Child Health Association. This organization found that 77 per cent of the milk investigated in twelve States must be classed as dirty and that 58 per cent showed a bacterial count of over 100,000 per cubic centimeter. Since 1909 more than 600 outbreaks of disease in the United States have been traced to contaminated milk, and the data is undoubtedly incomplete. During 1924 there were at least 43 such outbreaks and in 1925 there were 45. In such a state as Massachusetts, always noted as a leader in public health activities, there occurred nine milk-borne epidemics between 1924 and 1926. In not one of these various outbreaks was a canned milk the source of the disease.

The use of the concentrated forms of milk for safety's sake on many occasions is, in fact, something worth the consideration of all sanitarians. Milk is milk whether it comes in forty-quart cans or sixteen-ounce ones. The product in each of these containers has practically the same chemical constituents and nutritional qualities, but there may be a tremendous difference in bacteriological features. No outbreak of disease has ever been reported as caused by the concentrated milks, which include condensed, evaporated, and dried. No pathogenic bacteria can survive the heating process by which the water in these forms of milk is removed or reduced.

Safety is an invariable characteristic of concentrated milk.

Cleanliness is another, because it is a commercial as well as a humanitarian necessity. The human factor, which is so significant in the production of safe whole milk, is much less of a problem in the manufacture of concentrated milk. Temperatures far above those necessary to kill the most resistant of dangerous bacteria must be employed in the manufacturing processes. These concentrated milks are doubly pasteurized, and properly pasteurized milk is, of course, the only actually safe milk. If it is clean as well as safe, it is the only whole milk which is not potentially dangerous.

Concentrated milk has been made continuously since 1856, when Gail Borden took out the first patent for a successful scheme for condensing milk. The basic system is still in use, though with some modifications, and the complete or nearly complete drying of milk has also been developed in recent years. A brief description of the methods used in the manufacture of these concentrated forms of milk will indicate clearly why they are unquestionably safe.

Sweetened condensed milk is usually made in the following manner: Whole milk from supervised dairies is first standardized so that it will conform to Federal specifications as to its content of fat and solids and is then heated for five minutes at a temperature of 206° F. This process is alone sufficient to destroy pathogenic bacteria, whether spore formers or not. After a proper quantity of sucrose has been added, the milk so modified is again heated, this time at a temperature of about 140° F., until two and a half parts of the whole milk have been reduced by the removal of water to one part of condensed milk. This second heating, requiring an hour or more, is conducted in a vacuum, so that there is very little loss of the antiscorbutic vitamin, which is affected by heat and oxidation together. Finally the milk is cooled and placed in clean containers, which are then sealed. Sweetened condensed milk is not absolutely sterile, but the few bacteria and molds which it may contain are harmless and their further growth is inhibited by the added sugar.

Evaporated or unsweetened condensed milk is manufactured by a similar process. Standardized whole milk is forewarmed for ten minutes at 203° F., then condensed in vacuum. Before cooling the milk is homogenized, and after it has been cooled and placed in clean tin containers, it is sterilized in the cans at a temperature of 240° F. for 30 minutes. As a consequence, evaporated milk is absolutely sterile. It has lost none of its vitamins, except vitamin C, the antiscorbutic factor, but this is replaced by the fruit juices which are abundant in the modern diet.

Milk may be dried by means of several processes. The two principal methods are the so-called "roller" and "spray" systems, respectively. In the former, precondensed milk is introduced upon a revolving steel drum heated by steam to a very high temperature, so that the milk loses its moisture immediately and as a powder is automatically scraped from the drum and placed in clean tin receptacles. In the spray process, precondensed and pasteurized milk is sent under high pressure through a fine spray nozzle into a steel chamber of hot air, where it pulverizes and is then put in tin containers.

These heating processes have no detrimental effect on the milk. Not only is the milk made safe, but it is also rendered more digestible, as the large curds of the raw milk are broken up into finely divided particles. Concentrated milks are uniform in composition and they are stable, so that they can be stored for considerable periods of time. By the addition of water they become the equivalent of whole milk and may be utilized for all of the same purposes for which whole milk is employed. The promotion of concentrated milk is in no way detrimental to the interests of the dairy industry, because the more milk used, the better for the farmer.

Dried, evaporated, and condensed milks are and should be susceptible to the same kind of health regulations as whole milk. The concentrated forms are extensively shipped in interstate commerce, so that they must conform to standards of quality promulgated by the Federal Government. The same care must be exercised in their supervision, even though, as already set forth, the opportunities for contamination are much less in the case of milk heated to such a high degree than in that of ordinary liquid milk.

The stability of the concentrated milks in their sealed containers is an economic factor of importance, besides having its sanitary aspect. Production of milk varies throughout the year, reaching its peak in June or thereabouts. The demand also fluctuates, corresponding roughly to production, but influenced in a marked degree by climatic and other factors. Sometimes there is a surplus, sometimes an inadequate amount of whole milk. When the surplus is used for the manufacture of concentrated milk instead of being entirely or partially wasted, this surplus is made available in times of low production.

Only about four per cent of the 115 billion pounds (13.4 billion gallons) of milk produced annually in this country now goes into the manufacture of the concentrated milks. The quantity is growing, however, the output of evaporated alone having increased from 400,000 cans in 1913 to 1,400,000 cans in 1923. Slightly less than half of the total milk produced by the approximately 26 million cows in this country goes into household consumption, while the remainder is used by the dairy industry, chiefly in butter making. Most of the skim milk now left over after the manufacture of butter is virtually wasted. To be sure, much of it is fed to animals, later eaten by man, but this is only converting a fairly valuable food product into a rather poor one.

Only two per cent of this skim milk was dried in 1925, according to figures of the United States Department of

Agriculture. Although nearly 23 billion pounds of skim milk were available, only about 800 million were used to manufacture 73 million pounds of dry skim milk. This concentrated product, while lower in fat than dry whole milk, has many valuable industrial uses. It is extensively employed in the manufacture of bread, ice cream, and candy. There is, furthermore, no sanitary or nutritional reason why dry skim milk should not be properly blended with butter-fat and pure water to make a reconstructed milk, which, labelled as such, could be placed on the market at those times when production was inadequate to meet demand. Although this type of reconstituted milk was tried out successfully in certain localities during the World War, it is seldom, if ever, encountered today, probably because of an ill-founded prejudice against it.

A large proportion of the milk in this country is now transported by railroads and trucks. Inasmuch as all whole milk contains about 88 per cent water, an enormous quantity of unnecessary weight is being carried. Water has some value in nutrition, but it is the 12 per cent of milk solids in milk which contain the essential fats, proteins, carbohydrates, minerals, and vitamins, and the water is only so much excess baggage. Obviously, it is of greater economic value to ship milk with less than two per cent moisture than that with forty-four times as much. The cost of condensation is only a small fraction of this economic loss in transportation. Sweetened condensed milk contains only about 27 per cent water, while evaporated has about 74 per cent. A sixteen-ounce can of either type of condensed milk is equivalent to approximately one quart of whole milk, which weighs in the neighborhood of two pounds, or actually a little over.

Not only is there conservation of transportation bulk, but, as was pointed out by Dr. H. W. Redfield in a paper on remade milk delivered in 1919 before the International

Association of Dairy and Milk Inspectors, there is a saving with regard to labor and refrigeration when milk powder and butter are shipped instead of liquid milk. The concentrated products are likewise not susceptible to the undesirable and possibly deleterious changes which may occur during the holding and shipping of fluid milk. Thus, waste is not only prevented but our food supply is conserved.

Physicians, sanitarians, and nutritional experts are agreed that every child should get at least a quart of milk a day in some form, and that this amount would likewise be beneficial to adults. Milk is the one nearly perfect food, because it contains practically every one of the elements which are included in a balanced diet and which are necessary to produce optimum health and the greatest vital resistance. At present, the amount of milk consumed in the United States is about 55 gallons a year per person, or only a trifle over half a quart per capita per day.

The consumption of milk in this country must be nearly doubled, if the maximum results in national vitality are to be achieved. The promotion of the greater use of pure milk by all the people is a public health duty of primary importance and should be pushed with all possible energy. If there is to be this highly desirable increase in the demand for milk, more reliance must in the future be placed on the concentrated forms of milk. The late Dr. Herman M. Biggs, of New York, has been reported as prophesying some years ago that eventually nothing but concentrated milk would be sold for human use. Dr. Biggs's forecast has not yet come true, and it may never be entirely realized. It does seem likely, however, that as the public comes to understand the value which lies in the safety, uniformity, stability, digestibility, nutritional quality, convenience, and inexpensiveness of the concentrated milks, people will demand these products to a greater and greater extent. In the propaganda in favor of milk, the condensed, evaporated, and dried products should not and must not be omitted from consideration.

"Perfection may never be reached, but it is worth reaching for."

MILK PASTEURIZATION IN ILLINOIS

Paul F. Krueger, *Milk Sanitarian,* State Department of Health, Springfield, Illinois.

The control of milk supplies in Illinois is carried on largely by State agencies and to some extent by city departments of health. Milk sold in the State as raw milk is controlled by the Division of Foods and Dairies of the Department of Agriculture. The supervision consists chiefly of a system of sample collection and analysis, together with an occasional sanitary inspection. The department has adopted standards for the composition of milk and dairy products, and food stuffs that do not meet these standards are declared to be illegal.

Prior to 1925, the activities of the State Department of Public Health in milk control work consisted chiefly in assisting local health departments to improve milk supplies in their communities. In June, 1925, the Illinois General Assembly passed the milk pasteurization plant law, which may be summarized briefly as follows:

1. Pasteurization is defined as the process of heating milk or milk products to a temperature of at least 142 degrees F. and holding at such temperature for not less than 30 minutes.

2. Operators of pasteurization plants shall apply to the State Department of Public Health for a Certificate of Approval.

3. The State Department of Public Health shall prepare minimum requirements for the construction, equipment, operation, and maintenance of pasteurization plants.

4. A certificate of approval shall be granted to each plant when the minimum requirements of the law have been met.

5. A penalty is provided for violations.

6. Certain provisions for the sanitary quality of the raw milk which is to be pasteurized are made.

7. Pasteurization plants located in and supplying milk exclusively to cities having populations over 500,000 are exempted. This actually exempts only Chicago, because it was considered that the city health department would undertake equivalent sanitary control under existing or new ordinances.

8. A mobile milk testing laboratory is to be purchased and equipped to help carry out the provisions of the law.

The more important minimum requirements prepared and adopted by the State Department of Public Health in accordance with the law, and with which a plant must comply in order to receive a certificate of approval, are as follows:

Construction

Building. The building shall be provided with smooth floors of impervious material and properly drained. The walls and ceilings shall be painted with a light-colored paint or have other suitable sanitary finish. The plant shall be properly lighted and ventilated and shall be effectively screened against flies. Adequate toilet facilities shall be available for the persons in the plant and proper lavatory facilities shall be provided. The plant shall be provided with an accessible adequate supply of water of safe sanitary quality.

Equipment

Pasteurizers. Apparatus shall be such that the entire quantity of milk may be heated to a temperature of at least 142 degrees F. and held at that temperature for at least 30 minutes. Pasteurizers shall be such that every particle of milk will be held at the required temperature for the required period of time.

Time and temperature recording devices. Pasteurizers shall be equipped with accurate recording devices to show the temperature to which the milk is heated and the period of time for which it is held.

Coolers. Facilities shall be provided to promptly cool the milk after it is pasteurized to a temperature of 50 degrees or less. Open-surface coolers shall be provided with tight-fitting covers.

Bottle fillers and cappers. A suitable, completely closed bottle filler and a mechanical or hand-operated machine capper shall be provided.

Milk piping, pumps, and accessories. Piping, fittings, valves, and pumps shall be of the sanitary type, shall be constructed of noncorrodible metal, and shall be such that they can be easily taken apart and cleaned with a brush. The arrangement of piping and equipment shall be such that pasteurized milk can not be passed through piping, pumps, or other apparatus which earlier in the run has been used for raw milk, and by-passes and cross-connections in the piping shall not exist. All apparatus in which milk is stored shall have tight-fitting covers.

Washing and sterilization of containers. Facilities shall be provided to properly wash and sterilize the bottles and cans. Facilities shall also be provided to thoroughly dry the cans. If the bottles are not filled as they come from the sterilizer, they should be stored in an inverted position until they are to be used.

Operation and Maintenance

Health certificates. Every person employed in the plant coming in contact with pasteurization or bottling processes or the washing and sterilization of the equipment shall furnish a certificate from a competent physician showing he is free from any disease capable of being carried in milk.

Sediment test. All milk or milk products to be pasteurized shall not yield more than a perceptible amount of sediment or stain, other than that of natural butter-fat, when a pint sample is filtered through a cotton pledget one inch in diameter. This test shall be made of each producer's milk at least once each month.

Filtering or clarifying. Milk shall be filtered or clarified before pasteurization.

Cleaning and sterilization of pasteurization equipment. All pasteurization equipment, including all pipes, pumps, etc., shall be thoroughly cleaned and sterilized after each day's usage, and shall be effectively sterilized in the morning just previous to the day's run.

The work of carrying out the provisions of the law was supervised by the Division of Sanitary Engineering, and by June, 1926, the plants in the State selling pasteurized market milk had been visited at least once by a State representative. At these first inspections the operators were advised of the minimum requirements and were informed of the changes necessary in their plants so that a certificate of approval could be issued to them.

The condition of the plants at the time of the first inspections is reflected in the first column of the following table. The second column shows the condition of the plants on October 1, 1927:

TABLE 1

CONDITION OF PASTEURIZATION PLANTS AT FIRST INSPECTIONS, AND ON OCTOBER 1, 1927

Construction Items	June 1, 1926 per cent of plants unsatisfactory at first inspection	Oct. 1, 1927 per cent of plants unsatisfactory
Floors not smooth, impervious, properly drained or in proper sanitary condition	8	3
Walls and ceilings	29	6
Doors and windows—unsatisfactory facilities to eliminate flies	16	8
Light and ventilation	9	2
Toilet facilities—none, or insanitary	32	2
Lavatory facilities—none, or inadequate	48	10
Water supply—doubtful or bad quality	24	2
Items of Equipment and Operation		
Sanitary piping or fittings—none, or inadequate	6	1
Piping with blind elbows, insanitary pumps, or cross-connections between piping carrying raw and pasteurized milk or using the same pumps or piping for both raw and pasteurized milk	22	2

TABLE 1

CONDITION OF PASTEURIZATION PLANTS AT FIRST INSPECTIONS, AND ON OCTOBER 1, 1927

(Continued)

Items of Equipment and Operation—Cont'd.	June 1, 1926 per cent of plants unsatisfactory at first inspection	Oct. 1, 1927 per cent of plants unsatisfactory
Bottle fillers—none, or inadequate....	6	6
No cover for bottle filler..............	57	5
Open-surface coolers without proper covers	77	10
No adequate facilities for sterilizing bottles	35	1
No adequate facilities for sterilizing cans	31	2
No facilities for properly drying cans after sterilization....................	53	17
No filters or clarifiers.................	31	2
Filtering or clarifying after pasteurization only	21	2
No filtering or clarifying before pasteurization	53	4
No proper cappers.....................	29	3
Caps not obtained in sanitary containers	25	2
No medical examination of plant employes	99	13
Unsatisfactory Pasteurizers		
Commercial pasteurizers:		
Mechanically defective	83	23
Not provided with recording thermometers	38	4
Provided with recording thermometers, but out of repair or not attached to pasteurizer	6	1
Plants using cream cans for pasteurizers	5	0
Commercial pasteurizers and improvised pasteurizers not equipped with recording thermometers............	45	4

On June 1, 1926, there were 306 pasteurization plants under the department supervision (not including those in Chicago) located in 140 cities and pasteurizing 331,778 gallons of milk daily. On October 1, 1927, there were 330 plants located in 153 cities and pasteurizing 395,700 gallons daily.

A reasonable time was granted plant owners in which to complete the recommended improvements, and up to October 1, 1927, 148 certificates of approval had been issued to plants that had met all the requirements of the law.


DAIRY
ILLINOIS DEPARTMENT OF PUBLIC HEALTH
MOBILE LABORATORY

Since the law has been in effect approximately 85 per cent of the total defects have been corrected. The defects that still remain to be corrected are to be found in plants that have not as yet been certified. It is expected that during the first few months of 1928 all of the plants will have met the minimum requirements.

What is believed to be one of the best and most completely equipped mobile laboratories operated by any State department of public health is now available for service at milk pasteurization plants.

The mobile laboratory will visit plants throughout the State and while the milk sanitarian advises and cooperates with the plant owners on plant equipment, procedure and methods, the milk bacteriologist will make analyses and tests to determine the quality of the raw milk coming to the plant, the efficiency of the plant equipment, and the quality of the milk as it is ready to be distributed to the consumers. These tests and analyses will include temperature, acidity, sediment, and bacterial counts of the raw milk and the pasteurized milk collected at various points at the plant; also, analyses will be made of the cleaning solutions and wash water to determine their effectiveness and sterilizing qualities.

Normally the field personnel will consist of the milk sanitarian of the Division of Sanitary Engineering, who is in charge of the milk-pasteurization plant work, an assistant milk sanitarian, and a milk bacteriologist from the Division of Laboratories.

The mobile laboratory is a new 21-passenger street-car type Graham Brothers motor bus, with laboratory benches and equipment installed in place of the passenger seats. A central aisle gives ample work space at the benches located on each side. One bench 12 feet long and the other 9 feet long provide ample and convenient drawer and cabinet space of suitable size and construction to hold securely the necessary equipment and supplies. Effort was made to have the equipment and supplies so installed or stored that they would be easily available with the minimum amount of handling between laboratory set-ups. The equipment and supplies are sufficient to do all kinds of milk-testing work.

A white-enameled sink with running water is located in one bench, the water supply being stored in a 24-gallon pressure tank suspended from the car frame below the laboratory floor. Water and air connections, accessible through a hole in the body skirt, permit easy filling of the tank with water and applying air for pressure. The air connection is fitted with a tire valve and air can be applied at any gas station or from the air pump mounted on the car motor.

There are dual wiring circuits. One circuit supplies the regular body lights with 6-volt current from the regular electric system in the automobile. The other circuit is planned for 110-volt current and has a feed plug so that connection can be made easily and quickly by means of an extension cord to the 110-volt current at a pasteurization plant or wherever 110-volt current is available.

Prestolite gas tanks, housed in a cabinet near the driver's seat, furnish gas through concealed piping to bench outlets, incubators, and sterilizers. The steam sterilizer is heated by a self-contained gasoline pressure unit. A gasoline camp stove is used for heating the hot-air sterilizer. The incubator and milk grader are heated by electricity. Prestolite gas can be used for heating the sterilizers and incubators if desired.

The center aisle is wide and long enough to accommodate two army-type folding cots, which will be an advantage if the mobile laboratory at any time is placed in service in tornado or flood areas where sleeping accommodations are not available. A seat in addition to the driver's seat is stored when the laboratory is not in transit in a forward cabinet on the right-hand side, thus permitting easy access into and through the center aisle. A drop-step and door at the rear also give access to the center aisle. The windows are equipped with fine-mesh bronze screens.

During cold weather the interior can be heated by two floor heaters operating on an engine exhaust, or by 110-volt electric portable heaters when the laboratory is on service at a plant and is plugged in to the plant current.

"Progress is the law of life."

REPORT OF COMMITTEE ON SCORE CARDS AND THE SCORE-CARD SYSTEM OF RATING DAIRIES AND DAIRY PRODUCTS

C. Sidney Leete, *Chairman*

The Committee on Score Cards and the Score-card System of Rating Dairies and Dairy Products has decided to consider only the dairy farm score card in this year's report, reserving for future consideration a report on the other score cards.

During the past year a survey of the opinions of members of the committee and others engaged in dairy farm inspection has been made in order to determine their attitude toward the present score card. The results of this survey show that there is not a unanimous opinion regarding the present card.

It would seem that where there is a divergence of views upon this subject the cause is not the card *per se,* but rather a difference of opinion as to the purpose of the dairy farm score card.

Two broad views are held as to the primary value of the score card. One is that the score card should be used to assist the inspector in making an intelligent inspection of the farm and procure a record of such inspection. Associated closely with this thought is the thought that the card should also be of educational value to the farmer in that a detailed list of desirable features is given. The other view is that a dairy farm score card should be of such a character as to indicate the actual quality of the product produced upon the farm. So long as both of these views are held, there can be no unanimous agreement upon any one particular card.

Due to the fact that considerable controversy has arisen regarding the present card, the committee believes that the Association should take a definite stand upon this matter. Such action might bring the whole subject to a head, which would be advantageous. But in order to do this the actual purpose for which the dairy farm score card is used should be determined. The committee hopes and desires that at this meeting definite action will be taken, both upon the purpose of the card and upon the card itself.

Following are given the various opinions of dairy farm score cards obtained from the survey made during the past year:

Leslie, Cleveland.

Practically standard dairy farm score card of the United States Department of Agriculture, which from our standpoint seems to cover the scoring of dairies in a good way.

Strauch, Richmond.

Question as to whether the relative percentages assigned to the different points on the score card are really in proper proportion to their importance. A revision would be desirable and discussion at meeting would be beneficial.

Burke, Oklahoma.

I believe the score card is quite satisfactory, since I find it can be adapted to suit conditions in most any community and still is very serviceable from the standpoint of high-grade milk production.

Estes, New York.

Too often space for remarks at the head of card is too small. The "yes" and "no" system has great possibilities.

Frey, Sacramento.

The ideal for the score card should be to obtain the highest quality in the finished product. The present score card does not give the correct relative weights to the various factors. Methods are much more important than equipment and to a greater extent than is indicated on the card. The present card appears to give the greater weight to the largest or most conspicuous things about the dairy. Investigation has shown that the principal source of contamination comes from those articles with which milk comes in contact. Therefore the means by which this contamination is to be prevented so far as farm score cards are concerned should receive by far the greater emphasis on any card.

Veit, Los Angeles.

We are using the Federal dairy and modified score card and have as yet not found any card that will indicate nearly so well the exact conditions regarding sanitation, etc. However, we are now contemplating the use of the new State score cards, which we believe too lenient in that the range is too great for certain items. We think a score card should be limited; therefore our preference for the government card.

Wing, Oakland.

In my opinion any score card that is used which calls to the inspector's attention all items in a dairy is acceptable. Relative weights allowed do not make such a great deal of difference as long as it calls to a man's attention making a score all items of methods and requirements being used. I have found that Berkeley using a different score card entirely from ours and this department scoring the same dairy, that the difference in the total score as a rule came to tenths of per cent.

McGowan, Sacramento.

We have used both the Federal and State score cards and, as a result of our experience along these lines, we prefer the Federal card. It is quite complete and when the final score is made, the dairy has been gone over quite thoroughly, which is necessary in order to determine as to whether the dairy is properly equipped for the handling of milk. The State card is so abbreviated that all items are not considered which in reality should be given attention by an inspector in order to arrive at a definite conclusion.

Cooke, Berkeley.

We are using a modified Federal card (California State Department of Agriculture). It is a modification of the card developed by Woodward, of Washington, D. C. It is superior to most other cards by virtue of the following facts: It provides a rather detailed and careful score for cattle health. This is a phase of dairy inspection which generally does not receive the detailed attention it should. Second, the arrangement of the card is rather advantageous because the logical combination of items are grouped. In addition it gives a high numerical value to the small-top pail, facilities for steam and efficiency of sterilization, and cleanliness of milking.

Smith, New Orleans.

The writer has long believed that the so-called Dairy Division score card having a numerical value for the various items of equipment and method, has been the best single factor in the enlightenment of milk producers and the securing of permanent changes in equipment and methods on dairy farms. This score card has from time to time been incorporated into local ordinances, where it has been used by untrained inspectors as a report card rather than for the educational work for which it was designed and which is so desirable, if permanent improvement is wanted. The use of the score card with its numerical values by untrained inspectors is not desirable.

The writer believes that the committee can seriously consider elaborating somewhat on the items on the present score card, giving proper credence for economic and public health reasons for all items.

It is therefore suggested that a score card be considered for both educational and inspection service, which has major and minor items of equipment and sanitation, the major to be specific and agreeing with current sanitary knowledge, the minor to be listed under each major. Also that no item of equipment or sanitation be included, for each of which there is not a well-fortified public health and economic reason. The reasons can be stated on the reverse side of the score card or sheet itself, or can accompany the card in pamphlet form. It is also suggested that because of some controversy as to the particular numerical weights or values each item warrants, a check system for marking all defects or a "yes" and "no" reply system should be used.

Kelly, Washington, D. C.

There have been some criticisms directed at the dairy farm score card because of the fact that the farm score may not correlate exactly with the bacterial count of milk. I do not believe that such correlation is necessary or possible. Many features are considered in dairy sanitation which do not bear directly upon the bacterial count. Experience covering nearly 20 years with the score card shows that it has been a powerful instrument for improving dairy conditions. Large numbers of records show that there is, on the average, a fairly close agreement between the score and bacterial counts.

The American Dairy Science Association, which represents the State agricultural colleges and thus the dairy interests of the various States, has approved the present score card and officially adopted it. I see no reason for changing the card until a better one is amply demonstrated.

It is now hoped that the members present will express their own personal views and opinions upon this subject and that definite action be taken so that future committees will be able to devote their time to other score cards and systems which should be studied.

"Work with the construction gang, not with the wrecking crew."

NEW HAVEN'S MILK BOTTLE EXCHANGE

John L. Rice, M. D., *Health Officer*
and
Charles H. Amerman, *City Milk Inspector*
New Haven, Conn.

Until the year 1904 the milk industry in New Haven was carried on by over 100 dealers. These dealers operated altogether independently of one another. There was no organization to keep dealers in touch with one another and no thought of any united effort to improve or safeguard the community's milk supply. Each dealer was a law unto himself and local competition was keen.

In 1904 a few of the leading milk men thought that it would be a good idea to see if it might not be possible to unite these dealers on some common ground into some sort of organization for their mutual benefit and to the advantage of the milk supply. With these thoughts in mind a call was sent out to all dealers to attend a meeting. Out of about 140 dealers in business at that time, 31 signed as charter members.

At this first meeting the New Haven Milk Exchange Organization was started. It has continued up to the present time, 23 years, and has grown steadily in usefulness to the dealers and to the milk supply. It has spread to include neighboring towns within a radius of 18 miles, and has now a membership of 95, of whom only 38 or 40 are doing business within the territory which the original exchange covered. Retirements and consolidations account for the balance.

The primary object of the organization was to promote the best interests of the members and to improve the conditions of milk production and distribution.

Twice each year a banquet is held and practically every dealer attends. This affords an opportunity for the men to get acquainted with one another and to discuss their problems. There is nothing that creates a better spirit among competitors than acquaintance. One is less likely to be suspicious of a person if he knows him. At these semiannual meetings, speakers are brought in from the State Dairy Commission, the State and local health departments, the State Producers' Association, and other sources. These present opportunities for the dealer to get and understand the viewpoints of these groups.

Besides these two outstanding gatherings, meetings are held monthly where the dealers have a chance, very informally, to discuss milk and their business from every conceivable angle.

The second object of this organization is to provide the machinery for a clearing-house for bottles. The executive committee appoints an agent to operate the bottle exchange. He is paid on the fee basis and gets an annual gross income of around $5,000.

Each member of the exchange has his name or trade-mark registered under the laws of Connecticut. A milk bottle registered with this name or trade-mark may lawfully be used only by the designated dealer. The task of the agent of the Milk Bottle Exchange is to collect bottles that have gone astray from their owners and to return them. The great majority of his collections come from the dealers during his regular calls on them, to collect and deliver at a single trip. The agent has headquarters that are centrally located. Here junk dealers and other individuals may bring in bottles which they have picked up from various sources and which do not belong to them. For these salvaged bottles they receive one cent each. The agent himself may collect bottles from places where he learns they have been left, such as empty houses, dumps, etc. He may also inspect dealers' vehicles and plants for foreign bottles.

When the agent finds strange bottles being used by a dealer for his own delivery, if he is a member of the organization the dealer may be subject to a fine by the Executive Committee for violation of the Exchange rules, or he may be legally prosecuted if the situation warrants it.

At the headquarters of the agent the various stray bottles are assorted and returned to their proper owners. At the time of this delivery, all foreign bottles are collected from the dealers, allowing one cent for each bottle, and collecting two and one half cents for each bottle returned to the dealer. Milk cans recovered through this source give returns of 30 cents each to the agent.

New Haven consumes around 93,000 quarts of milk a day. To carry on this business means that the dealers must have on hand a stock of 1,000,000 bottles for the year. A dealer calculates that he needs to have on hand about four bottles for every one bottle customer. The life of a milk bottle averages between 25 and 30 round trips. Over 30,000,000 bottles are left on the New Haven doorsteps during the year.

Of this million-bottle stock for the year, each bottle starts on its trip once in three or four days. How many of these bottles fail to return to their owners through their regular course, no one knows.

During 1926, the Milk Bottle Exchange handled some 520,000 bottles, a daily average of 1,426. Of these bottles 144,000 were returned to the exchange by junk dealers from the public dumps and back yards. Besides this, 500 cans were returned. From 30,000,000 bottles sent out during the year, a half million found their way to the exchange. The cost of a half million bottles is about $26,000. The cost to the dealers in getting their bottles from the exchange is $7,800. By this method the average dealers buy back $445 worth of lost bottles for $205.

In this New Haven Exchange there is one outstanding weak point, and that is there is no provision made by the Exchange for the cleaning of these bottles before they show up at headquarters. To counteract this, however, the milk dealers give such stray bottles special washing on their return.

The Milk Bottle Exchange serves two useful purposes in New Haven: first, it forms the basis for an organization of milk dealers; and second, it provides a bottle exchange which saves money for its members.

"The number of square people, not the number of square miles, makes a country great."

IS DAIRY INSPECTION AN EXACT SCIENCE?

ERNEST KELLY,
In Charge, Market Milk Investigations,
Bureau of Dairy Industry,
U. S. Department of Agriculture,
Washington, D. C.

All of us are interested in the advancement of dairy inspection as a profession. We realize that as inspection is perfected and stabilized it functions more efficiently, accomplishing better results with the least misunderstanding. We look with pride upon our chosen work and jealously guard it against unwarranted attacks. Our hearts have warmed as we have seen the years bring improvements in methods and personnel; not so much because this progress has increased the dignity and prestige of our profession, but because we know that the upward trend has carried with it service to the public health and nutrition through constantly improved milk supplies.

Critics of dairy inspection—and there have been quite a number—have harped upon isolated instances of injustice and discrepancies of methods. We know some of these adverse comments have been well founded, but let us take stock of the situation and see if the fault is general or incapable of correction.

We need to spend little time to prove that dairy inspection of itself is not an evil thing. No man can gather figs of thistles; and no system radically wrong could have produced such beneficent results. Conceding, then, that dairy inspection is fundamentally sound, what is wrong with it to evoke criticism? Does the trouble lie with the critic or the criticized?

A good dictionary definition of "science" is: "Accumulated and accepted knowledge which has been systematized and formulated with reference to the discovery of general truths or the operation of general laws." This definition may be boiled down to the statement that "science is the logical arrangement of known facts."

I would call your attention especially to the phrases "general truths" and "general laws," and ask you to keep them in mind during the ensuing discussion. Observe that there are two prerequisites for science: first, the discovery of truths and laws; and second, the systematic formulation of thought regarding them.

With these definitions clearly before us, it may be fairly well established that dairy sanitation is a science. Now, is it an "exact" science? Let us clarify thought by again turning to the dictionary. "Exact science: Capable of great nicety, especially in measurements, adjustments, etc." Obviously, exactness must be based on a comparison with other sciences. It is predicated on relativity. We must also consider the magnitude of the operations involved. One can not measure the exactness or accuracy of a science without distinguishing between the finite and the infinite. The mathematician or astronomer weighing the earth or calculating distances and light-years between planets may obtain variations which would appall the chemist accustomed to working with his analytical balance, and yet the percentage of error might be practically negligible.

Let us briefly analyze an ideal system of dairy inspection. It is not a simple, but rather a complex science. It is based on the sciences of chemistry, bacteriology, and sanitary engineering. It receives contributions from other related sciences such as physics, medicine, and psychology. All in all, it is a vast lens collecting the rays from many directions. How well can this lens be focused and how clear an image can it outline?

Taking the basic sciences involved, we may pass over chemistry as an exact science without contradiction. Bacteriology is next. There may be some doubt as to the exactness of bacteriological methods; but I, for one, am convinced that the doubt has been created fictitiously more than in reality. I believe that the misapprehensions which have arisen have been due to two causes: first, failures through ignorance or oversight to follow absolutely uniform standard procedure; and second, lack of any accurate method of measuring results. To the first may be attributed many of our widely heralded discrepancies in comparative counts. The second accounts for certain apparently inexplicable results which are sometimes attained. We have certain preconceived notions as to bacteriological results which should be obtained and when the count does not correspond to our ideas we are apt to doubt. But how do we know that the count obtained is not a true picture? How can we measure it and condemn it? In all probability it is much more accurate than we imagine.

Sanitary laws are fairly well established. We know which are the most important, and that their violation will show in the results obtained. Bacteriology is our yardstick for measuring these results, and I believe that our measurements are really more accurate than we realize.

So far we have discussed dairy inspection as an ideal. Sometimes its practical application yields results which are far from being ideal. These field operations of the science have evoked much of the criticism which has existed. If dairy inspection is faulty it must be due to one or more of the following reasons:

1. Lack of knowledge of principles involved.
2. Lack of proper measuring instruments.
3. Faulty application of principles or measurements.

Let us see if we can discover the weak link in the chain. The principles governing the production of clean milk are definite and well known. Many dairies consistently produce and market milk of uniformly low bacterial content. This could not be so if the laws of clean milk production were not definite and exact. The application of the same principles in all dairies would eventuate in a universally high-grade milk supply. The trouble, then, is not a lack of access to systematized knowledge.

If dairy inspection fails in exactness, is it due to improper measuring instruments? It must be admitted that some of our yardsticks and balances are not wholly satisfactory, but in the main they are better than those used in some other sciences, and if intelligently used, they give measurements that are comparable and useful.

We come then to possible faults in the application of principles and measurements. Such faults do exist, as we well know. But it would be folly to decry a system because of weakness in the human element which operates it. Dairy inspection must depend to a very great degree upon the human element, and therein lies its greatest weakness. Improper application of the principles of dairy inspection is usually caused either by ignorance of the principles or by a false perspective which magnifies lesser objectives while dwarfing the major. With the present store of knowledge, there is little excuse for ignorance. Well-informed inspectors who fail in their mission may be divided into two classes: the careless, and the conscientious who, by oversight, fail to observe certain necessary conditions. There is a very clear distinction between the two classes, but the result of their labors is apt to be similar.

I would not have you think that I am indicting dairy inspection or inspectors. I would leave that to those who have had less contact with the subject and who have not watched the conscientious effort and the resultant benefits. Most dairy inspection is on a high plane, but it is well for us not to be too complacent and self-satisfied. A satisfied man looks for nothing better and so his progress is halted.

After all, the exactness of a science may be determined largely by the ability to predict results. This is made possible by an accumulation of knowledge based on previous experience. Langley built an airship. Men told him that it would not fly, and it didn't. But years later, after the jeers had subsided and the dreamer had died broken-hearted, "Langley's Folly" was equipped with a stronger motor and successfully flown. Langley's principles of wing structure and air pressure were just as correct when his plane fell as they were later when it flew.

Dairy inspection has proved its soundness by improving milk supplies in spite of increasing difficulties and complexities. That, in the end, is the best test of its exactness. I expect and hope that we will continue to discover and use new principles and measuring devices. But this anticipation does not alter the present status of inspection. A science does not have to be complete to be exact. There are still two or three chemical elements to be isolated, but this does not affect the exactness of chemistry as a science. Mathematicians and physicists still argue about the possibilities of the fourth dimension and squaring the circle, but such contingencies do not shake confidence in the existing sciences.

Do not let our minds be confused by possibilities of the future; do not let our judgment be warped by minor occurrences; and do not let our faith be shaken by human errors. Laws and principles are clear, measuring devices are adequate, and we have only to solve satisfactorily the human equation. If we fail, it is because we do not care to master the principles of our profession or because we are not painstaking in their application.

"Great minds have purposes, others have wishes."

EDUCATION IS SURER THAN LEGISLATION

DR. W. G. HOLLINGWORTH, *City Veterinarian*,
Utica, N. Y.

Instruction of the producer, the dealer, and the consumer regarding the need of employing sanitary methods in the care and handling of milk is of great benefit. No class of people seems more anxious to obtain knowledge which will improve their business and secure a better product than the milk dealer. The handling, preparing, serving, and dispensing of milk are under the supervision of the health department. Methods of education bring better results than do those of prosecution.

The confidence of the producer, the dealer, and the consumer is essential for success in this important task of milk supervision. When these different classes of people understand that the health department is anxious to give them all the information at its command, they in turn are likely to be in a receptive frame of mind. First, last, and always we should practice what we preach, and that is the method I pursued in a campaign started to increase milk consumption by our Health Officer of Utica, N. Y., Dr. H. H. Shaw.

The first thing we did was to call a meeting of all the milk dealers, at which our educational campaign was launched. A one-hundred-per-cent attendance was gratifying to us, and the health department's plan for betterment of the milk situation in our city was outlined in detail. Opportunity was offered for those who cared to do so to tell us their troubles, if they had any. Our department presented information indicating there must be something wrong in the milk situation. A city of 110,000 consumed only about 30,000 quarts daily, and this amount was being delivered by about 78 dealers who were not a friendly group as a whole. Only seven sold pasteurized milk.

It seemed necessary to secure a clear understanding of the possibilities of mutual helpfulness, and it was surprising to see what a love feast was started. The encouragement we received was beyond our expectation. When the meeting was adjourned, a rising vote of thanks was given the members of the health department for their efforts. Compliance with the department requests was promised. That meeting was held in November, 1925, and that same feeling is in effect today. A bureau of food hygiene was created January 1, 1926.

Our campaign was carried on through the press, movies, service clubs, nurses' classes in hospitals, etc. We found the way to get publicity is to do something in which our neighbors are interested. We gave information in every possible way as to the value of milk as a food and its cheapness as compared with other foods, urging increased consumption. We told of its effect on the public health, especially children, and made it plain to the public that the milk they drank should be clean, safe, and wholesome. We also told the public that they could come to or phone the health department and we would gladly give any information at our command in regard to the milk situation of our city. While we would not recommend any milkman, we did inform the inquirers as to the quality of the milk their milkman was delivering as per laboratory test. In order to be able to give such information, a sample is taken every week from each dealer and sent to our laboratory. In turn, two reports are sent out, one to our department, the other to the milk dealer. No public press reports of bacteria counts are published. The notices received by the dealers are kept on file after study, and it is astonishing how disturbed the dealers become if the report shows a high bacteria count or a low fat percentage. If anything like this occurs, a series of questions is certain to be asked of the health department as to what to do in order to improve conditions immediately. We always comply with these requests, and many times the inspector is asked to accompany the dealer on a visit to the producer.

So far, the consumption of milk has been increased nearly 100 per cent. We now have 40 dealers pasteurizing milk; 14 have gone out of business. This has been brought about without an ordinance, but by merely talking and suggesting the great importance of pasteurizing milk from a public health viewpoint. The bacteria counts, instead of running up in the hundreds of thousands, sometimes to the million mark, now average about 30,000, some being as low as 2,500 per c.c. Our pasteurized milk ranges from 2,000 to 20,000 per c.c. We made it plain that pasteurization should not take the place of sanitation. Of course, due to some oversight, a high count may take place, but once it occurs, we look for the cause and remedy the situation.

The first of the year, a notice was again sent out to dealers for a meeting. The health department notified the dealers at this time that all milk must be pasteurized or from tuberculin-tested cows. This measure will be carried out, I am certain, without any difficulty.

An excellent effect has resulted from a competition for two silver loving cups, competed for by the dealers in pasteurized and raw B milk. The winner has his name inscribed on the cup, and holds it for three months or until lost. This created a very friendly rivalry. Of course the department could not give these prizes, but an interested party donated them and a request was made that the winners should not make propaganda of the prizes.

We do not have prosecutions. There have been times when we had to speak plainly, but friendly feeling has always resulted. Dr. R. A. Pearson, President of the University of Maryland, in a letter to me wrote: "I have always contended that legislation can do no more than satisfy a minimum standard. The law can only describe the worst that will be tolerated. It will always be necessary for a few persons who are dishonest or who have no ideals. Education operates on higher levels."

Our health officer keeps a close watch to prevent any milk-borne disease outbreak. A very close check-up as to rural sanitation is always available. We do not ask anything unreasonable from the producer; on the other hand, we try to be elastic within reason. We appreciate the problems confronting the producer. In order to live up to the rules of sanitation, he must have cost plus a profit, as suggestions made to improve the quality and the quantity of milk may result in an increased cost.

Physicians now frequently come to our department and tell us that their calls on sick babies, due to gastro-intestinal disorders, have greatly diminished. No doubt this is due to the department's vigilance in regard to the handling, preparing, serving, and cleanliness of the milk consumed.

Our dealers are required to keep the health department informed of all important changes regarding the source of their supply. We insist on an immediate notice so that we can check up the situation. The New York State Department of Health immediately notifies us if any communicable disease exists on any farm from which milk comes to our city, and such being the case we are in a position to notify the dealer that the producer's milk may not be accepted until satisfactory conditions exist at the source. We visit the farm, look over the situation, and try to have the patient sent to a hospital. If that cannot be done, it may be suggested that the herd be moved to another farm if possible. In fact, we try to keep the farmer out of an unpleasant difficulty, and very often a dealer will compensate the farmer for his loss.

Our milk dealers are required to furnish us with a health certificate of all employes. We have seen the great necessity of this movement, and it is not considered a hardship on the part of the dealer.

Education has also produced results with the consumer. We get numerous complaints from our people as to their milkman. Of course we always make an investigation, looking up our records, but in a great percentage of cases we find the trouble is due to the consumer's carelessness. Our department recommends that the dealers distribute educational pamphlets on the care and use of milk. We also emphasize the need of a proper receptacle for the bottle of milk when delivered, and we think it good business for the milkman to furnish such receptacles at cost. A request has been made that plans for new homes provide for this need.

We make frequent visits to all milk plants and are always received in a friendly manner. Plant owners are requested to keep a pad and note suggestions made on the inspection tour. It is needless for me to say that this procedure is very useful for both parties.

In conclusion, it is very evident to me that municipalities should create bureaus of food hygiene, in which milk supervision holds the most important place, and should engage qualified inspectors whose aim should be to render service. Milk is the first of the necessities of life and must be made safe by inspection. The public is clamoring for information which should be given by those competent to serve. The best asset for any State or municipality is a health department with personnel constantly on the alert, making the State or municipality a better and healthier place to live in. In order that the heads of such health departments may be able to perform the duties that are required of them, they must have the cooperation of the health-respecting public.

"It takes a lot of energy to make up for bad judgment."

THE PHYSICIAN'S DUTY IN TEACHING THE PUBLIC THE VALUE OF MILK

DR. RALPH F. LOCKWOOD,
Health Officer and Milk Inspector,
Lakewood, R. I.

The physician has an opportunity to teach the public the value of milk. His position as an adviser in any community is second to none, except perhaps that of the clergyman. How much milk and how taken is asked of the physician when the new-born citizen arrives; during life, when illness overtakes the individual; and again when man is about to leave earth for the future home.

The physician has an opportunity to teach man concerning the great food value of milk. The opportunity should be grasped by the physician to teach the public how to obtain and how to use this food.

The physician, I am sorry to say, too often shirks his duty and loses his opportunity many times to advise his fellowman of the wonderful value of milk. If it required a long explanation, excuse could be offered, but milk is the food a physician must be in contact with constantly. He often, and erroneously, thinks the public knows all about milk as a food. He does not seem to realize that many people neglect milk by not keeping it clean and cold. The housewife should be taught by the physician to protect milk from outside elements by covering it, and to keep it at a temperature not higher than 50° F. until used. The physician should impress upon the housewife the many uses for milk while sweet. Even when it has lost its sweetness, it may be profitably used in many ways.

The duty of the physician to advise proper care of milk for the baby, before any other food material can be digested, is but a small part of the program. He should also advise regarding the use of milk for youth, and for school children especially. Those who dislike milk in its natural state may be influenced by the addition of flavoring or other attractive additions to suit the taste and please the eye, so that milk may be taken at meals and between meals, as a food.

The teaching program of the physician should also encourage the greater use of many foods containing milk, such as ice cream, cheese, and butter, and many other foods of which these form a part.

My paper, I hope, will suggest to those of our members gathered here the necessity of getting into the head and heart of every physician a realization of his opportunity to serve his fellowman by promoting the use of proper food, and thereby promoting the health and happiness of all our people.

"The world is blessed most by men who do things."

CHEMICAL AND BACTERIOLOGICAL QUALITY OF SOME COMMERCIAL MILK POWDERS

J. H. SHRADER, PH. D., *Director,* Bureau of Chemistry and Food, Baltimore City Health Department*

Delepine (1) studied the manufacture of milk powders in England and found that tubercle bacilli survived the drying process and were still capable of producing progressive tuberculosis in guinea pigs which were inoculated subcutaneously with the milk, but that the course of the disease produced by these organisms was very much slower than that of the disease produced in guinea pigs which were inoculated with the same amount of untreated tuberculous milk. Furthermore, he found that there was a material recontamination of the powder after the manufacture.

Supplee and Ashbaugh (2) found that the bacterial content of the powder as it comes from the cylinders by the Just process averaged less than 1,000 per c.c., regardless of the original bacterial content. Some of the original milk ran as high as 345,000,000 bacteria per c.c. and yet the average bacterial content of the powder immediately taken from the cylinder was about 520 bacteria per gram. They clearly show that the powder becomes recontaminated but that the organisms die off rapidly during storage. In further work (3) they show that during the process of powdering, the original bacteria in milk seem to be destroyed to a large extent but that microscopic examinations of reconstituted milk made from powder by the hot roller process are justified as a partial control measure for commercial laboratories when it is desired to ascertain the relative sanitary quality of the original milk. Their results indicate

* The laboratory work was performed by C. L. Ewing, F. A. Korff, and Lillian W. Conn, of the Baltimore City Health Department.

that about one half of the original content of bacteria can be identified in the reconstituted milk.

Jephcott, Hunwicke, and Ratcliffe (4) likewise found that milk powder may be materially recontaminated in the plant. They show remarkable results in reducing the latter by the introduction of improved sanitation. However, they express the surprising opinion that it is the number of living bacteria in the finished product which is the only thing that really matters, and yet they go on to state that dried milk of high quality and low bacterial content cannot be made from stale or heavily contaminated milk.

Ferris (5) studied samples of cream and butter made therefrom in 13 different creameries. High-score butter could only be made from cream of low initial bacteria count, whereas all the butters of low scores are made from centralizer creams which were sour and some of which contained more or less off-flavors. The cream with low bacteria counts contained low percentages of amino acid nitrogen and ammoniacal nitrogen, whereas those creams which were of poorer bacterial quality were higher in these nitrogen decomposition products. The respective butters yielded corresponding relative results but the absolute figures of nitrogen content were lower, presumably because of the washing out in the working of the butter.

In view of the increasing use of milk powders, and the indications from the literature that proper sanitation was irregularly applied, it was determined to make a survey of this industry and ascertain the sanitary quality of the powders which were being offered for sale in Baltimore. Accordingly, 100 samples were collected. Some of these could be definitely traced to the manufacturer but others were distributed through brokers. They were traced back to the following sources: Chicago, Cleveland, Seattle, Milan, Pa., New York State (5 sources), California (2 sources).

The powders were weighed out and diluted 1 : 5 by the addition of 5 c.c. of sterile distilled water and vigorously shaken. Plate counts were made according to standard methods of milk analysis of the American Public Health Association, 1923. The plates were inverted and incubated at 37° C. for 48 hours.

The Breed counts were likewise made in accordance with standard methods of milk analysis of the American Public Health Association, 1923. The bacteria were counted in 30 fields, but when the count was very high (over 25 bacteria per field) only five fields were counted, namely, each corner and the center of the smear. The *Es. coli* count was made on gentian violet lactose peptone bile medium containing 1 per cent of peptone, bile and lactose adjusted to a pH of 7.8. This medium favors the growth of the above organisms but inhibits the other milk flora so that any gas formation may safely be assumed to be due to members of this group without further confirmation (6). The tubes were incubated at 37° C. for 48 hours. The reciprocal of the greatest dilution showing any gas formation is reported as the *Es. coli* count per gram.

The test for Mycobacterium tuberculosis was effected by inoculating the reconstituted milk (in the proportion of one gram of milk powder to 5 c.c. of sterile water) into the left groin of guinea pigs. At the end of 30 days, one c.c. of Koch's old tuberculin was injected subcutaneously into the right groin. If the animal did not die, it was killed and autopsied after 24 hours. In order to ascertain if the above technique was suitable for the detection of the relatively small numbers which may occur in market milk samples, it was found that the above method was sensitive when the animals were inoculated with a maximum of 400 organisms.

With regard to the chemical analyses, the total nitrogen was determined on the dry powder by the Kjeldahl method. Free ammonia was determined by the Folin aeration method on a water solution of the powder. Amino acids were determined on a water solution of the powder by the formol titration method (Hawk, 7).

Food inspectors from the Health Department brought in

100 samples of milk powder taken from grocery stores, bakeries, confectioneries, and drug stores widely scattered over Baltimore. While it is not known what methods of manufacture were used in all cases, it is definitely known that six firms used the spray process and one firm used the roller process. All of the samples except No. 6532 and No. 6496 (canned) were brought into the laboratory loose and represented the product as actually used. After the bacteriological sample was taken, the remainder of the samples were placed in stoppered flasks and kept for analysis for a period ranging from one day to three weeks.

A grouping of the samples according to their sources showed that the geographical distribution does not seem to be a determining factor in the quality of the milk which is produced, because milk of high and low quality in some cases came from the same section of the country.

In not a single case were viable tubercle bacilli found as determined by the guinea pig inoculation. The dependability of our negative findings is confirmed by the sensitiveness of our controls.

When the bacteria counts were plotted against the percentage of ammonia, it was found that the scatter of determinations below 30,000,000 bacteria was so great that no relation could be observed, but when all of such were averaged and grouped, the relation established as tabulated in the following table presented itself:

TABLE I

RELATION OF DIRECT BACTERIAL COUNT TO NITROGENOUS DECOMPOSITION

Direct Bacteria count per gm.	Number of samples	Percentage of nitrogen of total nitrogen: Ammoniacal Range	Ammoniacal Average	Amino Acid Average
0— 30,000,000	49	0—0.26*	0.14	8.0
30— 60,000,000	5	0.06—0.25	0.17	7.2
60— 80,000,000	2	0.20—0.23	0.22	9.0
80—100,000,000	3	0.10—0.46	0.26	9.4
190,000,000	1	0.42	0.42	5.3

* Omitting one sample of 0.58%

The plate counts covered a very wide range, as indicated by the following table, expressed as per gram of powder:

TABLE II

SUMMARY OF LABORATORY DETERMINATIONS

	Maximum	Minimum	Average
Plate counts	26,000,000	800	750,000
Es. coli counts	over 500	less than 5	—
Breed counts	190,000,000	350,000	20,000,000
Myc. Tub.	0	0	0
Total nitrogen	5.28	3.51	4.59
Ammoniacal nitrogen of total nitrogen	0.578	0.0	0.169
Amino acid nitrogen of total nitrogen	9.89	1.13	7.74

It is clear from the above data that either the manufacturing processes are woefully lacking in proper sanitary control of the finished product or there is gross contamination in the channels of trade. As a matter of fact, the trade does not seem to consider milk powder as worthy of any more consideration than so much wheat flour. However careless the trade may be in handling this product, it is equally clear that the manufacturing industry does not use a quality of milk which the occasion demands. In view of the well-known fact that the Breed counts on reconstituted milk powder do not represent all of the original inoculation, and assuming that the count is about one-half of the inoculation, it is overwhelmingly manifest that the original milk comes from supplies which would not comply with the requirements of a reasonably enforced municipal milk ordinance.

The signs of the times indicate and the dairy statistics prove that the demand for milk powder will continue to increase for a long time to come. It is to be regretted that such a promising development is being shackled to such retroactive conditions of production and handling. Inasmuch as this situation will have to be corrected sooner or later, it is in the interest of all concerned that the beginnings be made right, and thus build a stronger industrial structure.

References

1. Delepine: Local government board, Food Reports, No. 21, 1914.
2. Supplee and Ashbaugh: Journal Dairy Science, Vol. 5, p. 216, 1922.
3. Supplee and Ashbaugh: *Ibid.*, Vol. 5, p. 570, 1922.
4. Jephcott, Hunwicke and Ratcliffe: Proc. World's Dairy Congress, Vol. 2, p. 1265, 1923.
5. Ferris: J. Dairy Science, Vol. 6, p. 412, 1923.
6. Kessler and Swenarton: J. Bact., Vol. 14, p. 47, 1927.
7. Hawk: Practical Physiological Chemistry, 5th edition, p. 502.

"Act well at the moment, and you have performed a good action to all eternity."

REPORT OF
COMMITTEE ON DAIRY AND MILK PLANT EQUIPMENT

GEORGE W. PUTNAM, *Chairman*

The Committee on Dairy and Milk Plant Equipment took as its subject for study this year the suggested standard specifications for pasteurizing plant equipment, developed by the United States Public Health Service, with the collaboration of the Chicago Department of Health and other organizations.

The Committee held meetings on June 2d and 3d. Conferences with various individual Committee members were held and correspondence conducted throughout the year by the Chairman.

The Committee submits the following tentative specifications for consideration and use by milk control officials and solicits criticisms and suggestions from the Association members.

PROTECTION FROM CONTAMINATION AND FLIES

All pasteurizing, cooling, bottling, and other equipment with which milk comes in contact shall be covered and otherwise protected to prevent the access of flies, dust, and other contamination during operation. To fulfill this provision, surface coolers must meet the following specifications:

(a) The sections of open-surface coolers shall be installed so as to leave a gap of at least one-half inch between the header sections to permit easy cleaning.

(b) Suitable means shall be provided to prevent leakage of brine or water from the headers dropping into the milk trough, by shortening the bottom trough, by the use of deflectors at the bottom of the headers, or by other approved method.

(c) All open-surface coolers and open-surface regenerative heaters shall be located in a separate dust-free room, or shall be provided with tight-fitting shields, preferably suspended on trolleys.

The shields shall conform to the following specifications:

1. The material shall be copper, tinned on both sides, or other approved metal.
2. All seams shall be flush soldered.
3. All parts shall be readily accessible for cleaning.
4. The shields shall be tight-fitting so as to effectively protect all milk surfaces from fly or dust contamination.

(d) The supports of the cooler sections shall be so located as to prevent drip therefrom reaching the milk.

(e) Regenerative heater-coolers shall be so constructed and maintained as to prevent access of the raw milk to the pasteurized milk. The pasteurized milk shall always be under greater pressure than the raw milk.

Milk Piping

1. All milk piping, fittings, and connections shall be of such a diameter, length, and so designed as to permit easy cleaning with a brush.

2. The milk piping and connections shall be surfaced with a heavy noncorrodible smooth finish, of tin, nickel, or other approved material, and all sweated connections shall be soldered smooth and flush.

3. The connections shall be of such design as to avoid sharp corners or crevices which are difficult to clean.

4. All parts of interior surfaces of pipe or fittings (including valves) shall be of such size and shape as to

be accessible either to the sight or the touch, thus making it possible to determine whether they are clean.

The specification excludes all ells and bends except 45° and 90° square shoulder ells with couplings on both ends, and all adaptable nipples or other fittings exposing pipe threads to the milk. Bent or dented milk piping shall be considered as violating this item. Wherever practicable, at least 1½-inch piping shall be used.

5. The length of milk pipe lines shall be reduced to the minimum practicable. In no case should single lengths of piping exceed twelve feet.

Construction of Equipment

1. All surfaces with which milk comes in contact shall consist of smooth, noncorrodible metal or unbroken vitreous material.

2. All joints shall be soldered flush with the surface or otherwise fitted to avoid open seams; or the surface, if vitreous, shall be continuous.

3. All surfaces with which milk comes in contact shall be easily accessible for cleaning, and self-draining.

4. In all cases where a rotating shaft is inserted through a surface with which milk comes in contact, the joint between the moving and stationary surfaces shall be close-fitting.

5. In cases where the thermometer bulbs are inserted through surfaces with which milk comes in contact, the thermometer bulb shall be provided with a pressure-tight seat ahead of all threads or crevices.

The above requirements preclude: (a) the use of iron milk pumps, which must be replaced by pumps constructed of smooth, noncorrodible metal, all parts of which can be readily taken apart for cleaning; (b) the use of any type of equipment so designed as to permit milk routinely to come in contact with threaded surfaces.

Design specifications: (a) Indicating and recording thermometers: The following specifications shall be complied with in the case of all new equipment and in the case of all replacements of indicating and recording thermometers. They shall also apply to all repairs of recording thermometers requiring a renewal of the tube system.

Paragraph 1 shall also apply to all existing equipment.

1. Both an indicating and recording thermometer shall be installed and used on each vat in which the holding time is not automatically controlled, and in both inlet and outlet manifolds of vat, pocket, or continuous-flow installations in which the milk is brought to the final pasteurization temperature before entering the holder, and in which the holding time is automatically controlled.

2. Indicating thermometers shall be mercury activated, armored, shall have not less than 1/16-inch scale divisions per degree, and shall be adjusted to be accurate within the limits of readability with the naked eye at the legally required temperature of pasteurization. A line shall be etched in the thermometer stem at this point. The thermometer shall be of such type and so located as to render reading convenient.

3. Recording thermometers shall have not less than 1/16-inch scale divisions per degree at the legally required temperature of pasteurization, on a standard 12-hour chart, and shall be calibrated and set to be accurate within the limits of readability with the naked eye at the legally required temperature of pasteurization. They shall be protected against damage at a sterilization temperature of 220° Fahrenheit. The case shall be moisture-proof. The tubing shall be as short as possible.

4. Bulb fittings of all indicating and recording thermometers must have pressure-tight seats against the inside

wall of the holder or pipe into which they extend. No threads shall be exposed to the milk.

(b) Uniform Temperatures and Flush Valves: The holder shall be so designed that no particle of milk will, at any time during the holding period, be more than 1° Fahrenheit colder than the temperature registered by the indicating and recording thermometers, when they are in proper adjustment, as determined with suitable testing equipment.

The above specification shall not be interpreted as permitting any milk to be pasteurized at a temperature below the legally required minimum temperature.

(c) Leak-Protector Inlet and Outlet Valves, or Valveless Method of Filling and Emptying: Leak-protector inlet and outlet valves, or a valveless method of filling and emptying, shall be provided for each vat or pocket of vat and pocket-type installation, except in the case of single vat installations. Leak-protector outlet valves shall be provided with a sterilizing connection. In a single vat installation, the outlet piping shall be disconnected during the filling and holding period and the outlet shall be sterilized just prior to emptying.

(d) Foam: If foam is present in the holder, which does not remain at the pasteurizing temperature for the full holding period, means shall be provided which will keep the foam and atmosphere above the body of the milk at a temperature equal to at least the legally required pasteurization temperature during the heating and holding periods. If steam is used, the steam line shall be provided with a trap and installed in such a manner as to avoid the discharge of water or other foreign substance into the body of the milk.

(e) Covers: The covers of vats must be so constructed that nothing on top thereof will drop into the vat in either their open or closed position.

(f) Insurance of Minimum Holding Time in Continuous-Flow and Pocket-Type Holders: Continuous-flow holders shall be constructed and equipped in a manner to insure that every particle of milk will be held for the required period. The holder shall be equipped at the inlet end with a constant head tank and a pump geared directly to a properly timed constant-speed motor, at the outlet end with a similar pump and motor, except that in the case of installations in which the holder empties by gravity the outlet pump is not required. In this latter case, the valve on the outlet piping shall be of such a size and so constructed that every particle of milk issuing from the holder during the emptying period will have been held in the holder for the legally required holding period.

Pocket-type holders shall be equipped with a timing device operated by a constant-speed motor so that every particle of milk will be held for the legally required holding period.

Each continuous-flow or pocket-type installation shall be tested to insure that it is subjecting every particle of milk to the required temperature for the required time.

Bottling

The bottling shall be done by automatic machinery which

1. Is of a design which does not require frequent adjustment during operation, thus exposing the milk to danger of contamination.

2. Is provided with overlapping covers which are so constructed as to protect the milk within it from contamination by dust or flies, condensation or waste milk.

3. Is of a design which can be readily cleaned and sterilized.

4. Is of such a design as to permit float adjustments without removing the cover.

5. Is provided upon the filler pipe of the bottler, and as close to the top of the bottler as possible, with an apron or other approved device to prevent water of condensation or drip from fingers reaching the inside of the bottler during float adjustments.

6. Has all surfaces with which the milk comes in contact of smooth, noncorrodible material, readily accessible for cleaning.

Capping

All newly installed bottlers shall be equipped with an automatic capping mechanism of a design which does not require frequent adjustment.

"He is most free from danger who, even when safe, is on his guard."

REPORT OF COMMITTEE ON MILK PLANT PRACTICE

H. A. HARDING, *Chairman*

Up to about five years ago, there was some difference of opinion as to the relative desirability of making milk safe by regulating the conditions under which milk was being produced and of making it safe by heat treatment. Gradually the conclusion seems to have become established that while it is well to insure the best obtainable conditions surrounding the production and handling of milk, these efforts must be supplemented by pasteurization before the general milk supply can be considered safe.

Perhaps partly because the necessity of proper pasteurization has come to be almost universally recognized, attention during the past year has largely centered upon improving the details connected with this process.

DEAD ENDS ON PASTEURIZERS

Until rather recently, practically all valves on pasteurizers were so located that some of the milk was not fully heated during the pasteurizing process. In some cases this difficulty was further increased by locating the outlet valves in sanitary pipe at some distance from the pasteurizer. This permitted an additional amount of milk to escape the desired heat treatment.

The attention which this problem has received during the past two years has resulted in the development of pasteurizer valves which cut off the milk flush with the inside of the holder. There is accordingly no reason why the installation of new equipment lacking flush valves on the pasteurizer should be permitted.

This development of new valves found an operating equipment which lacked them and for a time they could not be supplied by any of the makers of dairy machinery. Fortunately, the problem of designing modern valves which might be added to old equipment has been met by practically all of the manufacturers, so that there is now no longer any reason why the continued use of insanitary outlet valves and dead ends on pasteurizing equipment should be permitted.

Self-Draining Valves

The study which was given to the valve problem in connection with the development of flush valves made it plain that any valve would leak at times, and if heat treatment was to be given to every particle of the milk it would be desirable to provide for the draining away of such milk as should leak past the valve seat. This has resulted in the development of flush valves which are also self-draining.

These two improvements in valves following each other at such a short interval have necessarily led to some confusion. The valve to be desired upon milk pasteurizers is both flush-closing and self-draining.

Doing Away with the Need of Valves

Realizing that all valves would leak some and that provision for correcting valve leakage would necessarily be troublesome, a number of the manufacturers have devised pasteurizers which do not require the ordinary outlet valve, and therefore they have done away with that valve problem.

Recording Thermometers

The past year has witnessed an interesting swing in the attitude of inspectors toward recording thermometers.

Previously it was common practice to accept any recording thermometer as fully meeting the sanitary requirements. This attitude was open to criticism, since many of the thermometer charts in use cover a range of 200 degrees Fahrenheit. As a result, the space allotted to a single degree is so narrow that the temperature recording line is frequently as wide as the space allotted to two degrees and where the pen is worn it may cover five degrees on the chart. Plainly a record of this type cannot be read with the desired accuracy.

The present tendency goes quite to the other extreme and tends to look upon the recording thermometer as useful mainly as an indicator of the time at which changes in temperature occurred, relying upon a mercury indicating thermometer to show the correct temperature of the milk.

As usual in such cases, it is well to keep midway between these two extremes. Except for what he can see in connection with his occasional visits, the inspector is dependent for his knowledge of the temperature treatment of the milk upon the recording thermometer. It is therefore important that he insist upon the use of the best available recording thermometer charts. These are undergoing some change and it is probably too early to select the best form of chart. However, one of the important items is a sufficiently restricted range on the chart so that the record of the pasteurizing temperature can be recorded clearly and read accurately. A recording thermometer chart showing the pasteurizing range in single degrees is highly desirable.

Mercury Indicating Thermometers

The equipment of much of the pasteurizing machinery is defective in that the mercury thermometers which have been provided have so crowded a scale that they cannot be read easily or accurately. The results of this have been bad for all concerned. At times the milk has not been heated fully to the required temperature and thereby its safety has been brought into question. At other times the milk has been unwittingly heated too high and the dealer has suffered from the resulting loss in cream showing. Likewise, in many instances the dealer has attributed the poor cream showing to faulty construction of machinery when the trouble has been due to the thermometer. In this case the manufacturer has suffered unjustly except in so far as he should have equipped his apparatus with suitable thermometers.

In view of this situation, the present tendency to require an indicating mercury thermometer in each holder has considerable justification. It will be well if such thermometers have a scale divided into single degrees to facilitate accurate reading.

Foam Elimination

The microscopic picture of foam and of cork is much alike; in both cases there are relatively solid walls enclosing air spaces. Both are fairly good insulators. As a result, the upper surface of a foam layer on milk tends to cool rapidly when exposed to the air.

At present much effort is being directed toward the elimination of foam in connection with pasteurization, and in most instances the foam can be reduced to comparatively insignificant amounts.

Since foam is merely air incorporated into the milk, any improvement which reduces such incorporation decreases the resulting foam. Pumps with a larger capacity than the milk supplied to them are one of the most prolific makers of foam. Such pumps can be provided with controls which will stop their foam formation.

Where foam cannot be prevented from forming in the holder in troublesome amounts, the surface of the foam should be heated above the pasteurizing temperature by means of steam.

Electric Flash Pasteurization

Each generation enjoys toying with the problems which were settled by its predecessors. Such review rarely does harm and occasionally adds something to our knowledge. In the end the essential facts become more firmly established.

At present there is some interest in the flash pasteurization of milk at 160° F., using electricity as the heating medium. The available studies indicate quite clearly that the germ-killing effect is due to the transformation of electricity into heat.

A committee representing the Pennsylvania State Department of Health conducted four series of tests of the destruction of germs of tuberculosis in milk when such milk was passed through a commercial electric flash pasteurizer at 160° F. They demonstrated the presence of the living germs of tuberculosis in the effluent milk from each test.

These results indicate that when operated at 160° F., such a flash pasteurizer cannot be depended upon to destroy germs of tuberculosis which may be present in the milk supply.

Until more conclusive data have been obtained, we should not approve any method of pasteurization in which there is a greater element of danger from infected milk than the holding process now practically universally adopted.

Milk-Borne Epidemics and Their Relation to Pasteurization

During the present year the United States Public Health Service has reported a list of milk-borne epidemics for 1925 which may be summarized as follows:

Disease	Epidemics	No. of Cases	Deaths
Typhoid	33	640	50
Paratyphoid	1	7	1
Paratyphoid B	1	30	3
Scarlet Fever	4	136	3
Diphtheria	1	14	1
Septic Sore Throat	6	972	5
Totals	46	1,799	63

It is noteworthy that 78 per cent of these epidemics occurred in cities of less than 50,000 population. These are the cities in which the proportion of pasteurized milk is lowest. These are also the cities in which the facilities for following up epidemics are least, and there is a strong probability that many such epidemics still go unreported. As matters now stand, there is reported practically an epidemic a week in the United States.

Typhoid fever furnished 70 per cent of these outbreaks. Eleven of these epidemics were attributed to carriers, eight to cases, one to both a case and a carrier, while in 27 instances the infecting cause was not given.

It is important to know that 32 of the 33 typhoid epidemics were spread by raw milk.

We should also give thoughtful attention to the case where an epidemic was attributed to pasteurized milk. This epidemic occurred at Coffeyville, Kansas, in June, 1924. The details regarding this have been kindly furnished by Dr. C. H. Kinnaman, Epidemiologist of the Kansas State Board of Health, as follows:

> "My investigation traced all these cases of typhoid fever to consumers of milk obtained from this pasteurizing plant. An inspection of the plant showed it to be in a very unsanitary condition. The wash stands in the toilet rooms had been removed, and in the stock room everything was uncovered and no screens were on the building.
>
> "There were three proprietors, and in questioning these men I found that one had been absent from the plant for fourteen days and under treatment by a chiropractor. From the history obtained, this man no doubt had a mild case of typhoid fever; and upon examinations of specimens of his feces we recovered paratyphoid bacilli from his discharges. We also found that his brother, who was under treatment by a chiropractor, also had typhoid fever at the time of our investigation. He was employed at the plant and frequently drank milk.
>
> "On the day that the proprietor who had given this history of sickness returned to the plant, the only thing he had to do with the handling of the milk, according to the information received from him, was that he picked the bottles up by the neck as they came

from the pasteurizing plant and placed them in the cases.

"In questioning the employes as to where they washed their hands when they came from the toilet, they pointed to the tanks where they also washed the milk bottles.

"These cases came down with typhoid fever in from ten to fourteen days from the time this proprietor returned to the plant after his fourteen days' illness.

"The machinery and the evidence showed that the milk had been held at a temperature of 145 for 30 minutes, and as this plant was handling the production of 18 dairies and distributing approximately 500 quarts daily, our conclusion was that he contaminated the necks of the bottles as he placed them in the cases."

Apparently this is an instance where pasteurized milk was put into infected bottles, and it emphasizes the fact that we should give increased attention to the details of bottle washing.

In addition to the outbreaks enumerated by the United States Public Health Service, the Massachusetts State Department of Health reports during 1925 an epidemic of scarlet fever at Clinton with 56 cases due to a case; a diphtheria outbreak at Stoneham of 25 cases due to a case; and a typhoid epidemic at Quincy of eight cases, cause unknown. These additions alone bring the total of epidemics up nearly to the one per week average.

During the past year there has been the usual list of epidemics reported by the various agencies.

The Massachusetts State Department of Health reports that during September and October, 1926, there was a typhoid fever epidemic at Waverly spread through raw milk, producing 21 cases due to a case; in December a typhoid outbreak at Lincoln-Concord-Weston of 50 cases spread through raw milk, due to a carrier; and also in December another typhoid outbreak at Hyde Park producing 28 cases and one death, due to an active case who contaminated previously pasteurized milk.

The Pennsylvania State Department of Health reports four epidemics of typhoid fever spread through raw milk in 1926, and two such epidemics spread through raw milk during 1927 up to September 14th. The carrier at the farm causing two of these epidemics was located by the traveling laboratory.

The Iowa State Department of Health reports in 1926 an epidemic of 10 cases and three deaths at Waterloo due to typhoid, and in 1927 a similar outbreak at Hawarden causing 43 cases and three deaths, both spread through raw milk.

The Nebraska State Department of Public Welfare reports that during October to December, 1926, there was an epidemic at Hastings with 60 cases and six deaths due to two cases of typhoid at the dairy farm.

Wisconsin reports an outbreak of paratyphoid at Reedsburg in December, 1926, resulting in 12 cases and one death, spread by a raw milk peddler who developed the disease.

The New Mexico Bureau of Public Health reports a typhoid fever epidemic at Carlsbad, May and June, 1925, caused by boy who delivered bottles to the houses and resulting in nine cases but no deaths.

From Hawaii comes a belated report of a diphtheria epidemic in 1921 spread by raw milk infected by a carrier who was the owner of the dairy.

The State Board of Health of Indiana reports three typhoid fever epidemics spread through raw milk during 1926. One of 18 cases was at Mooresville, another of 33 cases at Elwood, and a third of five cases at Anderson.

The New Jersey State Department of Health reports the following milk-borne epidemics during 1925, 1926, and 1927:

Date	Disease	Location	No. of Cases	No. of Deaths	Vector of Infection
1926	Typhoid fever	Westfield Town Elizabeth City Newark City	9	1	Raw milk
1927	Typhoid fever	Riverside Boro.	8	1	Raw milk

Date	Disease	Location	No. of Cases	No. of Deaths	Vector of Infection
1927	Paratyphoid fever B	Saddle River Boro. Hokokus Boro.	43	0	Raw milk
1925	Scarlet fever	Netcong Boro. Standhope Boro. Roxbury Twp. Mt. Olive Twp.	50	0	Raw milk
1927	Scarlet fever	Washington Boro. Washington Twp.	199	0	Raw milk

The Winnipeg Department of Health reports a typhoid epidemic of 17 cases due to a carrier in a raw milk dairy.

The Missouri State Board of Health reports an epidemic of typhoid in 1925 at Lebanon causing 60 cases and three deaths, due to raw milk infected by a carrier.

The Tennessee State Department of Public Health reports as follows:

> "In July, 1926, Kingsport, Tennessee, had an epidemic of typhoid fever which was traced to one supply of raw milk which involved 25 cases and one death. It was concluded that the source of infection was a carrier in the dairy.
>
> "In September, 1926, Dyersburg, Tennessee, had an outbreak of acute gastro-enteritis caused by the *Salmonella suipestifer,* involving 150 cases and no deaths, and was traced to one supply of raw milk. The source of infection of this milk could not be definitely determined. It was probably due to some defect in the handling.
>
> "In July, 1927, Lenoir City, Tennessee, suffered from an outbreak of typhoid fever, the vehicle of infection of which was in all probability raw milk obtained from a dairy farm on which previously a suspicious case of illness was reported."

The California Board of Public Health reports an epidemic of typhoid causing 29 cases and five deaths, due to a typhoid carrier who did the milking.

The Illinois State Department of Public Health reports milk-borne typhoid epidemics during 1926 at Dupo, Sorento, and Rochelle, with a total of 39 cases. The outbreak at

Rochelle of 24 cases was attributed to the return of infected bottles from an original case without any proper heat treatment of the bottles.

During June, 1927, there developed 15 cases of typhoid at Cairo and Mounds attributed to raw milk infected by a carrier.

The Kansas State Board of Health reports a milk-borne outbreak of typhoid at Hoisington, where the source of the infection has not yet been determined.

The Arizona State Board of Health reports an epidemic of typhoid fever caused by raw milk at Tempe-Mesa, but details are not given.

Dr. E. C. Levy reports locating an epidemic of 12 cases of typhoid due to a raw milk supply just outside Tampa, Florida.

The Kansas City, Missouri, Health Department reports an outbreak of typhoid fever spread through raw milk. The proprietor of the dairy had a history of having had typhoid.

The New York State Department of Health reports during 1926 two epidemics of diphtheria, two of scarlet fever, eight of typhoid fever, and two of intestinal disturbances, all due to raw milk. These epidemics produced 393 cases and 18 deaths. Seven epidemics were spread from cases and four from carriers. One epidemic of typhoid fever was attributed to infected bottles returned from a case.

An important contribution to our knowledge of the carrier problem was made by the Ohio State Department of Health. In connection with a raw milk typhoid epidemic in August, 1926, at Wellington, with 154 cases and 14 deaths, they found a milker who had been associated with the Sandusky raw milk epidemic of the year before which had produced 70 cases and nine deaths and for which the cause had not been found. Continuous laboratory work for two months demonstrated that this milker was an intermittent discharger of virulent typhoid organisms. This long-continued study both explained the source of two epidemics and at the same time illustrates the difficulties which confront attempts to protect milk from carriers by mere medical examinations or occasional laboratory examinations of discharges.

The Ontario, Canada, Department of Health reports a typhoid epidemic at Chatham in August, 1927, with 108 cases and four deaths due to milk which was supposed to have been pasteurized. No recording thermometer was in use, the installation included a dead end of 27 inches between the pasteurizer and the outlet valve, and the raw and pasteurized milk passed through the same pump and pipe lines.

This long and disagreeable list of 52 epidemics, in addition to the 46 reported by the U. S. Public Health Service, is presented with two objects in mind. First, it shows that with very few exceptions such epidemics are spread through raw milk, and thereby emphasizes the importance of pasteurization as a means of safeguarding the milk supply. In the second place, the few epidemics spread through milk which had been pasteurized and was later contaminated emphasizes the necessity of giving closer attention to the details of plant organization and operation. The problem of proper handling of the bottles should be given more consideration than it is now receiving. Laboratory examinations of the excretions of all individuals coming into contact with the milk after pasteurization should be universal. Individuals who have had typhoid fever should be treated as carriers until repeated laboratory examinations fail to find evidence of typhoid germs. Where the history of individuals includes an attack of typhoid followed at intervals by cases among their immediate associates, health considerations would suggest the desirability of their elimination from the dairy business.

"Give light and the people will find their own way."

USE OF THE DIRECT MICROSCOPIC COUNT IN QUALITY CONTROL

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Securing a satisfactory quality of raw milk for pasteurization is a problem of interest to all connected with the dairy industry. Public health authorities are interested from the standpoint of public welfare, while milk producers' organizations and milk companies are interested because they know that a good grade of raw milk is necessary in order to put a good product upon the market.

For rapid grading of unpasteurized milk, the direct microscopic count has proved satisfactory. It has proved satisfactory because fairer judgment as to the quality of the milk is secured, since it is possible to recognize not only the numbers but also the morphology of the bacteria present. When milk is examined by the microscopic method, it is possible to determine whether a high bacteria count is caused by improper cooling, an insanitary condition of utensils, or a streptococcus infection of the cow's udder.

By grading the milk preliminary to inspection, attention can be concentrated on the shippers producing poor milk. When the inspector visits the shipper, this information makes it possible for him to locate the cause of the high bacteria count which, otherwise, he might overlook.

Many times producers do not cool their milk properly, even though they have good cooling facilities. The temperature of the milk as received at the plant may be low, and yet the milk may not have been cooled quickly enough to check bacterial growth. Some dairymen who are clean and careful in their methods are able to deliver better quality milk at a temperature of 65 degrees than others at 55 degrees. Too much emphasis should not be placed upon grading milk with the thermometer.

The direct count has proved satisfactory because it is quick and economical. Several of our large milk companies have been using it to determine whether the milk they are handling will conform to requirements which they are compelled to meet. They have used it with such satisfactory results that they expect to continue its use.

The technique of the direct count as used in the routine examination of milk is in accordance with Standard Methods, and is as follows:

One one-hundredth of a c.c. of milk or cream is measured by means of a clean capillary pipette accurately calibrated to discharge this amount. The straight pipette with the graduation mark one and one-half to two and one-half inches from the tip is most satisfactory. The milk or cream is then deposited on a clean glass slide. Glassware should be clean but need not be sterile. The few bacteria added through the glassware not being sterile can not grow, due to the quick drying, and do not appreciably affect the count. Cardboard or glass guide plates on which 16 square centimeter areas are conveniently placed are best for routine work where a large number of samples is to be examined. Glass slides measuring two by four and one-half inches are placed over these guide plates. The slides may be cut from thin window glass or old photographic negatives at less cost than they can be purchased. The margins of the slides are etched by sand blast or emery wheel to allow lead pencil labeling. In order to use these slides, a special large-size mechanical stage is necessary.

After placing the drop of milk on the slide, it is spread over an area of one square centimeter and dried evenly and quickly. Drying should be accomplished within five to ten minutes to prevent bacterial growth, and slides should be protected from dust and insects. For drying the smears, a tin box with a smooth level surface heated by an electric light bulb works satisfactorily.

After drying, the slides are placed in Xylol or other fat solvent for one minute. Slides may be left in longer without harm. This dissolves the fat so that the bacteria may be seen when stained. The slides are then dried and immersed in a 70-90 per cent solution of grain or denatured alcohol for one or more minutes. It is necessary to dry the slides because Xylol will not mix with alcohol. It is then removed from the alcohol, and with or without drying immersed in a solution of Loeffler's Methylene Blue. This is made up as follows:

30 c.c. saturated alcoholic solution of Methylene Blue
100 c.c. of a .01 per cent caustic potash solution

Old stains containing precipitates should never be used, as they may cling to the films and cause difficulty in reading. The proper length of staining is determined by close observation. If overstained, slides may be decolorized in alcohol. Slides are then rinsed in water, dried, and are ready for reading.

Before using the microscope, it should be standardized so that the area covered by each field is known. As this is covered in "Standard Methods of Milk Analysis," I shall only explain what is meant by standardization.

The diameter of the microscopic field is measured by means of a micrometer graduated in hundredths of a millimeter. From this, the area of a field can be computed. The area divided into 1 square cm. gives the number of fields in .01 c.c. of milk, which multiplied by 100 gives the number of fields in 1 c.c., or what we call the multiplication factor. It is possible by adjustment of the draw tube and the changing of lenses to so increase or diminish the size of the field as to arrive at a convenient multiplication factor. Factors commonly used are 300,000, 400,000, or 500,000.

At Pittsburgh, we are using a factor of 500,000, and our grades are as follows:

A (excellent) less than 500,000 individual bacteria per c.c.

B (satisfactory) between 500,000 and 2,000,000 individual bacteria per c.c.

C (unsatisfactory) between 2,000,000 and 4,500,000 individual bacteria per c.c.

D (very unsatisfactory) Over 4,500,000 bacteria per c.c.

Then these grades converted in terms of bacteria appearing per field will be as follows:

A—an average of less than 1 bacterium per field
B—an average of 1 to 4 individual bacteria per field
C—an average of 4 to 9 individual bacteria per field
D—an average of over 9 individual bacteria per field

An examination of twenty to thirty fields on each smear will tell us which grade to give unless it is on the border line between two grades, when it will be necessary to go slower and examine more fields. About four slides or 64 smears may be read per hour in this manner.

It is to be remembered that this is a count of individual bacteria, while the agar plate method is a count of colonies. A comparison of the agar plate and direct microscopic count shows that on the average the direct microscopic count is four times that of the agar plate. A direct microscopic count of 2,000,000 is then equivalent to an agar plate count of 500,000.

Every user of the direct count should be familiar with Circular Number 58, New York State Agricultural Experiment Station, "Counting Bacteria by Means of the Microscope," by Robert S. Breed and James D. Brew. For interpretation of results, Bulletin Number 120, New York State Agricultural Experiment Station, "The

Microscopic Appearance of Market Milk and Cream," by Robert S. Breed, is invaluable.

Perfection of the technique can only be attained through practice. Whenever possible, the beginner should visit a laboratory where the method is being extensively used, for a day or two of study and practice. Instruction offered in many of our dairy schools does not give the student the practical working knowledge which a laboratory handling hundreds and thousands of samples per month acquires.

I want to show you the adaptability of the direct microscopic count in quality control, by telling how it has been used by the Department of Health at Geneva, and commercially at Pittsburgh with members of the Dairymen's Cooperative Sales Company. Geneva has a population of approximately 20,000 and Pittsburgh 660,000, so you can see that the two offer different problems in milk control.

Geneva city milk control is under the supervision of Dr. Robert S. Breed, originator of the direct microscopic method for counting bacteria in milk. Geneva, while not claiming to have the best milk, unquestionably has the best system of milk control in the State of New York. Its milk supply comes from approximately 70 herds supplying two pasteurizing plants, and from four producers selling raw milk.

In this milk control work, samples from the individual cans of each shipper are taken at least twice a month. Testing each individual can gives much more complete information as to the past history of the milk than does one sample of the whole. As morning's milk need not be cooled if delivered before 9 A.M., it is possible to distinguish night's and morning's cans.

Let us take the case of John Smith, who is producing five cans of milk. He has good equipment, a good milkhouse, an up-to-date barn, and a milking machine, but has been receiving quite a few high bacteria counts. If his three night's cans grade unsatisfactory with lactic organisms present, in pairs or short chains, and the morning cans grade excellent, it is a safe conclusion that the night's milk was not properly cooled. If two night's cans are excellent, one unsatisfactory with lactics, the two morning's excellent, he probably mixed one can of night's and morning's milk without cooling the morning's milk. If one of the night's cans and one of the morning's contain long chain streptococci and leucocytes, garget is certain. If all cans are unsatisfactory with large clumps of bacteria, the milking machine is probably in a dirty condition. Suppose we call up Smith and ask him if he has cleaned his milking machine lately. He knows that we have the information, so will more than likely admit that he has been a bit slack and will try to do better. This conversation with the shipper over the telephone is nearly as effective as a farm visit and is much quicker and more economical.

A few days later, Smith's milk will be rechecked at the plant, together with the other shippers who received unsatisfactory tests. Their cans are set aside and examined at the plant within 15 or 20 minutes after delivery. Those cans that show an unsatisfactory bacteria count are returned to the shipper. Clean and well-cared-for morning's milk does not require cooling if delivered before 9 A.M., as bacterial development is not appreciable before that time. Temperatures are taken as a matter of record but are used with discretion. All microscopic slides are dated and filed for a permanent record. In case of dispute the slides can be gotten out and the dairyman shown the count of his particular sample.

Street samples secured from the dealer's wagons on the street are examined both by the direct microscopic and the agar plate count. By careful examination, it is possible to determine whether the count will go above 60,000. If it does, the dealer is notified and the trouble corrected immediately. This is later corroborated by the plate count.

A microscopic count is made of pasteurized samples as well as raw. While it does not differentiate between dead and living bacteria, their appearance is as significant in interpreting the past history of the milk as are living bacteria.

Experiments at Geneva a few years ago showed the presence of spore-forming rod-shaped organisms in samples of pasteurized milk which had not appeared in the raw supply. This same milk showed a low plate count, so it was apparent that they were not living bacteria. Examination of the interior of the pasteurizing equipment showed this to be their source. A few spores surviving pasteurization were forming millions of vegetative cells in the warm, moist tanks during the afternoon and evening. When the hot milk came through the following morning, these vegetative cells were killed and washed off into the milk. Thus the direct microscopic count is of value in detecting dirty pasteurizing equipment. Full results of this work are published in Technical Bulletin Number 119, New York State Agricultural Experiment Station, "Non-Thermophilic, Spore-Forming Bacteria Associated with Pasteurizing Equipment," by A. H. Robertson, M. W. Yale, and R. S. Breed.

Health authorities tell us that we are only using about two thirds as much dairy products as we should. Leaders of the producers, distributors, and consumers saw in this a chance to further the industry and improve public health by bringing this information before the public. The Pittsburgh District Dairy Council was formed in 1921 to serve this purpose.

Realization of the fact that an improvement in quality leads to an increased consumption of dairy products led to the formation of the Sanitation Department of the Dairy Council. The members of the producers' organization, the

Dairymen's Cooperative Sales Company, support us in our quality program in order to protect and build up a better market for their product. The distributors purchasing milk from the Dairymen's Cooperative Sales Company support us because they know their business depends upon the confidence the consuming public has in the product they are putting out. This work is supplementary to that of the city department of health and has been developed entirely by the industry itself.

The head of the department was sent to Geneva to study Geneva's system of milk control, with the result that the direct microscopic method was adopted here. Different field conditions make it necessary for us to apply it somewhat differently.

The Dairymen's Cooperative Sales Company supplies the markets of Youngstown, Ohio, Warren, Ohio, and Wheeling, W. Va., as well as that of Pittsburgh. Sanitation work is done in all of these districts. A brief description of the Pittsburgh milk shed will be necessary to acquaint you with our problems at Pittsburgh. About 65 per cent of the raw milk is received at country shipping stations in northeastern Ohio and northern Pennsylvania. This is shipped in glass-lined tanks mounted on railway cars or trucks to Pittsburgh, where it is pasteurized. Milk produced within sixty miles of Pittsburgh is trucked direct into the city and handled at city plants.

This makes it necessary for us to do most of our work in the field. We work in parties of two each and go out for a two-week period, coming back over the week-end for new supplies, and to keep in touch with the home office at Pittsburgh.

In order to carry as little equipment and work as economically as possible, we discontinued the use of test tubes in taking samples. For drying smears, we had a tin box made about 12 inches long, 8 inches wide, and 6 inches deep, with a cover to fit and a notch cut in one end to admit an electric light cord and 40-watt bulb. This box is placed waist-high beside the weigh vat in such a position that it is protected from dust and splashing of milk. Samples are taken from the weigh vat with a 10-c.c. dipper. The sample is taken direct from the dipper with a Breed pipette and placed on a glass slide resting on top of the box. The slide is numbered and the drop of milk spread over an area of 1 sq. cm. A pencil with a needle at one end and lead at the other is used for this purpose. The pipette is held in the mouth momentarily while numbering and making the smear. After taking each sample, the dipper, pipette, and needle are rinsed in clean water. It is not necessary to lay dipper, pipette, or pencil down and one man has been able to make smears as fast as two men can ordinarily dump milk. We tried this method out at our largest plant in the city of Pittsburgh with over 400 patrons, and one man was able to make all the smears. The stains are kept handy so that the slides may be stained between loads of milk. As soon as the last can of milk is in, the slides are ready to be read. As one man can average four slides per hour or 64 smears, it is possible to complete a plant with 200 patrons in approximately three hours. It is not best for one man to do more than this on account of the danger of eye strain. The binocular microscope is much easier on the eyes than the monocular and just as satisfactory.

The advantages gained through eliminating the use of test tubes were many:

1. Time and work required for washing, plugging, and sterilizing test tubes was saved.

2. There was less chance for error, as there were no test tube numbers.

3. It was not necessary to ice samples. There was less chance for growth of bacteria.

4. Less space was required.

The large number of patrons at our plants makes it impossible for us to test samples from each individual can except at small plants with less than 50 shippers. At first, we ran check tests on the second day from individual cans of shippers receiving unsatisfactory tests the first day. Later, this was discontinued, as we felt that getting around to each plant oftener with the one-day test accomplished more than the two-day test. Wherever possible, the testing from individual cans is to be preferred because of the extra information gained.

We have a record card for each shipper which is kept in duplicate, one card being kept at the home office while the other card is carried in the field when testing. The bacteria test is recorded on one side, the sediment test on the other, with space for a three-year record by months. At the top is the shipper's name, the plant to which he is shipping, and his number at that plant. Tests are recorded with a note as to the type of bacteria found when unsatisfactory. Shippers receiving an unsatisfactory test for the first time are notified by letter and a bulletin enclosed giving them proper instructions for the care of their milk. Shippers receiving a second consecutive high bacteria test are visited. When working in parties of two, one man will be testing the milk at a plant while the other man is visiting shippers with unsatisfactory tests at the plant tested the previous day. Plant inspections are also made, as we realize that a high grade of raw milk will not result in a high-quality product unless handled properly at the plant. With this system, the four men devoting their time to this work are able to reach each of 68 plants once every two months, and are averaging about 5,000 bacteria tests and 300 farm visits per month. Our tests are reaching 7,400 members of the Dairymen's Cooperative Sales Company.

One of the advantages of doing all of our work in the field is the confidence instilled in the minds of the dairymen and plant operators. They have an opportunity to see how the testing is done and a chance to ask questions. When they are up on a subject, they are not so apt to be down on it.

Up to this time our work has been chiefly educational, due to the fact that our bacteria testing has been going on for only two years and we have had to educate our dairymen in the production of quality milk. We are now ready to go ahead with more stringent regulations.

Securing a satisfactory quality of raw milk for pasteurization is not only a problem of interest but is of vital importance to the dairy industry. The direct microscopic count, by its adaptability to different conditions, has proved a valuable means toward this end.

"The world gives its admiration to those who do best what multitudes do well."

THE RELATION OF THE HYDROGEN ION CONCENTRATION TO THE TITRATABLE ACIDITY OF MILK

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The equivalent of the amount of alkali necessary to neutralize milk to phenolphthalein calculated as lactic acid is a suggestive indication of the age of milk and of its care. This is especially true in the different dairy manufacturing processes. In cheese making the acid test is used in determining the quality of the milk before the cheese-making process is started. The acid test is also used in determining the amount of acid present in the milk and whey at different stages of the operation. In butter-making the uniformity of the product depends on the ripening of cream, which can be properly controlled only by knowing its acidity. In the manufacture of condensed milk the acid test is used in selecting the milk to be used for condensing. Thus, in nearly all the dairy processes the acid test is used as one of the factors in determining milk quality. Its success depends partially, at least, on a uniform milk supply.

The titratable acidity of fresh milk is more or less related to its solids-not-fat content. Milk with a high solids-not-fat content has in general a higher titratable acidity than milk with a low solids-not-fat content. Accordingly, milk from Jersey and Guernsey cows has a higher titratable acidity when fresh than does milk from Holstein cows. This variation has been previously brought out by McInerney.

Our present knowledge of hydrogen ion concentration leads us to assume that it is this factor that causes some of the properties of milk to change with the acidity. There must be, therefore, a rather close relationship between the titratable acidity and the hydrogen ion concentration of milk. In this paper the authors present some information as to the general relationship between these two methods of expressing acidity.

Data presented by Baker and Van Slyke, and Rice and Markley, show a general relationship between the pH and titratable acidity.

We will show also that a distinctly different relationship exists between the titratable acidity and hydrogen ion concentration of fresh milk, as compared with milk after the production of lactic acid by bacteria has begun.

In our experimental work the hydrogen ion concentration was determined electrometrically at 25° C. The titratable acidity was expressed as percentage of lactic acid. The hydrogen ion concentration of fresh samples examined expressed as pH ranged from 6.0 to 7.73 and the titratable acidity from 0.05 to 0.50 per cent expressed as lactic acid. The samples consisted of normal milk, colostrum milk, milk drawn during the first few days of lactation, samples from diseased udders, gargety milk, and from cows that had not been milked for some time.

The results were plotted in Fig. 1 and show a definite relationship between the hydrogen ion concentration and the titratable acidity of fresh milk. With a few exceptions all points fell very close to or on the curve.

The results show that with a pH below 7.0, the pH of fresh milk can be estimated from the titratable acidity with an error which is usually less than 0.1 pH. There are 179 points in the figure and 91 per cent of their number fall within 0.1 pH of the curve. The average deviation from the curve is 0.058 pH units.

After completing the curve a table was constructed to show the relationship between the hydrogen ion concentration and the titratable acidity. This table gives the titrat-

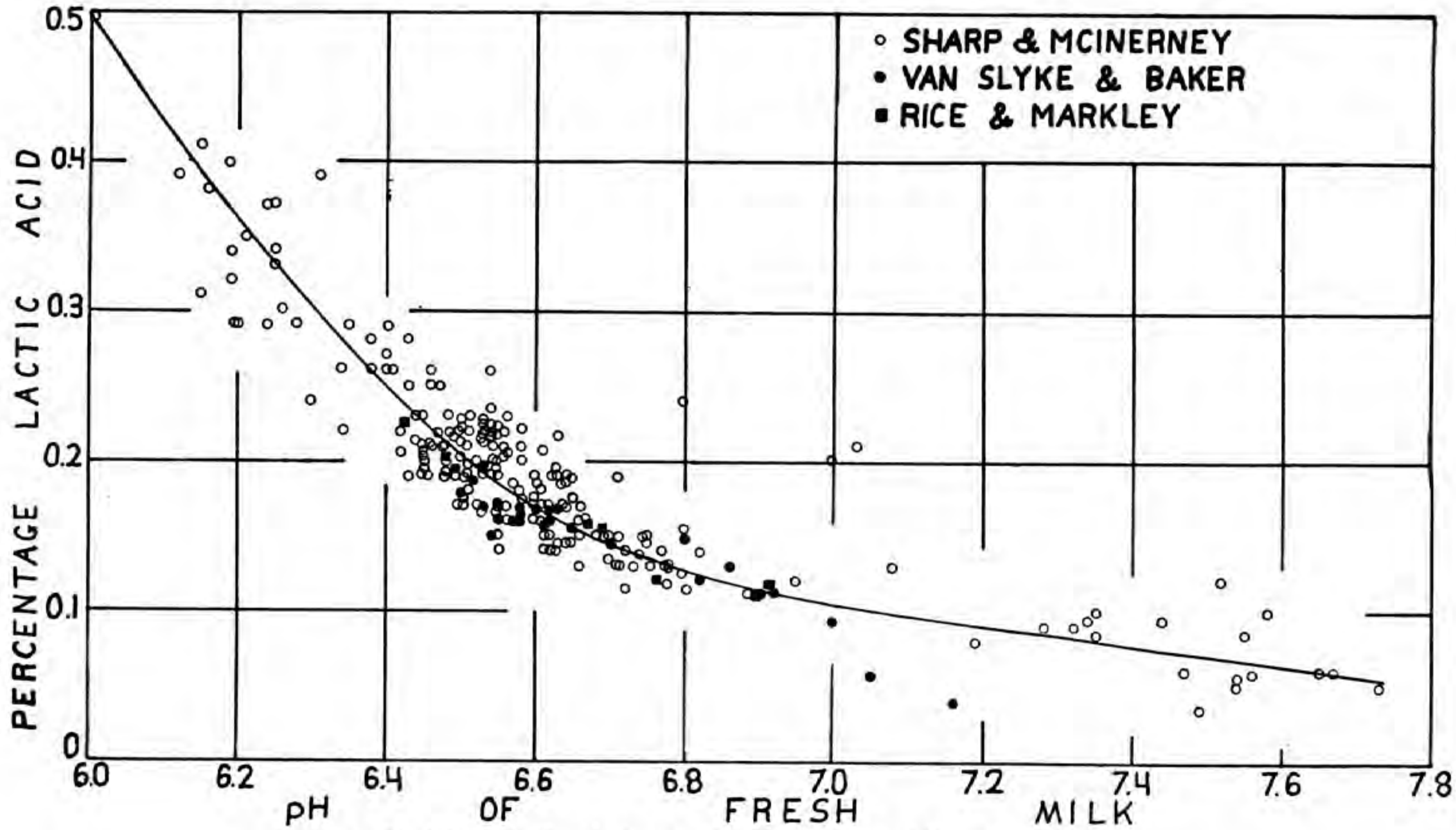


FIGURE 1. The relation between the titratable acidity, expressed as percentage of lactic acid, and the pH of fresh milk.

able acidity for each 0.1 pH interval as estimated from the curve.

TABLE I

The pH of fresh milk and the corresponding titratable acidity, expressed as lactic acid, determined from the curve.

pH	Titratable acidity	pH	Titratable acidity
6.0	0.50	6.7	0.145
6.1	0.43	6.8	0.125
6.2	0.36	6.9	0.115
6.3	0.30	7.0	0.105
6.4	0.25	7.1	0.095
6.5	0.205	7.2	0.090
6.6	0.165	7.3	0.085

This table may be used as follows: If a sample of fresh milk shows a titratable acidity of 0.25 it should have a pH of 6.4, and if a sample of fresh milk shows a pH of 6.5 it should have a titratable acidity of 0.205 per cent. As

TABLE II

DECREASE IN PH AND INCREASE IN TITRATABLE ACIDITY AS MILK SOURS

Sample No. 1		Sample No. 2		Sample No. 3		Sample No. 4		Sample No. 5	
pH	Titratable Acidity	pH	Titratable Acidity	pH	Titratable Acidity	pH	Titratable Acidity	pH	Titratable Acidity
	%		%		%		%		%
6.00	0.50	6.37	0.25	6.48	0.20	6.51	0.19	6.98	0.11
5.91	0.55	5.96	0.34	6.25	0.26	6.01	0.30	6.66	0.16
5.55	0.73	5.71	0.40	6.15	0.28	5.84	0.33	5.93	0.27
5.19	0.19	5.45	0.47	5.52	0.41	5.53	0.40	5.68	0.32
512	0.96	5.29	0.53	5.25	0.53	5.42	0.43	5.38	0.39
4.88	1.29	5.27	0.58	5.06	0.61	4.81	0.65	4.97	0.53
4.82	1.32	5.06	0.62	4.26	0.96	4.65	0.70	4.76	0.61
4.75	1.50	4.91	0.66	4.00	1.17	4.17	0.97	4.65	0.65
4.61	1.60	4.87	0.70	3.78	1.40	4.12	0.99	4.46	0.76
4.54	1.68	4.78	0.75	3.61	1.62	3.92	1.14	...	...
4.25	2.00	...	...	...	...	3.86	1.23	...	...
...	...	...	...	...	...	3.72	1.44	...	...
...	...	...	...	...	...	3.68	1.45	...	...
...	...	...	...	...	...	3.59	1.62	...	...
...	...	...	...	...	...	3.55	1.73	...	...

stated above, this relationship exists only in the case of fresh milk. When lactic acid starts to develop, an entirely different relationship exists.

The second part of the paper takes up the relationship existing between the pH and titratable acidity as soon as the real lactic acid starts to develop in the milk. Such samples of milk are spoken of as sour milk. In this experimental work, the titratable acidity and the pH were determined in the samples of fresh milk and then the samples were allowed to sour naturally or were inoculated with acid-producing organisms. These results are expressed in the form of curves in Fig. 2. The sour milk curves start on the fresh milk curve but soon leave it to form curves of their own. Thus each sample of milk having a different initial pH and titratable acidity will form its own curve. The slant of the

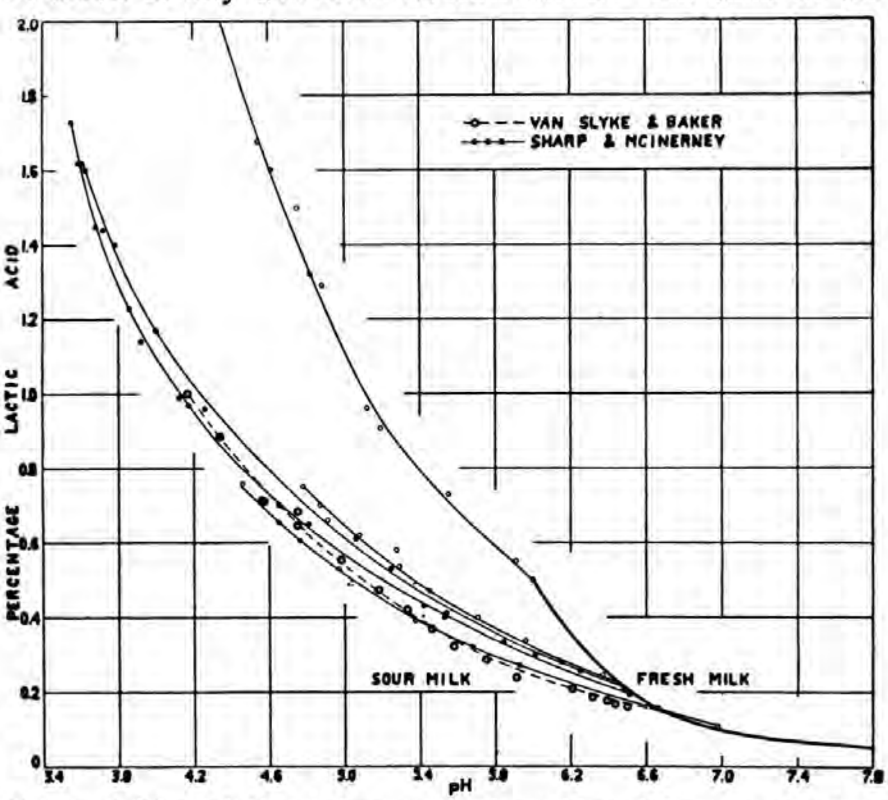


Figure 2. The relation between the titratable acidity, expressed as lactic acid, and the pH of sour milk. The heavy line curve is the curve for fresh milk. The sour milk curves start from this base curve.

curves formed from the sour milk samples is fairly uniform, but if the buffer content of milk is high, then the milk changes less in pH for a given unit of lactic acid produced than it does if the buffer content is low. Figure 2 also contains data given by Van Slyke and Baker.

As a practical application of this work, if we know the titratable acidity of a sample of milk and if along with this the pH of the sample of milk is determined, then by means of Figures 1 and 2 it can be told with approximate accuracy whether or not lactic acid has developed in the milk.

The following example serves as an illustration: A sample of fresh milk with a titratable acidity of 0.20 per cent should be approximately 6.5 in pH value. If the pH value is definitely lower, one can be reasonably sure that the milk is not fresh. One sample in Fig. 2 with 0.20 per cent acidity has a pH of 6.32; thus the point does not fall on the fresh milk curve but in the sour milk region. On the other hand, two other samples, when fresh, had a titratable acidity of 0.19 per cent and a pH of 6.51, and a titratable acidity of 0.20 and a pH of 6.48, respectively. These fall on the fresh milk curve.

Two samples of Fig. 2 were inoculated with a high acid-producing starter, while the other samples were inoculated with ordinary starters. The samples which soured naturally produced curves, the majority of which were very similar to those given in Fig. 2, but there were a few instances where the curves crossed. These differences were probably due to the reasons stated above; namely, the composition of the milk, the kind of inoculation, and the resulting product produced. The definite relationship between pH and titratable acidity does not hold for old sour milk.

A study of the effect of neutralizing sour milk to the titratable acidity of fresh milk, and a comparison of the pH of the neutralized milk with the pH of fresh milk, was also made.

Several samples of fresh milk were tested for titratable acidity and pH. These samples were then allowed to develop different amounts of lactic acid. This lactic acid was then neutralized to different percentages of acidity as found in fresh milk, and pH determinations made.

In over fifty samples of milk thus treated, the points fell in the sour milk region of the curve. That is, all points fell below the curve for fresh milk, varying from 0.01 to 0.4 pH more acid than the fresh milk with a corresponding titratable acidity. This is probably due to the fact that as soon as real acidity is developed in normal milk, the salt balance is changed and the addition of alkali does not readjust this so-called salt balance.

If these determinations are to be made on neutralized cream, the skim milk portion of the cream should be used.

Summary

Samples of fresh milk, including a few samples of colostrum milk, gargety milk, etc., were obtained which ranged in titratable acidity from 0.50 to 0.05 per cent expressed as lactic acid, and in pH from 6.0 to 7.73.

A relation between the pH and the titratable acidity of fresh milk was found by means of which the pH can be determined from the titratable acidity with an average error of ± 0.06 pH, provided the titratable acidity is greater than 0.10 per cent.

A different relationship exists between the titratable acidity and pH of sour milk, as compared with fresh milk, by means of which fresh milk, which has a high acidity, can generally be recognized.

The titratable acidity of milk is a simple index of the acidity factor, but this investigation indicates that as an adjunct a determination of the pH may in many cases be of great value in determining the extent of acid development in the milk.

Bibliography

1. Van Slyke, L. L., and Baker, J. C., J. Biol. Chem., 1919, xl, 345.
2. Van Slyke, L. L., and Baker, J. C., J. Biol. Chem., 1919, xl, 335.
3. Baker, J. C., and Breed, R. S., J. Biol. Chem., 1920, xliii, 221.
4. McInerney, T. J., J. Dairy Sci., 1920, iii, 227.
5. Rice, F. E., and Markley, A. L., J. Dairy Sci., 1924, vii, 468.
6. Murray, J. K., and Weston, V., J. and Proc. Roy. Soc. N. S. Wales, 1924, lvii, 256.
7. Sharp, P. F., and McInerney, T. J., J. Biol. Chem., 1926, lxx, 729.
8. Van Slyke, L. L., and Baker, J. C., J. Biol. Chem., 1918, xxxv, 147.
9. Sharp, P. F., and McInerney, T. J., J. Biol. Chem., 1927, lxxv, 177.

"The honors of genius are eternal."

GRADE "A" MILK IN WISCONSIN

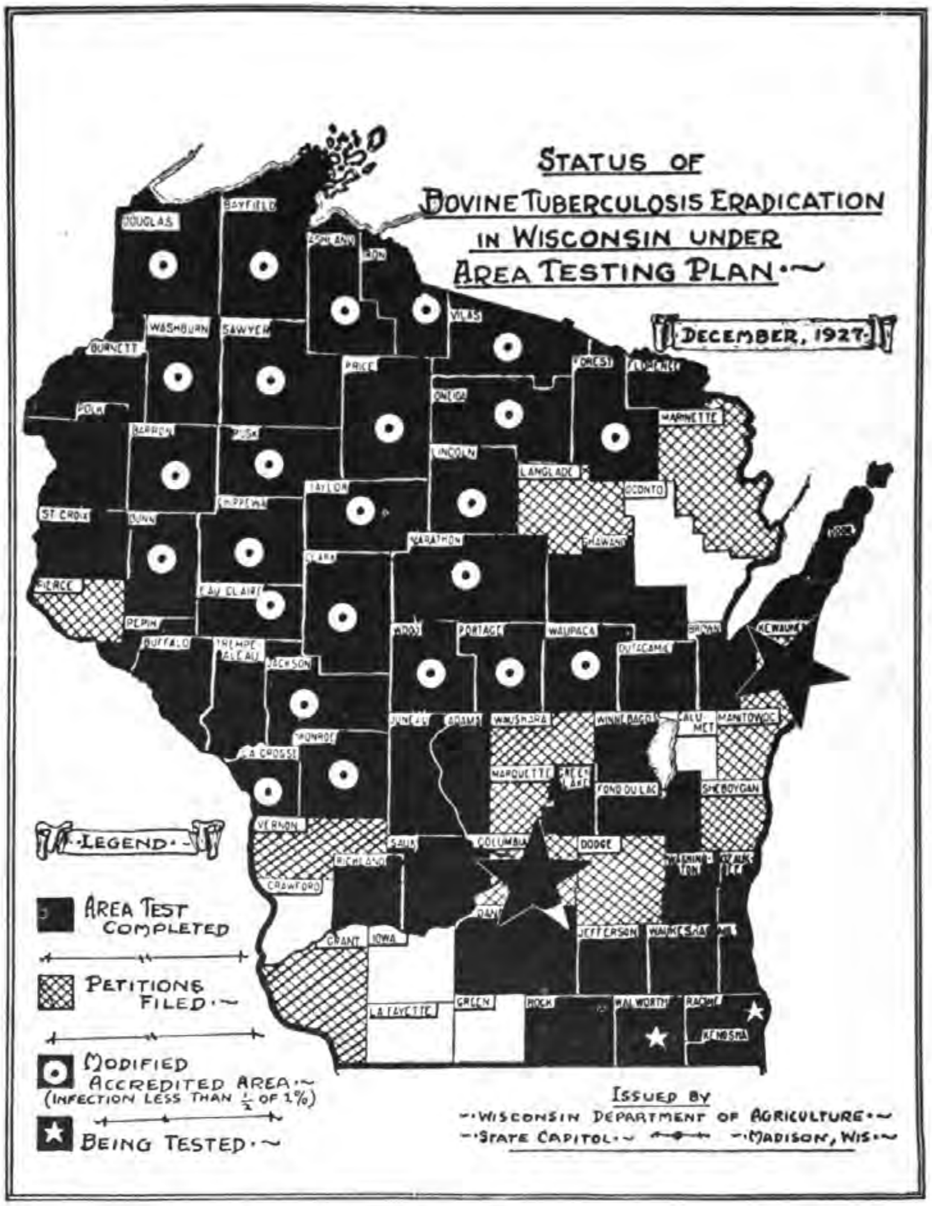
FLOYD C. RATH, *Dairy and Food Inspector*
Madison, Wis.

In this crusade period for better milk, Wisconsin is fortunate in having two of its State departments stand out in the limelight. Its Department of Agriculture has progressed with the eradication of bovine tuberculosis to the extent that 48 counties have had their herds tested, the herds in 17 counties are now tested or are ready to test, and only six counties remain to petition for the area test. In addition to this, some of the larger cities have required all their potable milk supply to come from tuberculosis-free cows. Madison adopted such an ordinance in 1924, and Milwaukee in 1926. In other parts of the State, especially in the southern part, herds have been tested to meet the Chicago requirements.

According to the Bureau of Agricultural Economics of the United States Department of Agriculture, the milk industry in Wisconsin represents 11 per cent of the total milk production in the United States, over ten billion pounds of milk produced annually, 190 million dollars in income, and 49 per cent of the total farm income of the State. There are 2,860,000 cows in the State.

The State Department of Markets, in order to stimulate a desire for a uniform grade of milk in the cities of the State and also to have a milk that is uniform in classification with milk in other cities of other States, adopted in the latter part of July, to be effective August 30 of this year, the model United States Public Health Service Standard Milk Ordinance for Grade A raw and pasteurized milk and cream.

The Bureau did not deem it necessary to include provisions for Grades B and C raw or pasteurized milk. According to Mr. J. W. Yates, their marketing specialist, present observation would indicate that 90 per cent of all the potable milk



supplies of the State will meet Grade A requirements. The Wisconsin climate, with its cool nights, relatively short hot periods, and abundant supplies of cool water, makes an ideal combination of conditions for the production of market milk.

The bacterial count for Wisconsin Grade A pasteurized milk was modified to require the milk prior to pasteurization not to exceed 200,000 colonies per cubic centimeter and not to exceed 25,000 colonies per c.c. (instead of 50,000) at any time after pasteurization and until delivery.

In addition to the United States Public Health Service requirements, the Department requires the following contract to use the label "Wisconsin Grade A Milk":

Contract to Use Registered Label

The following agreement is hereby made this .... day of ...., 19......, at ...., Wisconsin, between .... (Hereinafter called the "applicant") and the Wisconsin Department of Markets (hereinafter called the "Department").

1. The applicant agrees that .... will comply with all the lawful requirements contained in the standards established by the Department for "Wisconsin Grade 'A' Raw Milk" and "Wisconsin Grade 'A' Pasteurized Milk," and amendments thereto, and all lawful rules and regulations issued by the Department.

2. The applicant agrees that all laboratory work shall be done at a place and in a manner approved by the Department.

3. The applicant agrees that if .... violates any of the provisions of these standards or of this agreement the Department may on one day's notice in writing withdraw the use of its registered label.

4. The Department agrees that the applicant may use the Department's registered label covering "Wisconsin Grade 'A' Raw Milk" and "Wisconsin Grade 'A' Pasteurized Milk" upon milk meeting the requirements of the standards.

5. The Department agrees that it will supervise the field service and laboratory work provided by the applicant.

6. This agreement may be suspended on one day's notice in writing given by the Department to the applicant for violation of any of the provisions of this agreement, and either party may terminate the agreement by giving thirty days' notice in writing to the other one and returning the unused labels, if any.

7. The parties agree that the provisions of this agreement shall not affect the sale of any fluid milk labeled other than

"Wisconsin Grade 'A' Raw Milk" and "Wisconsin Grade 'A' Pasteurized Milk."

....
Company

By..

WISCONSIN DEPARTMENT OF MARKETS

By..

Although Madison, a city of 50,000 population, has 95 per cent of its milk supply pasteurized or certified, it was the first city in Wisconsin to pass the standards as promulgated by the Department of Markets. This was done to give the remaining 5 per cent of its milk supply a national classification.

In addition to State requirements, Madison requires the following health certificates: Every person connected with a dairy or milk plant whose work brings him in contact with the production, handling, storage, or transportation of milk or milk products shall have within six months passed a medical examination by a licensed physician and the health certificates from such examination filed with the Madison Health Department. The examination shall include a nasal and throat culture, together with an examination of the feces and urine by the State Laboratory of Hygiene. It is expected that all new employes shall file a health certificate within forty-eight hours after they commence work.

"There is no short cut to confidence."

STATISTICAL ANALYSIS OF BACTERIA COUNTS MADE BY THE DIRECT MICROSCOPIC AND AGAR PLATE METHODS

JAMES D. BREW, *Professor of Dairy Extension*
Cornell University, Ithaca, N. Y.

Laboratory technicians and investigators interested in the sanitary quality of milk have given considerable thought to the comparative accuracy of the various methods commonly used in bacterial control. The cultural plate method has been universally accepted as the standard, primarily because it was the first by which it was possible to make bacteria counts and because of its official adoption.

Marked deviations of the results obtained by any of the newer methods from results obtained comparatively by the official plating method have been and still are regarded as conclusive evidence that the method in question is unsatisfactory. For example, the prevalent opinion seems to be that counts by the direct microscopic method are highly variable and are so inaccurate that the application of this method is seriously limited. The popular conception regarding the application and accuracy of the direct microscopic method is well illustrated by the following quotation from a widely recognized authority: "The error in estimate is probably quite large. It should be used for general groupings, rather than for estimates of actual counts." (From Kelly and Clement's book—*Market Milk.*)

It is easy to understand why the inference is drawn by most readers that counts by the official plating method must be less variable and more accurate. With this idea in mind, many health officials refuse to institute any type of laboratory control of city milk supplies if they are unable to maintain a laboratory equipped for the making of plate counts.

Most conclusions regarding the accuracy of the two methods of counting bacteria have been based upon an analysis, by inspection only, of comparative counts made upon duplicate samples of milk. A satisfactory analysis of data by inspection is oftentimes possible, but it may, however, be misleading because actual differences do not always stand out clearly and also because too much reliance is apt to be placed upon averages.

We are apt to use the word "accuracy" too loosely in attempting to compare the two methods. If it were possible to make an exact count of the actual number of bacteria in a given quantity of milk, as it is possible to count the peanuts in a jar, it would be an easy matter to determine the accuracy of any method of making estimates of bacteria. But this being out of the question, we are forced to judge the comparative reliability of any two methods by making a long series of counts upon duplicate samples. In order to reach the safest conclusion, such data should be subjected to a careful statistical analysis. If the results obtained by the two methods should be widely divergent, then it would be difficult, if not impossible, to decide which was the more accurate. On the other hand, if they agree, at least fairly closely, the chances are that both methods give a comparatively accurate estimate of the number of bacteria present.

To make comparative studies of the two methods is a laborious and exacting task. The larger the number of comparative counts, the better. There are some data available in the literature. Comparative counts were made prior to 1917 upon 643 samples of raw market milk as delivered by the producers to the fluid milk plants at Geneva, N. Y. The results were published in Bulletin 439 of the Geneva station. Four hundred and ninety-one represent comparative counts made, using plain nutrient agar, and 152 using lactose agar. These studies were made prior to the publication of the first Standard Methods report. An effort was made, however, to employ a technique which would yield the highest plate count possible.

The medium used was made according to the following formula:

Liebig's Beef Extract	5 grams
Witte's Peptone	10 grams
Agar (shreds)	15 grams
Distilled water	1 liter

To this was added 10 grams of lactose in making the lactose nutrient agar. The H-ion concentration as determined colorimetrically ranged betwen pH-6.5 and 7.0.

Three dilutions were prepared and triplicate plates were made from each. All plates were incubated at 21° C. for five days and then counted with the aid of a magnifying lens, after which they were incubated two additional days at 37° C. and recounted. The count recorded in each case was the higher of the two. In selecting the plates for counting, only those were chosen which had more than 20 and less than 400 colonies. There were necessarily a few exceptions to this rule, which were noted in the tables as originally published.

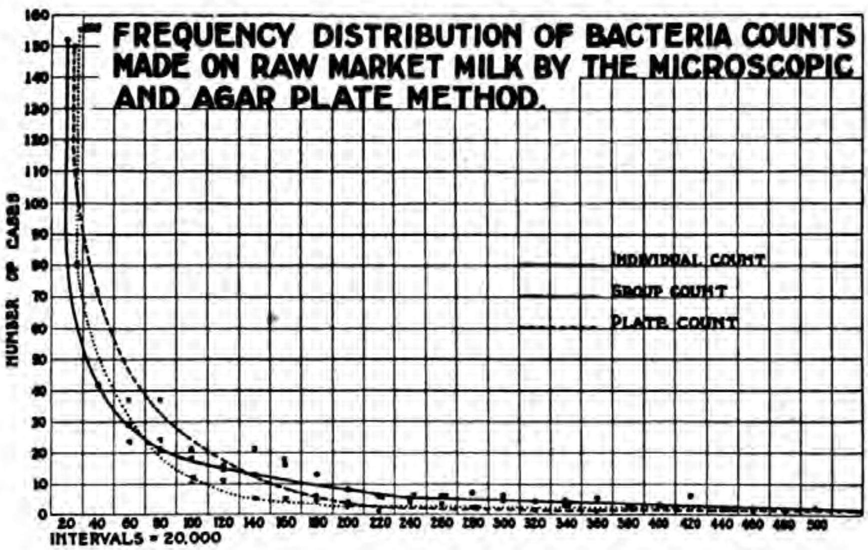
The microscopic counts were made according to the procedure described in Technical Bulletin 49 (3). The microscope was adjusted to give a multiplying factor of 300,000 for the computing of the number of bacteria per cubic centimeter. In order to secure as great a uniformity as possible the following rules were observed:

1. When there were few bacteria in number, 100 fields were counted; when fairly numerous, 30 fields were counted; and, if very numerous, 10 or even in some cases only 5 fields were counted.

2. Separate microscopic counts were made of the individual cells per cubic centimeter and of the groups of cells per cubic centimeter. Whenever a group was too large or too dense to make an accurate count of the individuals possible, an estimate was made.

It is impossible to repeat in this paper the long list of original counts. Any one interested is referred to Bulletin 439 (1). The results obtained for the 491 samples are presented in the accompanying graph, which shows the frequency distribution of the three types of counts. To conserve space, a graphic presentation of the 152 samples on lactose agar is omitted. Its inclusion would be a mere repetition, however.

It will be seen from the curve that the frequency distribution of the three types of counts shows a surprising agreement in the general distribution of the bacteria counts on



miscellaneous samples of raw market milk. In other words, one method is just as reliable in rating any given raw milk supply as the other. There occurred, however, marked discrepancies between counts made upon the same sample by the two methods. Occasionally one will obtain a very low individual or group microscopic count while the plate count will be considerably higher. This difference may be due to contamination in the plate method or possibly to the presence of an organism that is too small to see clearly under the microscope or to an organism that may not take the stain readily. Such an occurrence, however, is infrequent. Occasionally a very low plate count will be obtained while the microscopic count may be very high. The plate count may be even lower than the group count. Variations in the breaking up of clumps during the process of plating, together with the predominance in some samples of milk of organisms not adapted to growth, explain in a large measure this discrepancy.

The microscopic count of groups of bacteria per cubic centimeter is lower than the count of the individual cells per cubic centimeter and usually lower than the colony count by the agar plate method. This fact is explained by the breaking up of the groups during the process of preparing agar plates.

When one carefully weighs the possible causes of discrepancies by either method, together with the frequency distribution of counts, there is nothing to support the claim made by some that counts made by the plate method are more accurate than those made by the direct microscopic method. The coefficient of variability of the counts made by either method is very high. One method will give as reliable a picture of the bacterial condition, numerically speaking, of any given raw milk supply as will the other; except that by the direct microscopic method it is practically impossible to make exact counts where there are only a few thousand bacteria per cubic centimeter present.

The statement that has been made that the microscopic method should be used only to divide milk into "general groups" applies equally as well to the plate method.

"Thus each extreme to equal danger tends."

REPORT OF COMMITTEE ON METHODS OF BACTERIAL ANALYSIS OF MILK AND MILK PRODUCTS

GEORGE E. BOLLING, *Chairman*

In view of the increasing interest in the bacterial content of ice cream manifested in various quarters, it was thought advisable for this committee to devote its attention to trial of the two methods of measurement most commonly used, namely, the volumetric and the gravimetric

Any publicity given this subject will insure the interest of the consumers generally, and, logically, the milk control laboratory will be called upon to pass upon the merits of the various ice creams retailed in its jurisdiction.

It was found that a committee of the American Dairy Science Association, of which Prof. A. C. Fay is chairman, had formulated a report upon methods for determining the bacterial content of ice cream. The following extract from this report was sent to each member of the committee and the methods given therein were explicitly followed.

MEASURING THE SAMPLE

The sample of ice cream may be either weighed or measured: both methods have advantages and disadvantages. With ice cream it is frequently difficult to expel all the air, so that one ten-c.c. volume may contain more or less ice cream than another. Variations in the viscosity of the mix and in the cleanliness of the pipette may cause more or less of the mix to adhere to the glass. For these reasons the gravimetric method (weighed sample) is considered better than the volumetric method (measured sample) for the analysis of ice cream, ice cream mix, heavy cream, and melted butter. For the liquids of lesser viscosity the volumetric method is better. The gravimetric method has the disadvantage of being more tedious and more time-consuming, but in general gives more accurate and less variable results. However, if consecutive samples are being taken at the various stages in the process of ice cream manufacture, all determinations should be made on the same basis, either gravimetric or volumetric. The former method gives results in bacteria per gram, the latter in bacteria per c.c.

If the sample to be analyzed is frozen ice cream, it should be melted, and the air expelled by heating in a water bath at 45° C. (113° F.) for 15 minutes. A higher temperature used for melting the ice cream is likely to injure the organisms, and a lower temperature necessitates a sufficiently long exposure to permit noticeable growth of the bacteria. When the volumetric method is used for ice cream, extreme care should be taken to insure complete expulsion of the air and to rinse the pipette several times in the dilution water until the pipette is reasonably clean and free from cream.

Volumetric Method

Liquid Samples. The larger the volume of sample used in making the first dilution the less will be the error in measuring the sample. This is especially true of liquids of high viscosity, such as heavy cream and melted ice cream mix. The amounts most commonly used are one c.c. of sample in 99 c.c. of sterile water, five c.c. of sample in 95 c.c. of sterile water, or ten c.c. of sample in 90 c.c. of sterile water, giving dilutions of 1 in 100, 1 in 20, and 1 in 10, respectively. For all volumetric samples, the volume of the sample plus the volume of the sterile diluting water should equal 100 c.c. The dilution, therefore, should be expressed as "1 in 10," "1 in 100," etc., and the results in terms of "plate count per cubic centimeter—50,000," etc.

Gravimetric Method

The results of gravimetric analyses are reported in terms of "plate count per gram—50,000," etc. Although the gravimetric method requires more time, it has the advantage of eliminating the error due to the air included in melted ice cream, and to heavy viscous liquids adhering to the pipettes. If a ten-gram sample of cream, melted ice cream, condensed milk, etc., is weighed directly into a dilution blank, it does not matter how much adheres to the pipette or how much air remains in the melted ice cream.

Method of Weighing Sample Directly Into Dilution Blank

A dilution blank, containing 90 c.c. of sterile water, and a pair of Cornet forceps are counter-balanced on a good grade of torsion balances. It is more convenient to have a beaker of water on each pan of the balance to facilitate counter balancing. The instrument should be sufficiently sensitive so that one drop of water will disturb the balance. After counter-balancing to within one drop of a true balance, add a ten-gram weight to the pan opposite the dilution blank; remove the cotton plug from the dilution blank and suspend the plug over the edge of the pan by means of the Cornet forceps, taking care that the plug does not touch anything. Flame the mouth of the flask and introduce the sample to be analyzed, by means of a pipette, until the ten-gram weight is accurately balanced. Flame the mouth of the dilution bottle and replace the plug. Test the accuracy of the weighing by dropping one drop of the sample in the beaker on the opposite pan. If it is close enough so that one drop throws the balance to the other side, it may be considered sufficiently accurate for use in the analysis. If glass-stoppered dilution bottles are used, the Cornet forceps are unnecessary. (This is also the case when rubber-stoppered dilution bottles are used.)

Four laboratories have reported their work in time for presentation at this meeting. Without taking space for the numerous detailed determinations, a general average of the results follows, arranged alphabetically by States in which the laboratories are located:

Bacterial Counts of Ice Cream

	Volumetric Method	Gravimetric Method
Massachusetts	275,000	258,000
Michigan	269,000	293,000
New York	8,700	8,000
Texas	670,000	749,000

The majority of those engaged in the work arrived at the following conclusions:

Equally accurate counts can be obtained by either method.

The gravimetric method takes more time, one laboratory reporting this excess of time as 77 per cent.

In official control any question as to variation in density and air content raised by any one affected by or dissatisfied with a high count would be difficult to answer if the volumetric method were used. Such criticism would be obviated if the gravimetric method were used and the results reported in terms of "plate count per gram."

As empowered by this Association in 1923, we have continued to examine dehydrated media intended for use in plate counts of milk. Our approval was given to the product of the Digestive Ferments Company. This product is approved as a standard medium in the 1927 Edition of Standard Methods of Milk Analysis, published by the American Public Health Association.

"The optimist says, Keep the mud on the bottom; the pessimist, Keep the mud on the top. That's why they are both a nuisance to the man who wants the mud taken out."

SOME RESULTS OF THE REDUCTASE TEST AS USED IN ROUTINE MILK ANALYSES

E. B. Johnston, *Executive Officer,* Board of Health,
Framingham, Mass.

In the 1923 edition of the "Standard Methods of Milk Analysis" we find the following: "In spite of numerous attempts to find satisfactory and simple biochemical tests or tests for specific bacteria that will give results as valuable as those secured from bacterial counts, none have been found of such value that they have come into general use. For this reason only one of the most commonly used of these tests (the methylene blue reduction test) is included in the present report."

In the interval since that report was published, there has been an increasingly greater use of the reductase test, resulting in a better knowledge of the technic of the test and the interpretation and results. From the standpoint of research this increased use has been well justified; but has it given us a test which is simple and satisfactory, and which at the same time gives us information comparable with the cost and effort of making it?

For a period of over a year this test has been used routinely with all samples of milk taken in Framingham, and with a large number of samples of different but known qualities. The results have, we believe, brought out clearly some distinct advantages of the test as well as giving some information about its alleged disadvantages.

Advantages:

1. Test is simple and visible, making an impression on the milkman.
2. A more truly representative sample is obtained.
3. Test indicates the keeping quality of the milk.

4. Test requires little time and costs almost nothing.
5. Test has good effect on pasteurizing plant practices.

Disadvantages:

1. Result does not always agree with plate count.
2. Test requires great care in sterilization.
3. Test requires care in interpretation.
4. Test has too many unknown features.

I take it we have all had difficulty in convincing the small producer that a spot on a plate represents one germ in the diluted milk that was plated (especially when we ourselves know it often represents a clump of bacteria rather than a bacterium), or in obtaining his confidence in the more or less intricate and (to him) mysterious process of making a plate count. In the reductase test such a producer finds something simple that he can understand without difficulty, and something in which the results are startlingly clear to his eyes. If you want to see a producer interested in improving the quality of his milk, let him stand by while you make a reductase test of his milk, flanking it with two other tests using milk of high quality. When his milk turns white, leaving the other samples blue, you will see a really impressed dairyman. We have had several instances where we could get no result through the plate count, but a demonstration through the reductase test brought prompt action. In routine milk work, securing prompt cooperative action from the milkman is of great importance.

The second advantage and the first disadvantage may perhaps be discussed together, since in our experience these two observations are closely correlated. We all know error is possible in the plate count; if anyone doubts it, let him purchase a quart of milk and proceed in the usual manner to make fifty plates, and he will be surprised at the difference in the counts. In the "Regulations Relative to Establishments for the Pasteurization of Milk" recently adopted by the Massachusetts State Department of Public Health, this is recognized by providing for a median of not less than three nor more than seven samples, a requirement closely following that for Grade A milk in the same State. In the plate count we take one c.c. of milk, a very small per cent of the sample, and consequently one which it is extremely difficult to be sure is truly representative of the whole; we then introduce another danger of uniformity by diluting and again removing from the diluted sample a very small part of the whole. In the reductase test we have but one similar source of error, for we do not dilute. The one chance for error is smaller, for we remove *ten times as much* (10 c.c.) for the test. The sample used in the reductase test is therefore more truly representative of the whole than that used in the plate count. Furthermore, is not the usual one-tube reductase test more truly representative of the whole than the usual two- or three-plate plate count? We have tried to find the answer to this question by the old method of try-and-see, and our tests indicate strongly that the question must be answered in the affirmative.

Reference to Table II will show that different milks of the same plate count, kept under identical conditions (room temperature), showed great differences in the time they remained sweet, but that the reductase tests agreed very closely with the time the samples remained sweet. How much of this is accounted for by the "more truly representative sampling" is of course debatable. In an endeavor to obtain more information on this point, we selected four samples of different quality milks and made five plates and five reductase tests of each. The results may be found in Table I. It will be noted that the variation expressed in per cent of the smallest result was in every case much greater in the bacterial count than in the reductase test, being approximately ten times as large in the most favorable sample. We have reached the conclusion that in the reductase test we get a far more representative sample of the whole, and that when reductase test and plate count do not agree, the reductase test indicates much more accurately the "keeping quality" of the milk.

The reductase test has in our experience indicated very exactly the keeping qualities of the milk. The housewife is greatly concerned as to how long the milk she buys will remain sweet, and she has a right to know whether milk is "good," "fair," or "poor," from that standpoint. We do not attempt to say just how long a milk will stay sweet; we follow the method outlined in the "Standard Methods" with one exception; we designate as "excellent" milk which does not decolorize in eight hours. We thus give the public general information which we know to be true without making it so definite that we may overstep the bounds of fact, a thing which we must admit may often happen in publishing bacterial counts.

A distinct advantage of the reductase test is that it does not require costly or elaborate apparatus, it is simple and easy to make, and requires very little time. We secure our information at very little cost. Two alleged disadvantages bearing on this advantage were met and overcome. We first tried to sterilize our pipettes and tubes with steam, with results which were disappointing to say the least. For some eight months we have been sterilizing with commercial chlorine preparations with absolute success. For this process we fill tubes and pipettes with a dilution of the preparation five times as strong as that recommended and empty them a half hour later, making no attempt to drain them dry. Certainly with the much smaller amount of apparatus used and the greater volume of sample, the difficulty in sterilizing should be less with the reductase test than with the plate count. We were puzzled at the start to interpret some tests, particularly when the milk in the bottom of the tube decolorized after a short time, leaving the remainder blue for a long time. It soon became evident that the reaction in the bottom third of the tube bore apparently no known relation to the quality of the sample, and we now ignore reactions in that portion in reading the result. This point will be further discussed in treating the unknown features of the test.

One of the most pleasing results of the use of this test has been the real interest displayed by the operators of our pasteurizing plants. One operator is now making reductase tests himself on each jug of milk brought to the plant by each of his producers twice a week, while two others are making plans to adopt the same practice. By doing this the operator of the first plant referred to has succeeded in maintaining the quality of his product this summer at a far higher level than he has ever been able to maintain.

The big disadvantage of the reductase test is that there are still too many unknown factors about it. The whitening of the bottom of a sample while the top remains blue, a result already referred to, must mean something; what does it mean? A glance at Table II will show that in our experience pasteurized milk decolorized a little more quickly than raw milk of apparently the same quality; again, why? Is it possible that reactions like these might give us information about the kind of bacteria in the milk? Is it possible that the reaction in the lower third of the tube may depend on the manure or other decomposible dirt in the milk rather than on the bacteria? Questions like these are highly important, and there is a fertile field for research. The test is valuable enough without more knowledge about these points, and if we do learn that they have an important meaning, it will simply add to the value of the test.

In conclusion, we feel the reductase test is a simple, reliable, and inexpensive test, which gives us information at least as important and accurate as that furnished by the plate count; that it is most effective in dealing with plant operator, producer, and public, and that it may well be possible to so develop it as to obtain further important information as to the quality of milk.

TABLE I

	Tube No.	Time to Decolorize	Variation	Plate Count	Variation
Sample No. 1; Excellent Milk	1	14 hrs.		2,000	
	2	13 hrs., 30 mins.		10,000	
	3	14 hrs., 30 mins.	7%	14,000	600%
	4	14 hrs., 15 mins.		4,000	
	5	14 hrs., 30 mins.		8,000	
	6	13 hrs., 30 mins.		6,000	
Sample No. 2; Good Milk	1	5 hrs., 5 mins.		60,000	
	2	5 hrs., 15 mins.		110,000	
	3	5 hrs., 20 mins.	12%	70,000	133%
	4	4 hrs., 50 mins.		90,000	
	5	5 hrs.		140,000	
	6	4 hrs., 45 mins.		120,000	
Sample No. 3; Poor Milk	1	2 hrs., 20 mins.		420,000	
	2	2 hrs., 25 mins.		400,000	
	3	2 hrs., 15 mins.	11%	340,000	106%
	4	2 hrs., 20 mins.		440,000	
	5	2 hrs., 30 mins.		700,000	
	6	2 hrs., 20 mins.		600,000	
Sample No. 4; Very Poor Milk	1	15 mins.		2,000,000	
	2	17 mins.		1,200,000	
	3	14 mins.	36%	1,600,000	183%
	4	18 mins.		1,400,000	
	5	19 mins.		1,800,000	
	6	15 mins.		3,400,000	

TABLE II

Milk	Plate Count	Time to Decolorize	Time to Sour
Raw	10,000	14 hours	32 hours
Raw	100,000	6 hours, 10 mins.	18 hours
Raw	10,000	9 hours, 30 mins.	23 hours
Raw	1,000,000	15 mins.	5 hours
Raw	220,000	3 hours, 40 mins.	9 hours
Raw	10,000	13 hours, 40 mins.	30 hours
Raw	70,000	6 hours	17 hours
Raw	140,000	2 hours, 30 mins.	7 hours
Raw	60,000	6 hours	18 hours
Raw	28,000	12 hours	30 hours
Raw	4,000	13 hours, 30 mins.	32 hours
Raw	18,000	9 hours, 30 mins.	23 hours
Raw	12,000	12 hours	28 hours
Pasteurized	10,000	10 hours, 30 mins.	32 hours
Pasteurized	8,000	11 hours, 20 mins.	36 hours
Pasteurized	4,000	12 hours, 30 mins.	40 hours

Summary

Samples 1, 3, and 6, raw, and 14, pasteurized, with the same plate count remained sweet for varying periods of time, the reductase test indicating accurately this time except that the pasteurized sample decolorized somewhat more quickly than the raw sample remaining sweet the same time.

Sample 10, with more than twice the plate count of sample 13, remained sweet approximately the same time as the latter, while the time to decolorize the two samples was the same.

Sample 12, with nearly twice the bacterial count of sample 3, remained sweet the same time; the time to decolorize the two samples was identical.

Other comparisons of the same sort will show close correlation between time to sour and the result of the reductase test, with much lack of agreement with the plate counts. It will be noted that pasteurized milk decolorized slightly more quickly than raw milk which remained sweet for the same time.

"Men will use erasers for a long time to come."

ICE CREAM IN THE BALANCE

BENJAMIN VENER, *Brooklyn, N. Y.*

Air volume plays the following rôle in the manufacture of ice cream: First, air increases the palatability of ice cream. Experience has shown that a volume of air which increases the bulk of the original mix about 80 per cent is necessary to produce a very palatable ice cream. Second, it modifies the texture and increases the smoothness. Air also helps in the final product of ice cream in other ways which I will not refer to here.

When dipping out bulk ice cream from a 20-quart packer into pint and quart packages, I have repeatedly noted a reduction in volume to about fourteen to sixteen quarts; that is, from four to six quarts are lost in the transfer. Naturally the inference is clear that air so easily lost was in excess. Moreover, consumers appreciate this fact and usually demand their ice cream "fountain packed" rather than in "machine-packaged" sealed containers. In addition, the consumers report that in their experience the ice cream from the store-filled packages tastes better, and that it has a different taste from the ice cream of the machine-filled packages from the factory. One reason for this is that the store-filled package has at least 20 per cent more weight. In repacking, more ice cream is pressed into the original spaces occupied by the air cells. Moreover, there is noticed an added increase in concentration of flavor of fruit, of cream, and other ingredients. It is natural that the consumer should demand ice cream in store-packed containers.

The modern technique of ice cream manufacture has become standardized. The percentage of basic ingredients which enter into ice cream, such as fat, milk solids not fat, sugars, and fruits, is nearly alike for each manufacturer. Most of the large ice cream concerns are now producing a product averaging 10 per cent to 12 per cent butter-fat, 10 per cent to 11 per cent milk solids not fat, and 16 to 17 per cent sugar. With uniform percentages of ingredients, it is expected to have a uniform finished product, but in reality such is not the case. No two manufacturers' products are alike in final appearance, differing in such essentials as flavor, creamy taste, sense of coldness, satisfaction to the palate, and so on.

I have found after numerous trials that the average weight of bulk ice cream is from 20 to 25 pounds for plain vanilla, 21 pounds to 25 pounds for strawberry, and 22 to 28 pounds for chocolate, all contained in units of five gallons.

The lower figures indicate an average weight per gallon of ice cream to be from four to four and one half pounds, and the higher weights per gallon of ice cream to be five pounds and over for bulk ice cream. Package goods, made from bricks or machine-filled, run from nine ounces to 14 ounces per pint package, and 15 to 25 ounces per quart package. The higher weights average 12 ounces per pint and 23 ounces per quart.

The question may be asked, Why such a variation? The answer to me seems clear. It is due to careless manipulation and lack of control in the manufacture. As a suggestion to overcome this unintentional deficiency in volume, I suggest that all bricks, "carry-out pails," or any container of ice cream should have its weight specified on the package. Perhaps the introduction of a weight specification would be a proper requirement to be used in conjunction with our present widely used fat requirements for ice cream.

"Every time a man puts a new idea across, he finds ten men who thought of it before he did. But they only thought of it."

REPORT OF COMMITTEE ON SANITARY CONTROL OF ICE CREAM

RALPH E. IRWIN, *Chairman*

In 1925 your Committee made a study of State regulations concerning the sanitary control of ice cream. Now after two years the regulations of each State and each Province have been studied again, and we find there has been considerable activity. Fourteen States, the District of Columbia, and the Province of Saskatchewan have adopted sanitary regulations for the first time or have increased the requirements of existing regulations. Two States and one Province require the ice cream mix to be pasteurized as follows:

1. Louisiana—145° F. for 25 minutes.
2. Mississippi—145° F. for 30 minutes, or 150° F. for 20 minutes, or 170° F. continuous.
3. Saskatchewan—145° F. for 30 minutes or 180° F. for 15 minutes.

Eleven States and the District of Columbia require the milk and cream used in the mix to be pasteurized as follows:

1. Arizona—145° F. for 30 minutes.
2. Arkansas—145° F. for 25 minutes, or 150° F. for 20 minutes, or 170° F. flash.
3. California—140° F. to 145° F. for not less than 30 minutes or more than 1½ hours.
4. Connecticut—142° F. for 30 minutes.
5. Georgia—145° F. for 25 minutes.
6. Iowa—145° F. for 25 minutes, or 185° F. flash, or the use of all milk products obtained from herds that have been tested for bovine tuberculosis and had the reactors removed.
7. Indiana—145° F. for 30 minutes, or 165° F. for 30 seconds.

8. Kansas—145° F. for 30 minutes, or 180° F. for 30 seconds.
9. Montana—145° F. for 30 minutes, or 170 F. for 10 minutes, or 185° F. flash. All butter used in ice cream shall be made from pasteurized dairy products.
10. Nevada—140° F. for 25 minutes, or 170° F. flash.
11. Washington—142½° F. for 30 minutes. Pasteurization defined but not required.
12. District of Columbia—142° F. for 30 minutes.

Some of the above States require a record of the time and temperature used in pasteurization.

On June 2, 1927, Professor Fred Rasmussen, Executive Secretary, National Association of Ice Cream Manufacturers, delivered an address entitled "Legislative Tendencies" before the Board of Directors. This address is printed in the July, 1927, issue of *Dairy Products Merchandising.* Under the subject "Pasteurization" the following statement appears:

"Pasteurization of ice cream mixes should be made universally compulsive and it is interesting to see that so many States this year took action on this subject. The National Association is on record favoring pasteurization of the ice cream mix. It would seem desirable for State associations to encouarge the passage of pasteurization laws in their respective States."

The National Association of Ice Cream Manufacturers is also interested in the bacteriological content of ice cream and in plant sanitation. These questions, as well as the pasteurization of the ice cream mix, are of particular interest to our Association. This is especially true since one of our past Presidents, Dr. William H. Price, is Chairman of the Committee on Bacteriological Methods, which is working as a subcommittee of the Research Committee of the National Association of Ice Cream Manufacturers. Doctor Price is presenting his report before the Association of Ice

Cream Manufacturers in Cleveland at the same time we are meeting here in Toronto. To indicate the interest of the National Association of Ice Cream Manufacturers in this work, another reference is made to the address of Professor Rasmussen on "Legislative Tendencies." Under the heading "Bacterial Legal Limit for Ice Cream," Professor Rasmussen states as follows:

> "The State of California, this year, passed a law providing that ice cream cannot legally contain over 150,000 bacteria per gram. It is to be expected that interest of public authorities in bacterial counts of ice cream will increase rather than decrease. Bacterial counts, when correctly made, are indicative of the efficiency of pasteurization, of the bacterial quality of raw materials and of sanitary conditions in the plant.
>
> "There are many factors which influence the bacterial counts of ice cream and other dairy products. Frequently, samples of the same products examined by different laboratories, and even duplicate samples from the same laboratory, will show different results. There is very great need, before bacterial counts for ice cream become prescribed by law, to have established standard methods for the determination of bacterial counts.
>
> "Our Association recognizes the importance of this subject and a committee, with William H. Price of the Detroit Creamery Company as Chairman, is working on a report which will soon be presented to the industry. This report will cover three phases:
>
> "a—Introduction: A discussion of the possibilities and limitations of bacterial counts as applied to ice cream.
>
> "b—Technique: An outline of procedure for making bacterial counts which manufacturers should urge their laboratories to adopt.
>
> "c—Practical Suggestions for Production of Ice Cream of Low Bacterial Count. This would be intended primarily for those members of the Association who do not operate bacteriological laboratories.

"The Committee on Bacterial Standards, in consid-

> ering this plan, is working in close cooperation with the Committee on Standard Methods of Milk Analysis of the American Public Health Association, of which Dr. Robert S. Breed of the Geneva Experiment Station, Geneva, New York, is chairman; the Committee on Laboratory Methods of the International Association of Dairy and Milk Inspectors, of which Dr. George E. Bolling is chairman; and the Committee on Bacteriological Methods of Ice Cream Analysis of the American Dairy Science Association, of which Professor A. C. Fay is chairman.
>
> "In view of the consideration which is given by health authorities to the bacterial content of ice cream, it is important that individual members of the Association interest themselves in this subject and cooperate to develop a plan for bacteriological analysis and a plan for operations in factories to meet possible bacteriological requirements prescribed by regulations and laws."

You will note how this association of manufacturers is attempting to work in harmony with our own Association and with other groups interested in this subject.

Since our last meeting Professor F. W. Fabian, Agricultural Experiment Station, Michigan State College, has published three bulletins which are of interest. They are as follows:

1. "A Study of the Sanitary Significance of Air in Relation to Ice Cream."
2. "Production of Ice Cream with a Low Bacterial Count."
3. "A Suggested Bacteriological Standard for Ice Cream."

The studies made by Professor Fabian have been carried on with great care, and their results are of value to every inspector having to do with the sanitation of ice cream plants. Because of this, the principal points emphasized by this investigator are presented.

In discussing the sanitary significance of air in relation to ice cream, Professor Fabian states that other things being equal, the weather is the most important factor in determining the number of bacteria in the air. Next in order would come doors and windows, and then floor and machinery. This presupposes a factory with the same type of construction and where the same precautions are taken in its care and cleanliness. Weather has a big influence on the types as well as the number of bacteria.

It would appear that from a bacteriological standpoint, the center of the room is the most desirable location for machinery.

Professor Fabian's conclusions are as follows:

> "Bacterial contamination from the air was insignificant.
>
> "The number of bacteria found throughout the year varied widely.
>
> "The factors considered in the following order of importance in increasing the number of microörganisms present in the air of ice cream plants were: first, weather, dry and windy; second, open doors and windows; third, floor dry; and fourth, machinery running. Conversely, the opposite conditions in the same order are important factors in reducing the number of microorganisms in the air.
>
> "The majority of bacteria found were peptonizers, and alkali-producing and inert bacteria. There were few weak acid-forming bacteria and practically no strong acid-forming bacteria.
>
> "Fewer molds than bacteria were found. The number varied throughout the year."

Professor Fabian's bulletin dealing with the production of ice cream with a low bacterial content indicates three sources of bacteria in ice cream: first, the materials; second, the machinery; and third, the persons handling the product. He goes on to say:

> "Of the materials going into the mix—butter-fat (butter or cream), milk (skim, condensed, or powdered), gelatin, extracts, sugar, and fruit—the first three, butter-fat, milk, and gelatin, contribute by far

the greatest number of bacteria. Butter-fat may contain a tremendous number of bacteria. The same is true of milk, no matter in what form it may be. Gelatin, especially the poorer grades, may contain large numbers of bacteria. It has been shown that the larger the bacterial count of gelatin the less valuable it is for ice cream making. The last three materials, extracts, sugar, and fruits, are relatively minor factors from the standpoint of bacteria. It is assumed that good clean fruit is used."

"The care of machinery is well summarized under rule No. 4.

"In many respects the most important factor is the human element, the employes. It is a very wise law that provides for the medical inspection of all employes handling food. Any sign of sickness in any employe should be considered very seriously. * * * The personal habits of the workers are very important. Some are habitually insanitary in their habits and despite clean clothing and frequent admonition they are not likely to be clean in anything else, because they do not think in terms of cleanliness. They should never be employed to handle food, especially milk or ice cream. * * * None but energetic, conscientious people should be employed. People who take pride in their cleanliness and who are inherently as well as by training physically and morally clean should be hired. If this type is employed and educated to the necessity of cleanliness in handling the product, then the danger from contamination from this source will be reduced to a minimum."

The investigator gives the following rules to consider in producing ice cream with a low bacterial content:

1. Use only good clean materials for the mix.

2. Pasteurize at 150° F. for 30 minutes.

3. Age mix at 35° to 45° F. not longer than two days.

4. Clean machinery as follows: Rinse well with cold or lukewarm water. Next rinse with hot alkaline water. Scrub machinery with bristle brush where possible. Rinse again with hot water. Sterilize machinery, piping, cans,

etc. For this purpose physical means may be employed, as steam at five lbs. pressure for 20 minutes (when machinery and utensils are clean); or steam at 15 lbs. pressure for 15 minutes (when machinery and utensils are dirty); or hot water at 200° F. or higher. Flowing steam for three to five minutes effects considerable reduction. Dry machinery and utensils where possible. Chemical means of sterilization may also be employed, using sodium hypochlorite, calcium hypochlorite, or any other nonpoisonous, noncorrosive, odorless, efficient disinfectant. Physical sterilization supplemented by chemical sterilization produces good results.

It is possible and practicable, he believes, to produce ice cream with a bacterial content of 100,000 or less per gram throughout the entire year.

In his third bulletin, Professor Fabian discusses the matter of a bacteriological standard for ice cream as follows:

> "The data presented represent bacterial analyses of 1,110 samples of ice cream from 36 different ice cream plants located in five different cities of Michigan. The plants ranged in size from those making a few gallons per week to those making as high as 30,000 gallons per day. The data were collected over a period of nine years. The ice cream consisted of every kind known to the trade. In sanitary condition the plants varied from those located in the dirty cellar to the ultramodern, scrupulously clean, white-tiled plant. The number of bacteria per gram likewise had a very wide range —from 1,000 to 300,000,000.
>
> "The factors that govern the number of bacteria found in ice cream are numerous and the sanitary conditions of the plant and the number of bacteria do not always run parallel. However, in most cases the two do coincide to a remarkable degree. Another observation made from the data was that in general the counts are either very low or very high. There are few intermediates. This observation also holds true for plants making ice cream. Either they manufacture a product with a low bacterial count or their count is consistently high. This is true especially for plants

making ice cream every day or several times a week. This condition is entirely natural since they have routine procedures and standardized practices which vary but slightly from day to day. Plants form sanitary habits which govern the bacterial content of their product to a large degree. On the other hand, the bacterial content of small plants that make ice cream only once or twice a week is subject to greater variations because they do not follow any set regulations and their procedure is usually more variable. As a matter of fact the highest counts are usually found in the small plants."

The investigator's conclusions are as follows:

"A bacteriological standard for ice cream is needed.

"A bacteriological standard for ice cream would be a distinct advantage to all parties concerned.

"It is reasonable to expect a commercial ice cream plant to produce ice cream with a bacterial count (colonies) of 100,000 or less per gram.

"If proper methods are used there should be no great seasonal variation in the bacterial content of ice cream.

"Epidemics of typhoid fever, scarlet fever, diphtheria, diarrhea, and intestinal disturbances have been definitely traced to ice cream.

"Pasteurization of the ice cream mix is the best known safeguard against the spreading of these diseases by ice cream and should be required by law.

"Because of the nature of the product, 150° F. for 30 minutes seems to be the best temperature and time for pasteurization.

"Ice cream plants should be inspected regularly by a sanitary inspector the same as city milk plants."

Since the subject of plant sanitation is under consideration, the preparation of a score card for ice cream plants will no doubt be necessary. In this connection reference may be made to the score card prepared by Professor F. W. Fabian and published in the Journal of Dairy Science, Volume 3, No. 3, May, 1920.

It is gratifying to note these recent developments in sanitation through research and legislation. Much may be expected in the near future, since the problem is receiving the attention of the industry itself, as well as that of the inspector and legislator.

"Progress begins with the minority."

REPORT OF COMMITTEE ON MILK ORDINANCES

WM. B. PALMER, *Chairman*

One of the functions of this Committee, as defined in the resolution creating it, was "to give special consideration to the desirability of formulating minimum requirements, or uniform regulations for the production, handling, and distribution of market milk."

In the matter of unification of ordinances and regulations it obviously becomes necessary to consider the legal requirements which have been enacted by governing bodies and so-called model milk ordinances, such as in some instances public health organizations and food officials' associations have adopted and are recommending. Many communities have taken action to enact these into law. The Committee is familiar with two sets of such regulations; namely, the "Uniform Standard Milk Ordinance" drafted by the United States Public Health Service, and the regulations adopted in 1925 by the Central Atlantic States Food and Drug Officials' Association, both of which were for the purpose of accomplishing uniformity.

Certified Milk regulations are usually referred to in laws and ordinances as the "Methods and Standards of the American Association of Medical Milk Commissions," and if this practice is followed generally, so far as Certified Milk is concerned there will be uniform legal requirements. However, attention is called to the necessity of incorporating the regulations into ordinances, as legal opinion is to the effect that an official governing body cannot delegate its legislative powers to a nonofficial organization.

As to regulations which are officially enacted and now in force, there are many specifying various standards and requirements. Attempts have been made to unify ordinances, and the Sanitary Code of the State of New York is an example. This code applies throughout the State, with the possible exception of New York City, which operates with legal authority under a separate ordinance. Other States have taken similar action.

The Uniform Standard Ordinance of the United States Public Health Service has been enacted into law in 187 communities and 14 States, according to reports for the present year.

It would appear that difficulty would be experienced in an endeavor to apply a universal standard milk ordinance. Some districts have progressed and developed their supplies to a high standard and good quality. New districts which have not attempted official control require a number of years of education and development. Therefore, standard uniform requirements for market milk to meet all of present-day conditions are apparently not practicable from the standpoint of enforcement or operation. A standard ordinance must set exceedingly low standards to meet existing conditions in undeveloped sections. It would possibly be a detriment, as it would tend to set standards far below the quality of supply now secured in more highly developed sections.

However, there are a number of general principles and standards which can be accepted and incorporated in ordinances. This is evidenced by the above-named regulations and ordinances. These could be classified as follows:

1. Pasteurization of supplies.
2. Pasteurization standards.
3. Tuberculin testing of dairy cattle.
4. Physical examination of cattle by veterinarians.
5. Medical examinations and laboratory tests of milk handlers.
6. Regulations for Certified Milk.
7. Grading of supplies based on sanitary quality of the product, providing for Higher Grade Pasteurized, Lower Grade Pasteurized, Certified, and, if legally permissible, noncertified raw milk.
8. The bottling and labeling of milk.
9. Milk plant equipment and practices.

Last year's recommendation should be repeated, that "where legally possible, only Certified and pasteurized milk should be specified by ordinance."

Pasteurization standards ought to be agreed upon and accepted. It is our opinion that in view of present scientific knowledge this can be done. Most city ordinances require a pasteurizing temperature of not less than 142° F., with a holding period of not less than 30 minutes.

United States Department of Agriculture Dairy Bureau letters on ordinances show that more cities require 142° F for 30 minutes than any other one standard.

The United States Public Health Service Standard Ordinance specifies 142° F. for 30 minutes.

Regulations for enforcement of the Federal Milk Import Act, approved 1927, also set this standard.

This Association defines pasteurization as follows:

> "Pasteurization is the process of heating milk to a temperature 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."

The American Public Health Association has not officially approved a standard as yet, but a minimum of 142° F. for 30 minutes has many proponents.

The general commercial practice is 142° F. for 30 minutes.

Some ordinances specify 145° F. for 30 minutes.

The Central Atlantic States Food and Drug Officials Association adopted regulations which specify 145° for 30 minutes.

The Conference of State and Territorial Health Officers in 1926 adopted a like standard.

Observation shows that some officials urge one thing but tolerate another. This leads to confusion. They, to all intents and purposes, ask for 145° F. but accept as pasteurized milk and cream products which have been heated to and held at varying temperatures but which show an average below 145° F. and approximating 142° F. The difference between minimum and average ought to be clearly understood and interpreted. This Association's definition accomplishes this in an admirable manner, and if the specified requirement is strictly enforced and adhered to, the officials, the trade, and the public will be satisfied and the public health protected.

Tuberculin testing of dairy cattle is an important factor from the standpoint of public health, healthy cattle, better milk production, and economy. Public health officials ought to encourage the development of the Federal-State Accredited Herd System, and where sufficient funds are available to the Bureaus of Animal Industry, it is a practicable requirement to demand a milk supply from tested cattle. Some cities demand and secure their entire supplies at present from tested cattle and many others secure a large portion from accredited or modified accredited districts without official demand. The need for extending tuberculin testing of cattle is especially urgent in small communities where pasteurized milk is not available. Physical examinations of dairy cattle by veterinarians or other competent inspectors is necessary for the exclusion of diseased animals and to prevent the production of infected milk. Many ordinances require annual examinations and some demand semiannual. The more frequently this control is exercised, the better the protection afforded.

The medical examination of employes is obviously an important health factor in the control of milk-borne epidemics of communicable diseases if frequently applied. This practice has been demonstrated to be reasonable and practicable.

The grading of pasteurized milk based on sanitary quality and providing for two grades, namely, higher grade and lower grade, is a recognized feature in milk control and supervision. Lower grade pasteurized milk is accepted as a safe product, but much milk with proper supervision exceeds the standard as to sanitary quality, has lower bacterial content and better conditions of production. This should be recognized. By such a system there is incentive to raise the quality of the general supply of a community, the public benefit, and the better producer is compensated. A de-grading of supplies for noncompliance with requirements has quick and effective results.

It is our opinion that a grading system providing for more grades than those above mentioned is not practicable for enforcement, although it might be of value for purposes of survey in uncontrolled districts.

Last year's report stated "if raw milk other than Certified is permissible, regulations for the same shall correspond to those for Certified."

The bottling of milk is the method by which the product is protected for delivery to the consumer and needs no elaboration here. The proper labeling of milk is essential to insure to the officials and consumers the class of product being dispensed.

Milk plant equipment of proper type and construction is necessary. Much progress has been made and further improvements will be developed. Specifications for proper operation and maintenance of equipment are available. A properly constructed milk plant, specifications of which are also available, is a requisite.

In view of the general consideration being given to the Standard Ordinance of the United States Public Health Service by public health departments and associations, producers' and dealers' organizations, and food officials' associations, and others, which will undoubtedly result in the publication of revised regulations, the Committee does not feel justified in making any further report.

"Today is the tomorrow that you worried about yesterday."

REPORT OF COMMITTEE ON METHODS OF SECURING A SATISFACTORY QUALITY OF RAW MILK FOR PASTEURIZATION

W. D. Dotterrer, *Chairman*

In order to discuss intelligently methods of securing a satisfactory quality of raw milk for pasteurization, it is desirable to know what is required of such milk. For the purposes of this report, some of the more important and generally accepted requirements are as follows:—

1. Milk should come from healthy cows.
2. Milk should be accepted only from farms where no communicable disease exists.
3. Milk should be free from abnormal appearances and from objectionable odors and flavors.
4. Fat content should not be less than 3 per cent, nor the solids not fat less than 8.5 per cent.
5. Milk should be clean.
6. Milk should have a reasonably low bacterial content.

If the specifications and conditions noted above are complied with, the result will be a satisfactory quality of milk for pasteurization.

The details encountered in carrying out such procedures are not all simple in their accomplishment. Tuberculin testing of all milk-producing herds is perhaps the most valuable single thing which can be done to insure healthy cows. In some sections of the country this cannot be done without considerable disturbance, but the benefits will in the long run equal the cost. Physical examinations are also valuable in detecting certain conditions such as infected udders, etc.

For the elimination of milk from farms where contagious disease exists, health departments should have means of ascertaining the presence of such disease and rules to prevent the milk from such farms being delivered.

The prevention of undesirable flavors and odors, while not directly a public health measure, is of interest to the dairy inspector because their presence in milk will curtail the use of a valuable food. Flavors and odors in milk may come from the feed of the cow, from the air in which the milk is handled, or from bacterial growth. The effect of highly flavored feeds, such as turnips, cabbage, etc., may be lessened by feeding them as long as possible before milking. Wild onions and other weeds in pastures cause bad flavors also. The obvious way to prevent their bad effects is not to use a pasture where they are growing. Absorbed odors in milk can be prevented by keeping milk away from odors and by good ventilation in barns, milk houses, or other places where milk is handled.

Bacteria cause flavors and odors if allowed to develop in large numbers. They will be discussed later.

There is room for argument on the subject of the percentage of fat and other solids in milk. It must be recognized that tests vary with the breed of the cows and the lactation period. It is hardly fair to exclude a large number of herds by making requirements too high. On the other hand, there is no valid reason for placing the required test low enough to include the product of the poorest herds found in any breed. Without going into detail, some methods which will help in securing milk with sufficient solids are as follows:

Add some higher testing cows to the herd. Make use of cow-testing associations to weed out low testers. Some of the first milk from each cow may be kept out of the milk which is to be sold.

The cleanliness of milk as received at pasteurizing plants too often depends upon the effectiveness of the strainer. While the strainer is almost universally used and does improve the appearance of milk, it does not remove the readily soluble parts of the dirt which was there prior to straining. No doubt, more of the dirt would be dissolved if it were left in the milk longer, and for this reason the straining is a benefit. The ideal, however, is milk produced in such a way that straining is not necessary. The dairy inspector who teaches clean production is better than he who secures clean milk by straining

While it is not easy to get an agreement as to what is a practical requirement on the subject of bacterial counts, there are some well-known procedures which if followed will improve the bacterial quality of almost any milk supply. A reasonably low bacterial count for one district might be a very poor one for another or it might be entirely unattainable in still another section of the country. It is within the bounds of imagination to conceive of a milk supply which contained several millions of bacteria per c.c. and which would have to be used for pasteurization. It would not be wise to pass an ordinance excluding all of that milk from a city. Obviously the proper thing to do would be to make a survey of the district and use the best of the producers as an example for all to emulate. When sufficient improvement was obtained, the standard could be raised and the work continued. If the poorest of the producers in any district are made the principal objects of an educational program, all the milk supply will be improved. There will always be some milk of poorer quality than the average, so the work of improvement can be continued with a completely satisfactory supply as the object.

The methods used to improve a milk supply need not be discussed here in detail. They are all either well known or the descriptions of them are readily available.

Inspection of all milk as it is delivered at the receiving station will discover the worst milk, and it can be rejected. Other tests must be used to find the milk which is not bad enough to have an off flavor or odor.

The methylene blue reductase test has been found to be of help in locating high count milk. It probably does not locate high counts of all types of organisms, but will no doubt pay for the small expense in using it. Direct microscopic and plate counts may also be used.

Once the high count milk is located, the task of improving it is at hand. Some good has been accomplished by means of farmers' meetings where the fundamentals of milk production were discussed. Letters containing simple instructions will aid, if the producer can be induced to read them. Their effectiveness is dependent largely upon their source and the opinion held by the farmers of their authors. Visits by a field man are probably more effective than any other method in educating producers. Instructions, however given, should be presented in understandable language and should include the best knowledge available. The greatest single source of contamination of fresh milk is due to contact with nonsterile utensils at the farm. The methods used in cleaning utensils are not effective in removing all germ life. Under favorable conditions the remaining germs multiply rapidly and will contaminate milk placed in the utensils. Sterilizing the utensils just before use will eliminate this source of contamination. The use of hot water and steam for sterilizing milk equipment is accepted generally as very effective. There is always the probability that the water will not actually be hot enough to accomplish the desired result. Many farmers and even milk plant managers think that water which is uncomfortably warm to the hand will sterilize equipment. This impression needs to be overcome if good results are to be obtained. The use of chemical sterilization is becoming quite acceptable in the dairy industry. It has been shown by careful research work that chlorine in the form of hypochlorites is very effective in sterilizing milk utensils. The chlorine method of sterilization may be used with as good results as heat and with better results than heat under most farm conditions. Care should be taken to see that utensils are washed clean before attempting to sterilize them. Chloramines can also be used, but they are slower in action and must be used in greater concentration.

Cows which give off large numbers of organisms in their milk are sometimes the cause of high counts. They can be discovered by bacterial examination and eliminated.

The question of cooling milk is also important. If well-sterilized utensils are used and the milk cooled immediately to 60 degrees or below, there will not be a great increase in bacterial content before it is delivered to the pasteurizing plant.

To summarize very briefly: Milk from clean, healthy cows, handled in clean, sterile equipment, cooled immediately and kept cool until delivered, will be satisfactory for pasteurization.

"Energy and persistence conquer all things."

REPORT OF COMMITTEE ON SERVING MILK IN SCHOOLS, FACTORIES, AND OFFICE BUILDINGS

M. O. MAUGHAN,[1] *Chairman*

Promoting the use of milk in schools, offices, and industrial plants on a sound basis is a big job. Some have said it couldn't be done, others that it will take a long time; all will agree that the problem is not solved as yet.

MILK SERVICE IN SCHOOLS

Possibly less than 20 per cent of the school children in America now drink milk regularly at school. A recent survey conducted in Massachusetts[2] showed exactly 20 per cent drinking milk in the schools. Why is the percentage so low? Is it because the idea of serving milk is a poor one which will soon be cast aside, or is the delay due to the plan of procedure?

Many school authorities feel that milk is unnecessary for the average student and that it should be confined only to the children who are underweight. Some feel that the school room is not the place to dispense food of any kind; that the function of the teacher is to give sufficient time to check up on the child's food habits carefully and teach him good health habits, but not to permit food to be dispensed and consumed at the school.

It is truly surprising to observe the large number of little stores springing up near many schools where candy bars, soft drinks, hot dogs, etc., are sold.

As to the best plan to follow in providing milk service, your Committee is unprepared at this time to state. Possibly there is no best plan, because the plan of serving milk must be correlated with the other school activities, and these differ in different cities. Much depends on the attitude of the

[1] Executive Secretary, The Milk Council, Inc.
[2] *Nation's Health*, July, 1927, p. 25.

teachers and the other groups who are concerned in this activity.

The use of milk in the schools should definitely be tied up with a health education program that is correlated with the school curriculum. It is well for the children to keep the records, open up the bank account, and learn the handling of checks and paying of all bills as a part of their class work. When the serving of milk is handled in this manner, it becomes a school project rather than a commercial project.

There are, however, excellent plans in operation, and a few of them are outlined below:

1. Supervision by the school teachers. When the teacher is really sold on the importance of serving milk in the schools, and the importance of every child being up to normal physically, and when she realizes that a child cannot get very far mentally without a good, sound, physical body, then there is a good opportunity for splendid results.

A centralized school administration for the distribution of milk saves work and produces better and more uniform results. The teacher does more thorough work when the movement is stimulated and controlled by the school administration.

Each teacher can easily get a report each morning from her pupils as to how many bottles of milk are desired, and then this report can be sent to the principal's office, or given direct to the delivery man when he comes with the milk.

2. Another plan of handling the milk is through the Parent-Teacher Associations. Supervision by Parent-Teacher Associations has its advantages and its disadvantages. One trouble is that after the newness of the proposition wears off and a good many Parent-Teacher Associations get the milk into the schools, then they lose interest and soon the proposition is going down hill.

3. Another very splendid plan, and one which is working out now in Pittsburgh in particular, is to have the supervision of the milk service in the hands of a paid worker, an individual woman who stands well in the Parent-Teacher

Association and also very well among the teachers, and who has ability as a leader and who can, therefore, handle the milk very nicely without calling upon the teachers for very much help. Of course, in any plan the teacher must give cooperation; otherwise, the plan will not succeed.

4. Supervision by the older boys and older girls has its merits, yet there are many disadvantages, one of which is that it takes these children away from their school work quite a little, to which the teachers often object; and then these children with their energetic minds sometimes forget the importance of promptness in handling the milk service in a business-like way, with the result that things do not always move along as they should.

After determining upon the individuals and groups who will supervise the milk service, the next problem is to determine the best manner in which to serve the milk.

Plan I consists of milk service in each school room and at each child's desk. This plan is rapidly gaining in favor. It allows the child to drink the milk slowly, while being seated.

Plan II is serving the milk in the hall-ways or corridors. In this plan the children line up in a row, each stepping forward in his turn, paying his money and getting a bottle of milk, a straw, and generally one or two crackers. The children too often drink their milk very hurriedly.

Plan III is serving milk at tables in the basement. In this plan, a definite number of students are allowed to go down to the tables at a given time and drink their milk this way.

There are six reasons why milk service should be in the schools:

1. Milk service in the schools helps keep the children who are normal in a healthy condition.

2. Milk service in the schools helps overcome undernourishment among the children.

3. Children who participate in the milk service regularly generally do better school work.

4. Milk service affords a splendid opportunity for a tie-up between teacher and parent.

5. A bottle of milk at school helps make up the proper and standard amount, namely, a quart a day.

6. A bottle of milk in midforenoon serves to prevent children getting over-hungry before lunch time and thus prevents eating to excess, with resulting sluggishness during the afternoon.

In Cleveland, it is reported: "Milk service is established in nearly all of our schools in this city, the school board entering into a contract for the delivery of the milk, and then the milk is resold to the children at cost."

In Chicago, as another illustration, milk service is not progressing so well, in fact, the use of milk in the schools of Chicago has materially declined. This is partly due to lack of interest on the part of those charged with the educational supervision, partly due to indifference on the part of the parents, and partly due to lack of uniformity in the method of handling milk sales in schools on the part of the milk distributors.

Milk service in the schools of California has been very successful. For example, in 1923 the serving of milk was started in Los Angeles, and at the close of the year 72 schools had taken on the milk service and the consumption of milk had been approximately 560,000 half pints.

In 1924 the consumption of milk increased approximately fourfold, the figure being 2,231,000. The next year showed an additional 50 per cent increase, namely, 3,696,000 half pints. In 1926 there was a very slight decrease, the figure being 3,404,000. It is expected, however, that the 1927 figure, which has not as yet been compiled, will show a continued increase. At the present time 263, or 80 per cent, out of 328 schools in Los Angeles have established the milk service.

Whether cash or tickets should be used in purchasing milk is debated. The advantage of tickets is that the child purchases a book and the money cannot be spent for something else. The disadvantage is that the loss of a ticket book represents loss of money.

Your Committee feels that no milk distributor should attempt to make a profit on the milk sold to the children. However, he should not sell it at a loss.

Surveys Conducted

A recent survey was conducted in Massachusetts in the schools of Cambridge, Arlington, Newton, and Malden.[3] Thirty thousand children in 65 schools were carefully studied. Fifty of the 65 schools served milk. Two thirds of the principals in the schools where milk was served stated that they believed the physical condition of the children was improved by the use of milk. One fourth of the principals reported that they believed the academic standard and discipline had also been improved. All of them say they believe milk service is worth while, yet the percentage of children drinking milk was only 20 per cent. What is the reason?

Another survey of interest is the one conducted by the Pittsburgh District Council[4] and reported in the August issue of *Nation's Health* by Dr. Fetterman and others. Over 80,000 school children were included in the survey in Pittsburgh and the county in which Pittsburgh is located, with some very interesting results. The children were in the first eight grades. They found that the children in the public schools drink approximately 50 per cent more milk than those in parochial schools.

Average city public school child drank 1.47 glasses milk and 0.81 cups of coffee daily.

Average city parochial school child drank 0.93 glasses milk and 1.52 cups of coffee.

Average county public school child drank 1.58 glasses milk and 0.72 cups of coffee.

Average county parochial school child drank 0.89 glasses milk and 1.37 cups of coffee. Practically all children drank some coffee.

This survey also shows that children who drink milk liberally generally do better school work.

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[3] *Nation's Health*, July, 1927.
[4] *Nation's Health*, August, 1927.

This survey, because of the large number of children studied, namely, 80,070, is very much worth while and should form the basis of further surveys to make more exact data. This survey substantiates the claim made that the drinking of milk in schools promotes better school work.

Other surveys and observations have shown that the discipline of the children is much improved when they drink their midmorning milk. This should be of interest to every school teacher in the country.

The following suggestions for improving milk service in schools are offered for your consideration:

1. Establish milk service through the cooperation of the education and health authorities.

2. Avoid all suggestions that the service is for undernourished, sick, or poor children. Wherever children are gathered together for long hours, milk should be available to all, because it is a good food and easily digested.

3. Milk service can best be arranged in each school through a principal who is accustomed to organizing the pupils under her care. (The home economics teacher will frequently handle details.)

4. Milk should be cold. To insure this, service should be arranged by the dairyman. Milk should be sold at the lowest price consistent with highest quality.

5. Children should be seated, preferably, when drinking milk, and not hurried.

6. Crackers should be served with the milk.

7. Compensate a teacher who is appointed by the principal to handle the service. Teachers cannot usually be expected to handle milk without compensation.

8. Children should be served before 10.30 A.M.

9. Milk service in the schools should be part of the health education program.

10. Free milk is not advisable to any child. A special fund can be arranged by the class teacher to supply indigent children.

11. Contests, games, and even animal feeding experiments, entered into by the children, will often stimulate that interest, so much needed, in drinking milk. In Athens, New

York,[5] this is being done, and now 56 per cent of all the children get their midmorning milk regularly.

There will always be some school systems which sell more milk than others because of the spirit of the school principal. Also, the service will be organized more satisfactorily in some schools than in others, because of the organizing capacity of the principal.

The presence of a correlated curriculum to teach health in the schools generally increases the number of children drinking milk. All schools should teach health.

There is a great field of work yet to be done. Quoting from Prof. Store and Turner:[6]

> "In short, we are greatly in need of precise and sufficiently extensive data upon the health value of the milk lunch, the responsibilities of school superintendents and principals in connection with it, and the best methods of organizing milk distribution within the school."

Milk Service in Offices

Office workers, too, are finding milk service of great value. A large percentage of office workers go to work with little or no breakfast, and a bottle of milk about 11 o'clock is a wonderful tonic. However, more office workers take milk in midafternoon than in midforenoon. It seems that office workers grow quite tired about 3.30 and their work drags, but a bottle of milk removes that tired feeling and gives them the pep necessary to carry out the day's work. As a result, they do their work with greater ease and they do more work.

Vice-President Wilshur, of the Fleischmann Yeast Company, a few years ago, gave the following statement:

> "As a result of serving a glass of milk and a cooky each afternoon at 3.30, the efficiency of our office workers increased 25 per cent during the afternoon period."

[5] Reported in "The Commonwealth Fund," March, 1927, p. 10: Child Health Program Series.

[6] Store, James G., and Turner, Clair E.: *Nation's Health*, July, 1927.

Furthermore, according to office managers, it is found that as a result of serving milk the sick list is very materially reduced. This one item alone is sufficient to warrant the milk service in offices.

A good many insurance companies, employing hundreds of clerks under a single roof, put milk service under the direction of the matron or nurse, and each day those employes who wish milk may secure it.

Another form of industrial business open to the milk dealer in the cities is the daily supply of milk to the rest rooms of large office buildings where the clerks and stenographers congregate and which often take on the character of a girls' club.

Doubtless, a little effort on the part of any interested milk dealer would greatly broaden this source of business, especially where his contracts permit and where he has the machinery to make prompt deliveries in a wholesale way.

As in the case of school milk service, there is much room for improved methods and practices in perfecting this important activity.

Serving Milk in Factories

Thousands of factories are now serving milk with great success. These include the Franklin Manufacturing Company, manufacturers of automobiles; American Woolen Company, the largest producers of woolen and worsted cloth in the world; Westinghouse Air Brake Company; A. G. Spalding and Company, and other prominent and large institutions.

Men engaged in outside work as well as inside work are recognizing the great value of milk. Builders are now great users of milk. It is now customary on most buildings in Chicago, and other cities as well, for a milk delivery man to "go the rounds" during midforenoon and again in midafternoon and sell milk to the men as they go about their work.

At noon nearly all large buildings are favored by having at least one milk delivery wagon there.

The advantage of factory milk service are in part:

1. Employes do their work with greater ease.

2. Employes do a greater amount of work each day, thereby increasing their earning power.

3. Employes work more regularly, resulting in larger pay checks throughout the year.

4. Employes do their work with greater accuracy and efficiency.

5. Helps build up those who are undernourished and who should take added nourishment to continue their work.

6. Reduces doctor bills, because of improved health.

7. Helps build factory morale, thereby developing a better attitude toward work, with less desire to watch the clock and to slow up and neglect work in midmorning and midafternoon.

8. Serves as a partial protection against poisoning to those whose work involves handling paints, chemicals, etc.

9. Reduces number of accidents, because milk steadies the nerves and reduces fatigue.

10. Results in the men feeling better at the end of the day's work, so that they can better enjoy their evenings in recreation with their families.

11. Results in an increased consumption of milk in the home and thereby improved health, because the message of the goodness of milk is carried home from the factory.

There are three general plans of distributing milk in the factory:

1. Factory employe distribution.
2. Milk dealer distribution.
3. Milk station plan.

One of the biggest problems in approaching factory managers is to prove to them that milk service will be conducted on a strictly business-like basis; that it will not be handled in a "hit-and-miss" fashion, but that quality, service, and courtesy will be strictly observed; that bottles will be collected promptly and not allowed to accumulate and get broken and become dangerous to the workers, as well as detract from the appearance of the factory.

Also, it is advisable to assure the factory manager that no salesmanship methods requiring the time of the factory worker will be used, but that the service will be developed on its own merits.

The factory manager must be convinced that the plan is simple, that it requires a negligible amount of time, and that it will result in increased efficiency on the part of the workers. After it is given a fair trial, both employers and employes become highly enthusiastic over it. In nearly all cases it has been found advisable to sell the milk to the employes and not supply it free of charge.

Most of the larger factories now have a welfare director. This person is interesting himself in the subject of milk and its use by employes and, therefore, affording a wonderful contact personally between the dairyman and the factory worker.

There is undoubtedly a great future ahead to serving milk in factories. There seems to be no question but that every factory man should get milk regularly, either at midforenoon or midafternoon or both. Of course, it is well understood by practically every one today that all workers should have their milk at lunch time. Of course this idea hasn't been put into practice fully, but it is on its way.

In the Detroit factories milk is usually dispensed through a company that serves box lunches at the factory. This same company sells milk with or without the sale of the box lunch.

It is the feeling of your Committee that the most satisfactory manner of serving milk to employes in a factory is by direct service from the milk company itself. The delivery man should gather up all empty bottles and remove them from the factory each day.

Young and old should have the opportunity to secure milk to drink during the daytime, because unless it is available and suggested to them, they will be drinking some beverage which is not beneficial to their health. If there were as many people asking the public to drink milk as there are people asking the public to use light beverages, candy, etc., then the consumption of milk would be increased enormously.

A few suggestions for improving milk service in industrial plants are given below:

1. Establish milk service even though the sales are small. Time must usually be allowed for employes to become accustomed to the idea.

2. Sell at lowest price consistent with high quality.

3. Serve ice cold.

4. Serve direct to consumer, collecting money at time of delivery.

5. Select a distributor who is cheerful, clean, neat, and attractive.

6. Place factory milk service on a business-like basis. Avoid all suggestions of charity or welfare activity. The American workman is too self-respecting and independent to welcome charity.

7. The milk salesman should carry a clean, soft cloth to wipe mouth of bottles in the presence of the consumer, sharp instruments to open each bottle, and straws to be inserted if desired.

8. Methods of popularizing milk service:

(a) After service has been established on a fairly satisfactory basis, arrange competition of two groups, giving them names, such as "men and women," "talls and shorts," etc. Offer a banner to the side consuming the most milk, or some honor, however slight. Use this method once or twice in a year for a period of a week.

(b) Arrange competition with another plant occasionally. This may not be practicable always but is a method worth considering.

(c) Post amount of milk consumed every week.

(d) Secure scales, posting adult height and weight standard over the scales, with sign, such as "Are you under or over weight for your age and height? Both are danger signals. Milk helps you keep your balance true."

(e) Post fresh signs carrying one definite message about the value of milk, first, to the individual worker; later similar messages as to the value of milk to the workers' families. It is important for such posters to be changed often, at least once a week. The value of a sign or poster lies in its novelty and freshness.

CONCLUSIONS

Your Committee is of the opinion that more attention can well be given the serving of milk in schools; first of all, to secure the unqualified support of the teachers and other educators; second, to work out more practicable methods for the distribution of this milk in the schools.

Your Committee feels that the opportunity is great for a further development of milk service in offices. Your Committee feels that factory milk service is well under way because the factory manager is quick to recognize the value of milk service.

In presenting this report, the Committee men want to express their appreciation for the splendid suggestions and help given by Miss Sally Lucas Jean of New York City, and also to the many others who contributed liberally of their ideas and material.

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

CHEMICAL STERILIZATION IN DAIRY INDUSTRY

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It is a well-known fact that the dairy utensils and the dairy plant equipment, if not properly "sterilized," may add large numbers of bacteria to the milk and its products. Frequently the high bacterial content of the dairy products is due largely to the utensils.

The importance of the utensils as a source of bacteria has long been recognized in dairy industry, for the modern dairy plant is built around the steam boiler. The steaming or the scalding of the utensils with hot water has been considered an essential step in dairy operations.

Both the steam and the hot water, when properly used, effectively control the germ life in the utensils. The results obtained in many dairy plants are a sufficient proof. However, taking the dairy industry as a whole, there has been a pronounced failure in the matter of effective sterilization of the utensils and of the plant equipment by means of steam and hot water. The reasons for this are not difficult to find. In some cases it is the lack of proper standardization of operations in the plant, or it is due to the fact that some equipments, such as external tubular cooler, etc., are difficult to sterilize with steam or with hot water. Again it may be due to the fact that the steam or the hot water are not always available in sufficient amounts when needed. Finally, it should also be remembered that on most dairy farms steam is not available and hot water is scarce.

In recent years attempts have been made to introduce into the dairy operations the chemical sterilization of the utensils. There is a certain amount of opposition to the use of chemical sterilizers in connection with the handling of food in general and of milk in particular. The practice is, however, being permitted and even encouraged in some communities. It is claimed that since the sterilization of drinking water by means of chemical sterilizers is recognized as a sound sanitary practice, similar sterilization of the water with which the utensils are washed and rinsed, which water is often of questionable sanitary quality, is also a sound sanitary practice. There is every reason to believe that the chemical sterilization of the dairy utensils and other equipment and also the chemical sterilization of the dishes in public eating places will become a common practice.

The number of chemical compounds known as disinfectants, germicides, or sterilizers is large. Not all of them, however, are fit to be used in connection with the handling of food. Some are highly poisonous and must not be used at all. Others have strong, lasting, and objectionable odors and cannot be used. Therefore, only those chemical sterilizers can be used which are not poisonous and which do not impart to the treated utensils any lasting odors. In looking over the entire field of chemical sterilizers we find one group which seems to be best suited for this purpose. This group is known as the Chlorine Group of sterilizers. Some members of this group have been used with marked success for sterilizing the drinking water in many of our cities.

The following chlorine sterilizers are being offered for sale:

I. Chlorine gas.

II. Hypochlorites.

III. Organic chlorine.

This paper is to be considered as a report in the investigation on chemical sterilization, as applied to dairy industry, and not as a final conclusion on the subject.

All the chlorine sterilizers have one common property, namely, they have a certain amount of loosely combined chlorine in their molecules. This chlorine is usually referred to as the "available chlorine." It is generally agreed that the available chlorine is directly or indirectly concerned in the destruction of the germ life. Hence the sterilizing strength of these compounds is measured by the amount of such chlorine.

The available chlorine in these compounds tends continually to be given off and this makes the compounds unstable; that is, they lose strength on standing. The different compounds, however, vary in this respect. For example, two commercial preparations were kept 30 days at room temperature of about 75° F. One lost 60 per cent of the available chlorine and the other lost only one per cent. This question of stability is an important one because uniformly good sterilization is difficult to obtain with sterilizers that rapidly decrease in strength before they are used up. Some of the commercial preparations have been successfully stabilized and standardized and they are to be preferred, especially where the facilities for testing the solutions are not available.

The chlorine sterilizers for dairy purposes are supplied by the manufacturers in a concentrated form. For sterilizing purposes they are added to the water to make solutions of desired strengths. If such a solution is used, the available chlorine in it becomes gradually used up and the solution gets weaker and weaker until it finally loses all the sterilizing power. This readiness to give off the chlorine should not be considered as a defect but a virtue, because it is the given-off chlorine that causes the destruction of the bacteria. If no chlorine were given off, these compounds would lose their sterilizing property. It also should be mentioned that those compounds that give off the chlorine more readily when in solutions cause quicker sterilization.

When a sterilizing solution is subjected to a continuous use under dairy conditions it is to be expected that traces of milk and some washing powder may get into the solution. What effect this will have on the available chlorine and consequently on the sterilizing action is of importance. A number of experiments have been carried out on this point, in which small amounts of milk and some alkalies were added to the solutions and these were exposed to different temperatures. Complete data are too voluminous to be presented here. In Table 1 are shown a few of the results which give some idea of the behavior of the available chlorine.

TABLE 1
EFFECT OF TEMPERATURE, SMALL AMOUNTS OF MILK AND TIME EXPOSURE ON THE AVAILABLE CHLORINE IN THE SOLUTIONS OF VARIOUS CHLORINE STERILIZERS

Temperature F.	Initial Strength ppm.	Minutes exposed	Percent of Milk Added 0.0%	0.1	0.2	0.5	1.0	2.0	5.0
			Sodium Hypochlorite						
80°	198	5	198*	184	177	149	106	113	135
80°	198	30	198	163	142	85	71	85	113
160°	215	5	215	163	85	57	42	35	35
160°	215	30	205	50	35	21	14	14	0
			Chlorinated Water						
80°	198	5	198	184	142	127	92	85	42
80°	198	30	182	127	113	99	78	50	35
160°	234	5	234	170	156	120	99	113	57
160°	234	30	200	127	99	78	42	28	14
			Chloramine T						
80°	177	5	177	177	177	177	163	142	142
80°	177	30	177	177	177	170	163	142	118
160°	177	5	177	146	146	142	106	78	78
160°	177	30	174	146	146	106	71	36	0
			Sodium Hypochlorite Plus 1% of Sodium Hydroxide						
80°	240	5	240	190	180	70	70	70	70
80°	240	30	240	113	62	35	10	10	10
160°	190	5	190	35	24	0	0	0	0
160°	190	30	190	15	0	0	0	0	0

* The figures here given represent parts of available chlorine per million parts of water.

It will be observed in Table 1 that the solutions when no milk was present lost none or very little of the chlorine when they were exposed for thirty minutes at temperatures ranging from 80 to 160° F. The chlorinated water lost more chlorine than the other solutions. The addition of small amounts of milk promptly caused a reduction in the amount of the available chlorine. As the amount of milk was increased from 0.1 per cent to 5 per cent, the reduction in chlorine became greater. In a similar manner, as temperature of the solution was increased the reduction became greater and faster, especially with the increasing amounts of the milk. Thus sodium hypochlorite solution having about 200 ppm. of the available chlorine to which five per cent of milk was added lost about 43 per cent of the available chlorine after it was held 30 minutes at 80° F. When a similar solution was exposed to 160° F., it promptly lost all the chlorine. All the different compounds behaved in a similar manner.

The effect of the alkali on the available chlorine was interesting. Without any organic matter in the solution, the presence of the alkali tended to make the solution more stable. In the presence of the organic matter the available chlorine disappeared faster in an alkaline solution.

From these results it is evident that improperly washed utensils will tend to reduce the available chlorine in the solution with which the utensils are being sterilized.

As already stated, the active agent that is directly or indirectly concerned in the destruction of the germ life is the available chlorine. The sterilizing strength or effectiveness of a solution is measured by the amount of this chlorine. The pertinent question in sterilization is: What strength of the solution in the available chlorine is necessary for practical sterilization of the dairy utensils?

Before proceeding to discuss this subject, it may be advisable to define the term "sterilization." Technically speaking, the word "sterilization" means the complete destruction of all the bacteria. In the language of the commercial dairy operator, the word has a different meaning. Here it is used to designate the reduction of the bacterial life to an insignificant number, rather than a complete destruction of all the bacteria. The question may be viewed from another angle. Bacteria in general may be divided into two groups, namely, those that have spores and those that do not have spores. The bacteria that do not have spores are relatively easy to kill, while the spores are hard to kill. What is actually accomplished in a thorough sterilization of the utensils in the milk plants, when flowing steam or hot water is used, is the destruction of all the bacteria that do not have spores. The destruction of the bacterial spores in the utensils by means of steam or hot water is not practical because it requires too long an exposure at temperatures higher than that of flowing steam.

The bacteria in general respond to the chemical sterilizers in a similar manner as they do to the heat. Those that do not have spores are readily killed, while the spores are hard to kill. It is, however, possible and practical by means of some of the chemical sterilizers to destroy the spores in the utensils. For this purpose the sterilizing solutions must be much stronger than is necessary for the destruction of the bacteria that do not have spores.

The experiments carried out on the sterilizing effectiveness of the different compounds have been carried out both in the laboratory and under commercial operations. In the laboratory the compounds studied were the calcium hypochlorite, chlorinated water, chloramine T, sodium hypochlorite (A), and sodium hypochlorite (B).

The determinations were made in tap water suspensions both with and without small amounts of milk. These data show that the solutions of chlorinated water, of calcium hypochlorite, of sodium hypochlorite (A) and of sodium hypochlorite (B) having five parts of the available chlorine destroyed the bacteria in 10 minutes of exposure, the solutions having 10 parts of available chlorine destroyed the bacteria in less than five minutes, and the solution having 20 parts of the available chlorine in less than one minute.

Chloramine T also destroys the bacteria but it requires longer exposure and stronger solution.

The addition of small amounts of milk to the solutions retarded the sterilizing action. The larger the amount of milk added, the greater was the retardation. Very small amounts of milk, as 0.1 per cent and 0.2 per cent, had almost negligible influence, but when five per cent of milk was added to the solutions having 50 ppm. of available chlorine, it practically destroyed all the sterilizing action of all the different compounds.

From these results it is very evident that the utensils and other dairy equipment must be properly cleaned in order to get proper sterilization. Another conclusion also might be drawn from the results, namely, that very large quantities of the sterilizers would have to be added to the whole milk in order to inhibit the bacterial action in the milk.

The methods by which the chemical sterilizers are applied to the utensils are relatively simple. On dairy farms where the number of the utensils is small, the utensils may be rinsed with the sterilizing solution. For this purpose one or two gallons of the solution of desired strength is prepared and is then poured from one utensil to another. The solution must come in contact with all the inner surface of each utensil for at least ten seconds or more. To treat each utensil effectively requires at least one half minute per utensil.

When the number of the utensils to be treated is large, the dipping of each utensil in the solution is more practical than rinsing. In this case a wash vat is filled with the solution and each utensil is dipped in the solution, submerging it for several seconds.

In milk plants equipped with large utensils such as vats, tubular coolers, bottle fillers, etc., the spray method is convenient. In one milk plant, a two-gallon spray pump, such as is used for spraying the shrubs for insects, was used with success. When applying the sterilizing solution by spray it is necessary to use stronger solutions, because the surface of the utensils may be exposed to the solution for only a very short time. A solution having 500 ppm. of the available chlorine has effectively sterilized the utensils.

In some milk plants the equipment is sterilized by pumping large quantities of the solution through the entire system through which the milk passes. Probably this method in conjunction with the spray method is most satisfactory for the milk plants.

There is no doubt but that when properly applied, the chemical sterilization of the utensils is effective in reducing the germ life to a negligible number. Numerous examinations have been made during the past three years of utensils so treated and also of the milk that was put into such utensils. The results from these examinations indicate that when the dairyman rinses his utensils prior to the milking with a solution of hypochlorite having 50 or more ppm. of the available chlorine, the utensils will be practically free from bacteria. In case of chloramine T, similarly good results have been obtained when solutions having 170 ppm. of the available chlorine have been used for rinsing of the utensils. When the dairyman keeps his cows clean and promptly cools his milk to below 60° F., he can regularly deliver milk under 10,000 bacteria per cubic centimeter.

A somewhat careful study was made on the chemical sterilization of the plant equipment. No steam or hot water has been used in the milk plant where this study was made for nearly eight months. The method of application was as follows: the vats, the holding tank, the weighing tank, the bottle filler, the cooler, the sanitary piping and all other utensils with which the milk may come in contact were sprayed with a sodium hypochlorite solution having 500 ppm. of the available chlorine, using about six quarts of the solution. Following the spraying, the weighing tank was filled with enough water (about 50 gallons was needed) to permit a full flow pumping. To this water was added the sterilizer to make a solution of 50 ppm. of the available chlorine, and this was pumped through the system in order to bring in contact with the solution all the inner surfaces that were not reached with the spray and also to remove the strong spraying solution. This treatment was applied just before the equipment was used for handling the milk. The milk bottles were not chemically sterilized because the bottle-washing machine did not lend itself to chemical sterilization and tests have shown that some of the bottles so treated were not sterile. It might be added here that the farms supplying milk to this plant were also put on chemical sterilization of the utensils at the time the experiment was started.

TABLE 2

STERILIZING EFFICIENCY OF THE DIFFERENT CHLORINE STERILIZERS*

Minutes Exposed	Strength of the Solutions 5 ppm.	10 ppm.	20 ppm.	35 ppm.	50 ppm.
	Per Cent Reduction of Bacillus Coli				
	Chlorinated Water				
1	40	99	100	100	100
5	99.9	100	100	100	100
10	100	100	100	100	100
	Sodium Hypochlorite (A)				
1	40	99	100	100	100
5	99.9	100	100	100	100
10	100	100	100	100	100
	Sodium Hypochlorite (B)				
1	30	95	100	100	100
5	99	99.9	100	100	100
10	100	100	100	100	100
	Chloramine T				
1	0	0	0	40	60
5	0	30	50	95	99
10	0	40	80	99	99.9
20	0	60	95	99.9	100
30	50	80	99	100	100
	Calcium Hypochlorite				
1	30	99.9	100	100	100
5	99.9	100	100	100	100
10	100	100	100	100	100

* Plate count of the bacterial water suspension was 400,000 per cc.

At the start of the experiment the regular plant operators were shown how to apply the chemical sterilization, and after that it was applied by them throughout the experiment. During the eight months of the experiment four different operators have been doing the sterilization and the handling and pasteurizing of the milk, so that the results represent what may be expected of the average plant operator, and not what the experimenter is able to do.

The pasteurized milk put out by this plant during the summer months contained about 2,000 bacteria per cubic centimeter of milk. Some days it was much below that. The writer feels that these results can be duplicated in any milk plant.

In summing up these experiments, it seems evident that the results from both the laboratory experiments and also from the commercial milk plant experiments clearly indicate that chemical sterilization of the utensils by means of chlorine sterilizers is effective and practical, and simple of application. A solution of the hypochlorite having from 50 to 100 ppm. of the available chlorine will give good results. When the spraying method is used, a solution having 500 ppm. of the available chlorine gives good results. Solution of this strength appears to have a good margin of safety, *provided the utensils are properly washed.* In order to bring about good sterilization of poorly washed utensils, very much stronger solutions would have to be used. As a matter of fact good results can not be obtained when the utensils are not thoroughly cleaned before they are to be sterilized.

"Ideals are peculiar little things. They won't work unless you do."

THE APPRAISAL OF MILK CONTROL ACTIVITIES

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In the organization of services for the control of milk supply the health officer is confronted with two conditions. He must set up restrictions and requirements as to quality and condition of the delivered product and at the same time must make ample provision for developing the source of the supply so as to supply the demands of his community at all seasons of the year. Obviously, then, the program of milk control must be an educational one which will lead the producer gradually into the production of a better and safer product without any serious curtailment of the supply, and in many instances with an actual stimulation to greater production.

The discussion of an effective educational program for the development of a clean and safe milk supply, which is the second part of this paper, was prepared by Dr. S. J. Crumbine, General Executive of the American Child Health Association, based upon the experience of that Association in conducting Clean and Safe Milk Campaigns in the various States, under the auspices of the State departments of health.

The standards and criteria by which milk control activities are judged in the appraisal of public health services in cities and rural areas were arrived at after careful study of prevalent practices by the Committee on Administrative Practice of the American Public Health Association. The standards which are here discussed appear either in the Appraisal Form for City Health Work[1] or the Appraisal Form for Rural Health Work,[2] and represent the thought of the Committee on Administrative Practice at the present time. These standards, however, are in no wise rigid and

[1] Second Edition, 1926. [2] First Edition, 1927.

fixed. They are subject to periodic revisions and provision has already been made for the assembling of information during the next twelve months, with the presentation of revised standards in October of next year.

As some of you may know, the Appraisal Form for City Health Work was devised by the Committee on Administrative Practice of the American Public Health Association in collaboration with the American Child Health Association and a large group of health officers after careful study of the various public health administrative methods employed in cities of over 40,000 population throughout the United States. Surveys by the United States Public Health Service of cities over 70,000 and by the American Child Health Association of cities from 40,000 to 70,000 population furnished the basis of these studies.

The aim in mind of the Committee has been to devise a brief appraisal form which would yield a reasonably adequate picture of the health services actually performed in a city, as evidenced by certain typical sample activities. The idea was to measure the immediate results attained, such as statistics properly obtained and analyzed, physical defects of school children discovered and corrected, milk pasteurized, dairies inspected, laboratory tests performed, and the like, with the confidence that such immediate results would inevitably lead on to the ultimate end of all public health work—the conservation of human life and efficiency. The Committee also had in mind in attempting such an appraisal form the outstanding results obtained by the application of scoring or appraisal methods in the dairy industry; also in the grading of medical schools and hospitals.

Farm Inspection

The first control measure which is commonly employed is the inspection of the dairy farms. This service, which is almost universally practiced by cities to a certain degree, becomes increasingly difficult and costly with the increase in size of the city, necessitating an increase of milk-producing area. The average frequency of these farm inspections in the one hundred largest cities in 1923 was twice a year. This is the frequency which has been accepted as a standard for judging this service.

Tuberculin Testing

The next control measure is that of tuberculin testing of dairy cows. In 1923, 26 per cent of the cities over 100,000 population reported 100 per cent of cows supplying milk to their customers to be tested, and the average for all cities was 62 per cent. With the ultimate completion of tuberculin testing it is conceivable that this standard for judging the adequacy of control might be withdrawn, or possibly a standard of frequency of tuberculin testing be substituted. The 1923 experience shows that of 100 cities, 67 report annual testing, the others at longer intervals. It is possible that such a requirement as annual testing should be coupled with the original requirements of 100 per cent tuberculin testing of cattle as a qualitative measure.

Laboratory Control of Raw Milk

Proceeding to the requirement of laboratory control of raw milk before pasteurization, we find here a restriction which was not universally practiced in 1923, though many cities were experimenting with laboratory control either by plate counts or by the methylene blue test.[3]

Inspection of Milk Plants

Another important phase of the program of milk control is the inspection of milk plants. The standard established for this part of the service is one weekly inspection of each distributing plant. Of the 84 cities reporting on this activity in 1923, 58 per cent attained the required standard, and in some instances—seven cities—daily inspections were made. To carry out this part of the milk control service

[3] The standard established for the bacterial quality of raw milk is that not more than 20 per cent shall exceed a count of 500,000 per c.c.

the full time of one inspector, devoting his attention to the inspection of creameries and milk plants within the city, is required for a city of 100,000 population.

Pasteurization

Pasteurization is coming to be recognized as the principal factor in the control of milk supplies; the Appraisal Form allots 75 per cent of the total score for milk control to this item. In 1920 only 18 cities reported 95 per cent of the milk supply pasteurized, while in 1923, 27 cities reported a like amount pasteurized. The standard for this control measure is pasteurization of the entire milk supply.

Temperature Control

All distribution plants should have recording thermometers to meet the requirements for this part of the control program. Practically all cities of the 100 studied in 1923 reported the use of recording thermometers at pasteurization plants, though there was a slight variation in the temperature and time requirements. Forty per cent of the cities reporting on this item specified 142° F. for 30 minutes, while 36 per cent of the cities favored the combination of 145° F. for 30 minutes.

Licensing and Labeling

The next function encountered in the control program is that of securing ordinances for the proper licensing of milk dealers and for adequate labeling of the bottled supply. It is usually the responsibility of the health department to issue permits to each distributor for the sale of milk or milk products in accordance with established ordinances or regulations. This also includes the power to revoke any permit or have the sale of milk discontinued that does not meet with the health department regulations. Few cities are concerned with permits for milk producers. The ordinance for labeling bottled milk should cover the following points: All bottled milk to be plainly marked to show (a) Producers or distributors; (b) Grade; (c) Date of production or pasteurization. This part of the control program was not studied in 1923, but of the 47 cities reporting their health activities for the year 1925 on the basis of the Appraisal Form, 39 cities required the name of the producer; 19 required the grade; and 13 required the date of production or pasteurization. Only six of the cities reported ordinances covering the three items listed above.

Laboratory Control of the Final Product

The final effort to provide a safe milk supply is the laboratory examination of milk after pasteurization. The Appraisal Form sets four per cent of the pasteurized samples showing a bacterial content in excess of 50,000 per c.c. as the maximum allowed for a perfect score on this item. This phase of the control program has not been well developed in the cities throughout the country. Only five of the 47 cities reporting in 1925 attained the established standard.

42. MILK SUPPLY CONTROL (60)*

a. Per cent of the milk supply pasteurized.......... 25

Standard: 100 per cent

Per cent	100	25 *Pts.*	*Pct.* 50	10 *Pts.*
	90	20	30	0
	75	15		

Quota..........................

b. Frequency of inspection of dairy farms.......... 5

Standard: Semi-annual.......... 5 *Points*
Annual.............. 3

c. Control of distributing plants.................... 5

i. Periodic inspection of pasteurizing plants, score 3

Standard: Once a week
Weekly .... 3 *Points*
Each 2 weeks.............. 2
Monthly 1

ii. Systematic effort to install recording thermometers, score 2

* Appraisal Form for City Health Work.

Standard: Per cent of pasteurizing plants with thermometers

Per cent	100	2 *Points*
	75	1
	0	0

Quota..

d. Per cent of milk samples before pasteurization showing a bacterial content in excess of 500,000 per c.c.[1] 5

Standard: 4 per cent

Per cent	4	5 *Pts.*	*Pct.*	13	2 *Pts.*
	7	4		16	1
	10	3		19	0

Quota..

e. Per cent of pasteurized samples showing a bacterial content in excess of 50,000 per c.c......... 15

Standard: 4 per cent

Per cent	4	15 *Pts.*	*Pct.*	16	4 *Pts.*
	8	12		20	0
	12	8			

Quota..

f. All bottled milk required by ordinance to be plainly marked to show.................. 5

Producer or distributor.................. 1
Grade 2
Date of Production, or Pasteurization....... 2

The responsibility resting upon public officials who are charged with the safeguarding of public health in relation to the milk supply is no greater than that of the individual dairyman or milk dealer. Nor do the benefits from pure and safe milk supplies acrue only to the public, for if State and local officials can assure the public that the milk supply of a community is safe, increased consumption is sure to follow with increased profits to producer and distributor.

There are two ways available to officials in a campaign for Clean and Safe Milk:

1. The passage and rigorous enforcement of regulatory measures designed to exclude all milk that

[1] Score for this item should only be given when the samples of milk analyzed are reasonably well distributed throughout the year, as it would be manifestly unfair to give credit for low counts obtained only during the winter months.

does not come up to certain predetermined standards.

2. A patient and understanding, although thoroughgoing, educational program designed to show or demonstrate to producers and distributors the advantages, commercial and otherwise, of, and the methods that will produce, Clean and Safe Milk.

This educational program should include the consuming public as well. It is this latter method that has been adopted in the National Campaign for Clean and Safe Milk, sponsored by the American Food, Drug, and Dairy Officials, the Conference of State and Provincial Health Authorities of North America, and the American Child Health Association.

The steps or phases of this program succeed each other in the following order:

First: A community survey as to the quality of milk delivered to the consumer. With but two exceptions three types of examination were made of all milk supplies.

a. Visible dirt test
b. Bacterial count, including in most cases
   B. Coli determination
c. Chemical examination for detection of adulteration either by adding water or skimming

The standard methods of the American Public Health Association are used.[4]

Second: A careful study of the results of the survey with a diagnosis of palpable defects and suggestion of appropriate remedies. Here it is important that the producer be immediately advised of the condition of his own supply. This can usually be done most effectively by showing him the cotton plugs on which is revealed the visible dirt from his own milk and the colonies of bacteria that can be seen on the plates of culture media. There are very few dairymen but are impressed with such a demonstration, while a simple written notice of their delinquency is more likely to arouse antagonism and resentment.

Third: Public education of the dairyman, the distributor,

[4] **Standard Methods of Milk Analysis, 5th Edition, 1927.**

and the general public, including the local city authorities charged with the responsibility of the protection of the public. The methods that might be effectively used in the educational programs are as varied as the individual communities. The local conditions, general attitude of the public and officials, and the urgency of the situation must be the guides for a resourceful health educator as to the type of education and the manner of its presentation.

Fourth: Perhaps included in the general program of education is that of impressing the community with the vital importance of increased per capita consumption of milk (when its safety is assured) particularly by children and under-nourished.

Fifth: And finally, to conclude the entire program by assembling the community's resources and fixing local responsibility for effective milk control and supervision. In the smaller communities the laboratory of the local high school or the local hospital, or the water supply laboratory might be pressed into service for systematic milk examination.

There can no longer be a reasonable excuse why practically 50 per cent of the population of the United States continue to live under the hazard of an unsupervised milk supply.

Not many years ago the chief criteria for general approval of domestic and public water supplies were those of reasonable cleanliness and freedom from obnoxious odor and taste. Today we demand all that, but in addition our chief demand is that the water be at all times free from dangerous contamination that might imperil life or health, which can only be guaranteed through sterilization—that of almost universal choice being chlorination.

Our chief criteria at present for domestic and public milk supply are those formerly held for water, namely, freedom from visible dirt and objectionable odor or flavor. It is believed that the time is now here when the public should demand reasonable safety for its milk supply, which under our present knowledge is only practicable through efficient pasteurization.