

Journal of Milk and Food Technology

JOURNAL OF

MILK

TECHNOLOGY

Volume 1

Number 4

MAY, 1938

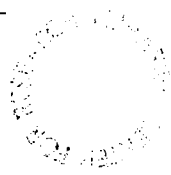
*Twenty-seventh Annual Meeting
Cleveland, Ohio, October 19-21, 1938
Headquarters, The Allerton*

Official Publication of

INTERNATIONAL ASSOCIATION OF

MILK SANITARIANS

C
2
4
7
4
1





Safe-Deposit Vaults!

As securely as a safe-deposit vault protects money or jewels, a Welded Wire Seal protects the purity of milk. Like the lock of a vault a Welded Wire Seal cannot be tampered with, without instant detection. Notice how the long, sturdy hood completely covers the pouring lip of the bottle

making it an absolutely sanitary closure.

Milk Sanitarians studying hood-capping are invited to write for free leaflets giving authoritative and helpful information on this subject. Address your requests to Standard Cap and Seal Corporation, 1200 Fullerton Avenue, Chicago, Illinois.

IT'S TAMPER PROOF



IT'S EASY TO OPEN



IT'S SANITARY



THE STANDARD

Welded Wire

HOOD SEAL

THE NATIONAL TRADE MARK OF BETTER MILK AND CREAM

VITEX VITAMIN D MILK

always has been marketed as a 400 USP unit per quart vitamin D milk. Assays to check this vitamin D potency are conducted in accordance with state and local food control regulations.

Laboratories in the following colleges and universities are now cooperating with food control officials and with Vitex Laboratories, Inc., in conducting these assays:

Massachusetts State College, Amherst, Mass.
Michigan State College, East Lansing, Mich.
Ohio Experiment Station, Wooster, Ohio.
New Jersey State College, New Brunswick, N. J.
Iowa State College, Ames, Iowa.
University of Nebraska, Lincoln, Nebr.
Medical College of Virginia, Richmond, Va.
Albany Medical College, Albany, N. Y.
University of Louisville, Louisville, Ky.
Pennsylvania State College, State College, Pa.
Indiana University Medical School, Indianapolis, Ind.
Tulane University, New Orleans, La.

VITEX LABORATORIES, INC.

a Nopco Subsidiary

Harrison, N. J.



Once the crimped edge is stretched by opening, it can't be restored to its original snug fit. Tampering is betrayed. For full information and samples of all types of Alseco Aluminum Hoods, write ALUMINUM SEAL CO., 1347 Third Avenue, New Kensington, Pa.

T.M. Reg.  U. S. Pat. Off.

Alseco ALUMINUM
MILK BOTTLE HOODS

Advertising in the
Journal of Milk Technology

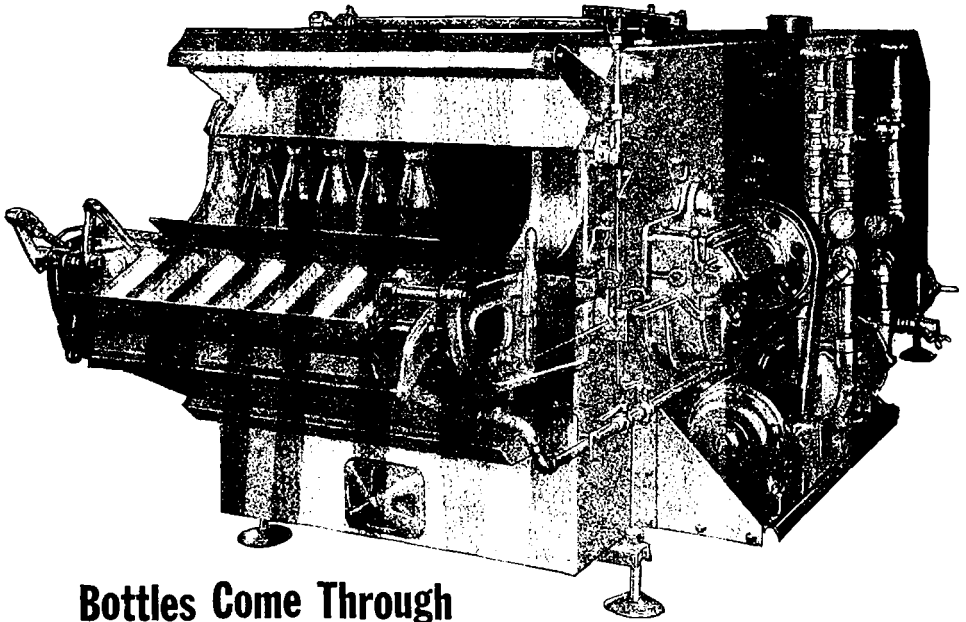
carries your message to the

Leading Milk Sanitarians

and most progressive dairy companies thru the
medium of their own journal

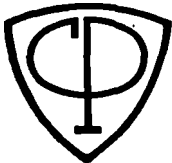
When writing to advertisers, say you saw it in this Journal.

GENTLE HANDLING



Bottles Come Through

Safe, Scratch-Free and CLEAN



Junior MILK BOTTLE WASHER

Longer life to milk bottles is the plus feature of the CP Junior. To its regular job of turning out positively clean bottles in volume, this soaker-type washer adds a high degree of protection. After an operator loads the automatic feed, all handling is mechanical—the gentlest mechanical handling the industry affords.

Practical elimination of breakage will mean a lot to some milk plants installing a CP Junior. But longer bottle life also means freedom from scratches which make "ground glass" of the surface—a dull, clean but non-sparkling exterior which does not do justice to the good milk inside. CP bottle pockets leave the outside open to soaking action and jet scrubbing, but stops all abrasive action.

Especially valuable is this protection for applied color lettering which adds advertising value to sparkling bottles. The CP Junior preserves it. Ask your CP representative about this washer which is the soaker-type but is not big and costly. Two sizes: 24-32 and 38-48. Send for descriptive bulletin.

THE CREAMERY PACKAGE MFG. COMPANY

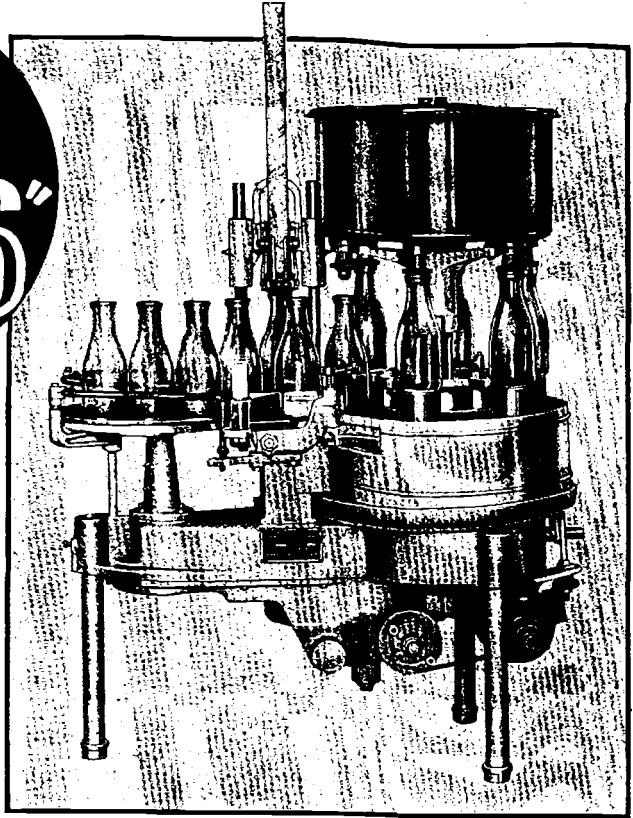
1243 WEST WASHINGTON BOULEVARD - - - - Chicago, Illinois

Branches: Atlanta - Boston - Buffalo - Chicago - Dallas - Denver - Kansas City - Los Angeles
 Minneapolis - New York - Omaha - Philadelphia - Portland, Oregon - Salt Lake City
 San Francisco - Seattle - Toledo - Waterloo, Iowa

CREAMERY PACKAGE MFG. CO. OF CANADA, LTD. THE CREAMERY PACKAGE MFG. COMPANY, LTD.
 267 King St. West, Toronto, Ont., Canada Avery House, Clerkenwell Green, London E. C. 1., Eng.

THE
New
 "6-16"

- COMPACT
- SIMPLE
- ECONOMICAL
- RUGGED
- EFFICIENT
- RUNNING IN OIL



Cherry-Burrell 6-16 Bottle Filler — capacity is 16 quarts per minute.

CHERRY - BURRELL SALUTES THE SMALLER MILK PLANT OPERATORS with a NEW BOTTLE FILLER BUILT ESPECIALLY FOR THEIR NEEDS

THE new 6-16 BOTTLE FILLER AND CAPPER by CHERRY-BURRELL has most of the features of the larger fillers and cappers—yet is designed and priced for small milk plant owners having from 200 to 500-gallon capacities per day.

Whether hand fed or with Automatic Bottle Conveyor Infeed from a Baltimore Soaker Type Washer the "6-16" efficiently fills and caps all products in any size standard milk bottles at the rate of 16 full quarts to the minute.

Successful filling and capping of special products makes the "6-16" a most useful machine in large plants as well. Write us today for Bulletin No. G-319 which illustrates the 18 features of the new CHERRY-BURRELL 6-16 BOTTLE FILLER AND CAPPER or call your nearest CHERRY-BURRELL sales office.

CHERRY-BURRELL CORPORATION ~ 427 W. RANDOLPH ST., CHICAGO

JOURNAL OF MILK TECHNOLOGY

Official Publication of
The International Association of Milk Sanitarians

Volume 1

MAY, 1938

Number 4

CONTENTS

Editorials	1
Need for Official Supervision of Laboratories—Friend Lee Mickle.....	3
A Colorimeter For the Phosphatase Test—W. H. Boynton and P. E. Nelbach.....	8
The Problem of Recontamination of Pasteurized Milk and Its Products—L. C. Bulmer	10
Practical Farm Sterilization—Arthur H. Williamson	14
New Creamery Butter Standards	19
Report of the Committee on Ice Cream Sanitation—F. W. Fabian, <i>Chairman</i>	20
Filled Milk Decision	31
Modern Methods of Milk Plant Inspection—Maurice H. Shorago.....	32
Report of Committee on Laboratory Methods—A. H. Robertson, <i>Chairman</i>	36
An Evaluation of Some of the Tests Used in Detecting Mastitis in Dairy Cattle—A. C. Fay	38
What the Colleges are Doing in the Training of Milk Sanitarians—Fordyce Ely	43
Abstract of Proceedings of the Twenty-Ninth Annual Meeting of the American Butter Institute	46
Research with Cream at the Massachusetts State College—Merrill J. Mack.....	50
Information Concerning Journal of Milk Technology	53
Application Blank for Association Membership	54
Constitution—International Association of Milk Sanitarians.....	55
Index to Advertisers	VIII

INTERNATIONAL ASSOCIATION OF MILK SANITARIANS

Secretary's Office: State Department of Health, State Office Building, Albany, N. Y.

OFFICERS 1937-1938

President, Alexander R. Tolland.....Boston, Mass.
First Vice-President, Victor M. Ehlers.....Austin, Texas
Second Vice-President, Paul B. Brooks, M. D.....Albany, N. Y.
Third Vice-President, Leslie C. Frank.....Washington, D. C.
Auditors: J. R. Jennings.....Chicago, Ill.
 F. D. Holford.....New York City
Secretary-Treasurer, C. Sidney Leete.....Albany, N. Y.

EXECUTIVE BOARD

The Executive Board consists of the Association President, the three Vice-Presidents, and the Secretary-Treasurer

COMMITTEES AND COMMITTEE CHAIRMEN

COMMUNICABLE DISEASES AFFECTING MAN—Their Relation to Public Milk Supplies
 I. A. Merchant, *Chairman*.....Ames, Iowa

DAIRY AND MILK PLANT EQUIPMENT
 Walter D. Tiedeman, *Chairman*.....Albany, N. Y.

SANITARY PROCEDURE
 Walter D. Tiedeman, *Chairman*.....Albany, N. Y.

DAIRY FARMS METHODS
 F. D. Holford, *Chairman*.....New York City

SANITARY CONTROL OF ICE CREAM
 F. W. Fabian, *Chairman*.....East Lansing, Mich.

LABORATORY METHODS
 A. H. Robertson, *Chairman*.....Albany, N. Y.

METHODS OF IMPROVING MILK SUPPLIES IN SMALL COMMUNITIES
 Leslie C. Frank, *Chairman*.....Washington, D. C.

PUBLICITY AND PUBLIC RELATIONS
 Sarah Vance Dugan, *Chairman*.....Louisville, Ky.

RESOLUTIONS
 Ernest Kelly, *Chairman*.....Washington, D. C.

LOCAL COMMITTEE ON ARRANGEMENTS FOR THE 1938 MEETING
 H. O. Way, *Chairman*.....Cleveland, Ohio

JOURNAL of MILK TECHNOLOGY

Volume 1

May, 1938

Number 4

Editorial Section

*The opinions and ideas expressed in papers and editorials are those of the respective authors.
The expressions of the Association are completely recorded in its transactions.*

A Pediatrician Talks to Milk Technologists

Dr. Irving J. Wolman of the Children's Hospital of Philadelphia recently addressed the Metropolitan Dairy Technology Society on the researches that he and Dr. Chambers are conducting on the digestibility of milk, especially of soft curd milk. The milks are tested in bladder-like bags kept at body temperature by immersion in a water bath. A special apparatus gives a kneading action simulating the peristaltic contractions of normal stomachs. Synthetic gastric juice is supplied from burettes. All experimental conditions are kept constant in the various tests. The curds which form are carefully measured in sieves, and the data subjected to mathematical analysis. By this technique the kinds and sizes of curds which form in the human stomach under different conditions can be carefully studied and the various kinds of milk compared with one another.

Soft curd milks form smaller curds than does usual market milk, which regularly yields huge cheesy masses. Curd tension readings obtained by the Hill tests do not always run parallel to curd size. Homogenized milk yields large or small curds depending on various factors including the head of pressure used. Base exchange milk under conditions of low acidity does not curdle and remains liquid. However, when the acid is high, as occurs in adults, this milk coagulates and forms large hard masses. Sonic or sound wave treated milk regularly forms small curds.

Dr. Wolman pointed out that the improved digestibility of fine curds had been clearly demonstrated by Brennemann over twenty years ago, and reminded us that this significant finding had been ignored by the dairy industry whereas the evaporated milk concerns considered it very important. The large curds from fluid milk account for much of the antipathy towards milk drinking.

The medical profession needs a definition of soft curd milk. Is the Hill test a good index? The many factors which enter into milk curdling within the stomach clamor for scientific study. The dairy industry would be farsighted and wise in sponsoring research on this problem. Improving the digestibility of market milk would stimulate consumption and sales.

EDITORIALS

It was pointed out that no cow's milk is satisfactory for infant feeding until it is modified in the direction of the composition of human milk, namely, fat 3.5 percent, protein 1.5 percent, carbohydrate 7 percent. A large amount of clinical and experimental evidence has shown that the percentage of sugar in cow's milk must be raised to the breast milk level before infants can thrive upon it. One wonders whether ice cream mix could be converted into a satisfactory infant food, since its ingredients are in approximately the same proportions as are those of human milk.

Dr. Wolman asked us many questions about milk which showed that we have much to learn about our own product, as for example, what is the effect of freezing on the digestibility of milk? Why are baby milk formulas diluted? Why is unmodified cow's milk unsatisfactory for infant feeding? Why is the carbohydrate-protein ratio of human milk superior in nutritional value to that of cow's milk? How does the boiling of formulas eliminate indigestion?

When we think of the large number of laboratories and the hundreds of investigators who have engaged in dairy research, it does seem surprising that there still remains so much that we do not know down in those brackets, so to speak, of our every-day use of milk. Moreover, we have witnessed the inroads of evaporated milk into the market for fluid milk. We have seen the household freezing of ice cream come in great volume. We see soybean milk looming. We behold the doubtful status of filled milk legislation. We see an increasing market for oleo- and nut margarine. The dairy industry can weakly bewail this situation and weep over its lost markets, or it can rise in its might and organize research to open new markets. It has the choice of either course.

J. H. S.

Butter Score Versus Quality

The official method of scoring butter is being superseded by a new rating procedure. The past practice has prorated the score over various factors, including the type of package. The new method classifies butter at a certain flavor level which carries a score between 85 and 93 with small tolerances for minor defects. From this rating is subtracted the sum of the ratings for defects of body, color, and salt (see page 19 of this Journal). No mention is made of the sanitary quality of the butter.

Milk sanitarians know that in the production of milk there are important considerations of cleanliness which never can be measured by even the most refined laboratory examination. The public themselves insist on certain esthetic and public health provisions in the handling of milk—sound cattle, clean farms and equipment, sanitary practices, healthy employees. The same carefulness obtains in the manufacture of ice cream. This is the basis for farm and plant inspection, namely, to see that which no examination of finished product can reveal.

The scoring of butter ignores these factors of sanitation—factors which the public demand in milk and ice cream. Therefore, scoring must be considered as merely a commercial expedient for the organoleptic grading of an agricultural commodity (like wheat and apples and cotton). We must not be misled into thinking that the score is anything more than a partial rating of quality.

The new scoring procedure seems to be an improvement in reasonableness, simplicity, and accuracy over the former method. In view of the increasing attention that food control officials are giving to the public health relations of butter, it would seem that the score should recognize proper pasteurization and freedom from extraneous material. These need not necessarily appear as factors in the organoleptic score but they might be used to determine whether the butter is first class or second class, the former when the cream had been properly pasteurized and was clean, and the latter when otherwise. The word "grade" should not be used because of its application in other connections.

J. H. S.

The Need for Official Supervision of Laboratories*

Friend Lee Mickle, Sc.D.,

Director, Bureau of Laboratories, Connecticut State Department of Health

This address is not a plea for official supervision of laboratories. It should be plainly self-evident to an assemblage of milk sanitarians and food and health officials that a need exists for some official control over laboratories where examinations — bacteriological, chemical and other—are made of milk, cream, frozen desserts, and milk products just as it exists in other branches of public health laboratory activities. The opportunity will be used to present in the light of experience and observation some reasons for believing that supervision of local laboratories is necessary and to discuss briefly procedures and standards that have proved feasible for improving the quality of work in laboratories already under supervision. This cannot be done without making evident the need for official supervision.

Without general oversight from some official control agency, there is no question that at times results will come from certain laboratories that will not only cause real annoyance to city and state officials but, far more important, will bring to the milk producer and milk dealer, definite losses of money and business. Where is the milk control official who has not experienced embarrassment in attempting to explain conflicting plate count findings on similar samples examined in different laboratories! It is an illuminating comment that in one state the annoyances caused to the milk industry by the analyses and interpretations from unsupervised laboratories—private and public—became so serious that the milk industry itself, independent of the state control agencies, sponsored the passage of legislation that now requires approval of

dairy laboratories and the licensing of all personnel.

There are several reasons for unreliable reports from laboratories. The shyster who deliberately falsifies his findings for the benefit of his client has seemed to be much more of a rarity than might be expected. Far more frequently encountered is the well-intentioned person who has a lack of adequate training and experience, but who considers himself or herself capable of making and reporting to the public examinations of milk or dairy products. Too often, the college graduate with very little training in bacteriology and chemistry, and sometimes with no experience, carries on laboratory work or makes interpretations of results that may give false impressions of the quality of the supplies under examination. Failure to use proper apparatus and the improper use of equipment are frequent causes of unreliable results. The overcrowding of incubators with plated samples and the use of incubators so constructed or so small that reliable findings could not by any possibility be expected are examples of instances where conditions may be improved by supervision and inspection.

Let it be said at once that official supervision is not *per se* a panacea for all the ills of unsatisfactory laboratories. It must be constantly borne in mind that the best trained laboratory expert, whether supervised or not or even when acting as supervisor, has to be constantly on guard against the many pitfalls that beset him who tries to do a perfect job of analyzing a sample of milk, dairy product, or frozen dessert. Most of those who produce inaccurate and misleading findings are honest persons trying to do the best of their ability and training to do a good job. No one can do a perfect job

* Read before the Twenty-sixth Annual Meeting of the International Association of Milk Sanitarians and the Conference of Ohio Valley Food, Drug and Health Officials, Louisville, Ky., October 13, 1937.

all of the time. To bring about improvement under conditions such as these, supervision must go hand in hand with co-operation. The official who would be successful must bring to his task an interest in his work and a spirit of co-operation toward those with whom he works. Regardless of the authority he represents, he must be friend, fellow worker, teacher, and diplomat to a far greater extent than he is inspector. Authority and inspection by themselves will never produce the desired results.

It is not so much that a supervising agency will be enabled to improve the quality of work in local laboratories by some magic show of policing authority. Rather will results be accomplished by restraint in the use of a potential power held in reserve for the very occasional instance where coercion must replace co-operative and educational effort. Yet the power to revoke approval that has been extended gives to a state or provincial department of health the opportunity to make thorough investigation in the infrequent instance when it is necessary and at the same time equips that department with a handy correctional weapon. Through the agency of approval and in a manner not at all magical, there is a tendency for the quality of the work to improve in both the good and the mediocre laboratory while the bad laboratory may pass out of existence.

GENERAL OR SPECIFIC APPROVAL

Blanket laboratory approval may be given to a laboratory after inspection of the equipment and investigation of the qualifications of the personnel or of the person in charge. On the other hand, it is entirely feasible to require that the person operating a laboratory apply for approval for a specific list of tests and to insist that the results of no other examinations be used or published until approval has been extended to cover those tests. Blanket approval is beset with difficulties for the reason that the person in charge of a laboratory may be capable of making certain varieties of examinations or tests and yet be incapable of

making or interpreting the results of some other determination. For example, many well-trained chemists may not have the background of training to make and interpret properly rather simple bacteriological tests. Limited approval for specific lines of work is more generally in vogue than is unqualified approval.

LAWS AND REGULATIONS

Prerequisites for official control of laboratory work in whatever field are law and regulations. A law may be either simple or involved. An example of the former is a statute requiring merely that any laboratory making specified examinations be registered with or approved by the official control agency—usually the state department of health. Registration without approval is not to be recommended. A more involved law might specify in detail the methods and procedures to be followed, the requirements for housing, equipment, and apparatus, and the qualifications of the personnel or of the person in charge. Under most circumstances it is desirable to have the law as simple and brief as is consistent with rather broad powers, and preferably to have it provide full authority for the approving agency to promulgate rules, requirements, and standards on which approval shall be based. The power of revocation of approval for cause should be specified. Requirements now in effect throughout the country are in some instances in the form of sanitary code regulations; in others, merely departmental rules. It is desirable that all types of laboratories be covered including those in city departments of health, in educational institutions, in hospitals, in milk plants, and in those laboratories operated commercially or privately for profit.

The limiting of approval to those tests where the results are "used" or "published" has been found to have advantages. Under a law which embodies that provision, a laboratory operated by a milk plant only for the examination of both process and bottled samples of the firm's own product and of samples from cans of producers' milk would be exempt

from approval. Thus the law would not intrude into the private business of an individual, a firm, or a corporation. The laboratory technician at a milk plant might even become interested in testing the products of competitors and could legally do so under this type of law without applying for approval unless the results were published or some of them "used" by salesmen or in some other way that the sales or interests of competitors might be affected or unless the products of the firm were advertised on the basis of the findings obtained. Should the results be used in such ways, it is evident that the requirement of approval should apply.

HOUSING AND QUARTERS

It is rather universally considered that adequate housing for the laboratory shall be made a prerequisite for approval. There is room for a wide range of opinions but it must be realized that reasonably reliable examinations even of a bacteriological character can be carried on in fairly crude quarters if the rooms are decently clean. For that reason standards for housing should not be set too high. Yet in this day and age, it is certainly not going too far to require clean, comfortable, fairly commodious, and well-lighted working quarters without involving undue expense. Regulations should be sufficiently flexible to allow the common sense and good judgment of the approving official a reasonably wide range of play.

EQUIPMENT AND SUPPLIES

In a system for the control of laboratories provision should be made for requiring the use of standard equipment. It may be sufficient merely to require that apparatus be on hand, complete, and in good order at all times for making each determination, examination, or analysis, according to the methods which the person in charge has agreed to follow and has been authorized to use. Such a requirement allows the control official enough leeway to meet special situations and yet gives him the necessary authority for insisting that standard supplies be

used. Where there are available standard methods that are sponsored by some national association, as in the case of milk and dairy products, it is feasible and usually desirable to require the equipment necessary to carry out the standard method in question, especially since in many instances certain pieces of equipment are described in the printed method or are given in specifications.

Inspection should be provided to determine at reasonable intervals that the several kinds of apparatus in use are kept adequate for any increasing volume or changing lines of work, and that all equipment is kept clean and in good condition. It should be possible to insist that pipettes with broken tips be promptly discarded and that only pipettes of given specifications be used. It is surprising how greatly the discrepancies between plate counts or milk-fat tests among different laboratories can be reduced by enforcing such simple provisions. It is equally surprising how far afield in these matters well-trained laboratory technicians—and for that matter even directors of laboratories—will allow themselves to go where there is no supervision. In laboratories where the volume of plate count examinations varies from day to day, the inspector should be prepared to look for overcrowding of incubators. Owners of laboratories are far too prone to purchase incubators that are much too small or too cheaply made. There is an all too general laxity that permits operating incubators at varying temperatures, often falling outside of the allowable range unless there is supervision and the laboratory personnel is advised of and educated to a proper understanding of the serious and troublesome errors that result. Regardless of opinions as to the value of the standard plate count or any other laboratory test, a test had better be left undone than to be poorly or indifferently made because of poor equipment or for some other reason. Inspection should be so designed and carried out as to eliminate bad apparatus and promote the use of good standard equipment, supplies, and reagents.

METHODS AND PROCEDURES

The value of the work done in a laboratory usually is more a function of the method or procedures followed and of the accuracy and intelligence with which they are adhered to than it is a function of the housing and the equipment. Before approval is extended it is desirable that there be definite agreement on the part of the person in charge of a laboratory that any determination, examination, or analysis of a milk, cream, frozen dessert, or dairy or other product will be made strictly in accordance with a specified procedure. This may be either the latest edition of the Standard Methods of Milk Analysis of the American Public Health Association, the Methods of Analysis of the Association of Official Agricultural Chemists, the Methods of another similar organization, or the latest edition of any method approved by the supervising agency, in each case using the equipment specified in the method followed or in any written modification with which the person may have been supplied. Since standard methods, national or international in scope, may not always be applicable to local situations or quickly amendable to changed conditions, it is a wise precaution to provide authority for demanding adherence to methods and procedures drafted by the regulating authority and capable of being modified from time to time when need arises.

LICENSING OF PERSONNEL

In some states, the licensing of personnel is considered a sufficient safeguard against laboratory work of poor quality without any other requirements; in other places, licensing of personnel is merely a prerequisite for approval of the laboratory. It is customary to require the applicant for a license either to pass an examination or to submit credentials from an accredited institution of learning to the effect that certain courses in dairy bacteriology or chemistry have been completed with satisfactory passing grades. In one state, a person passing an examination to do the simpler tests must later take a second, or even a third, test

before receiving a license to make certain more complicated determinations or to take charge of a laboratory. In another part of the country, any applicant who can pass a written examination and demonstrate his ability to perform a butter-fat test, an official plate count, or some other determination is given a "limited" license empowering that person to perform that test or tests, working as an assistant in a laboratory. Yet to take charge of a laboratory where not only are such tests made but the results interpreted to persons outside of the laboratory, the person must hold a "full" or unrestricted license which is issued only to a person who, before taking the examination, has obtained a bachelor's degree from a college or university and has passed a course of instruction in the test or tests covered in the license. The obtaining of an unrestricted license is made the first step toward securing approval of the laboratory.

RESPONSIBILITY OF THE HEAD OF THE LABORATORY

When approval is extended to a laboratory, some person—usually the one in charge—should be made strictly accountable for the reliability of the work done and for the accuracy of the interpretations of findings issued from the laboratory. Experience has indicated that requiring the signature before a notary of the person concerned brings home the seriousness of the approval agreement in an effective way.

The person in whose name the laboratory is approved may be required to agree that:

1. The conduct of the laboratory will be strictly in accordance with recognized standards of laboratory ethics and that no method or procedure will be followed that fails to meet the requirements of the approving authority.
2. Any determination, examination, or analysis will be made strictly in accordance with specified methods as already discussed under the heading "Methods and Procedures."

3. The person in charge will notify the approving authority immediately when changes in technique or personnel are made or are about to be made.

4. The person in charge will be responsible for the accuracy and reliability of the laboratory findings made by any person or persons employed in the laboratory, and for any interpretation based upon those findings. Any examinations, determinations, or tests will be actually carried on by a person or persons holding either a full or a restricted license from the licensing authority.

5. Copies of all reports issued from the laboratory will be kept as permanent records in the files of the laboratory available at any time to representatives of the approving authority.

6. If at any time the person in charge is engaged on a part-time basis, that person will inform the approving authority of the approximate amount of time given to this position.

7. In the event the person in charge severs connection with the laboratory, or is about to sever it, that person will immediately notify the approving authority in writing and return to him the certificate of approval.

SUMMARY

At times, there are issued from laboratories the results of findings that are inaccurate and interpretations of laboratory tests that may range from those which are merely misleading to others that on occasion may have a serious effect on the profits or the reputation of a milk dealer or producer. Erroneous or fallacious laboratory reports and conclusions tend to lower the confidence of the public in the worth of laboratory testing in general. Very occasionally, unreliable reports are the outcome of dishonest attempts to mislead. Far more often they result from careless or thoughtless errors on the part of well-meaning persons improperly qualified and experienced to make and interpret particular tests. Perhaps they frequently occur because the analyst has failed to follow an improved

and up-to-the-minute procedure that should have been readily available to him or because he has used poor equipment, supplies, or reagents that have rendered the findings unreliable. Once in a while an experienced person in charge of a busy laboratory may base an interpretation on unreliable findings or on tests made by an unqualified or careless person.

If the person in charge of a laboratory is legally required to obtain a certificate of approval before reporting any test where the results will be used or published, this step will go far toward improving the quality of work of the laboratory, providing a well organized system of approval and inspection gives opportunity for education and cooperation along with the regulatory aspects. If the laboratory director has agreed under oath to surround the work with a variety of safeguards, he is likely to supervise with care all the steps of each analysis and to weigh well the conclusions based on the laboratory findings. Requirements for adequate housing and standard equipment, apparatus, and reagents are desirable, but even more important is provision for determining the qualifications of personnel—particularly of the person in charge—either by examination or through investigation of credentials before approval is extended. It is important that the person in whose name approval is extended be required to sign an agreement with the certifying agency that specified standards for high grade work will be consistently maintained.

Experience with a system of approval has shown that closer coordination of results between laboratories has been secured and that there is less complaint than formerly from persons whose products are under test. Under a system of approval, there is added incentive for persons operating laboratories to man them with qualified personnel and for technicians to demand proper equipment and supplies with which to work. While it is seldom necessary to exercise the vested authority, the machinery is set up for preventing the bungler or the novice from issuing laboratory reports, for supervising the shy-

ster laboratory almost before it comes into existence, and for improving the quality of work in the laboratory where the training or experience of the personnel is barely adequate for carrying on the variety of tests for which approval has

been extended. It would seem that no laboratory should be the worse for being under a properly conducted approval system and certainly the poor laboratory should be improved or show reason why it should continue to exist.

A Colorimeter For the Phosphatase Test

W. H. Boynton and P. E. Nelbach,

*Department of Public Health, Yale University School of Medicine,
New Haven, Conn.*

In view of the rapidly increasing use of the phosphatase test for determining the degree of pasteurization of milk, a suitable method of reading the results of the test has become important.

The results of the original tests performed by Kay and Graham¹ were read by comparing the depth of blue color produced in the tests with blue glass standards in a tintometer. Gilcreas and Davis² have found that a comparison of the characteristic color reaction of the phenol liberated in the test with known phenol standards provides a more convenient and accurate determination of degree of treatment than the measurement of the color in a tintometer; but since phenol standards deteriorate even when stored in an ice box and protected from light, they used stable inorganic solutions in a series of permanent standards corresponding to the phenol standards.

These permanent standards were developed for use with natural daylight, a variable quantity, and under any but optimum conditions the blue color of the standards has a reddish tinge which is not present in the samples. A sample may be matched readily with the standards by using, as a background, a cloudless blue sky without glare, but when these ideal conditions are lacking, the difference in the color quality of the standards and samples makes matching difficult. Gilcreas and Davis³ later found that the comparison of the intensities of the two

slightly different colors was made somewhat easier by using a blue glass plate as a background against which to read the tests. With this information in mind, a colorimeter was designed and built, consisting essentially of a light-proof box containing a daylight bulb and a blue glass plate with a sliding rack for samples and standards fitted into a viewing chute.

An opaque turquoise blue vitrolite glass tile⁴, size 8 x 12 inches, forms the bottom of the colorimeter. To obtain an "egg-shell" surface for diffuse reflection, the glazed surface of the tile was etched with hydrofluosilicic acid.

A light-proof box with viewing chute at a 45° angle was built to fit over the glass tile. (See diagram). The light source is a 100-watt daylight bulb centered in the top of the box so that no direct illumination can penetrate the viewing chute. The inside of the top was finished with aluminum paint to act as a diffuse reflector, and the remainder of the box was painted matte black. Ventilation holes were bored in the back and sides of the box to remove the heat of the bulb.

In the upper end of the viewing chute, a slot was cut for the rack containing the inorganic standards and the sample to be read. This sliding rack was built to hold 6 x 5/8 inch test tubes (requiring 10 cc. samples), and the standards were arranged in alternate holes in order of increasing depth of color. A light baffle

placed in the chute directly behind the rack makes only three spaces visible at a time, the sample occupying the middle space with a standard tube on each side.

Light rays from the daylight bulb and reflected from the aluminum painted top strike the blue plate perpendicularly and can pass up the viewing chute only by diffuse reflection. The longer (red) wave lengths given off by the daylight bulb will be absorbed to a large degree by the blue tile. The elimination of direct reflection from the tile plate assures that the light reaching the observer's eye will be of a color quality which will minimize the color difference between the standards and

the sample, making possible a reading based on depth of color alone. Avoidance of direct illumination and outside light make the comparison relatively simple. The light chute set at an angle and the rack containing the complete set of standards add to the convenience of use.

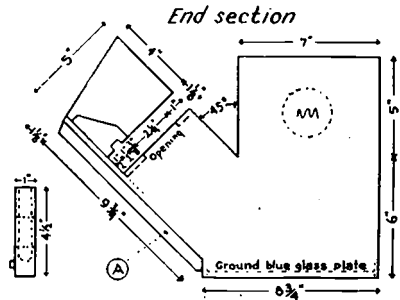
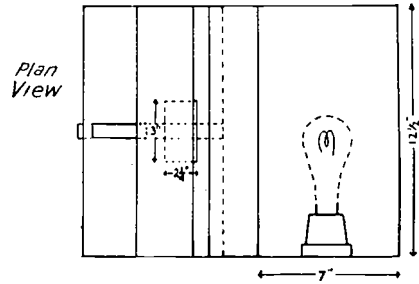
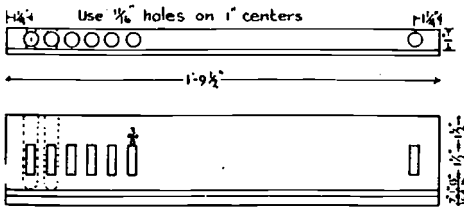
This colorimeter, used in studies of the phosphatase test,* has been found to give constant readings. Different observers can obtain the same readings with the same samples at any time of day or night, and under varying weather conditions.

**Colorimeter
for the
Phosphatase Test**

Specifications

Box made of $\frac{1}{4}$ " plywood, corners cleated with $\frac{1}{2}$ " quarter round stock.
Guide strip on rack $\frac{1}{4}$ " x $\frac{1}{4}$ ".
Center brace (A) - $\frac{1}{2}$ " x $\frac{3}{4}$ ".

Detail of sliding rack



* Aided by a grant from the Fluid Research Fund of the Yale University School of Medicine.

REFERENCES

1. H. D. Kay and W. R. Graham, Jr.—“The Phosphatase Test for Pasteurized Milk.” *Journal of Dairy Research*, Vol. 6, pp. 191-203, (1935).
2. F. W. Gilcreas and W. S. Davis—“Investigation of the Amylase and Phosphatase Tests as an Indication of Pasteurization.” *Twenty-fifth Annual Report of the International Association of Milk Sanitarians*, pp. 15-39, (1936).
3. F. W. Gilcreas and W. S. Davis—“The Practical Value of the Phosphatase Test in Determining the Efficiency of Pasteurization.” *Laboratory Section—Proceedings of the Thirtieth Annual Convention of the International Association of Milk Dealers*.
4. Tile manufactured by the Vitrolite Company of 570 Lexington Avenue, New York City.

The Problem of Recontamination of Pasteurized Milk and Its Products*

L. C. Bulmer

Director, Bureau of Food and Dairy Inspection, Jefferson County Board of Health, Birmingham, Alabama

One of the great handicaps toward progress in the final solution of the city milk problem is the fact that we hear too much ballyhoo about the magic of pasteurization. A stage has long been reached, where we are in need of more enlightenment as to the dangers of possible recontamination of pasteurized dairy products under routine commercial conditions.

It should be clear to everyone that if pasteurization of milk and its products is a necessity of safety—and all recognized authorities agree that it is—then it is equally as important to go the limit in protecting such products, once pasteurized, against recontamination, for otherwise, the whole purpose of pasteurization has been defeated. Public officials and commercial interests who do not fully recognize this fact are living in a fool's paradise. In fact, they are sitting on a powder keg which may explode and utterly destroy public confidence in pasteurization for a period of years.

The problem of adequately safeguarding pasteurized dairy products against recontamination is one that has received scant, if indeed any, worthwhile attention either in this country or abroad. This fact bespeaks a lack of appreciation of one of Pasteur's greatest contributions, not only to the health protection of the human race but also to the stability of the dairy industry.

It is a rather shocking confession to have to make that while the process of pasteurization has been in vogue as a commercial expediency for almost half a

century, and has been accepted as an important public health safeguard for more than thirty years, the fact still remains that a great volume of pasteurized milk sold under present market conditions is actually little or no safer than raw milk.

In Birmingham, we are persuaded that in the official control of milk and its products, there are certain paramount fundamentals to be attended to, and that the less we confuse these in petty detail, the better off we shall be. We have a code which we believe to be practical, and while it embraces certain detail which may confound a lawyer who aims to contest its validity in court, we have, nevertheless avoided the inclusion of all superfluous detail apt to confuse ourselves.

In keeping with this discussion, the question naturally presents itself as to what are the fundamentals as we see them in Birmingham? We believe that pasteurization of milk products adequately controlled is only part of the answer to the city milk problem. In addition, we go further than this and contend that the final solution of the problem depends equally as much upon subsequent rigid supervision and control after pasteurization against possible routine recontamination.

About ten years ago, Dr. J. D. Dowling, Health Officer of Birmingham, blazed the trail in this country when he fostered and persuaded the City Commission to adopt regulations that required all milk, cream, and ice cream mix to flow directly from the pasteurizer into the final container. It is worthy of note that the validity of this provision was recently reviewed by the Alabama Supreme Court and upheld.

* Read at the Dairy Short Course, Dairy Department, University of Tennessee, Knoxville, Tennessee, Thursday, February 10th, 1938.

It is obvious that such a provision in official control of milk and its products is of major importance in the matter of safeguarding against recontamination of a product after pasteurization. To clarify this point in respect to milk and cream, the final container is legally construed as the bottle itself, while in regard to ice cream mix, it is construed as the freezer which automatically prohibits promiscuous freezing or rehandling of ice cream mix in soda fountains, restaurants, or, in fact, any place outside the ice cream plant where the mix is manufactured.

What are the actual conditions in the average American city today in regard to the rehandling and possible recontamination of pasteurized milk and its products? With a view to determining this fact, I recently addressed a questionnaire to the forty-one major cities of the United States of more than 200,000 population, and I am indebted for what I consider to be an excellent response insofar as questionnaires go.

Thirty-four replies were received out of the forty-one requests. In addition, our files carry copies of the milk ordinances of the few cities which failed to respond, thus providing an extremely clear picture of the present situation.

Based on the response to the questionnaires, sixteen of the cities require the bottling of milk on the same premises where pasteurized, but not a single one prohibits the sale of bulk pasteurized milk in cans to restaurants, soda fountains, and similar eating establishments. Twelve of the cities have compulsory pasteurization ordinances, but this is not all that it may seem since up to 20 percent or more of the entire milk supply in such cities is distributed in bulk. Repasteurization of the product is allowed, or at least not prohibited, in thirteen of the cities, while eighteen do not require the dating of milk. Twenty-two of the cities permit bulk milk for service in hospitals, four in school lunch-rooms, while several cities were indefinite in their replies on this subject.

Not a single city in America requires compulsory flow of the product direct

from the pasteurizer to the final container excepting Birmingham, and while a number of cities claim to require bottle milk service of milk in restaurants, review of the ordinances of most of such cities who claim such provision reveal that the requirement is more or less arbitrary rather than one of definite legal provision in the milk code. It is gratifying to observe, however, that thirteen major cities thus far have adopted regulations requiring caps that adequately protect the lips of the bottles.

We may pause here a moment to observe that those persons with field inspection experience will appreciate the fact that where bulk milk is permitted to be handled in a restaurant, it will be served more frequently than not, as dip milk in a glass, and that it would take a squad of inspectors as large as a regiment of soldiers to prohibit such practice, no matter whether the bulk milk be grade A, B, C, or labeled Grade D Raw Milk "for cooking purposes only" as it is so labeled in the Standard Milk Ordinance.

Insofar as the so-called United States Standard Milk Ordinance is concerned, it is inadequate in so many ways that it is difficult to briefly summarize its shortcomings without going beyond the scope of the subject under discussion. Briefly, however, while it goes into a maze of minute detail as to how milk shall be pasteurized and the niceties of the equipment used, the provisions of safeguarding the product after pasteurization are either entirely overlooked or are omitted.

To exemplify, it has no provision which prohibits repasteurization of milk, while it sanctions milk pumps in restaurants and soda fountains under provisions of petty detail for the service of both raw and pasteurized milk. Those with practical experience with such milk pumps will appreciate the sanitary significance of this fact.

In fact, nothing in the ordinance prohibits the juggling of pasteurized milk or ice cream mix after processing at the plant, restaurant, soda fountain or elsewhere. It not only affords but rather extends itself toward multiplicity of

grades, and there is nothing that prohibits a restaurant keeper, for example, having grades A, B, and C of both raw and pasteurized milk simultaneously in his possession in promiscuous bulk form. Indeed, a restaurant keeper may serve grade D raw milk, delivered in cans and labeled "for cooking purposes only", simply by pouring it into a glass and presenting it to some poor deluded patron who will consume it, provided, of course, that the eagle eye of some inspector overburdened with petty detail, happens not to be peering through the window at the time.

Insofar as the questionnaires showed, it is of interest to note that only ten of the major cities in America have adopted the said Standard Milk Ordinance or some modification of it. On the other hand, about five hundred or more smaller municipalities have adopted it. There is no doubt that regardless of its faults, and there are few if any milk ordinances which have none, the Standard Milk Ordinance may serve a useful purpose in certain rural communities which are confronted with more or less primitive conditions. However, we, in Birmingham, have never seen the wisdom of experimenting with it in an effort to make its provisions practical of enforcement in a large city milk shed. On the other hand, the few large cities of this country which have adopted the Standard Milk Ordinance have mostly modified it to a degree almost beyond recognition by way of laying greater emphasis on fundamentals and omitting provisions which have no public health basis on which to stand.

To return to the subject and summarize some of the major problems incidental to the recontamination of pasteurized dairy products, particularly milk, cream, and ice cream mix, there is:

1. The question of rehandling of pasteurized milk and cream in bulk form after processing. This applies to the plant itself as much as to elsewhere. This may be and should be corrected by requiring flow of the product from the pasteurizer into the final container which is the bottle itself.

2. The question of promiscuous rehandling of ice cream mix in soda fountains and other places of business where it is frequently subject to careless practices, slipshod methods, and often held for prolonged periods of time, even days, at too high temperature before the product is eventually frozen. This also may be corrected by requiring not only that such mix shall be pasteurized on the same premises where frozen but also that mix shall flow directly from the pasteurizer into the freezer. In addition to the obvious advantages of this provision, it also controls careless rehandling of the product at the point of manufacture, namely, in the plant itself.

3. The question of covering the lips of the bottles with an appropriate hooded cap that not only affords sanitary protection but also cannot be removed or tampered with without the possibility of the fact being clearly revealed to the consumer. This is to be regarded as a much neglected factor in the protection of pasteurized milk against recontamination.

All such fundamental milk control requisites as these are based upon practical necessity rather than theory. They afford enough talking points that with the proper approach by public health officials, pasteurization interests of most every city could be prevailed upon to endorse them as a cold-blooded business proposition without unduly involving a controversy in local politics.

We have never found it such a difficult matter to make a friendly approach to industry and obtain its wholehearted cooperation in matters that can be shown to have some practical virtue of progress. On the other hand, I am sure that the majority of us realize that industry bemoans and quickly becomes resentful of governmental agencies who are inclined to egotistically place full responsibility upon its shoulders for all the ills that attend the present day milk business. The action of such officials is to be deplored since it often impedes and sometimes totally arrests over long periods of time, initiative and ingenuity of industry.

After all, industry has done its full share in the past, indirectly at least, toward solving many of the modern day sanitary milk problems.

Contemplation will reveal many examples where zealous measures of public health today are merely the aftermath of research in the interest of commercial expediency of the dairy industry in one way or another. Pasteur, for example, in 1864, introduced pasteurization to safeguard against the "diseases of wine". Denmark, about thirty years later, applied it to safeguard against "off flavor" of butter and the spread of tuberculosis among hogs through skim milk. Another quarter of a century elapsed before it dawned upon boards of health, led by Chicago and Toronto, that pasteurization could be utilized as a safeguard of the public health.

Similarly, the milk bottle was first introduced to expedite retail distribution of milk and for advertising the cream line. Many public health officials at the outset gravely frowned upon this departure from dip milk. Furthermore Koch's research in bovine tuberculosis in the late nineties was largely a commercial endeavor to eradicate a great economic plague among cattle, while we may all recall the commercial origin of the old cremometer, the lactometer, and the Babcock test.

The important part played by industry as a leader in the solution of many sanitary problems illustrates that probably some of us as governmental officials are apt to take ourselves too seriously and take more credit to ourselves than we really deserve at the expense of industry.

With more careful and rigid official supervision but with much less unnecessary petty interference, industry as in the past is more likely than not to outstep government in the final solution of many of our peculiar milk and general food problems as we know them today.

The problem involved is becoming constantly more complex because we are befogging the whole question in this country by adopting milk ordinances which are overflowing with trivial detail that cannot possibly influence the mortality rate one iota and, at the same time, are omitting consideration of the most vital fundamentals.

Many years ago, Hastings of Toronto, truly said that there are but two grades of milk with which a board of health can concern itself, "safe" and "dangerous" milk. Yet today, if we look around over the country, we find that milk ordinances are sponsored and frequently adopted by certain boards of health, recognizing and indeed dignifying multiplicity of grades to the extent that A, B, C grades of pasteurized milk and A, B, C, and D grades of raw milk are officially approved. In other words, instead of an effort being made to concentrate entirely upon absolute minimum requirements of safety as, for example, in the case of water supplies, there are those who would condone and officially dignify every grade of rotten milk imaginable in alphabetical order on the erroneous and pitiful assumption that the great public at large knows its milk alphabet.

Insofar as the subject discussed is concerned, there are but two amazing conclusions to reach: In the first place, we as public health officials, are causing American industry to expend thousands of dollars annually to perfect the niceties and various gadgets of pasteurization machinery, only to permit the product so scientifically pasteurized to be subsequently kicked around like a football in the mud;

And, in the second place, from the public health side of the matter, we are in the ludicrous position of "straining a gnat and swallowing a camel."

Practical Farm Sterilization*

Arthur H. Williamson, B. S., D. V. M.

*State Dairy Supervisor, Florida State Board of Health
Jacksonville, Florida*

From a public health viewpoint it does not matter how sterilization is accomplished. Hot water, chemicals, steam, dry air, or a combination of any or all are equally effective, if properly carried out. It is the haphazard way in which farm sterilization is attempted that constitutes the weakness of most of the programs which have been observed. In the deep south, there is a redundancy of small raw milk producer-distributors. The hazard of such a situation is well recognized. It is one of the big reasons why we especially should insist on proper sterilization and storage of dairy equipment and see that the dairymen have adequate facilities for accomplishing it. The human element is the big factor in any milk program, and it is with this fact in mind that we discuss the subject of farm sterilization.

A practical process should have many virtues. First of all, it should be efficient; it should entail as little labor as possible; and it should not be prohibitive as to cost even to the relatively small producer.

If the process is laborious, the average dairy employee will "cut the corners," so to speak. He is prone to follow the line of "least resistance." If he should follow the easy way, the result is inefficient sterilization and a loss of time and money to the dairy owner, to say nothing of the health hazard attendant upon such practice. If, on the other hand, the system makes the easiest way the best way, we can then be fairly confident that we shall get proper sterilization day by day throughout the entire milk shed.

There is another fact that should be borne in mind. It is one thing to properly sterilize equipment and quite another

thing to keep it sterile. Poor storage after sterilization can and often does nullify the process.

The next factor in recontamination of dairy equipment is

WATER OF CONDENSATION

Under most of the sterilizing processes now in general use, there is left adhering to the cleaned and sterilized equipment this condensed moisture. Moisture is conducive to the development of bacteria. The presence of this water would not have great significance if the equipment, after bactericidal treatment, were bacteriologically sterile.

This is not the case, however. Practical farm sterilization is a "far cry" from absolute sterilization, and thermophiles and other bacteria which are probably attenuated but not killed take on new life under moist conditions and the result is re-contaminated equipment. Especially is this true in Florida where the year-round temperature is relatively high and where it is a practice of the dairymen to leave their equipment in the sterilizing cabinet which is left closed until the next milking period. If, on the other hand, the equipment is taken from the cabinet and stored on racks before open windows or in any other place where flies, roaches, or other insects have access to it, the result is quite the same—recontaminated equipment.

Any sterilizing process which leaves moisture of condensation on sterilized equipment has still another and greater disadvantage from the dairyman's viewpoint at least, and that is the deterioration of dairy equipment caused by rust. Hundreds of thousands of dollars are lost each year by the industry on this account. Therefore, when we devise sterilizing ap-

* Read at the 26th Annual Meeting of the International Association of Milk Sanitarians, Louisville Kentucky, October 11-13, 1937.

paratus for use by the dairy farmer, we have several matters to consider—efficiency, initial cost, cost of operation, durability, convenience, storage, and ventilation.

Just how, then, can we approach the ideal in a practical way? The ultimate answer will be dry air sterilization.

At present, this treatment has not been developed to where it can be put to general use. When it has been developed, it will revolutionize dairy sterilization in this and other countries. There is a crying need for it. Its development is inevitable.

STERILIZATION

Of the sterilizing systems which are in general use today, a chemical and two-door steam chest combination is especially adaptable to the retail raw milk producer-distributors, and to the farm pasteurized distributors. It has proved, by far, the most satisfactory (in our experience, at least) and is gaining the favor of the industry. We like it especially because it is a double-check against a "slip" at the farm. The dairymen like it because of its simplicity, efficiency, economy, and convenience.

Of course, either the chemical or steam process, used independently, would suffice, if properly used, but here again we run into that big factor the "human element." If for instance, the chlorine content of the rinse water became so low as to be non-effective, you still have the steam on which to rely. If on the other hand, due to negligence of a dairy employee, or for any other reason, sufficient steam is not introduced into the cabinet to accomplish sterilization, the chlorine in the rinse, in all probability, is there in sufficient quantity to do the job.

I am not going to discuss chemical sterilization at this time, except to say this—if we are going to depend on chlorine alone for sterilization, we should by all means employ the three-compartment wash and rinse vat. We know that organic matter dissipates chlorine very rapidly. During the cleaning process there is a large "carry-over" of the wash water, which inevitably contains a lot of organic

matter, into the rinse water, if only two compartments are used.

It follows then that unless extra precautions are taken, the first utensils put through the rinse are sterilized, while those following may be actually contaminated. By employing a vat with the extra compartment, a very large part of the organic matter is rinsed off in the second compartment and never reaches the third compartment containing the chlorine. This insures, to a large extent, the chlorine content of the rinse remaining sufficiently high throughout the process to accomplish its purpose.

This has been recommended for years. It is one recommendation that we can well afford to heed.

STEAM CHESTS

Now we come to a discussion of the steam sterilizing cabinet, its location, construction, and operation. The most convenient place for the sterilizer is between the milk room and wash room—one door opening into the wash room and as convenient to the wash vat as possible; the other opening into the milk room and as convenient to the cooler and filler as possible.

Steam chest sterilization is relatively new. In our early experiences we wrote everywhere for information regarding cabinet construction. When we received the requested information, it was usually someone's opinion not backed by experiment or experience. We tried their suggestions, however, and failed. We tried our own ideas and failed. Eighty-nine cabinets were constructed under our supervision at that time and of the eighty-nine, not one was satisfactory. The doors would buck, sag, and stick—a crow bar was standard equipment with which to pry them open. The worse part of the whole situation was that we had to live with those monstrosities until they deteriorated. We could not very well condemn equipment that had just been built according to our instructions, and we certainly did not. For two years and more we awaited the decaying process and listened patiently to the vigorous protests of

eighty-nine farmers against a system which required the use of such musty, ill smelling, inconvenient equipment.

The consensus of opinion at that time was that steam cabinet construction should follow closely refrigerator construction. We now know this is not the case. Radiation in refrigeration takes place twenty-four hours a day, every day in the year—while radiation in sterilization occurs for only a very short period each day.

USE OF STEAM

We were told that steam should be directed through a small pipe and released in the bottom of the cabinet through small holes drilled in the pipe at regular intervals to insure even distribution of heat.

We thought it proper to keep the boiler fired and constantly generating steam to keep pouring in on the utensils inside the cabinet. We know now that this is erroneous. Steam flowing at atmospheric pressure is at a temperature of 212° F., steam at 30 pounds pressure is at 250° F., steam at 80 pounds pressure is at 312° F., and steam at 100 pounds pressure is at 328° F.

Steam under high pressure is the answer at present to our sterilization problems, and not just ordinary steam. Upright boilers are made usually to work at 125 pounds pressure and there is no reason why they should not be worked at 90 to 100 pounds pressure in every-day practice. In this way you can make a small inexpensive boiler working at high pressure do the work of a large expensive outfit working at low pressure.

We know now that it is necessary to use a medium size supply pipe and that releasing the steam through the small holes spaced at regular intervals is not only unnecessary but altogether undesirable. If we use a $\frac{3}{8}$ inch pipe, for instance, inefficiency results; if we use a 1 inch pipe, there is too great a "carry-over" of water from the boiler to the cabinet. Therefore, we have to strike a happy medium.

MATERIALS OF CONSTRUCTION

We were told that concrete sterilizers were inefficient and should not be used except in instances where large heating units were available. We now know that concrete construction is probably the best we have, and by painting the inside of a concrete cabinet with Valdura aluminum asphalt paint, it can be made practically as efficient as a wooden cabinet. We know now that the inside wall of a concrete cabinet should not be plastered, because the constant expansion and contraction of the wall will cause the plastering to work loose and fall off. We simply pull the inside form while the wall is green and polish it with a brick, let it dry, and paint it with aluminum paint.

CONDENSATION

What little we know, we have learned by the expensive and laborious "trial and error" method—all at the expense of the unfortunate dairyman. By this method, we have learned that wooden cabinets, with dead air space within the walls, would deteriorate in twenty-four months—the strange fact being that the outside of the wall would decay first. By dismantling several of these cabinets, we found the reason.

The change in temperature, after steam has been introduced into a cabinet, causes the moisture in the air within the wall to condense. Consequently, the interior of the cabinet wall, after the first use of the cabinet, remains wet, and under such a condition the interior of the cabinet walls deteriorates very rapidly. The reason that the outside wall decayed first was that the inside wall was twice as thick as the outside, and therefore, lasted twice as long.

The inside wall of a wooden cabinet usually consists of sheathing diagonally disposed and covered with $\frac{3}{4}$ inch flooring material in a vertical position. The outside wall consists of weatherboarding only. We solved that problem by simply designing a cabinet with the four walls as chimneys or flues. Instead of the air remaining in the wall and forming water of condensation, the flue-like action of the walls carried it out at the top of the cab-

inet and no dampness resulted. Wooden cabinets of this construction, if made with good material and properly operated, will last from seven to nine years.

The rusting of equipment was largely prevented by cabinet design and operation. It is just as necessary for a dairyman to learn how to operate properly a sterilizer as it is for him to know how to operate a disc harrow. Neither is "fool proof" and neither will operate by itself. The correctly designed cabinet should have two rabbeted doors, oppositely placed to allow cross-ventilation. The top of the doors should be as near the top of the cabinet as possible to prevent an air pocket forming above the door top level. In properly operating a cabinet, both doors should be opened at the end of the sterilization period in order that the retained heat of the sterilized equipment can drive off the water of condensation and thus prevent rust. This it will do very effectively. The equipment should remain in the cabinet until ready for use. After the doors are opened, however, copper screen inserts should be placed in door openings to prevent recontamination of the utensils by flies. This will not interfere with the ventilation of the cabinet, and the arrangement affords perfect storage for the cleaned and sterilized equipment.

The two-door feature, provided the doors are oppositely placed, makes for convenience that no cabinet should be without. The one door cabinet is undesirable from every viewpoint; it never ventilates and is always inconvenient. A two-door cabinet with the doors in the same side of the cabinet and only the milk house partition separating them is little better than a one-door type, except possibly for convenience. To put two doors in one side of a cabinet necessitates too large a cabinet (or one that is all out of proportion) for an average producer. It is economically unsound to maintain a large heating unit for heating a lot of space that is never used. What sometimes happens is that a small boiler is coupled with a large box and inefficient sterilization results.

TEMPERATURE CONTROL

Every cabinet should be checked by the inspector with a portable recording thermometer to determine its efficiency. Cheap angle thermometers installed close to steam inlets near the top of sterilizing cabinets are unreliable.

"A chain is only as strong as its weakest link"—and by the same token a sterilizer is only as efficient as its doors. There is quite an art in the building of a satisfactory sterilizer door—one that will not warp, one that will not sag or stick, one that will be efficient.

DOOR CONSTRUCTION

In the early days most of our sterilizer doors followed refrigerator door designs. This was a mistake. Live steam is quite different from cold air. Any wood swells in the presence of steam, and the steam, in addition to swelling the wood, softens up its texture and predisposes it to warping.

A correctly designed cabinet door is rabbeted all the way around. Space is allowed between the edge of the door and side of the jamb for swelling. Experience has shown that swelling takes place away from the hinge side of the door. Therefore, it is necessary to leave more space on the latch side than on the hinge side when erecting the door.

With ordinary kiln-dried # 1 pine construction, $\frac{3}{4}$ inch space on the latch side of the door between the edges of the door and the side of the jamb is the correct clearance. While $\frac{1}{2}$ inch clearance on the hinge side is sufficient. One-half inch clearance at top and bottom is sufficient although $\frac{3}{4}$ inch clearance all the way around could be left without affecting the efficiency of operation.

Efficiency does not depend on this clearance, but on how well the door is pressed against the packing on the rabbet—if sufficient clearance is not allowed between the edges of the door and the sides of the jamb, the door will inevitably stick.

Sagging is caused by two things—weak construction of the door itself and under-hinging. If, instead of using two light hinges put on with wood screws, three

heavy hinges put on with lag screws are used, the trouble would be eliminated. Most of the heavy doors in actual practice are under-hinged, and therefore, sag.

The latch is an important factor in sterilizer efficiency. The best latch, of course, is the heavy refrigerator door latch that we see in large refrigerating plants. This latch is expensive, though, and dairymen hesitate to make the expenditure.

A very satisfactory latch can be made by welding a malleable iron handle to a $3/16'' \times 1/2''$ spring steel shaft. By bolting this shaft to the jamb and by using a beveled piece of iron on the door itself, we make a fulcrum that accomplishes the purpose splendidly. Two such latches on each door are necessary to insure against warping of the door.

DRAINS

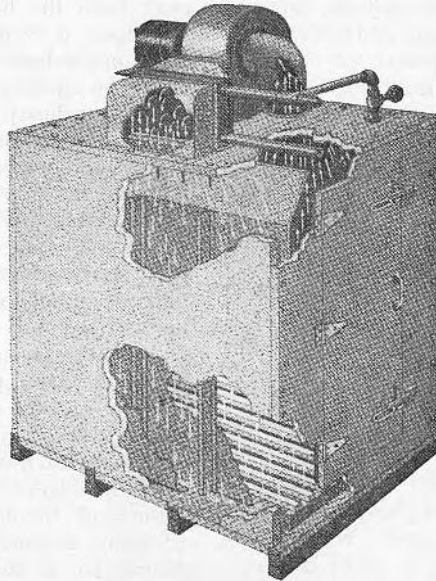
All sterilizers should be well drained. The drain serves two purposes: first, it facilitates cleaning with water under pressure; and second, it allows for air expansion—this is important! We have seen doors blown from their hinges by what we thought, at that time, was steam pres-

sure but what later proved to be air pressure due to air expansion. The drain then acts as a safety valve and should be left open at all times.

The drain should be large enough to accommodate the outflow of wash water and admit of easy cleaning. About a 2'' pipe has been found suitable for the average cabinet. This drain if left entirely open, permits too much loss of heat. It is not necessary that the air escape valve be so large. Cap the pipe and drill a suitable size hole in the cap through which the air can escape. The size of this hole as determined by experience, should be one inch in diameter for a 120 cu. ft. cabinet. With this arrangement, we have a two inch drain—and a one inch safety valve.

SUMMARY

Farm sterilization can, at very little cost, be made efficient and convenient. A chemical and two-door steam chest combination process of sterilization best accomplishes the purpose. The fact that location, construction, and design play a most important part in the efficiency of the equipment should not be overlooked.



STEAM CHEST FOR STERILIZING UTENSILS ON FARM

Report of Committee on Ice Cream Sanitation*

F. W. Fabian, *Chairman*

Sanitation is based principally on three fundamental sciences, physics, chemistry, and biology. It can progress only as these sciences open up new avenues of approach to the control of human and animal diseases. This has been demonstrated amply in the past in the control of infectious and organic diseases. It was possible to reduce materially the death rate in such diseases as tuberculosis and practically wipe out such diseases as typhoid, diphtheria, smallpox, yellow fever, cholera, malaria and bubonic plague only after the science of bacteriology had demonstrated the cause, and the public health official had applied this knowledge to the water, milk, and food supply as well as to environmental factors such as sewage and garbage disposal and insect control such as flies, fleas, and mosquitos.

Likewise chemistry has made its contribution in many various ways such as in the eradication of deficiency diseases and correcting nutritional deficiencies and in giving us new and better disinfectants, to mention but a few of the many applications. Physics has aided us in demonstrating the role sunlight plays in health, in providing means of duplicating a part of the sunlight by irradiation, as well as many other forms of energy such as radium emanations, Roetgen rays, Hertzian waves, electrical and heat energy, all of which have been put to good use by the sanitarian.

THE LAG PHASE IN SANITATION

In every line of work there is a period known as the lag phase. We have it in mechanics, in medicine, in biology, in sociology, and in sanitation. Many discoveries are made that are not applied immediately. In engineering many improvements are held in abeyance until

needed to increase sales. In medicine many lives could be saved yearly if all physicians and surgeons would make available to their patients the latest scientific knowledge. Even bacteria when transferred from one medium to another undergo a period known as the lag phase in their growth. Ordinarily the lag phase is without serious consequence except where human life is at stake. In sanitation one of the most glaring examples of it is in the matter of pasteurization of milk and milk products. It has been demonstrated without any reasonable doubt that pasteurization is both an economic and a health measure. When correctly done, it eliminates all the milkborne diseases, thereby saving human life and needless suffering. Yet, there are in the United States many cities in which only a fraction of the market milk is pasteurized, and none of the other dairy products. Diseases such as tuberculosis, undulant fever, and streptococci infection in humans can be greatly reduced by proper testing for these organisms in animals, yet, many communities have no well organized program for such work.

Sanitary inspection of dairy farms producing milk for use as market milk, ice cream, butter, and cheese as well as the sanitary inspection of the plants making these products is considered an important part of every well organized health department. Yet, there is scarcely a city in the entire country that has enough inspectors adequately to inspect the market milk supply alone so that ice cream, butter, and cheese are neglected.

FOUNTAIN SANITATION

Those familiar with the ice cream industry recognize that no matter how the ice cream may be manufactured, whether in a large or small plant or in a retail store by means of a counter freezer, the dispensing of it by the retailer leaves

* Presented before the 26th Annual Meeting of the International Association of Milk Sanitarians, Louisville, Kentucky, October 11-13, 1937.

much to be desired from a sanitary standpoint. This fact was first emphasized by Horn⁵ in a paper before this Association in 1935. Later, Fabian and Hook⁴ and Krog and Dougherty⁶ confirmed his work.

In reply to a questionnaire sent out by the Chairman to the Committee members Mr. Parker makes this pertinent observation:

"We still go on piling requirements on the manufacturers of ice cream and supinely do nothing about the handling of ice cream in stores and other places where it is served. Doctor Horn showed the importance of this problem. The plain fact is that none of us know just how to deal with it. The serving spoons are used for long periods without being washed or kept in running water, and are perhaps partly clean. The washing of dishes of various kinds in which ice cream is served is not covered. I have sometimes thought that an appeal to the manufacturers of utensils might interest them in the problem. I believe that it was the manufacturers of dairy equipment who are largely responsible for the excellence of sanitation in milk plants and dairies. I believe that manufacturers might help out with this problem of dirty ice cream dishes."

At the request of the Chairman, Dr. A. J. Krog, one of the members of the Committee, has prepared the following statement:

"How a single step in the handling of food can be the means of contaminating it is demonstrated by a study recently made by the Health Department of Plainfield, New Jersey. In this case the step is the last one and the food is ice cream.

"Anyone who has given the matter a little thought must have concluded that the usual method of dispensing ice cream at retail is a dirty one, due to the almost universal custom of keeping the scoops or dippers, when not in use, in small cans of water. The idea is, of course, to prevent the ice cream from drying and sticking to the scoops, not to keep them clean.

"With few exceptions, ice cream in the small original packages was found to contain fewer bacteria than the same kinds, from the same manufacturers, when served

from large cans. More than 200 tests by the following simple, but effective, procedure, determined what the real reason is.

How It Was Done

"One sample of loose ice cream was taken with the vendor's scoop in the exact manner that it would be served to a customer. A second was taken with a sterile spoon, also from the top layer. Then two more similar samples were secured from deeper down after the surface layers of ice cream had been scraped away with one sweep of another sterile spoon. All samples were examined for numbers of bacteria by the approved agar-plate method.

"Bacteria counts were invariably higher in the scoop samples than those taken with the sterile spoon; in some cases they were three hundred times as great. The surface ice cream had more bacteria than that below due, no doubt, to the previously added dirty scoop water which evidently penetrated as far as three inches. The number of bacteria in the scoop water were usually found to be enormous, indicating that it was a good medium for their growth.

Why It Was So

"Several other factors were found that influenced the contamination of the ice cream. The smaller the amount of ice cream in the can the larger were the numbers of bacteria accumulated from numerous dippings. Samples taken early in the day were usually best, presumably because the dippers were washed and clean water put in the containers the first thing in the morning. The appearance of the scoops were also a good index of the final degree of contamination of the ice cream; when broken and mended with pieces of cloth or string, or when the working parts contained slimy or cheesy deposits, the counts were high.

"Some of the ice cream merchants in Plainfield were persuaded to try the plan of rinsing their scoops in running water before and after each use, and between times to keep them on dry racks protected from dust, flies and other sources of contamination. A series of samples, taken in exactly the same way as before, showed that this solved the problem. The bacteria

in scoops and sterile spoons were considerably less, both on the surface and deep down in the cans.

"The picture that developed out of this survey may be demonstrated by the averages shown below which are based on one hundred samples of ice cream dispensed by the old method by which the scoops were kept in receptacles containing water, and one hundred samples of ice cream taken by scoops which were rinsed in cold running water before and after each use and placed on a dry rack.

"In this table it will also be noted that the average counts of ice cream sampled with sterile spoons were considerably lower, regardless of whether they were obtained from the surface or sub-surface, than those taken from the same areas with the vendor's scoops. The answer to the problem will be found in the average count of one hundred samples of water in which scoops were kept.

Average Count of 100 Samples	
	<i>Bacteria per cc.</i>
Scoop samples from surface.....	178,000
Scoop samples from sub-surface	78,000
Sterile spoon samples from surface	38,000
Sterile spoon samples from sub-surface	42,000
Samples of water in which scoop was contained	1,650,000
Samples from scoops stored on racks and rinsed before and after each use.....	20,000

What To Do About It

"It is logical to conclude that we must put into effect whatever new regulations are needed to keep ice cream clean all the way from the cow to the ultimate consumer. Such action is no more than fair to the public and evidently does not need to be a hardship to those who make a business of selling this valuable product."

COUNTER FREEZERS

Counter freezers, one of the newer developments in the ice cream industry, still presents certain sanitary problems to the public health official due to the fact that they do not conform to the requirements contained in many state laws and city or-

dinances covering the manufacturing of ice cream. Many of these laws or ordinances were enacted long before the advent of the counter freezer so that discrimination cannot be claimed in this respect.

An interesting case in point is the city of Birmingham, Alabama, which enacted an ice cream ordinance out of experience gained from a serious epidemic of typhoid fever involving 350 cases in 1916 due to ice cream. After the epidemic an ordinance was passed and operated successfully until 1935 when it was challenged by the installation of a counter freezer in a store operated by the Gilchrist Drug Company. Dr. J. D. Dowling, the Health Officer of Jefferson County, enjoined the Gilchrist Drug Company from selling the ice cream in violation of the ordinance. Relief from the injunction was first sought in the lower courts and finally in the Alabama Supreme Court. The decree of the lower court was affirmed by the higher court and the injunction was made permanent.

The section of the Birmingham ordinance in question was Section 5249 (g) which is as follows:

"Section 5249 (g). All ingredients used in the manufacture of ice cream or other frozen substances, composed in whole or in part of milk or milk products, shall be pasteurized as provided herein, and shall flow or be conveyed through appropriate pipes or conveyors from the pasteurizing apparatus directly into the freezing apparatus, and from that directly into a sterile can, carton, or other final container, in such a manner as to protect same against contamination."

By another provision of the ordinance, ice cream manufactured by any other method is condemned as insanitary, and the manufacture and sale is prohibited. Expert witnesses called from many parts of the country unqualifiedly endorsed the continuous flow method as provided in the ordinance. The complainant elicited from the witnesses the fact that they knew of no epidemic attributable to the counter freezer or a case of typhoid fever that could be so traced. In this connection

Justice Gardner, who wrote the scholarly opinion for the Alabama Supreme Court, says:

"But we think complainant over-estimates the importance of such negative proof."

"Perhaps, also in *Mannix vs. Frost, supra*, the city in requiring milk dealers to cover or enclose the milk was likewise unable to trace any particular illness to that source. But, observed the court, 'the police power of a city means a power to prevent an anticipation of danger to come, an active and earnest interest to protect the people, and in so doing to curb and restrain the individual tendency.' The *Mannix Case* was decided twenty years ago, and the requirement that milk sold to the public in centers of large population should be protected from exposure, was vigorously contested; and yet there would be few today bold enough to question the wisdom of such a precautionary measure.

"Rapid advance has been made in the science of medicine and in the field of bacteriology. That the health and welfare of the people have been greatly advanced by the conscientious and intelligent labor of the scientists and members of the medical profession cannot be open to question. Their labors are not to be restricted to curing disease and alleviating suffering, however important these may be, but the greater benefits are to be realized by the use of preventative means in anticipation of the danger of an epidemic. And it is fully as important that the health authorities should anticipate danger to public health, and provide against them, as it is to take steps to eradicate conditions after the disease has appeared.

"An array of experts have unqualifiedly endorsed the continuous flow method, and have given their reasons for condemning the counter freezer method, now in use by complainant. No one can doubt their high standing in their chosen field, nor their sincerity of purpose, and lack of any selfish motive."

Another case of litigation over the counter freezer is that of *F. A. Robertson vs. Commonwealth of Virginia* before the Virginia Supreme Court at Richmond. The court held that the counter

freezer type of ice cream manufacturing was not manufacturing within the scope of the Virginia Ice Cream Law. The Attorney General has petitioned the court for a rehearing of the case at which point it now rests.

Pennsylvania in July 1935 passed a new state law covering ice cream. Mr. Irwin, one of the Committee members, was asked to comment on it for this report. His comments are as follows:

"The subject of counter freezers is still unsettled in Pennsylvania, as well as many other places. The state law under which we operate requires that the milk products used in the preparation of ice cream shall be pasteurized before or during the preparation of the ice cream. The rooms of buildings in which ice cream is exposed during and after preparation shall be properly lighted, ventilated, drained, clean and shall be used for no other purpose than to provide a place for cleansed containers and utensils and for the handling of ice cream. The ice cream, during and after preparation, and cleansed containers, utensils and equipment shall be protected from flies. The plant in which ice cream is prepared shall be provided with an adequate supply of steam and hot water for cleansing containers, utensils and equipment. Equipment with which ice cream comes in contact shall be constructed in such a manner as to be easily cleansed. Demountable apparatus with which the ice cream comes in contact shall be taken apart and cleansed each day such apparatus is in use. Surfaces with which ice cream comes in contact shall be of smooth non-corrosive material and free from open seams. The plant in which ice cream is to be prepared shall not be constructed nor altered until the plans and specifications thereof have received approval of the Secretary of Health. Equipment before being installed shall likewise be approved by the Secretary.

"We have had the above requirements and the state law since July 1935. We are making progress slowly and I believe that the general requirements of the Act are sound from a public health standpoint and are acceptable to the manufacturers. It is apparent, however, that the counter freezer cannot be operated on the store room coun-

ter as was originally intended. It is proving successful, however, when placed in a room provided for the purpose."

One of the reasons given by operators of counter freezers for noncompliance to city ordinances requiring pasteurization of the mix on the premises where the ice cream is frozen is that there is no suitable machinery for pasteurizing and properly handling small amounts of mix. The machinery used by wholesale manufacturers is too large and too expensive to meet their requirements. A machine has been designed and placed on the market which is a combination of a pasteurizer, holding vat, cooler and storage tank all in one. They range in capacity from ten gallons costing \$300 to 300 gallons costing \$1125 with intermediate sizes and corresponding prices. They are being used in Baltimore whose city ordinance requires pasteurization of the mix at the place of freezing. This is certainly a step in advance and will enable the counter freezers to meet more nearly the requirements of such ordinances.

CHEMICAL STERILIZATION

Chemical sterilization is a subject which is of interest to all of us. Most of us are familiar with its uses and abuses in the dairy industry. A great deal of time and study has been devoted to it and several new preparations of merit have recently been placed on the market. Time nor space will not permit of giving it adequate treatment in this report. Those of you who are interested in the subject are referred to the many excellent papers dealing with the subject.

California does not permit the substitution of chemical sterilization for steam sterilization. For this reason your Chairman has asked one of the Committee, Dr. R. V. Stone, from that state to outline in brief their reasons. Dr. Stone's comments are as follows:

"Fundamentally, for many years, the California Dairy laws have included the regulation that steam must be used for sterilization purposes. Any exception to this was a method 'acceptable to the state' but no such official exemptions became recognized.

"All of ten or more years ago, trouble with milking machine rubber occurred when chlorine washes were used upon quiescent rubber; pulsations and movement of such treated rubber surfaces permitted seeding with small, surface, crack-imprisoned contaminants with resultant pin points and other high count difficulties. Heating as by pasteurization of rubber equipment corrected the trouble.

"In pasteurizing vats and other metallic equipment subjected to changes of temperature, repeated occurrences of bacterial count difficulties came from small cracks in vat walls, paddles, pipe lines, floats, etc. Suspicion, at times, indicated that certain chemical sterilization solution actually entered into the dairy products from certain establishments; a possible excuse being that such was unavoidable. There was at least a limited belief that if some of this solution was 'accidentally' allowed to become a part of the finished product, lower bacterial counts would result and that health officials would not be able to detect such a practice. The merit or lack of merit in such an opinion is not of moment; of actual import was a sincere opinion that chemical means were used to attempt some control of faulty or careless environmental sanitation.

"Added to this was the lack of definite control over standards of solutions; differences existed years ago (as even now) as to the parts per million of residual chlorine that a disinfectant solution should carry. Variation from 25 to 300 parts per million, or over, are usual experiences. A variety of preparations of different strengths of powder or liquid form, etc., all introduce a situation impossible to control *practically*. Furthermore, atmospheric exposure of chlorine compounds leading to decreasing strengths of available chlorine is a usual condition.

"Thus, when solutions are made up from directions on the package (which is usual) by so many 'tablespoonfuls' or other bulk measurement, the actual available chlorine resultant is a matter of no control. The compulsory and careful use of ortho-tolidine control of solutions by the producer of a dairy product is difficult to accomplish.

Variation in temperature introduces more variables.

The effect of organic matter within a dairy product present as a residual in or upon production-soiled equipment influences again the actual effective chlorine available for bactericidal effect. Inspection evidence indicates that chemical sterilization is used as a means of overcoming poor washing, an inadequate equipment or method. A course of least resistance attitude has been evident upon occasion where the slopping around of a chemical sterilizer was taken as a means to control all ills."

Mr. Fred W. Milner, ice cream specialist, California State Department of Agriculture in a lecture of the short course, University of California, College of Agriculture, Davis, January 1937, stated:

... "The chemical action of a detergent creates a solvent action by rendering insoluble substances soluble and which can be removed mechanically.

"In the washing of equipment, I wish to emphasize the fact that the detergent or cleanser does not clean the equipment but really prepares the sediment for its subsequent removal by adequate scrubbing with a stiff brush and rinsing. *Bear in mind that there is no substitute for old-fashioned elbow grease.* In some instances, operators of small freezers have resorted to the use of soap powders. Such products are good emulsifying agents but form greasy insoluble films, very much similar to milk stone, thus creating a harboring place for the bacteria.

"Sterilization is Important. The next important step in the proper handling of the equipment after a thorough cleansing is proper sterilization. Sterilization is a procedure which involves the destruction of bacteria by heat. *California laws require that all equipment, if properly sterilized, must be heated to a temperature of not less than 170 degrees for a period of not less than 15 minutes, with either hot water or steam.* If this is properly done, the equipment will be so hot that all moisture will be removed. It is this drying effect that prevents bacteria from multiplying."

Further, in his published article in *Ice Cream Trade Journal*, April, 1936, he stated:

"*WHY AND HOW CLEAN?*" After equipment has been used, there remain certain residues which, bacteriologically speaking, are referred to as 'dirt' or 'sediment' and which must be immediately removed or prepared for removal. Residues present have been divided as follows:

1. Sediment or milk solids which hang to the surface by means of an oily film, acting somewhat as a binder.
2. Sediment or milk solids which are held to the surface by absorption.
3. Milk stone deposits.

"It has been our observation that there is not always an accurate conception of what is meant by proper washing and sterilizing. There are two distinct operations. Cleaning can not be accomplished by sterilization, nor can proper sterilization be effected without proper cleaning. The complete removal of all milk solids before sterilization cannot be over-emphasized. If the equipment is not properly washed and sterilized, bacteria lodge and develop in the film of dirt or grease on the surface, and they are protected from the penetration of the heat. We must bear in mind that naked bacteria are easily killed. However, when they wear a coat of grease or film of milk solids, they are protected and will remain unharmed by the sterilizing agent.

"I asked Mr. Milner to visit me in order to discuss this 'why heat only' in California practice. On July 29 we glanced through a great deal of data which showed very high counts in ice cream from counter freezers where chemical sterilization had been used and which counts dropped dramatically upon compliance to the demand that heat be substituted.

"Out of 785 producing establishments inspected by the State Department of Agriculture in California there was provided approximately 10,000 ice cream samples. Oftentimes, the same day, the same street, and the same flavored product, such as vanilla, yielded high versus low counts in parallel with chemical versus heat sterilization. These high counts dropped to low counts upon changing methods.

"Mr. Milner's observation that those who followed the 'course of least resistance' and used chemical only had grief while those

who had followed the heat treatment program seldom met with production high count problems.

"Bacteria require food, moisture and optimum temperature for growth promotion. Remove the food mechanically by cleaning, remove moisture by heat, and the bacterial counts will be adequately taken care of."

TOTAL FOOD SOLIDS STANDARD FOR ICE CREAM

Last year in our report the subject of controlling overrun in ice cream was discussed at some length. This is a subject which is receiving considerable attention at present in many places. The Federal Government in Canada has been making a study of the whole subject with a view of regulating the amount of overrun. Mr. W. C. Cameron, one of the members of our Committee, who is Chief Inspector of Dairy Products of the Federal Government at Ottawa, has been in close touch with the work. The Chairman, therefore, asked Mr. Cameron to report on this phase of the work. His report is as follows:

"The ice cream industry in Canada has for a considerable time been subject to comparatively few regulations either as to composition of the finished product or sanitary requirements. This condition, though not desirable, did not, until recently, result in an inferior product being offered for sale, nor was it prompting any undesirable practices in the trade. This was due to the fact that the manufacture and distribution of ice cream was in the hands of comparatively few well established dairy companies, who, as a general thing, assumed the attitude that what was best for the industry generally would result in direct benefit to their own private interests and hence, quality both as to composition and sanitation was maintained at a high level.

"As new developments, both in the ice cream industry and also in allied trades, made their appearance, such as certain adaptations of machinery, advances in mechanical refrigeration, cheap non-returnable containers, and by no means the least, a gradual change in the mode of transportation, the manufacture and distribution of ice cream

has found its way to many and varied locations. Too often the manufacturer of ice cream, who has just recently entered the business, is not a trained dairyman, does not realize the importance of the place that the industry holds in our national life and, as a result, regards his particular business from a purely local viewpoint with the thought in mind of trying for a personal advantage or gain, even though only temporary, with little or no regard for the welfare of the industry as a whole.

"Therefore, it was necessary to revise existing ice cream regulations so as to fit the present stage of development in the industry. It was realized that such revisions as were necessary should regulate but not restrict in any way the normal, sound growth of the industry.

"A survey of the industry revealed the incorporation of excess air in ice cream as being the phase of ice cream manufacture where the greatest variation existed. Hence, some method of regulating overrun in ice cream was considered necessary.

"The various means of regulating the amount of air that may be legally incorporated in a mix while being frozen into ice cream was studied. This was done with a view towards determining which method would exercise adequate control over the amount of air in ice cream and at the same time meet the following requirement which the industry deemed necessary:

"The consumer should be assured of a reliable product and in no way be exploited for the gain of any other section of the industry—the manufacturer who wishes to use a mix of high total solids content should be compensated for the extra cost so entailed without increasing the price of ice cream to the consumer—the use of more milk products should be encouraged—no restrictions should be placed on the development of new or advanced methods of manufacture which might embody the use of more air in ice cream, providing the finished product contains a definite minimum of food value—there should be a certain elasticity in the definition for ice cream which would permit the adjusting of ingredients to meet the varying demands of the consuming public which appear to differ depending upon

location and climatic conditions—ice cream should be so manufactured as to induce the maximum consumption per capita.

"The one method of controlling the amount of air in ice cream which appeared capable of meeting the requirements of the industry as stated above was that in which ice cream is required to contain a definite minimum weight of food solids per unit volume.

"The amount of food solids alone is not sufficient to ensure a good ice cream. There must be some guarantee that they are the right kind of food solids. The nature and the amount of the various solids contained in ice cream may be controlled within limits by so drafting the definition for ice cream as to stipulate the ingredients from which it may be manufactured and in so doing specify the minimum percentage by weight of fat and total solids and also the maximum percentage by weight of stabilizer permitted. At present, it is believed that the proportions of the solids in ice cream other than fat and stabilizer, will be regulated by consumer preference and the resulting body and texture of the finished product. It is also felt that the introduction of undesirable solids into ice cream is not a serious possibility at present.

"It may be, however, as more study is given to the problem, and with certain new possible developments, that a more specific statement will be required as to just what shall constitute the food solids in ice cream. Should there be a tendency to increase the total solids in a mix at the expense of milk fat, then a statement will be required stipulating the proportion of milk fat that shall be present in the total solids of ice cream. Such a statement may also be required for milk solids not fat. Further, it may be that the 'flavors' used for ice cream may require modification should there be any attempt at adulteration with certain products disguised as 'flavors.'

"From the standpoint of the manufacturer and the producer, the food solids requirement for ice cream does compensate a manufacturer for using a richer mix by permitting a higher overrun. But a limit is placed on the amount of air that can be legally incorporated. Actually the food solids require-

ment for ice cream automatically places a maximum limit on the amount of air that can be incorporated and also the minimum weight of a unit volume of ice cream for each and every type of mix used. It does foster the use of more milk products which should be reflected in a distinct benefit to producers.

"There was one question which was uppermost in the minds of those responsible for approving the method of controlling overrun by the food solids requirement in the finished ice cream and that was—Is there a maximum overrun that can be taken on ice cream regardless of the richness or total solids content of the mix beyond which the body and texture of the resulting ice cream suffers and which would permit placing on the market an ice cream with an undesirable body and texture, not palatable, and which would tend toward decreased consumption?

"A limited number of experiments conducted in a commercial ice cream plant showed that properly balanced mixes frozen with modern machinery gave ice creams (in which overruns varying from 100 to 152 per cent had been taken) which were almost identical as to body, texture and palatability. Judged by a number of employees from both the plant and the office, including a fair percentage of women who were taken as representing the average consumer and also by men considered to be authorities on commercial ice cream, it was revealed that when the finished ice cream had the required food solids per unit volume and was manufactured from what was considered well balanced mixes, that the amount of air incorporated did not have any undesirable effect on the finished product. The majority picked the high overrun ice cream manufactured from a mix of corresponding high per cent total solids as being the best product.

"At the present time, it appears as though a comprehensive definition for ice cream which embodies the feature of requiring a minimum of food solids per unit volume will regulate overrun, will permit adjustments of the mix to meet the various demands of the consuming public in different localities, will foster the use of more milk products in ice cream, will permit sound

developments in manufacturing processes, will stimulate consumption and prevent fraud or the exploiting of the consuming public."

MATERIALS ADDED AFTER PASTEURIZATION

Last year in our report² attention was called to the sanitary problem existing in relation to the addition of raw products to the mix after it had been pasteurized. The addition, during the freezing process, of nuts, fruits, extracts, and coloring materials that contain many organisms, some of which may be pathogenic, is not a safe procedure and should be corrected. It has been shown by several investigators, Fabian³, Newman and Reynolds⁷, Prucha⁸, Prucha and Tracy⁹, Smallfield¹⁰, Tracy¹², and Brown¹ that the ingredients added after pasteurization may contain many bacteria and a certain percentage of the samples contained the *Escherichia-Aerobacter* group. The way in which the materials were handled led the investigators to believe that undoubtedly some of the *Escherichia coli* were of human origin.

Brown¹ has shown that two pathogenic organisms *Staphylococcus aureus* and *Eberthella typhosa* when inoculated into three different shades of coloring materials were capable of surviving for a period of two weeks although the numbers decreased rapidly during the storage period.

Prucha⁸ in discussing the materials added after pasteurization of the mix from the public health standpoint reaches these very important conclusions:

In concluding this discussion on the sanitary aspects of the fruits, nuts, flavors, and colors, the following comments might be made:

1. There is no definite evidence that these materials had infected ice cream with disease bacteria and that such ice cream caused epidemics.
2. The plants where these materials are handled and prepared are not properly controlled by the health officers.
3. The storing of these ingredients in the ice cream plants should be inspected and controlled by the health officers and by the ice cream plant superintendents.

4. Potential possibilities for contamination of these ingredients exist. We should not wait until somebody contracts a disease by eating ice cream in order to get proof and in order to start in to correct the situation.

5. Much can be done by the ice cream plants themselves, such as:

- (a) Keep the ingredients under proper sanitary conditions.
- (b) Treat the ingredients in some manner to keep them safe.
- (c) Purchase only good products from houses where some effort at sanitation is being made.
- (d) Use good ingredients in the mix, properly pasteurized mix, and efficient safeguards¹¹ against the contamination of the ice cream so that ice cream can be made the safest food on the market, the goal for 1937.

SOLUTION OF THE PROBLEM

It is evident from these conclusions and also from the observations of other investigators that here is a problem that exists and one that should be corrected. Many manufacturers of ice cream say when approached on this subject that if you tamper with fruits you immediately destroy the real fruit flavor.

They also contend that nuts become soggy and less brittle when treated. Flavoring extracts, since they are made with ethyl alcohol and are also volatile, lose much of their value when treated. Coloring materials while they are less sensitive, may likewise be impaired by any germicidal treatment. What are the facts in the case?

Brown¹ has found by extensive experiments that it is possible to reduce greatly the bacterial content and improve the sanitary quality of all the materials added to the mix after pasteurization without materially affecting the quality or flavor of the product. In fact some of the materials such as pecan nut meats were actually improved in flavor after such treatment.

Time will not permit to go into detail regarding the methods used by Brown to improve their sanitary quality but his conclusions which should be of interest are as follows:

1. The three methods of preparing pecans for the cracking process that were studied injured the texture of the nut meats.
 2. The sanitary quality of pecan nut meats can be greatly improved by dipping in a 50-75 per cent boiling solution of sucrose plus 1 per cent salt followed by drying in a hot air oven. (Details found in his Table 2). A marked improvement in the flavor of the nut meat usually results from such treatment.
 3. The treated meats can best be stored in glassine bags at room temperature. The relative humidity should be around 42 to 50.
 4. One-tenth of one per cent of sodium benzoate added to coloring materials will not inhibit the growth of bacteria.
 5. The addition of 25 per cent alcohol to coloring materials will prevent the growth of bacteria and mold.
 6. Coloring materials can be heated to 140°, 160°, or 180°F. for 30 minutes without injuring the quality of the colors. Additional heating, in some cases, slightly reduces the intensity of the color.
 7. Strawberries and raspberries can be pasteurized to 140°F. for 30 minutes to improve their sanitary quality when used to flavor ice cream.
 8. Peaches mixed with sugar can be boiled for three minutes without injuring the flavor of the peaches.
 9. The flavor of oranges is not affected when dipped in 75-100 parts per million chlorine water to improve the bacteriological aspects of the fruit for use in ices or sherbets.
 10. It is possible to heat some of the flavor extracts to 145°F. for 30 minutes without injuring the quality of the flavors.
- By requiring that all materials added to the mix after it has been pasteurized be given such a germicidal treatment will remove the last weak link in the manufacturing chain and insure a product that is above sanitary reproach.

PROPOSED NEW MEDIA AND INCUBATION TEMPERATURE

For the past several years the Standard Methods Committee on Milk Analysis of the American Public Health Association has been studying new media to replace standard agar which has been used for many years and which they believe has outlived its usefulness. They have been studying also a more favorable incubation temperature. The new edition of Standard Methods of Milk Analysis which is to be issued shortly will not contain any change in the present medium or incubation temperature but a change will be made in the future without a doubt.

There are two different opinions amongst those interested in this question. The first group consists chiefly of milk control officials who have built up a set of bacteriological standards around the present standard medium. They contend that the introduction of the proposed changes in the medium and incubation temperature will disrupt their standards and throw the whole milk question in chaos. Another group opposing the proposed changes is the dairies buying milk on a quality basis. Here it will likewise result in some confusion at first. A third group are laboratory workers who see at this time no reason for changes which will necessitate the use of two or more incubators run at different temperatures and cause considerable expense and confusion. A fourth group might also be listed who oppose the proposed changes on general principles as they would any change which would upset their routine.

Those who favor the proposed changes likewise have good and sufficient reasons for so doing. They argue that the present medium gives only a small percentage of the actual number of organisms present in the milk in most cases. Many bacteria fail to grow on the present standard agar. That the present standard agar gives only a fraction of the number of viable bacteria present in milk has been known for a long time by checking the milk with the direct microscopic method of Breed. In fact, when the present

standard agar was originally proposed in 1915, it was known by the Committee and others that the addition of nutrients such as dextrose and milk would increase the count many fold. Those favoring a change contend and show by many experiments that 37 degrees C. should have never been used for milk work. It was originally used as a matter of convenience because most laboratories do other types of work such as pathogenic bacterial analysis, and need incubators at this temperature. It is very convenient to place a few milk plates in these incubators. That 32 degrees C. is a far better temperature for the growth of most milk bacteria cannot be questioned. Numerous experiments show that many more bacteria present in milk grow at this temperature than at 37 degrees C. At the latter temperature it has been found that a two degree change in temperature either side of 37 degrees C. greatly reduces the count, especially if the temperature is increased, whereas at 32 degrees C. a slight fluctuation in temperature, such as two degrees, either side of 32 degrees C., makes little difference. A study of 37 degree C. incubators show such fluctuations are the rule rather than the exception.

Other arguments in favor of the proposed changes are in brief: (1) we are striving to increase rather than decrease the requirements for good milk; (2) we want to use a medium and incubation temperature that will grow all the bacteria present that should grow so as to know the real quality of the milk, so that then we can improve the milk supply; (3) it has been shown that with the present standard methods of milk analysis, the bacterial counts of 50 percent of the raw Grade A milk in 25 representative cities were below 10,000 per ml. This would show that if these figures hold throughout the United States and Canada, then much of the milk now produced in these countries would meet the requirements under the proposed changes; (4) if a change is desirable as most agree, then the sooner the change is made, the better, before any more state and city laws are enacted specifying bacterial stan-

dards based on our present methods; (5) comparative tests made with the two media at 32 degrees and 37 degrees C. have demonstrated that the better the quality of the milk, the less difference there is in the bacterial counts, whereas, the poorer the quality of the milk the greater the difference in counts. One worker comparing counts with the two media gave the following figures which illustrates this point: Certified pasteurized milk gave a 10 per cent increase, certified raw, 31 per cent increase, Grade A raw 55 per cent increase, and ordinary raw milk before pasteurization 62 percent increase in the bacterial count when the proposed new medium was compared with standard agar.

Finally, one country, England, has changed from standard agar to a new medium giving a much higher bacterial count than standard agar, and the American Association of Medical Milk Commissions has adopted a new medium which also gives a much higher count than standard agar formerly used by them. These changes give some indication of the dissatisfaction with the present standard medium.

F. W. FABIAN, *Chairman*
 W. C. CAMERON
 R. E. IRWIN
 A. J. KROG
 J. M. LESCURE
 H. N. PARKER
 R. V. STONE
 P. F. KRUEGER

REFERENCES

1. Brown, W. H.—This matter of mix. *Ice Cream Field*. 31: (3) 9-13, (4) 27-29 (1937).
2. Fabian, F. W.—New problems in ice cream sanitation. 25th Annual Report. Int'l. Assoc. of Milk Sanitarians. pp. 330-345 (1936).
3. Fabian, F. W.—Bacteria added to ice cream in flavors and colors. *Ice Cream Field*. 16: (6) 16 and 102 (1930).
4. Fabian, F. W. and Hook, A. E.—Escherichia-Aerobacter group in ice cream (c) At the fountain. Proc. 36th Annual

- Convention, Int'l Assn. I. C. Mfrs. 2: 30-39 (1936).
5. Horn, D. W.—Ice cream contamination by dippers (in retail stores). Annual Report Int'l Assn. of Dairy and Milk Inspectors. pp. 249-256 (1935).
 6. Krog, A. J. and Dougherty, D.—Scoops as a source of contamination of ice cream in retail stores. Jr. Am. Pub. Health Assn.
 7. Newman, R. W. and Reynolds, A. E.—Bacterial flora of some ice cream ingredients. Cal. Agr. Exp. Station Monthly 19: 677-680 (1930).
 8. Prucha, M. J.—The relation of fruit, flavors, nuts and colors to the sanitary production of ice cream. (a) Importance of problem from public health point of view. Rept. Proc. 36th Ann. Conv. Int'l. Assn. Ice Cream Mfr's. 2: 40-45 (1936).
 9. Prucha, M. J. and Tracy, P. H.—Unpublished data. Cited by Brown. See Reference No. 1.
 10. Smallfield, H. A.—Bacterial contamination of ice cream from color solutions. Ice Cream Review. 16: 42-43 (1933). (April).
 11. Tracy, P. H. and Prucha, M. J.—Are flavor and coloring sources of bacteria in ice cream? Ice Cream Trade Journal. 32: 17-18 and 20 (1936).
 12. Tracy, P. H.—Study of methods used to improve sanitary quality of nut meats, flavoring and coloring used in ice cream. Rpt. Proc. 36th Ann. Conv. Int'l. Assn. Ice Cream Mfrs. 2: 56-67 (1936).

Filled Milk Decision

The Food and Drug Administration of the U. S. Department of Agriculture warns that it will institute legal action against all interstate shipments of any product falling within the statutory definition of filled milk.

The warning follows the recent decision of the United States Supreme Court in the case of *United States v. Carolene Products Company*, which upheld the Federal Filled Milk Act of 1923 as constitutional.

By its terms the Filled Milk Act prohibits the interstate distribution of any combination of milk, cream, or skimmed milk, with any fat or oil, other than the milk fat so as to resemble or imitate milk or skimmed milk in any form. The legislation was enacted after a Congressional hearing. Congress determined and declared: "That filled milk, as herein defined, is an adulterated article of food in-

jurious to public health and its sale constitutes a fraud upon the public."

The indictment in the Carolene case alleged the unlawful interstate shipment of "Milnut" and "Carolene" manufactured by Carolene Products Company of Litchfield, Illinois. Analyses by the Food and Drug Administration showed the products to be composed essentially of evaporated skim milk and cocoanut oil in semblance of evaporated whole milk. After prosecution was started, the manufacturer filed a demurrer to the indictment on the ground that the act was unconstitutional. The demurrer was sustained by the Federal Court for the Southern District of Illinois. The United States appealed to the Supreme Court of the United States which upheld the Filled Milk Act as constitutional.

Do you know the official procedure for making

VITAMIN D BIOASSAYS?

See the March issue of this Journal

Modern Methods of Milk Plant Inspection

Maurice H. Shorago

Consultant to the Dairy Industry, Boston, Massachusetts

It has been said, and aptly so, that the modern public is one of the best regulatory forces where foodstuffs are concerned. The indifferent plant operator soon finds that his carelessness pays dividends in the form of loss of revenue and good will. Since, however, we have hardly reached the Utopian age where we can permit men to wholly regulate their own actions while engaged in any industry affecting public health, it is necessary to have inspectorial forces supervising such activities. It is possible, by the "police" method, to catch the unscrupulous operator but what usually happens is that this type, with the technical help available, can if they so desire, circumvent control. This of course is not the end desired. When improper methods are found and a correct solution offered, the suggestions have usually been followed in good faith.

To carry out properly the duties of an inspector, it is necessary to keep posted on the literature pertaining to the industry, attend technical meetings, and take part in an interchange of information. By using practical tests now available, the work can be performed in an intelligent manner.

Before making a physical inspection of a plant, it is necessary first to examine the accumulated reports on the plant and products in question. The use of the resazurin test in conjunction with a microscope has proven of invaluable aid in gaining quick information. A follow-up check by use of the phosphatase test will offer a picture as to whether the pasteurization process is being completely carried out or, as has been found in some instances irregularities, intentional or unintentional, are indicated.

It is obvious that if a microscopic smear of the milk presumed to have been pas-

teurized shows a predominance of what appears to be lactic acid bacteria, the infection has taken place after pasteurization. This statement is based on the assumption that the phosphatase test on the sample has been negative. If, however, samples were taken of each successive vat of milk pasteurized, and then have been mixed with resazurin dye and incubated, we can determine whether a thermophilic infection is present. The two instances cited call for two different types of inspection. In one case, the trouble will usually lie in an unclean distributor pipe, pump, or other apparatus used in handling the milk after pasteurization, or, in some cases, the filling of buttermilk prior to milk. Instances have been found where the filler has been thoroughly washed but the filler rubbers were not removed.

In the case of thermophilic contamination, laboratory pasteurized samples are to be examined and the plant inspected for milk stone. As a concrete example, an actual case may be cited:

Plant "A" was receiving continued bacterial reports of an unsatisfactory nature. The State Department of Health checked the raw milk supplied to this plant and found that in all cases the producers were shipping milk having a plate count of less than 40,000 colonies per cc. In spite of this, however, the pasteurized milk on the same day showed a count in excess of 500,000. Before making a physical examination of the plant, samples were taken of raw milk in the mixing vat, and checked by means of the resazurin test. This same milk was followed through the system and samples taken from the filler at such time as to coincide with the influx of milk from successive vats. All samples were immediately cooled and held for the resazurin test. The results were quite dramatic: Sample No.

1 representing the first milk through the system gave a distinct blue color while successive vats gave increased change in color until the last sample which ran white. It was obvious that since all vats of raw milk were apparently of good bacteriological quality, we were getting growth at some point during the processing period. A follow-up physical inspection revealed the fact that there was a thermophilic infection having its origin in a thermometer retaining nut in the preheater. This, coupled with the fact that milk stone was found on the inner edges of the distributor pipe holes and also on the upper edges of the plate-type heater was sufficient to give information necessary to eliminate the trouble.

In a routine physical inspection of a plant about which there is no information, we must begin at the tank trucks, tank cars, or storage tanks. One of the greatest difficulties encountered with the tank car is dirty air lines leading to the tank. Often these lines are not cleaned for long periods of time, and actual cases of green mold have been found. General sanitation of the tanks, of course, must be checked.

One of the most common faults in certain types of tank trucks is that the operator of the truck does not take time to replace the cap on the outlet pipe, and on the trip through the city streets various types of road dust and dirt are picked up. Outlet valves of these trucks are many times neglected, particularly the springs and rods. The commonest fault in the washing up of storage tanks is that so called "leak-proof" thermometer receptacles belie their name, and when these are not regularly removed and washed, a source of infection results. Leaky stuffing boxes on agitator shafts are another common source of infection and must be checked carefully. In the older type tanks, manhole gaskets are often neglected. Of all possible points of infection in this type of equipment, the sampling petcock seems to be the greatest offender. It is beyond my understanding why certain types of petcocks are permitted.

Dump tanks and weigh scales offer many points of possible trouble, such as non-removable valves and corners of screening. Because nothing but cold milk ever touches the surfaces of this type of equipment, there is no excuse for any accumulation of milk solids.

Raw milk pumps (and lines) are more often neglected than those handling pasteurized milk. The general impression seems to be that the pasteurizing system will take care of any oversight at this point. This same opinion, apparently, seems to hold where filters and clarifiers are concerned. Based on actual experimental and practical experience it would seem that any plant handling more than 4,000 quarts of milk per day should be using cold milk clarification. It is realized that this is a controversial point. It is the author's opinion that there is no justification for pumping clean milk thru a filter, hot or cold, that may possibly have its surface impregnated with dirt from the milk of a careless producer. Hot milk filtration is a subject that should be dignified by discussion.

The subject of preheaters is rife with possibilities. The plate type preheater, or regenerator, is easier to inspect and properly cleanse than the tubular types, regardless of make, and therefore offers less possibility of trouble. It is important to remove completely and disassemble all thermometers in this type of equipment because it is usually at these points that difficulty is encountered. Gasket insertions must also be carefully watched. Tubular preheaters, on the other hand, usually give trouble at those points where the tubes are inserted through the header, resulting in a small crevice.

Pasteurizing vats of all makes seem to be neglected most at the insertion of the outlet valve. For some unexplainable reason, men will spend hours scrubbing equipment thoroughly and then undo whatever good has been done by neglecting the short surface between the inside of the tank and the valve. While on this topic it should be unnecessary, in view of the recent rise to popularity of the phosphatase test, to caution about check-

ing the clocks of the recording thermometers, as well as apparent holding temperatures. There is, even today, equipment being installed which provides no means of adjusting the temperatures of milk, once it has reached the holding tanks, nor is there any method provided for agitation during the holding period. Unless an inspector can actually find milk running into the filler before it has been heated and held properly, it is difficult, except through the use of the phosphatase test, to locate the difficulty. In plants where milk is being preheated to the final temperature before entering the vat, it is impossible for an inspector to determine at what time the vat was filled and consequent holding time began. The practice of preheating to a few degrees lower than the required temperature and then polishing off in the vat will automatically show when the holding time began.

Milk pumps which are so constructed as to allow milk to gain entrance to parts inaccessible to clean-up operations have no place in the well regulated plant. These can very readily be detected by examining the grease cups (looking for an admixture of milk) or the motor end of the shaft. All pumps should be checked carefully.

Another source of great trouble has been the practice of making distributor pipes from one to two feet longer than the tubes of the surface cooler, creating pockets or dead-ends in which milk can lie for long periods of time, dropping in temperature and offering a breeding ground for bacteria. This difficulty can be readily remedied by either shortening the pipe or filling each end with a removable plug. Particular attention must be paid to the holes in the distributor pipe, because these small spaces tend to accumulate milk-stone on their edges. Surface coolers should be checked so that milk is not allowed to splash off of cat-walks or end guards and then drop back into the cooler trough. This has been the cause of a great deal of difficulty. Cabinet coolers, particularly the type made of very thin gauge material, should be checked occasionally by putting a small

amount of pressure inside the cooler while no milk is flowing over the outside. In this way, small leaks can readily be found. Plate coolers are checked in the same manner as plate heaters.

The usual points neglected in milk fillers are the valve sleeves and the inside portions of the overflow pipes. It is a simple matter to check these. In some cases where trouble has been present, it was found that the filler was first being used for cream or buttermilk or similar by-products, carefully washed and sterilized, and then used for milk. The valve rubbers, however, were not removed, and small amounts of the former were held in these points and slowly discharged into the following milk. In one type of vacuum filler, milk has a tendency to back up into the air line. Unless this line is kept scrupulously clean, a foul odor will result. This can best be determined when the machine is empty.

One point usually neglected by the average inspector is to determine whether contaminated water is being used for washing purposes or whether there are any cross connections between city water lines and well waters. The recent Chicago epidemic points to the significance of extreme care in the selection and maintenance of water supply lines. This is particularly true in a dairy plant because of the possibility of the spreading of contagion.

There are many types of bottle washers, each of great value in its particular field. The greatest difficulty seems to be in the proper maintenance of these washers. It should be ascertained that the correct amount of caustic is used at the proper temperature and that either the bottles are subjected to sufficient heat (and causticity) to kill pathogenic organisms or that, preferably, chlorine sterilization be practiced.

The correct routine for washing up a plant and equipment depends on the type of equipment used, i.e., tinned copper, glass, or stainless steel. After carefully checking most of the washing compounds sold today, it is the author's experience that "elbow grease" is still the main in-

redient for any successful washing compound. If care is used to see that all hot milk handling equipment is immediately cooled following the run of milk, the wash-up job will be made much easier. It has been found that chlorine sterilization by far offers the greatest protection. If sufficient hot water (not just hot to the hand) were used, there is no question but that proper sterilization would result. However, a temperature high enough to sterilize dairy equipment is dangerous to use because personal injury to the workmen may result. One instance has been noted where steam, under partial pressure, has been used and where milk immediately followed. The first milk striking the groove inlet valves was immediately cooked on and obstructed the correct operation of the leak detectors.

Because of limitation of time and space, no attempt has been made to cover thoroughly all equipment used in the dairy industry but rather to indicate those points which usually present the greatest difficulty under actual operating conditions. It is obvious that regardless of the experience and training of the inspector, unless he gains the willing cooperation of the plant operator, it will be well nigh impossible to cover thoroughly all plants in his territory. Here might be pointed out the value of willing cooperation, thereby enabling the inspector to devote his time toward supervising recalcitrant plants. There is absolutely no reason why any plant properly designed and having the proper equipment and care, cannot produce safe wholesome milk of the kind which will tend to increase consumption. In all instances but one, the author has been able to show plant operators that the correct way is the easiest and cheapest way of processing milk and will enable him to have peace of mind as well as pennies in pocket.

Metropolitan Dairy Technology Society

The Metropolitan Dairy Technology Society recently elected the following officers for the ensuing year: Dr. J. H. Shrader, *president*, succeeding Professor F. C. Button; Dr. C. H. Kimberly, *vice-president*; Dr. O. F. Garrett, *secretary-treasurer*; and D. F. Snyder, *sergeant-at-arms*. The society meets on the third Tuesday of every month in the McGraw-Hill Building, New York City. Dinner at 6:30 precedes the meeting. The members are engaged in some phase of milk technology or in a closely allied subject. Visiting milk sanitarians are cordially invited to attend the meetings. These begin at 8 o'clock, each with a paper by some well-known worker in the dairy field, and this is followed by an informal discussion in which the membership quite generally participate.

Hiscock Elected President of National Health Council

Ira V. Hiscock, professor of public health in the Yale University School of Medicine, has been elected president of the National Health Council for 1938, succeeding Dr. Donald B. Armstrong, vice-president of the Metropolitan Life Insurance Company, who becomes a member of the Council's Board of Directors.

—Health News, Albany, N. Y.

Corbin Elected Sheffield Vice-President

Dr. C. I. Corbin, an associate member of the International Association of Milk Sanitarians, has been elected a vice-president of the Sheffield Farms Co. He joined their organization in 1911 as the company's first veterinarian and sanitary inspector of dairy farms. In 1927 he was made head of the Sanitation Department. He has been an active member of the Association, and has rendered substantial help in the establishment of this Journal.

Report of Committee On Laboratory Methods

A. H. Robertson, *Chairman*

The Committee on Laboratory Methods was directed at the close of the 1936 annual meeting to continue its review of the several modifications of the Babcock technique for the rapid approximate quantitative determination of fat in frozen desserts. Conditions did not permit the continuation of this project in 1937 but during 1938 more of the preliminary work will be executed. The Kniaseff method for fat in ice cream (*Ice Cream Trade Journal* 30, No. 12, p. 29, Dec. 1934), probably will be included among others to be compared.

In the interest of uniformity, three items pertaining to the agar plate method of estimating the bacterial content of milk and cream will be discussed for the benefit of the Association.

A questionnaire was submitted to several milk laboratories to discover the common methods of determining the reaction of culture media and the forms of labeling petri dishes to indicate their dilutions when making standard plate counts by the agar plate method. Replies were received from 12 state laboratories, 10 city health departments, and 12 dairy laboratories at either agricultural experiment stations or agricultural colleges.

The first question was:—How do you determine the hydrogen-ion concentration of your media:—(1) electrometrically, (2) drop ratio method, (3) standard buffer solutions, (4) prepared buffer standards (Hellige, LaMotte, Taylor, etc.)? Nine of the state health laboratories, seven of the city laboratories, and five of the experiment station or college laboratories are using one or more of the different types of prepared buffer standards. One of the twelve state laboratories uses stand-

ard buffer solutions, and one the drop ratio method. Four of these laboratories, after adjusting the reaction of the media with the prepared buffer standards, check the accuracy of the reaction occasionally by the electrometric method. One laboratory uses the electrometric method only for adjusting the reaction.

In the municipal laboratories, a similar relationship exists among the methods used although one laboratory makes no determination because Standard Methods of Milk Analysis, 6th Edition, (American Public Health Association) states:—"If the agar is prepared from ingredients specified above (Difco) the medium will ordinarily have a reaction of about pH 6.6. Do not adjust the reaction if it is found to fall within the range of pH 6.4 to 7.0." The college and experiment station laboratories are more prone to vary in their methods of media reaction adjustment. The drop ratio method is used in two laboratories. Five laboratories use standard buffer solutions while six make the adjustment electrometrically either for research work or to check the reaction by the prepared buffer standards. Five laboratories use the prepared buffer standards.

The second question was:—Where a series of different dilutions are used in plating dairy products, what is the simplest, quickest, and best method of marking plates to indicate the dilution used? The first question was asked with expectations that one method would be more commonly used than any of the other three. The replies to the second question obviously are largely the result of long usage in any particular laboratory. The motive was to find out the method of marking which is least liable to cause confusion. Several suggestions for marking were offered on the questionnaire.

The use of Arabic figures to indicate the sample number over or followed by a variety of combinations of symbols of the Roman style with or without under-scoring and various alphabetical symbols were most common. In a few instances the Roman style of indicating unit, ten, hundred, thousand, ten thousand, hundred thousand and million was followed systematically. In other instances, the use of "H", "T", "MM", and "B" were common to indicate dilutions of 1-100, 1-1000, 1-100,000, 1-1,000,000,000 respectively. Some laboratories even take the time to write out the entire dilution figures in fractions, decimals or ratios.

Probably no attempt should be made to add confusion by suggesting the use of a different method where any of the above mentioned systems are well established. The simplest method seems to be that of marking first the sample number either over or preceding the dilution symbol. The simplest dilution symbol is the Arabic figure corresponding to the number of ciphers in the dilution used, as follows:—If 16 is the sample number, then "16-0" is put on the plate with no dilution of milk, "16-1" for a 1-10 dilution, "16-2" for a 1-100 dilution, "16-3" for a 1-1,000 dilution and "16-4" for a 1-10,000 dilution, etc. The above system is offered primarily in the interests of uniformity and simplicity and probably will find its widest use when establishing new laboratories and when teaching courses in bacteriology.

During 1937, attention has been focused on the need for uniform conditions for counting bacterial colonies on the plates*. Under varying conditions of illumination and magnification, the technicians frequently obtained widely discrepant counts on the same plate. The result of these observations is the Quebec Colony Counter which has been perfected and is now offered for sale**. Both direct and reflected oblique light from a 60 watt bulb is thrown on the colonies

which appear as brilliant spots or points over a subdued background. The observer is not blinded by the glare from the light source. The counter will accommodate Wolffheugel, Stewart, or Jeffers guide plates. A centering device permits perfect centering of the petri dish which is essential with different styles of guide plates. A 4½ inch lens magnifying about 1½ diameters is mounted above the counter so that it may be raised or lowered for proper focus. The use of this counter or one giving equivalent results for counting colonies is accepted as standard equipment by the Laboratory Section of the American Public Health Association.

A. H. ROBERTSON, *Chairman.*

GEORGE E. BOLLING

H. E. BOWMAN

JAMES P. BUCKLEY

R. L. GRIFFITH

D. W. HORN

C. K. JOHNS

H. W. LEAHY

F. L. MICKLE

HORATIO N. PARKER

M. E. PARKER

J. H. SHRADER

H. R. THORNTON

H. O. WAY

F. P. WILCOX

Cleveland Committee on Arrangements

President Tolland has announced the personnel of the Local Committee on Arrangements for the next annual meeting in Cleveland, as follows:

H. O. Way, *Chairman*.....Cleveland, Ohio

R. P. FowlerOberlin, Ohio

Charles McDonaldAkron, Ohio

E. B. BuchananCleveland, Ohio

Dr. J. C. WickhamCleveland, Ohio

Dr. L. B. Simmons,

Cleveland Heights, Ohio

The meetings will be held at the Hotel Allerton, and the date is October 19-21, 1938.

*Archambault, J., Curot, J. and McCrady, M. H. The Need of Uniformity of Conditions for Counting Plates. (With a Suggestion for a Standard Colony Counter). *Am. J. Pub. Health*, 27, (1937).

**Spencer Lens Company, Buffalo, N. Y.

An Evaluation of Some of the Tests Used in Detecting Mastitis in Dairy Cattle*

A. C. Fay

Director of Laboratories, H. P. Hood & Sons, Inc.
Boston, Massachusetts

INTRODUCTION

Definitions.

The term mastitis comes from the Greek word "mastos" meaning breast, and the suffix "itis" meaning inflammation. The several terms which describe the various forms of mastitis may be classified under the general headings of traumatic mastitis and infectious mastitis:

Traumatic mastitis is inflammation of the mammary gland resulting from injury such as a bruise or from prolonged exposure to cold as may occur when a cow lies down on a cold cement floor. Traumatic mastitis is usually transitory in character, although it may lower the local resistance of the gland and thereby encourage the growth of organisms already present in the tissues.

Infectious mastitis is inflammation induced by the growth of organisms in the tissue, and may be either acute or chronic in character.

Acute mastitis is characterized by intense local inflammation, little or no secretion from the infected quarters, but if secreted, the milk is purulent and coagulable by heat. There is severe toxemia, and the cow is febrile and frequently prostrate. Organisms are present but are difficult to isolate and the disease does not spread in the herd. Fortunately the incidence of the acute form of this disease is only about 0.8 percent, but unfortunately, most well developed cases of acute mastitis are fatal. Acute mastitis should not be confused with chronic mastitis.

Chronic mastitis, in contrast, is rarely fatal, is very prevalent, the cow is usual-

ly normal in health, and the milk may or may not be abnormal in appearance. If the milk is abnormal in appearance, the dairy farmer usually refers to the cow as having garget. In one dairy section of Michigan, 88 percent of the herds and 27 percent of the cows examined were found to have chronic mastitis. The chronic form of mastitis is the only form discussed in this paper.

TESTS FOR MASTITIS

Obviously the first step in the control of mastitis in any herd is the detection of the affected cows. Numerous methods for the purpose have been devised, some of which lend themselves readily to field use, whereas others necessitate laboratory facilities.

Field Tests.

The methods adaptable to field use are the brom-thymol-blue test, the manual palpation of the udder to detect fibrosis or scar tissue, and the observance of abnormal milk which may contain fine flakes detectable only by filtering through a fine mesh screen or may be purulent and watery in appearance. The brom-thymol-blue test depends upon the fact that milk secreted by the diseased mammary tissue is alkaline in reaction, and the indicator affords an easy method of demonstrating this fact visibly. The indicator may be added directly to the milk, or the milk may be placed on a blotter which contains the indicator. The presence in the udder of fibrosis or consolidated scar tissue which can be detected with the fingers, is a normal body response to irritation set up by infection.

Laboratory Tests.

The laboratory tests may be classified as cultural, chemical, and microscopic ex-

* Presented before the Massachusetts Milk Inspectors Association, at Worcester, Mass., January 6, 1938.

aminations. The cultural methods for detecting mastitis consist of isolating the streptococci on special media usually containing blood, and subsequent identification of the isolated strains, and the Hotis test. The latter method consists of incubating at 37°C. for 48 hours a mixture of 9.5 ml. of milk and 0.5 ml. of a 0.05 per cent solution of brom-cresol-purple. The common mastitis streptococci cause the indicator to turn yellow and the organisms grow as small yellow colonies or "buttons" closely adhered to the walls of the test tube.

The chemical methods employed in the laboratory are the examination of milk for chlorides and for the enzyme catalase. The chloride test depends upon the fact that the membrane surrounding the diseased secreting cell loses its normal function of allowing certain constituents of the blood to pass through and to restrain other constituents. Normally, milk contains about 0.14 percent of salts in the form of chlorides. If chlorides are found in excess of this arbitrary maximum, it is assumed that mastitis exists in the udder.

The irritation set up by mastitis results in the infiltration of numerous leucocytes and the sloughing of many tissue cells into the milk. These cells, especially while still living, secrete the enzyme catalase which breaks down hydrogen peroxide liberating free oxygen. A test tube containing 15 ml. of milk is filled with a dilute solution of hydrogen peroxide and the tube is fitted with a one-hole rubber stopper containing a capillary tube. When the test tube is inverted, the oxygen liberated from the action of the catalase on the hydrogen peroxide collects in the top. If the amount of gas exceeds 2.5 ml. after 3 hours at 37°C., the milk is assumed to be abnormal.

In the microscopic examination of milk, an attempt is made to enumerate the number of leucocytes and to determine the presence or absence of long-chained streptococci or other organisms likely to be the cause of mastitis. The usual procedure is to incubate the milk for 12 to 16 hours at 37°C. in order to favor the growth of mastitis streptococci if pres-

ent, then make a Breed smear for microscopic examination. The presence or absence of long-chained streptococci is recorded and the number of leucocytes is interpreted on a basis of an arbitrary standard of 500,000 per ml.

THE EVALUATION OF TESTS

In the evaluation of any mastitis test one should regard it from four separate points of view, i.e.,

1. How accurate is the test in detecting known positive cases of mastitis?
2. How accurate is the test when applied to known negative cases?
3. What percentage of all positive reactions actually indicate positive cases?
4. What percentage of all negative reactions indicate animals which are free from mastitis?

These first two questions assume the situation in which the positive or negative diagnosis of the disease in the cow is the known factor, and the performance of the test is the variable to be measured.

On the other hand, under practical conditions, when the inspector applies the test to the animals in a herd, the diagnosis is the unknown factor and the reading which he makes of the test is the only known factor at his command. This presents the other two viewpoints presented in the last two questions.

For example, if we had a perfect test and should apply it to 100 cows known to have mastitis and also to 100 cows known to be free from mastitis, we would get 100 true positive tests and no false negative tests on the positive cows; similarly on the cows known to be free from mastitis, we should get 100 true negative tests and no false positives. On the other hand, suppose that the test were not perfect and that in testing 100 cows known to have mastitis, we obtained 75 positive readings and 25 negative readings. In this case we would have 75 true positives and 25 false negatives. Similarly, if in testing 100 cows known to be free from mastitis we obtained for example 90 negative readings, the remaining 10 would be false positives. Obviously a given test

may be more reliable when applied to positive cows than when applied to cows free from mastitis or vice versa.

An attempt has been made to express the value of the various tests for mastitis in the form of a coefficient, and the data are presented in Table 1. In making the calculations, the successful or unsuccessful isolation of typical streptococci from the milk has been taken as evidence of a positive or negative diagnosis of mastitis. The data are based partly upon work recently completed at the Kansas Experiment Station by the author working with Professors H. W. Cave and F. W. Atkeson, and partly upon data published in Bulletin 626 from the New York Experiment Station and in Circular 400 from the U. S. Department of Agriculture.

For sake of comparison, the relative values of the tests have been measured by subtracting the percentage of false

readings from the percentage of true readings; since there is a chance of making 100 true and 100 false readings, the result is divided by 2 in order to return the coefficient to a basis of 100. For example, in calculating the percent agreement for detecting mastitis by microscopic examination of a smear from incubated milk, there were 96 true positive tests on cows that had mastitis as indicated by the isolation of streptococci from their milk, and 4 false negative tests which should have been positive. Similarly, when applied to 100 cows that did not have mastitis, 91 showed true negative tests whereas 9 showed false positive tests. The calculation of the percent agreement is as follows:

$$\frac{96 \text{ true positives plus } 91 \text{ true negatives, minus } (4 \text{ false negatives plus } 9 \text{ false positives})}{2} = 87 \text{ per cent agreement}$$

TABLE 1

The percent of true and false positive and negative results from various tests for mastitis based upon the isolation of streptococci from the milk as evidence of mastitis. (The data are calculated from results reported from the Kansas and New York Experiment Stations and from the U. S. Department of Agriculture.)

TEST	Percent True		Percent False		Percent Agreement*	Percent of Readings Not Confirmed	
	Positives	Negatives	Positives	Negatives		Positive	Negative
Streptococci							
Cultured	100	100	0	0	100	0	0
Streptococci in smear							
from incubated milk	96	91	9	4	87	8.6	4.2
Hotis test	98	65	35	2	63	26.3	3.0
Leucocytes							
(500,000 or more)	96	59	41	4	55	30.0	6.3
Fibrosis	97	43	57	3	40	37.0	6.5
Catalase test	99	40	60	1	39	37.8	2.4
Chloride test	95	43	57	5	38	37.5	10.4
Brom-thymol-blue test	37	99	1	63	36	2.6	39.0
Strip-cup test	37	89	11	63	26	22.9	41.4
Streptococci in smear							
from unincubated milk....	14	100	0	86	14	0	45.1
Abnormal milk							
(purulent or watery)	8	100	0	92	8	0	47.9

*Percent agreement equals the sum of the true positives and true negatives minus the sum of the false positives and false negatives, all divided by 2.

It should be pointed out that the figure showing the percentage agreement is only of comparative value, and applies only to the hypothetical situation in which the test is applied to a group of cows half of which produce milk containing long-chained streptococci and the other half produce milk from which these organisms could not be isolated. As will be noted in the table, some of the tests are more efficient in detecting negative cases of mastitis than in identifying positive cases. If such a test were applied to the cows in a herd in which little mastitis existed, the weakness of the test would not be emphasized and the coefficient of agreement would apparently be high.

A study of the data in the table brings out the following statements regarding the value and shortcomings of the various tests for mastitis:

The microscopic examination of a smear from an incubated sample of milk is the most reliable of the simplified tests. This method successfully detected 96 percent of the positive cases of mastitis and failed in only 4 percent. When applied to cows that were free from mastitis, it gave false positive results in 9 percent of the tests.

The Hotis test is remarkably effective in detecting a positive case of mastitis when it exists, (98 percent and failing in only 2 percent), but unfortunately this test gave misleading results when applied to 35 percent of the cows that were free from mastitis. This leads to the general statement that a negative test is rarely false but a positive test is frequently obtained from cases that do not have mastitis.

The same general statement may be made regarding the enumeration of leucocytes, the manual examination of the udder for fibrosis, the catalase test, and the chloride test.

On the other hand, if a positive test is obtained by the brom-thymol-blue test, strip cup test, the microscopic examination of the unincubated smear for streptococci, or if the milk is abnormal in appearance, the odds are quite high that the results of the tests will be confirmed by isolation of streptococci. This apparent reliability,

however, is discredited by the fact that a high percentage of positive cases are not detected (false negatives) by these tests. In other words, a positive test by any of these methods is highly significant but a negative test gives little assurance that mastitis does not exist in the udder from which the milk was taken. It should also be pointed out that these tests rarely give a false positive test on cows that do not have mastitis.

Special attention is directed to the brom-thymol-blue test and the strip-cup test because they are field tests and are so widely employed by inspectors and dairy-men as a means of segregating the mastitis cows in herds. These tests indeed have value in that they do identify positive cases of mastitis, but their value should not be over-estimated by under-estimating their limitations. The fact should not be overlooked that these tests fail to point out all of the positive cases of mastitis in the herd. To the extent that the data in the table are applicable to generalization, it may be assumed that 63 percent of the cases of mastitis will not be identified by either of these two tests. If an inspector applies the brom-thymol-blue test to the cows in a given herd, he should recognize two facts, (1) that the positive tests are true positives and, (2) that the test has left about two-thirds of the positive cases of mastitis in the herd. This is a significant point in a program of control of the spread of mastitis in the herd.

Attention is also called to the increase in the reliability of the microscopic examination for streptococci which results from incubation of the milk for 12-16 hours before preparation of the smear. It appears from the data at hand that the microscopic examination of an incubated sample of the milk affords the most dependable method of identifying the presence of mastitis in a herd. Since the value of the incubation for a short period (12-16 hours) at 37° C. depends upon the fact that the mastitis streptococci, if present, will grow more rapidly than the other udder types of bacteria likely to be present, it is important that the sample be

taken in a sterile container to exclude contamination from external sources.

SUMMARY

This paper includes a description of the various types of mastitis and a discussion of the tests commonly employed to identify positive cases of the disease. The value of a test must be viewed from its performance with milk from cows known to have the disease or known to be free from the disease; its value must also be interpreted on a basis of the reliability of the positive and negative results when the diagnosis of the disease in the animal is the unknown quantity.

An analysis of data from several sources shows the percentage agreement of various tests with the isolation of the streptococci from the milk. This analysis shows that the percentage agreement of the various tests with the isolation of streptococci is in the following order:

- (1) microscopic examination of a smear from incubated milk 87 percent,
- (2) the Hotis test 63 percent,
- (3) enumeration of leucocytes 55 percent,
- (4) manual palpation of the udder for detecting fibrotic tissue 40 percent,
- (5) the catalase test 39 percent,
- (6) the chloride test 38 percent,
- (7) the brom-thymol-blue test 36 percent,
- (8) the strip-cup test 26 percent,
- (9) microscopic examination for streptococci in the unincubated milk 14 percent, and
- (10) abnormal (purulent or watery) milk 8 percent.

These tests fall into three rather well defined classes:

- (1) The microscopic examination of the incubated milk which is fairly

dependable when applied to known positive cases of mastitis and also to milk from cows known to be free from the disease.

- (2) The Hotis test, the enumeration of leucocytes, the examination of the udder for fibrosis, the catalase test, and the chloride test rarely give a false test on a positive sample, but milk from one third to two thirds of the cows known to be free from the disease will give a false positive test. In other words, a positive test does not necessarily indicate that the disease exists.
- (3) The brom-thymol-blue test, the strip-cup test, the microscopic examination of the direct smear for streptococci, and the observance of purulent, watery abnormal milk are characterized by failing to point out a sufficiently high percentage of the known positive cases to warrant their use as the sole means of identifying mastitis cows for segregation from the herd.

Ernest Kelly Made Assistant Chief of Bureau

Mr. Ernest Kelly, a long-time and active member of the International Association of Milk Sanitarians, has been named assistant chief of the U. S. Bureau of Dairy Industry. He will assist Mr. Reed in planning and coordinating the Bureau's research work, and in determining its policies. He will continue, however, to serve also as chief of the Division of Market Milk Investigations. He joined the U. S. Department of Agriculture in 1910, and has been in charge of the market milk problems since 1912.

What the Colleges Are Doing in the Training of Milk Sanitarians*

Fordyce Ely

Professor of Dairy Husbandry, University of Ky., Lexington, Ky.

Excellent work has been accomplished throughout the land by milk sanitarians. However, only the surface has been scratched in this field of public service. The next decade will see much progress in the hygienic production and distribution of not only milk but probably also other dairy products. This will be greatly beneficial to the public health as well as to a great and constantly changing industry.

The data contained herein are taken mostly from a questionnaire which was mailed to dairy department heads in land-grant agricultural colleges throughout the United States. The response came from thirty-seven states. An attempt was made to secure an opinion from these men regarding what progress proper milk inspection service was making in their respective states. Professors of agriculture and dairying in land-grant colleges have the interest of the public as well as the industry and the farmer at heart and offer a fairly broad view of some phases of the problem as guardians of the public health with especial reference to milk supplies.

First, how adequate is milk inspection service in the various united states in the opinion of this group of outsiders, as far as the actual inspection service is concerned? Twenty-two report that a majority of local milk ordinances in operation in their states conform in most essentials to the U. S. Public Health Code. Ten indicated that such is not the case, and four were non-committal, due to a lack of reliable information.

About the same relationship exists between the yes and no response to a question regarding whether or not new ordinances which have recently been prepared and put into effect conform to the same code.

Eleven report that in their opinion, milk ordinances in their states are properly and adequately enforced and fourteen answered in the negative. Most of these qualify their answers by indicating that too frequently the principal difficulty is in the smaller population centers. Seven mentioned poor ordinances or no ordinances at all were a serious cause of inadequate inspection. Nineteen mentioned definitely that a lack of properly trained inspectors as well as political interference of one kind or another presented a serious obstacle to adequately inspected milk supplies. One asserted that the difficulty was in failure of the authorities to employ trained inspectors even though plenty were available. Presumably this was a description of a type of political pressure having to do with appointments. Twelve mentioned insufficient funds as at least partially responsible for a poor milk inspection service, and a majority applied the failure again to the small centers of population. The general attitude was of course one of sympathy and understanding on the part of dairy department heads throughout the land. There is little the group can do to help you in solving the problem of political interference, but the group can make some contribution which may help in providing trained inspectors.

About one-third of those reporting (thirteen) report a substantial demand

* Read before International Association of Milk Sanitarians, October 11, 1937, Louisville, Kentucky.

for men to be employed as milk inspectors; five hesitate to refer to the demand for men in this field of work as substantial but do describe it as an increasing demand; nineteen state that there is no substantial demand of which they are aware; and ten state further that there is no noticeable increase in such a demand for men.

In response to a question as to how many four-year graduates who have majored in some phase of dairy work have found employment in milk inspection work during the past five years, the total number estimated was about 140 in thirty-seven states. One hundred of these were employed as field plant inspectors and forty as public laboratory technicians. This ratio is about what one would expect but the total number employed seems undeniably low.

It is customary for faculty members to keep rather accurate track of their graduates for a period of years following graduation. This fact prompted a question, the answer to which has a definite bearing on the future of the type of service which you are attempting to perfect. The question was: "Do graduates who go into this field of work tend to remain to progress in this work or do they drift from this field into other fields of work"? In a number of instances, the question was not answered for the simple reason that in the opinion of the one who filled out the questionnaire the program on the whole was too new to furnish such information. Twenty states, however, mentioned a definite drift to other fields of work. If this is true, we may conclude that the work furnishes valuable experience which qualifies men for more remunerative employment in other fields. This is not altogether an unhealthy situation from the standpoint of the man but it is a little hard on the service to have to replace experienced men with those of less experience as frequently as is described. The answers to this question described a reason for this. Here again, political pressure on workers is mentioned and politics entering into the matter of salary increases. Three dairy

department heads qualified their statements in answering this question to the effect that they cannot conscientiously urge their graduates to enter this field of work because other lines of work for which dairy students are trained offer more attractive opportunities. One stated that the work in this field lacks a future.

These are only expressed opinions. To be sure, there exists a limit to the capacity of some workers who feel that they should be in positions of more responsibility. Those who have the best interests of this valuable service at heart should do their part to develop a personnel service which will provide for less politics in appointments and the freer movement of experienced inspectors to other markets into positions commensurate with their ability. I vividly remember the political howl which was heard here in Louisville when Mr. Jennings came from the great open spaces of the west to assume the leadership of the city milk division.

COLLEGIATE INSTRUCTION

Let us now consider specialized courses of study which are offered to four-year-degree students and which are calculated to furnish useful background information for milk sanitarians. The following are typical of those in colleges of agriculture:

Farm Dairying, Dairy Bacteriology, Dairy Chemistry, Market Milk or City Milk Supply; the usual sequence of commercial ice cream, butter and cheese making, and dairy herd management. These courses are of course preceded by appropriate science prerequisites and are supplemented by one or more courses in Comparative Physiology and Disease of Farm Animals. Opportunity is also given for students to elect other suitable courses in Public Health Administration, Hygiene, Water and Food Bacteriology, and many others. However, the student seldom contemplates this field of work before it is too late to elect a sufficient number of the courses which would be of most benefit to him.

An average of about eighteen credits is offered in specialized dairy courses in various colleges of agriculture as being

extremely valuable to one contemplating milk sanitation supervision. About 175 students graduate each year who have completed such a sequence of courses. During the past five years only about one-sixth of these have found their way into your field of work.

SHORT COURSES OR CONFERENCES

We are involved in an ever changing industry. One must be everlastingly alert to keep pace with the development of new equipment, new ideas and new discoveries in the field of dairying, and their ramifications into the field of public health. Thirteen states offer short courses or conferences ranging from two to three days to as many weeks duration. These could be made very useful to milk sanitarians. A majority of such conferences are sponsored or conducted by the dairy departments in colleges of agriculture in these thirteen states. The programs of these short courses as a rule make their strongest appeal to men of the dairy industry who, during the slack season, wish to brush up on the newer ideas or qualify for positions of more responsibility. A few such conferences are sponsored by the universities through their departments of hygiene or veterinary medicine. Those in charge are constantly making an effort to feel the pulse of those most interested, and milk sanitarians could definitely influence the selection of speakers and the building of the programs to suit the need if this were made known.

In answer to a question as to where in different states health departments go to seek men of training as milk inspectors, their replies were not so encouraging. A large number described a very nicely working relationship with those health authorities having to do with locating men trained in this field, but invariably the answer to this question was: "Insofar as health authorities are permitted by politicians to look anywhere for trained men they come to us."

In answer to the question as to the type of experience and training which is desirable for milk sanitarians, dairy department heads agreed quite generally. The

field of work should be made sufficiently attractive to interest four-year graduates who major in dairying, veterinary medicine, or bacteriology, with carefully chosen electives in the other two.

It was also generally agreed that experience on a farm and in a dairy plant were prime requisites for a young man entering this field of work. Several also mentioned another type of experience, namely, experience as a milk inspector at least for a few months under the guidance or supervision of a man who is thoroughly capable of directing a modern program of milk inspection service. There are many ways to avoid the "policing" aspects of milk inspection and substituting therefor a type of service which will gain the confidence and good will of farmer and processor alike. This is much to be preferred to a fear relationship which is rapidly becoming a thing of the past.

We can furnish you young men with farm and plant experience, and with a theoretical background on which to build. We cannot, however, teach anything which will substitute for the experience under fire where the trained but inexperienced man can learn to meet the many trying situations which constantly arise. The men in charge of the service in key markets must accept the responsibility of furnishing men with this type of experience in addition to the actual supervision of the local service. Men with the right background and training will respond quickly, and a place should be found for them where this training and experience can do the service the most good.

Thus the training of milk sanitarians who are truly qualified to render an adequate service is not accomplished by the colleges alone but by the colleges combining their efforts with the men actually in the service. It is suggested further that ways and means be seriously considered of offering a chance for these good men to keep up-to-date in ideas. The annual short course or conference for men actually engaged in the work is a means to accomplish this end.

**Abstract of Proceedings of the Twenty-Ninth Annual Meeting
of the American Butter Institute
November 30 and December 1, 1937, Chicago, Ill.**

Symposium—The Keeping Quality of Butter

At the 29th Annual meeting of the American Butter Institute held in Chicago, Illinois, on November 30 and December 1, 1937, a symposium on the keeping quality of butter was held. The sessions were well attended by buttermaking superintendents, plant operators, agricultural staff members, and creamery managers. The subjects discussed were divided into two groups comprising both the microbiological and the chemical changes involved in the production and distribution of creamery butter.

HOW TO MAKE THE PLANT SANITARY

The influence of the sanitation of plant and equipment upon the keeping quality of creamery butter was discussed by Professor B. W. Hammer of Iowa State College. He emphasized the great importance of physical cleanliness, the necessity for bacterial destruction by heat and chemical sterilization, and the proper drying of equipment in the interim between use. Proper cleansing involves first the rinsing of the milk solids from the equipment with warm water, then scrubbing it with hot water and washing powder, rinsing this off with more hot water, and then sterilization with steam or scalding water adequate in amount to heat all the equipment thoroughly. The treatment involves the disassembling of all pipe lines and pumps, their effective cleansing, and also that of the vats, coolers and other equipment.

The churn needs particularly careful attention. Dr. Hammer stated that to clean the churn, it should first be rinsed by revolving it for several minutes with a generous amount of water at a temperature of

100° to 120°F. and then draining it. It is then filled about one-third to one-half full of water at 170° to 180°F., washing powder added, and then revolved for about 15 minutes in low and then high gears, and drained. It is again filled about one-half full of water at about 200°F. or higher, and revolved for about 20 minutes, in low then high gears. The butter-milk gate must be opened at the start to relieve the air pressure. The churn is thoroughly drained and finally left with the doors about two-thirds of the way up, preferably covered with muslin screens, to dry thoroughly. If prompt cleaning is neglected, it later becomes difficult. The wood is seriously damaged if it is left moist over a long period. A musty, sour, or other objectionable odor indicates improper care that may be reflected in the keeping quality of the butter.

The equipment should be free from fat or curd. These may be detected by rubbing with the hand or a cloth. Microbiological examination can be made by suspending the organisms in water run through the equipment, and plating them by standard technique, or by pouring some agar onto the surface and then lifting off the solidified disc and placing it in a sterile petri dish for incubation and subsequent colony counting.

He made the interesting observation that wooden churns have not as yet been satisfactorily replaced by those of metal construction, and that the hot water treatment for cleaning them must be severe from the standpoint of its effect upon the life of the churn if it was to be effective in its sanitary performance.

In order to locate sources of contamination in a plant, line run tests are made by examining samples of cream and butter taken at various points during their progress through the equipment. Yeasts and mold counts show whether these general groups of organisms were picked up in the equipment. Bacterial counts can be made on a differential basis such as those which are not butter culture types, or counting the lipolytic or proteolytic bacteria. Useful line run tests can also be made simply by taking 1 pint samples of cream in sterile glass jars, churning them by hand or in a machine, washing the butter with sterile water, and holding portions of the salted and unsalted halves at different temperatures. From time to time these are examined for defects.

He pointed out especially the need for testing the water to ascertain its freedom from disease germs as well as those types of organisms which impair butter quality. Its effect on the butter can be determined by washing small experimental churnings with untreated water and also with water that has been boiled and cooled.

RELATION OF ACIDITY TO FLAVOR

The importance of churning acidity and its proper control was presented in a paper by Dr. N. E. Fabricius, also of Iowa State College. He was one of the two American buttermakers who received a perfect score at the World's Dairy Congress in Germany last year. Defects associated with too high churning acidity are sour, metallic, oily, and fishy flavors, whereas too low an acidity leads to putrid, cheesy, and surface taints. Improper addition and treatment with the neutralizer may impart a burned neutralizer flavor, a scorched, cooked, oily, or a soapy flavor. In general, the limes (calcium oxide and magnesium oxide) in 10-15 percent solution are the most desirable cream neutralizers. At least 20 minutes should elapse between the time the lime is added and the heat is applied. The temperature should not be higher than 80°F. It is important that only enough neutralizer be added before pasteurization to reduce the acidity to 0.25 percent, and the rest of

the neutralizer is added after starting to cool the cream down. Titrations should be made on cooled cream.

The fine flavor of butter is largely due to compounds formed from the citric acid in milk. About 0.15 percent by weight of citric acid crystals are now added to the milk just after adding the mother culture. This milk is set for 14-16 hours at 70°-72°F., and the peak of the flavor development is reached at an acidity of about 0.85-0.95 percent. This gives a mild culture flavor. A more highly flavored product can be obtained by adding 2 percent of good culture directly to the butter in the churn.

IMPORTANCE OF PROPER PASTEURIZATION

The development and function of pasteurization as a unit operation was discussed by M. E. Parker, Manager of Production of the Beatrice Creamery Co. Cream is pasteurized by indirect heat exchange through metal walls, preferably when the heating medium is only a few degrees higher than the cream, or by direct heating by mixing steam into the cream under high pressure at 230°-300° F. and suddenly expanding the mixture into a high vacuum, thereby exposing the cream to the high temperature for only a few seconds at the most and then almost instantly cooling it by the expansion. However, common practise in the treatment of cream is to use two flash pasteurizers in series, the first to boost the temperature of the cream, and the second to finish it off. About 30 seconds is required to heat the cream from 100° to 180°F. The distance of travel from the heater to the cooler keeps the cream at the high temperature for variable lengths of time according to the setup. Therefore, flash pasteurization is not an instantaneous operation but should be recognized as high-temperature, short-hold pasteurization. Some preliminary laboratory experiments showed that at pasteurization temperatures of 175°-190°F., about one-third of the surviving bacteria were proteolytic types, and at 195°-205°F., these constituted about two-thirds of the microbic

population. He pointed out the lack of detailed information as to the types of surviving organisms and the need for research to determine definitely the effect of pasteurization on the bio-chemistry and microbiology of cream and their effect on the finished butter.

COOLING, CHURNING, AND WORKMANSHIP

Dr. O. F. Hunziker in charge of manufacture of the Blue Valley Creamery Co. discussed the factors between the pasteurizer and the churn as well as the workmanship as affecting good keeping and eating qualities. Oily-metallic flavor develops in butter made from farm-skimmed, sour, neutralized cream, especially when abnormally rich in butterfat. It appears in the fresh butter at the churn. It is chemical in nature and is caused by high acid cream, high fat content (over 33 percent), flash pasteurization at 180° F. or higher (preferably 165° F. for 30 minutes), prolonged holding after pasteurization or for over 6 hours after cooling before churning, and the presence of metallic salts such as exposure to rusty cans and copper plant equipment. Overworking lowers the aroma and quality of good butter and covers up to some extent the defects of inferior butter. Overwashing not only leaches out much of the desirable aroma but also removes the lactic acid and its salts and lactic bacteria, all of which help to hold in check the development of putrefactive types of organisms. Excessive washing also removes the protective films of protein and sugar from the fat and exposes it to oxidation. On the other hand, heavy washing may be favorable for butter from cream of poor quality. Polluted water may cause objectionable flavors.

THE BODY OF BUTTER

The structure of butter was described by Dr. S. T. Coulter of the University of Minnesota as consisting of granules of free fat in which is dispersed other fat retained in what is left of the original fat globules as they occurred in cream, and also droplets of buttermilk. The texture

of the body of butter is largely determined by the proportion of fat of low solidifying point, and this is controlled by the temperature and method of cooling the cream, the churning temperature, and the temperature of the wash water. Harder butter is produced by lowering the temperature of churning and by cooling the cream over a surface cooler instead of in a vat. Also, the lower the temperature of the wash water, the softer the butter. For churning from winter cream, the cream should not be excessively cooled but only to or slightly below the churning temperature, and the butter should be washed with water at a temperature of 40°-50° F. or lower. For churning summer cream with its softer fats, the cream should be cooled to, and held and churned at temperatures as low as practical, and the butter should be washed with water at a temperature no higher than that of the buttermilk and preferably several degrees colder.

THE ADDITION OF FLAVOR

The addition of starter distillate to butter was described by Dr. H. A. Ruehe of the University of Illinois as contributing materially to the improvement of the flavor. When 1 part of diacetyl was added to 800,000 parts of butter (0.00012 percent), the latter scored higher than the control after being held for 6 months at -10° F. storage. Butter containing added distillate also possessed a better keeping quality. A rapid method to determine the diacetyl volumetrically has recently been worked out. It depends on the oxidation by hydrogen peroxide of diacetyl to two molecules of acetic acid. The acetic acid is then titrated directly. Acetyl-methylcarbinol can be determined at the same time if it is first oxidized to diacetyl.

CHEMICAL CHANGES ASSOCIATED WITH DETERIORATION

A close correlation was shown by Dr. G. E. Holm of the U. S. Bureau of Dairy Industry to exist between the loss of score and the development of peroxides. Butters churned from cream of relatively low

acidities (below 0.20 percent as lactic acid) were found to be superior in keeping quality to those made from cream of higher churning acidities (0.30 percent or more). Apparently a measure of the rate of oxidation of its butterfat will provide a reliable index of the rate of deterioration of a butter.

MICROBIOLOGICAL EXAMINATION

The various microbiological methods for the examination of butter were discussed by Dr. E. H. Parfitt of Purdue University. The yeasts and mold count of butter is comparable to the total bacteria count of milk as a measure of its sanitary quality and the conditions under which butter is made. In general, a high yeast and mold count indicates that conditions exist which may be detrimental to good keeping quality. The direct microscopic count is useful to forecast the keeping quality of sweet cream butter containing a low percentage of salt but is not so dependable for salted butter. When applied to salted butter made from sour cream, it is useful to determine whether the lowering of the score of the butter during storage was caused by microorganisms. A new microscopic method has been developed within the past year to detect whether butter is made from cream containing excessive amounts of mold. There appears as yet no relation between the frequency of distribution of mold mycelia and keeping quality. Differential techniques have been developed to determine the proteolytic and lipolytic bacteria in butter. In general, low counts of these types are desirable but high

counts do not necessarily mean that the possibilities of deterioration are great. Organisms of the coli-aerogenes group may cause flavor defects in butter. They tend to follow the numbers of yeasts and molds, and indicate contamination, although they are not significant to indicate the keeping quality of butter. Preliminary work indicates that the new phosphatase (monophosphoesterase) test is applicable to butter to determine whether it was made from properly pasteurized cream.

PRACTICAL TEST OF KEEPING QUALITY

A new practical test was described by C. H. Parsons of the chemical laboratory of Swift and Company for the measurement of the keeping quality of butter. A research of six years duration in which many thousands of samples of butter have been constantly assayed, has fully demonstrated that the holding of butter for 14 days at 60°F. gives excellent information as to its keeping quality as well as any outstanding flavor defects. The butter is first held overnight at a temperature of 45° to 50°F. The following morning it is scored for quality. Then it is transferred to an incubator at 60°F. where it is held for 14 days. It is transferred to a 45°-50°F. room, held overnight, and again scored by the same judge. The degree of keeping quality is proportional directly to the loss in score. Similar but less informative results are obtained by holding at 68°-70°F. for 7 days.

M. E. Parker
J. H. Shrader

NEXT ANNUAL MEETING

The Twenty-seventh Annual Meeting of the International Association of Milk Sanitarians will be held in Cleveland, Ohio, October 19, 20 and 21, 1938, with headquarters at The Allerton.

Research with Cream at the Massachusetts State College*

Merrill J. Mack

Comparatively little research has been conducted on cream and on the many problems arising in marketing it. A real need for research on this dairy product is quite evident.

DESIRABLE CHARACTERISTICS OF CREAM

Good cream should possess these characteristics:

1. A clean and pleasant flavor.
2. Excellent keeping quality.
3. Good color and "high coloring ability" in coffee.
4. High viscosity.
5. Absence of cream plug.
6. Absence of serum separation or "cream line".
7. Absence of "oiling off" in coffee.
8. If whipping cream, good whipping property, and a finished whipped cream of stiff consistency, high overrun, and absence of serum drainage.

At the Massachusetts State College we have been concerned with two of the above factors, namely, (1) the extent of oiling off of cream when used in coffee, and (2) the factors affecting whipping cream and the characteristics of the finished product.

Our publications on these subjects will be sent to any one requesting them.

OILING OFF OF CREAM IN COFFEE

In our principal New England cities, a somewhat unique situation exists in that many milk distributors skim but a small portion of the cream they sell. This is particularly true of the smaller companies. A few creamery companies distribute a large share of the cream, skimmed in northern New England and sold in can lots to the milk distributors.

The milk distributors differ in their treatment of this cream. Some of them—

1. Standardize it cold with milk or skim

milk and bottle it with no further treatment.

2. Standardize it with their own cream and pasteurize all of it together.
3. If coffee cream, standardize, pasteurize, and homogenize the product.

In recent years buyers of cream in New England have placed considerable stress on the matter of oiling off. For this reason Mr. Herbert Jenkins of New England Dairies was glad to cooperate with me on this problem.

At the beginning of the study, the need for a test for "oiling off" of cream was apparent. For research purposes, mere observation of the cream when added to hot water or coffee was not exact enough.

The test used by us is given in our article in the November, 1937, issue of the *Journal of Dairy Science*. It simply consisted of centrifuging 1 cc. of cream in a skim milk test bottle under such conditions that the large droplets of fat which would normally separate out in coffee would be separated out in the graduated neck of the test bottle. The test must be considered as a qualitative test, though it did give sufficiently accurate results for research purposes. We recorded the divisions on the test bottle as round numbers, any reading above 1 producing enough oil to be noticed on the surface of a cup of coffee.

In running the test, quick pipetting after thorough mixing is essential, otherwise the large oil drops will rise in the warm test sample and a representative sample will not be secured.

The test evidently has other uses. In one dairy company it has been used in a study of fat losses at heating surfaces in preheaters, vats, etc. Dr. Keenan of the Whiting Milk Company has used the test in studying the effect on oiling off of coffee cream by such treatments as the Dahlberg process for heat treating cream.

* Presented before the Metropolitan Dairy Technology Society, New York City, February 23, 1938.

Factors causing oiling and its prevention:

1. Partial freezing of milk before separation will increase the oiling tendency of the cream.

2. As separating temperatures are increased above 90° F., the fat emulsion becomes increasingly less stable.

3. The temperature of cream when standardized and whether standardized with skim or whole milk makes no difference. Neither does the time or temperature of standardizing make any significant difference.

4. Filling vat direct from separator. Applying heat slowly as vat fills is a satisfactory procedure. Also have cooling medium flow through vat jacket but no agitation is satisfactory. Never heat and hold at near the pasteurization temperature while vat fills.

5. Pasteurization: (a) prolonged holding (40 min.) at the pasteurization temperature increased the amount of oiling, (b) partial filling of vats also proved harmful to the fat emulsion, (c) type of vat. The coil vat and fast propeller agitator both were unsatisfactory. Paddle agitation and slow propeller agitation both proved satisfactory. (d) Heating to a temperature above 145°F. increased the amount of oiling off. (e) A heating medium above 160° also caused trouble.

6. Pumping cream by proper sized pumps did not increase the tendency to oil while the use of over-size pumps did. Steam piston pumps do not affect the fat emulsion adversely; in fact with cream that oiled badly, piston pumps actually re-emulsified some fat and improved it slightly.

7. Cooling in the vat increased the tendency to oil off considerably. Cooling over the surface cooler had no effect unless freezing of cream to the cooler occurred. This was found to be a serious cause of oiling off in retail coffee cream.

8. Aging cream at low temperature had no effect on the stability of the emulsion.

9. Shipment had no effect if the cream was cold and cans were full enough to prevent churning.

10. Homogenization completely stabilized the emulsion and prevented oily separation, 300 lbs. pressure being sufficient. The colloid mill and hand homogenizer were ineffective. No trouble was experienced with homogenized

cream if freezing on the cooler later were prevented.

11. Storage in the home refrigerator did not increase the tendency to oil off.

12. Some restaurant cream dispensers were found to break the fat emulsion and cause bad oiling off.

WHIPPING PROPERTY OF CREAM

Much of the published research concerning whipping cream was done with hand operated whippers. These results may be open to question because of the lack of sensitivity of the method.

In our studies an electric whipper was used and the rate of whipping was secured by recording the input in watts necessary to run the whipper. This proved to be a satisfactory method of comparing different creams.

Especially desirable properties of whipping cream have been enumerated as: high viscosity, good whipping ability, stiff-whip, high overrun, absence of serum drainage. A number of factors affect these properties and will be discussed in detail.

When whipping cream, trouble is often due to—

- a. Over-full bowl. Whipping will not occur if whipper is submerged.
- b. Temperature. Temperature above 40° F. progressively lowers whipping ability, reduces stiffness and overrun, and increases serum drainage. Precaution: Use cold cream and cold utensils.

Considerations for dairyman.

1. Fat test. 30 to 35 percent fat most desirable. Low fat cream is low in viscosity, whips slowly to soft product. Cream higher than 35 percent fat produces no serum drainage but a soggy product with low overrun. Great danger of churning.
2. Separating temperature. Low separating temperature desirable. 90° F. proved superior to 100° F. because cream was more viscous, had less drainage and gave a stiffer whip and whipped easier.
3. Pasteurizing temperature. A pasteurizing temperature of about 155° F. prevents serum separation, lowers bacteria

counts, imparts good keeping quality, lowers serum drainage from whipped cream, and does not affect adversely other properties of whipped cream.

4. Standardization methods. Standardization with whole or skim milk, either before or after pasteurization, appeared to be of little consequence. Standardization prior to pasteurization recommended because bacterial contamination was less likely to occur.
5. Temperature treatment during cooling. Delayed cooling, according to the Dahlberg process, is said to increase the viscosity of cream. If you practice this method of cooling and find it beneficial to viscosity, the practice should be continued. Our experiments indicate that this method of cooling, however, does not improve whipping properties of cream or benefit the finished product.
6. Increasing serum solids content of cream. This practice is followed by some dairymen as a means of increasing the body of cream. We found it to be of no value in that it did not improve whipping properties or reduce serum drainage. Not worth the added trouble and expense.
7. Aging time. Aging cream longer than 24 hours is of no practical advantage so far as whipping ability is concerned.
8. Addition of stabilizer. This is clearly an infraction of most state regulations. Yet the practice of adding gelatin, Dariloid, or some other stabilizer is continued by some companies. The addition of a stabilizer benefits some properties and injures others. Dariloid and gelatin are the most desirable particularly Dariloid because so small an amount is needed. As little as 0.1 percent increases cream viscosity noticeably and lowers the amount of serum drainage. In general, stabilizers lower whipping ability and overrun.
9. Effect of adding sugar. About 10 percent by weight of sugar is desirable in whipped cream. This should not be added to cream before whipping because this lowers whipping ability. Add-

ing the sugar any time after the first minute of whipping causes no difficulty in whipping or in any other respect.

10. Effect of homogenization. Homogenization at 300 lbs. or higher reduces whipping ability, and increases serum drainage and fat loss in the drain. Very low homogenization pressures of 50 to 100 pounds at low temperatures are said to increase viscosity without noticeably decreasing whipping ability. It also prevents serum separation in the bottled cream. This cannot be done with an ordinary homogenizer because gages do not register these low pressures.
11. Effect of freezing milk or cream. Partial freezing (13 percent) of milk prior to separation did not seem to decrease whipping ability. Freezing of cream before pasteurization lowered whipping ability but freezing of cream during delivery had very little effect on whipping ability. However, such creams exhibit "cream plug" and oil off in coffee.
12. Feed of cow. The source of protein, whether animal or vegetable, made no difference in the whipping properties of cream. England (Maryland) reports that the breed of cow does make a difference, Guernsey cream whipping 30 percent faster than Ayrshire cream. England also reports that the air whip is preferable to the turbine type of whipper for the commercial production of whipped cream. (Bul. 393, Maryland Agr. Expt. Sta.)
13. Increasing the acidity of cream does not affect the whipping properties unless the cream is sour. The poor whipping of cream in the late winter can be corrected by the addition of 0.1 percent sodium citrate (Sommer). This does not affect flavor of the whipping cream.

In conclusion, it should be stated that, in general, defects in cream are due to excessive agitation in processing, too rapid heating, or reprocessing. If cream is handled a minimum number of times, carefully pasteurized and cooled, and marketed when fresh, little difficulty should be encountered with the product.

JOURNAL OF MILK TECHNOLOGY

Official Publication of the

International Association of Milk Sanitarians

Editors

W. B. PALMER, *Managing Editor*
Orange, N. J.

J. H. SHRADER, *Editor*
East Orange, N. J.

Associate Editors

C. A. ABELE
Montgomery, Ala.

ERNEST KELLEY
Washington, D. C.

SARAH VANCE DUGAN
Louisville, Ky.

P. F. KRUEGER
Chicago, Ill.

J. G. HARDENBERGH
Plainsboro, N. J.

H. N. PARKER
Jacksonville, Fla.

M. A. HEINZMAN
Ventura, Cal.

M. E. PARKER
Chicago, Ill.

J. A. KEENAN
Boston, Mass.

G. C. PUTNAM
Chicago, Ill.

C. K. JOHNS
Ottawa, Canada.

H. R. THORNTON
Edmonton, Alberta, Canada

The JOURNAL OF MILK TECHNOLOGY is issued bimonthly beginning with the January number. Each volume comprises six numbers.

Subscriptions: The subscription rate is \$5.00 per volume.

Advertising: All correspondence concerning advertising, reprints, subscriptions, and all other business matters should be addressed to the Managing Editor, W. B. Palmer, 29 North Day Street, Orange, N. J.

Manuscripts: All correspondence regarding manuscripts, editorials, news items, announcements, and other reading material should be addressed to the Editor, J. H. Shrader, 339 Springdale Avenue, East Orange, N. J.

Membership and Dues: Active and Associate Memberships in the Association are \$5.00 per year. This includes all issues of the Journal. All correspondence concerning membership in the ASSOCIATION OF MILK SANITARIANS, including applications for membership, remittances for dues, failure to receive copies of the JOURNAL OF MILK TECHNOLOGY, and other such matters should be addressed to the Secretary of the Association, C. Sidney Leete, State Department of Health, Albany, N. Y.

Application for Membership

I wish to apply for membership in the International Association of Milk Sanitarians.

.....19.....

Name
(Print name in full and degree)

Address
(Street and City)

Present occupation

Previous positions

Application is for:

.....Active membership

.....Associate membership

Applicant may qualify for

MEMBER if officially engaged in dairy or milk inspection, or laboratory control, or administration of such function for any country or subdivision thereof; or officially engaged in research or educational work related to dairy or milk inspection for any country or subdivision thereof.

ASSOCIATE MEMBER if interested in the promotion of dairy sanitation.

DUES: \$5.00 per year payable in advance, and includes the Association

JOURNAL OF MILK TECHNOLOGY.

Application endorsed by:

..... } Active or Associate Members

Mail with remittance to:

C. SIDNEY LEBTE, *Secretary*,
Int. Assn. of Milk Sanitarians,
N. Y. State Dept. of Health,
Albany, N. Y.

INTERNATIONAL ASSOCIATION OF MILK SANITARIANS

CONSTITUTION

Adopted October 16, 1911*

NAME

This Association shall be known as the International Association of Milk Sanitarians.

OBJECT

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

MEMBERSHIP

There shall be two classes of membership in this association: Active and Associate.

The active membership shall be composed of persons who are officially engaged in dairy or milk inspection, or the laboratory control of, or the administration of such function for any country or any subdivision thereof, and of persons who are officially engaged in research or educational work related to dairy or milk inspection for any country or subdivision thereof, provided, however, that all persons who at the time of the adoption of this amendment are members of the Association, shall be active members.

The associate membership shall be composed of any persons not eligible for active membership, who are interested in the promotion of dairy sanitation. Associate members shall not be eligible to vote, serve as officers, hold the chairmanship of any committee, serve on the Resolutions Committee, or serve as majority members of any committee of this Association.

Any properly qualified person may make application for active or associate membership to the Secretary-Treasurer and if application is accepted by the Membership Committee, said applicant may become an active or associate member, as the case may be, upon payment of the annual dues of five dollars (\$5.00).

OFFICERS

The officers of this Association shall be a President, three Vice-Presidents, a Secretary-Treasurer, and two Auditors, who shall be elected by a majority ballot at the Annual Meeting of the Association, and shall hold office for one year or until their successors are elected. An Executive Board, which shall direct the affairs of the Association when not in Annual Session shall consist of the President, the three Vice-Presidents, and the Secretary-Treasurer.

AMENDMENTS

This Constitution may be amended by a two-thirds affirmative vote of those active members of the Association who register their votes with the Secretary. Any member proposing amendments must submit the same in writing to the Secretary-Treasurer at least sixty days before the date of the Annual Meeting, and the Secretary-Treasurer shall at once notify all members that the proposed amendments will be open for discussion at the Annual Meeting immediately succeeding such notification. After discussion at the Annual Meeting such Amendments, upon a majority affirmative vote of the members in attendance shall be, within 90 days, submitted to the entire membership of the Association by the Secretary-Treasurer. All members voting on such amendments shall, within 60 days after receipt of such notification, register their vote in writing with the Secretary-Treasurer on blanks furnished by the Association. These ballots shall be opened and recorded by the Executive Committee, and the results shall be reported by the Secretary-Treasurer at the next Annual Meeting; and if the amendments are passed they shall become a part of the Constitution from the date of such report by the Secretary-Treasurer at the Annual Meeting.

* Amended October 20, 1932 and October 15, 1936.

WHAT ARE THE ANSWERS?

Is there a relation between mastitis and Bang's disease?

How useful are platform tests?

How do bacteria counts run in a city ice cream supply?

What are the weaknesses in heat-regenerator set-ups?

How can washing and sterilizing performance be made dependable?

Read the July issue

Borden's Offer 2 Kinds of Vitamin D Milk

IRRADIATED VITAMIN D MILK

A 135 Unit Vitamin D Milk that is used in thousands of homes today. 135 U.S.P. XI units of Vitamin D in every quart. A safe and dependable source of the "Sunshine" vitamin for the entire family.

400 UNIT VITAMIN D MILK

A "400" unit Vitamin D. Milk for babies under 2 years and special cases where the physician believes an extra measure of vitamin protection to be desirable. This milk is prepared with IRRADIATED ergosterol and contains 400 U.S.P. XI units of Vitamin D per quart.

Both Borden's 400 unit Vitamin D Milk and Borden's IRRADIATED Vitamin D Milk have been accepted by the Council on Foods of the American Medical Association.

CONSULT YOUR PHYSICIAN AND DENTIST ABOUT YOUR DIET



Look the World Over!

..... And you find outstanding dairy plants in the leading milk producing countries using Wyandotte Specialized Cleaners and Alkalies. "Wyandotte" aids dairy operators "the world around."

Profitable Plant Cleaning

Your Dealer will supply Wyandotte "Cleaner and Cleanser"—"Poma" Cleaner—or "Cherokee"—as indicated by the analysis of your local water supply. Every one assures quick, thorough cleaning with strict economy.

Safe and Sure Sterilizing

Dissolve "Steri-Chlor" (powder) in water and have clear sterilizing solution of any desired strength. Ready for instant use. Does not corrode metal. Convenient—Economical.

The J. B. Ford Company
Wyandotte, Michigan





but

**YOU CAN'T KILL WITH
A POP GUN!**

PLAYING "cops and robbers" makes an ear-splitting din . . . but it's harmless. A steam line also makes a deafening roar . . . but it too, is harmless. Heat . . . not noise . . . will kill bacteria. Unless equipment is heated to at least 180° F. for fully 2 minutes, it amounts to just another game of make-believe.

Why play games with bacteria? Diversol kills bacteria quickly and surely at any temperature. Easy to use. Unlike ordinary sterilizers, Diversol never corrodes or damages equipment. Won't lose its strength. Want facts? Write today for Research Bulletin on the relative efficiency of heat versus chlorine sterilization.

MAKE THIS TEST

Place a thermometer at varying distances from the steam hose nozzle. See how quickly temperature drops below minimum necessary to kill bacteria.



DIVERSOL

KILLS BACTERIA IN COLD WATER

Index to Advertisers

	PAGE NO.
Aluminum Seal Company	IV
Borden	VII
Cherry-Burrell Corporation	VI
Creamery Package Company.....	V
Difco Laboratories	Back Cover
Diversey Corporation	VIII
Ford Co., The J. B.....	VII
Sealtest, Inc.	IX
Standard Cap and Seal Corp.	II
Vitex Laboratories	III

"VITALLY NECESSARY"

Sealtest has come a long way since its inception three years ago. And, of course, much of its progress has been due to the fine co-operation of Milk Supervisors with Sealtest Representatives, throughout the country. This Laboratory System of over 100 chemical and bacteriological laboratories, several hundred technicians, headed by some of America's foremost food scientists—this System has yet many milestones to reach and pass. And, in the attainment of these goals, the help and understanding of Milk Supervisors will be vitally necessary.



SEALTEST, INC., 120 Broadway, New York



COLI IN MILK

BACTO-BRILLIANT GREEN BILE 2%

Bacto-Brilliant Green Bile 2% is recommended for the detection of coliform bacteria in milk. When this product is prepared for use, it conforms in every way to the medium specified for this purpose in "Standard Methods of Milk Analysis" of the American Public Health Association.

Results obtained by direct inoculation of the milk sample into fermentation tubes of medium prepared from Bacto-Brilliant Green Bile 2% are reliably accurate and require no further confirmation. Production of gas in this medium is an indication of the presence of coliform organisms in the milk.

Bacto-Brilliant Green Bile 2% is readily made up for use. It is completely soluble in water and requires no adjustment of its reaction. After autoclave sterilization the medium has a reaction of pH 6.8.

Specify "DIFCO"

THE TRADE NAME OF THE PIONEERS

In the Research and Development of Bacto-Peptone and
Dehydrated Culture Media

DIFCO LABORATORIES

INCORPORATED

DETROIT, MICHIGAN