

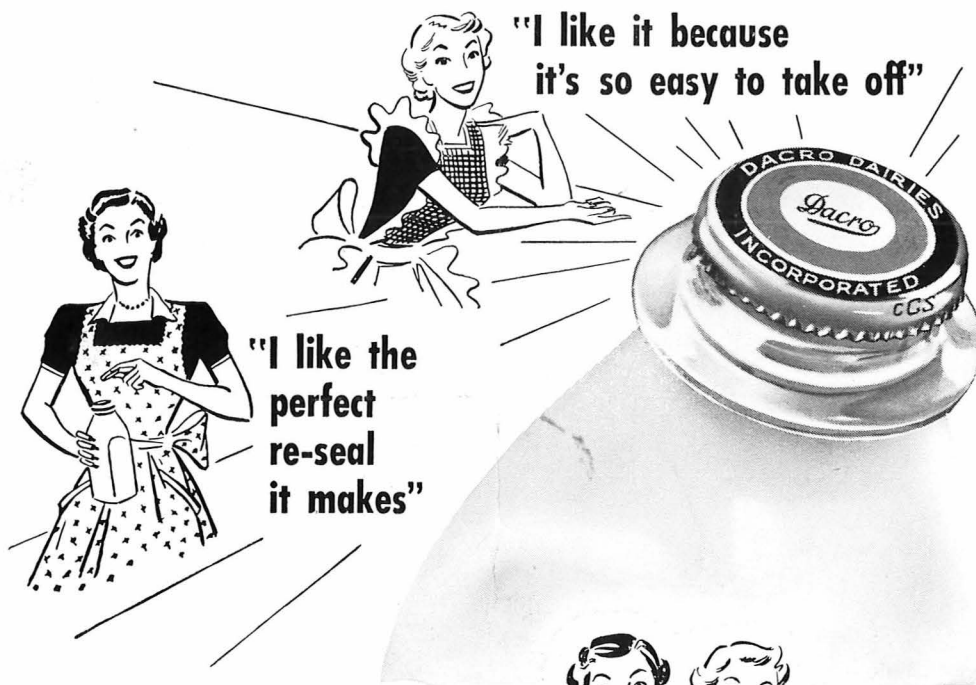
VOLUME 14 NO. 2
March-April 1951

Journal of

MILK and FOOD
TECHNOLOGY


Official Publication

International Association of Milk and Food Sanitarians, Inc.



"I like it because
it's so easy to take off"

"I like the
perfect
re-seal
it makes"

**... and they both  like
the way DACRO P-38 protects
the milk they buy!**

Housewives all over the country like the many advantages of *Dacro Protected* milk. Dairy operators, too, find that the Dacro P-38 Capping System gives them many important savings . . .
a more profitable operation.

Dacro P-38

- Covers the pouring lip of bottle
- Forms an air-tight seal
- Makes a perfect re-seal
- Lessens the danger of seepage
- Eliminates cap seat

CROWN CORK & SEAL COMPANY

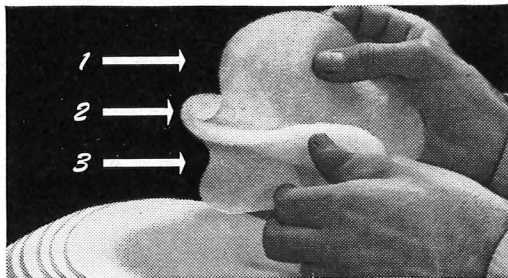
DACRO DIVISION • BALTIMORE 3, MD.

7/19
Dankowski Dept

PROTECT MILK QUALITY THREE WAYS SAVE MONEY, TIME AND LABOR

WITH *Perfection* DUBL-CHEM-FACED MILK FILTER DISCS

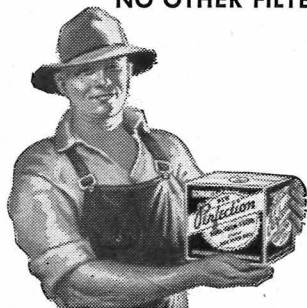
"Tripl-Filtrinq"[®]



- 1—THE TOP SURFACE Filters
- 2—THE CENTER AREA Filters
- 3—THE BOTTOM SURFACE Filters

Only DUBL-CHEM-FACED Filter Discs provide this "Tripl-Filtrinq" action . . . fast and thorough . . . at less cost . . . fewer filters required . . . dependable protection of milk quality is assured three ways!

NO OTHER FILTER DISCS CAN CLAIM TO FILTER MILK BETTER



Milk filters generally depend solely on a single thickness of filtering cotton to catch sediment as milk passes through. In DUBL-CHEM-FACED "Tripl-Filtrinq" construction, however, two important "extras" are provided, because in addition to the super-thick center area of specially carded cotton, the toughened TOP and BOTTOM surfaces both act as filters, too! Highest quality, low in cost, easy to use, popular with top grade milk producers . . . worthy of your endorsement.

Write for samples

SCHWARTZ MANUFACTURING CO., Two Rivers, Wisconsin
Manufacturers of *Perfection*, *Blue Streak*, *Elgrade*, and *DUBL-CHEM-FACED* Filter Discs, Rolls, Bags and Tubes . . . *Fray-Seal* Cheese Bandages and Circles . . . and a complete line of cotton goods for the Dairy Industry.



.. find these hidden
savings in your plant
with **CHERRY-BURRELL**

"CC"
**Spray
Pasteurizer**



"CC" Spray Pasteurizer. Stainless Steel lining, paddles and covers. Sturdy agitator assures thorough mixing of heavy bodied products. Available in 200 and 300 gallon sizes.

Here's a modern, stainless spray pasteurizer that can uncover important savings in your plant . . . in labor costs, in electric power costs, in steam costs, in lower maintenance costs, and give you safe pasteurization with low water temperatures.

Large and small dairies alike will find that the "CC" Spray turns out batch after batch of rich, flavorful milk with maximum cream layer, good body color, and low bacteria count.

With Cherry-Burrell's exclusive, patented Sentinel Control there are no wasted steps checking the temperature . . . every batch is positively held at the proper temperature. There's no overheating or underheating . . . "burn-on" is eliminated.

If you haven't found these hidden savings, ask your Cherry-Burrell representative for details on how soon you can profit from the dollar-saving results of "CC" Spray pasteurization.

CHERRY-BURRELL CORPORATION

General Sales and Executive Office:

427 W. Randolph Street, Chicago 6, Ill.

Milk and Food Plant Equipment and Supplies

FACTORIES, WAREHOUSES, BRANCHES, OFFICES OR DISTRIBUTORS
AT YOUR SERVICE IN 56 CITIES



trendmaker in a great industry

OFFICERS

- President*, DR. K. G. WECKEL
Madison, Wis.
- President Elect*, H. L. THOMASSON
Shelbyville, Ind.
- First Vice-President*, H. J. BARNUM
Denver, Col.
- Second Vice-President*, J. D. FAULKNER
Washington, D. C.
- Secretary-Treasurer*, GEORGE A. WEST
Rochester Health Bureau,
44 Marshall Street, Rochester 2, N. Y.
- Auditors*: DR. R. G. ROSS
Tulsa, Oklahoma
DR. W. H. HASKELL
Beloit, Wis.

Publication Board

- WM. B. PALMER J. H. SHRADER
GEORGE A. WEST

Editors

- WM. B. PALMER, *Managing Editor*
29 N. Day St., Orange, N. J.
- DR. J. H. SHRADER, *Editor*
23 East Elm Ave., Wollaston 70, Mass.

Associate Editors

- | | |
|-------------------------------------|--------------------------------------|
| C. A. ABELE
Chicago, Ill. | M. D. HOWLETT
Los Angeles, Cal. |
| F. W. BARBER
Oakdale, N. Y. | C. K. JOHNS
Ottawa, Ontario |
| F. C. BASELT
New York, N. Y. | J. A. KEENAN
New York, N. Y. |
| A. E. BERRY
Toronto, Canada | J. C. OLSON, JR.
St. Paul, Minn. |
| P. B. BROOKS
Altamont, N. Y. | E. H. PARFITT
Chicago, Ill. |
| F. W. FABIAN
East Lansing, Mich. | G. W. PUTNAM
Chicago, Ill. |
| C. R. FELLERS
Amherst, Mass. | J. L. ROWLAND
Jefferson City, Mo. |
| A. W. FUCHS
Washington, D. C. | W. D. TIEDEMAN
Ann Arbor, Mich. |
| J. G. HARDENBERGH
Chicago, Ill. | K. G. WECKEL
Madison, Wis. |
| R. W. HART
Kansas City, Mo. | G. H. WILSTER
Corvallis, Ore. |

The Journal of Milk and Food Technology (including Milk and Food Sanitation) is issued bimonthly beginning with the January number. Each volume comprises six numbers. Published at 374 Broadway, Albany 7, N. Y., by the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC., with executive offices of the Association at 44 Marshall Street, Rochester 2, N. Y.

Entered as second class matter at the Post Office at Albany, N. Y., March 4, 1942, under the Act of March 3, 1879.

Editorial Offices: J. H. Shrader, *Editor*, 23 E. Elm Ave., Wollaston 70, Mass.; Wm. B. Palmer, *Managing Editor*, 29 N. Day St., Orange, N. J.

Manuscripts: Correspondence regarding manuscripts and other reading material should be addressed to the Editor, J. H. Shrader (address above).

Booklet entitled "JMFT Style-book" can be obtained from the Editor for the use of contributors of papers.

Business Matters: Correspondence regarding business matters, advertising, subscriptions, orders for single copies, etc., should be addressed to William B. Palmer (address above).

Subscription Rates: One Volume per year
Personal Subscription \$5.00
Public Libraries 3.00

Journal of

MILK and FOOD TECHNOLOGY

INCLUDING MILK AND FOOD SANITATION

Official Publication

International Association of Milk and Food Sanitarians, Inc.

VOL. 14

MARCH-APRIL 1951

NO. 2

Contents

Editorials	
The International Association of Milk and Food Sanitarians As An Official Organization.....	47
Award For Meritorious Achievement In Food Sanitation.....	47
The Cholesterol In Foods—Is It A Threat To Health?.....	48
A Comparative Study of Stains Proposed for the Direct Microscopic Examination of Milk..... <i>J. C. Olson and L. A. Black</i>	49
Destruction of Lactic Acid Streptococcus Bacteriophage by Hypochlorite and Quaternary Ammonium Compounds <i>R. B. Parker and P. R. Elliker</i>	52
The Occurrence and Survival of <i>Brucella abortus</i> in Italian Cheese Curd Made from Raw and Pasteurized Milk <i>H. L. Gilman and J. C. Marquardt</i>	55
Exigent Problems in the Use of Quality Appraisal Standards in the Procurement of Dairy Products for Military Requirements <i>R. J. Miller</i>	57
The Problem of Antibiotics in Milk..... <i>H. E. Calbert</i>	61
Missouri's Plan for Milk Analysts in the State and Laboratory Certification..... <i>Mrs. Irma C. Adams</i>	65
Detection of Horse Meat by the Biological Precipitin Test <i>Emanuel Kaplan and T. C. Buck</i>	66
Common Causes of Off-Flavor Milk and Their Control.. <i>C. J. Babcock</i>	68
Problems of Midwest Producers in Interstate Shipment of Milk <i>J. C. Olson</i>	71
Summary Report of Committee's Findings up to Date <i>F. L. Zimmermann</i>	73
<i>Escherichia coli</i> as an Index to Sanitation..... <i>R. W. Newman</i>	75
New Books and Other Publications.....	78
Affiliates of the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC.....	79
Association News.....	79
News Items.....	81
Industrial Notes.....	85
Calendar.....	87
Index to Advertisers.....	xiv

Governmental Agencies (Not Individuals) \$3.00
Educational Institutions 3.00
Single Copy 1.00

Orders for Reprints: All orders for reprints should be sent directly to the publisher: The Boyd Printing Co., 374 Broadway, Albany 7, N. Y.

Membership Dues: Membership in the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC., is \$5.00 per year, which includes annual subscription to the JOURNAL OF MILK AND FOOD TECHNOLOGY, INC. (including MILK AND FOOD SANITATION). All correspondence regarding membership, remittances for dues, failure to receive copies of the JOURNAL, changes of address, and other such matters should be addressed to the *Secretary-Treasurer* of the Association, George A. West, 44 Marshall St., Rochester 2, N. Y.

TARIANS, INC., is \$5.00 per year, which includes annual subscription to the JOURNAL OF MILK AND FOOD TECHNOLOGY, INC. (including MILK AND FOOD SANITATION). All correspondence regarding membership, remittances for dues, failure to receive copies of the JOURNAL, changes of address, and other such matters should be addressed to the *Secretary-Treasurer* of the Association, George A. West, 44 Marshall St., Rochester 2, N. Y.

**Johnson & Johnson CONTRIBUTES AGAIN
TO QUALITY MILK PRODUCTION
With New, Improved Formula *RAPID-FLO*
Trade Mark of Johnson & Johnson
Filter Disks and New Factory-Sealed Carton**

The better, safer filtration reported by milk producers everywhere, plus the obvious sanitary advantages of the new Factory-Sealed Carton, have earned immediate and enthusiastic response from Dairy Industry leaders, including dairy farmers, haulers, fieldmen, plant managers and health authorities.

**Dairymen Everywhere Endorse
New Formula *RAPID-FLO* Filter Disks
in the New Factory-Sealed Carton**



"Boy, it's a lot easier to handle and will surely keep the disks clean." Carlos R. Leffler, Puritan Dairy, Lebanon, Pa.

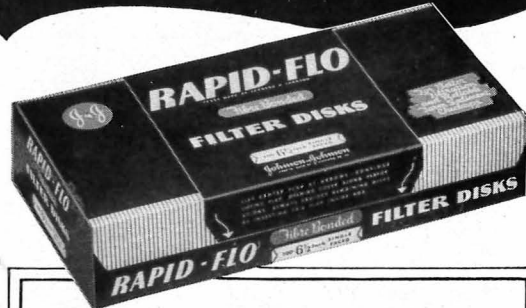
"This is what we have been looking for, for years." N. S. Rissler, Puritan Dairy, Lebanon, Pa.

THE "REAL MCCOY"
"The new package is easy to handle and doesn't take up as much room in the cab as the old one did. My patrons think this new package is the real McCoy and they like the self-closing lid on dispenser." Arnold Edwards, Milk Hauler, Deerfield Creamery Co., Deerfield, Wisconsin.



"JUST THE TICKET"
"My experiences with Rapid-Flo filter disks have proven their ability to do an exceptional job of filtering milk for their users. The new method of packaging has made it more attractive to producers in that they are not only convenient but provide protection for disks yet to be used. Milk haulers are also pleased with the new

style of package. The Rapid-Flo metal dispenser box is just the ticket for proper storage of disks on producers' farms." Gene Florence, Field Supervisor, Dairyland Cooperative Assoc., Juneau, Wisconsin.



**THE ORIGINAL FIBRE-BONDED
RAPID-FLO FILTER DISKS NOW MADE
BETTER—SAFER, MORE RETENTIVE**

Rapid-Flo, the first and best FIBRE-BONDED filter disk, has been improved with a new formula developed after several months of laboratory research and farm testing. More retentive, Rapid-Flo now removes finer microscopic extraneous matter than ever, providing an even more reliable Farm Sediment Check-Up, urged by milk authorities as an effective aid to Quality Milk Production.

The new Factory-Sealed Carton protects filter disks from factory to farmer. 100 Disks to a Carton. Can also be obtained in the 300 put-up, 3 cartons of 100 disks tied together as illustrated.



The package is easy to carry, easy to open—closes with a touch of your finger-tip.

New Sanitary Dispenser—Made exclusively to hold the new Factory-Sealed Carton. Sturdy metal construction. Specially designed sloping lid closes automatically. Ask your supplier for this convenient sanitary dispenser.



DAIRY FILTERS DEPARTMENT FILTER PRODUCTS DIVISION

Johnson & Johnson

4949 WEST 65TH STREET CHICAGO 38, ILLINOIS

Consumers prefer
smoother,
finer-tasting
Ice Cream



Globe, Cerelose and Puritose are registered trade-marks of Corn Products Refining Company, New York, N. Y.



... make it with
PURITOSE

Ice cream manufacturers have found that PURITOSE corn syrup produces superior results of highest quality. CERELOSE has also won great usage in the making of ices and sherbets, as well as ice cream.

Make a finer product . . . win consumer preference for your brand.

Full technical service, no obligation

CORN PRODUCTS REFINING COMPANY, 17 Battery Place, New York 4, N. Y.





In Rome milk is delivered in two-wheeled pushcarts. A block of ice in a container is suspended in the tank. When

the cover is lifted to measure out the milk, there is nothing to bar the entry of dust and street germs.



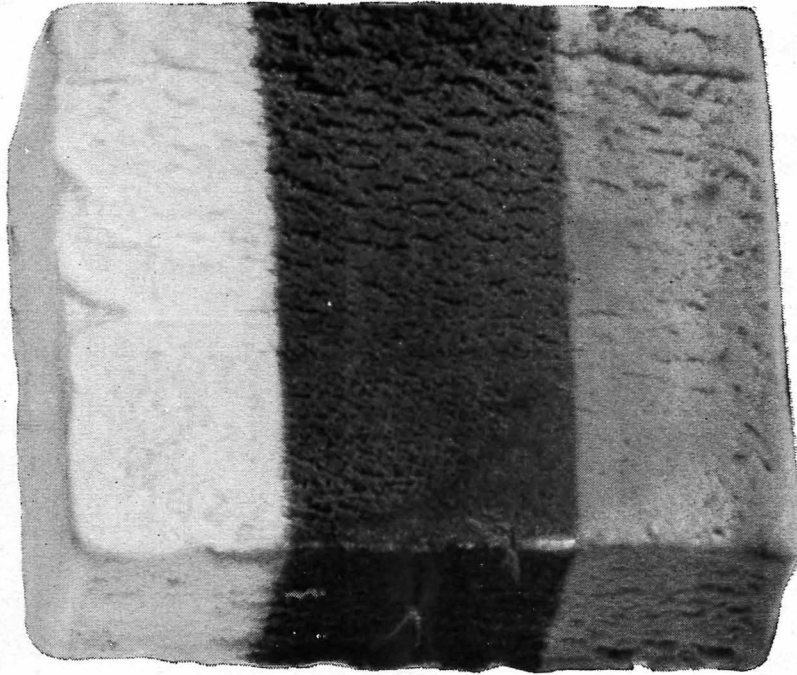
In America we frown on such dangerous methods and use Canco's paper milk containers—the safe, sanitary and convenient system so widely sanctioned by Public Health officials.



New York, Chicago,

American Can Company San Francisco, Hamilton, Canada

- 1. Single-trip** — used once, then discarded!
- 2. Rinse test** reveals no Escherichia Coli, and a high percentage of complete sterility in containers delivered to the dairy!
- 3. Opened, filled, and closed** in a jiffy by machine!



“The dietary flag of the U.S.A. . . .”

What would be your guess as to the food you might hear mentioned most frequently anywhere in the world as “typically American”? Ten to one it would be ice cream.

“Ah, sí, Señor . . . your ice cream! It is as familiar as your flag. You might call it the dietary flag of the U.S.A. We have heard how everybody in the States eats ice cream . . . for breakfast, lunch and dinner. Nowhere else in the world will you find such luxury.”

The exaggeration makes you laugh. As a physician, you would be tempted to remind your foreign friend that ice cream is a valuable food as well as a treat. Ice cream contains, in highly palatable form, all the known food elements essential to health—proteins, fats, carbohydrates, minerals and all the vitamins for which dietary allowances have been established, in quantities ranging from small amounts of vitamin C and iron to liberal amounts of calcium and riboflavin. No wonder you frequently include ice cream in the special diets you prescribe.

Borden's ice cream is used in American hospitals in large quantities, for dietitians know that acutely ill or convalescent patients eat ice cream when they refuse to touch most any other food. Dietitians know, too, that they can depend on Borden's ice cream to be of uniform high quality, day in and day out. You too can depend on the quality of all Borden foods.

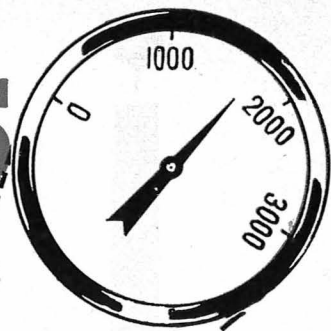
Manufacturers and distributors of BORDEN'S Beta Lactose, BIOLAC infant food; DRYCO infant food; KLIM powdered whole milk; MERRELL-SOULE Powdered Skimmed Milk; MULL-SOY hypoallergenic food; BORDEN'S Evaporated Milk, STARLAC non-fat dry milk, Instant Coffee, Fresh Milk, Ice Cream & Cheese.

The
Borden
Company

350 Madison Avenue, New York 17, N. Y.

TRUE LOW PRESSURES

GIVE "HIGH PRESSURE" Results



Multi-Flo



HOMOGENIZERS

FOR MILK, CREAM OR MIX

Because of CP's unique Single-Service Valve and Multi-Flo head design, CP Multi-Flo Homogenizers provide full homogenizing efficiency at 1,250 to 2,000 pounds pressure—with results normally obtained only at pressures from 2,000 to 3,000 pounds! Cream is homogenized at a fraction of the pressures listed. Equally important, you get "new machine" performance on every run, simply by replacing the inexpensive CP Single-Service Valve . . . in just a few minutes.

LOWER OPERATING COSTS

By operating with full efficiency at low pressures, CP Multi-Flo Homogenizers reduce the power required by as much as *one-third*. This means smaller motors; lower electric power costs.

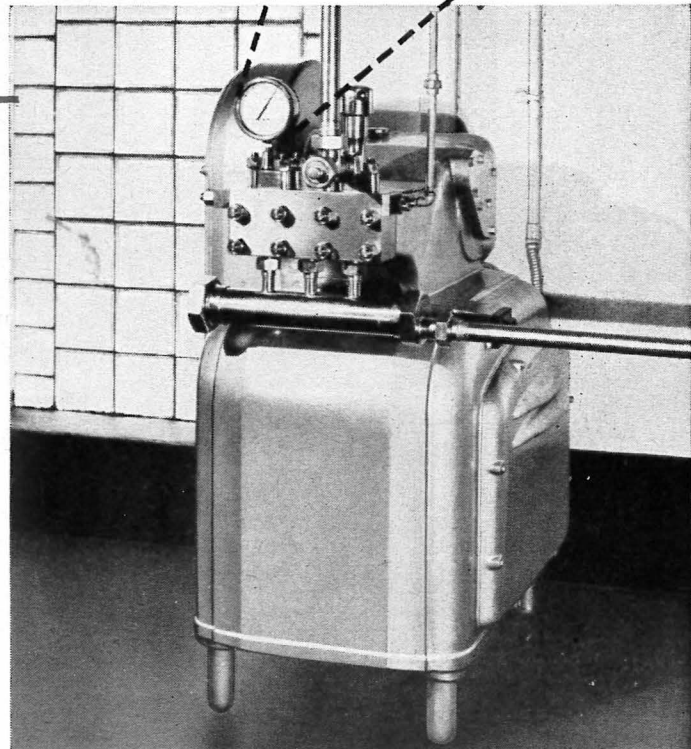
LOWER MAINTENANCE COSTS

Low pressure operation reduces wear and repair bills! Simple, rugged design further holds down maintenance costs.

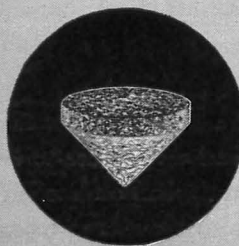
FASTER CLEAN-UP CONSTRUCTION

Clean-up time and costs hit a new low with CP Multi-Flo Homogenizers. The whole head can be disassembled in 5 to 9 minutes—reassembled as quickly.

Whether you need homogenizing capacity of 125 up to 2,000 gallons per hour, CP Multi-Flo Homogenizers can open the door to lower costs and better protected quality of product. Ask your CP Representative for data—or write direct.



Only CP Has the Single-Service Valve!



Assures Uniform Homogenization with Every Run

No expensive, difficult grinding of worn valves. Simply replace this Single-Service stainless steel valve. Its countless tiny passages provide multiple interflow action that breaks up fat globules for uniform dispersion.



THE *Creamery Package* MFG. COMPANY

General and Export Offices: 1243 W. Washington Blvd., Chicago 7, Illinois

Atlanta • Boston • Buffalo • Chicago • Dallas • Denver • Houston • Kansas City, Mo. • Los Angeles • Minneapolis • Nashville • New York • Omaha • Philadelphia • Portland, Ore. • St. Louis • Salt Lake City • San Francisco • Seattle • Toledo, Ohio • Waterloo, Ia.

CREAMERY PACKAGE MFG. CO. OF CANADA, LTD.
267 King St., West, Toronto 2, Ontario

THE CREAMERY PACKAGE MFG. COMPANY, LTD.
Mill Green Road, Mitcham Junction, Surrey, England

REPLACE
OR
REPAIR
NOW

EDITORIAL NOTES

THE INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS AS AN OFFICIAL ORGANIZATION

ONE of the noteworthy developments current in the public health field is the increasing degree to which the officials have been setting up advisory groups to assist them in matters of policy and in getting public support. These advisory groups consist of industrialists, educators, professional men, and just plain citizens—none of whom may be in governmental employ. Coincident with this, we observe that environmental hygiene in general and sanitary food control in particular have emerged from their hidden place under the bushel, so to speak, and now beam their light from the hill-top. How did all this come about?

In the food field, it evolved by the conscientious devotion and intelligent application of milk inspectors and food control officials to the task of safeguarding the quality of our food supplies. At first, the emphasis was regulatory; the means, the police power. Gradually, we learned that many milk and food, non-official sanitarians knew as much about food and were as interested and were as conscientious as we were. So, increasingly our meetings and our literature and our regulatory laws are enriched and strengthened by the collaboration of all branches of applied food sanitation. The great increase in the

effectiveness of our work and the attendant awakening of the interest of the public are due to this fusion of the two streams of officialdom and citizenry.

In recognition of this, the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC., has reorganized its membership to admit non-official personnel. All members are now on the same basis. However, provision is made that the Executive Board must be predominantly in governmental employ. This step was taken to maintain the dominant "official" note. (By the way, the very fact that our members so preponderantly are engaged in those aspects of food sanitation that involve legal considerations would enable our Association to render—and receive—unique value from collaboration in the work of the Food Law Institute, Inc.)

We have heard of a few instances where milk and food sanitarians fear that the IAMFS is now no longer an "official" organization. This idea is erroneous. The very fact that governmental men must constitute the majority in control preserves the official character. Yes, we are official—and at the same time, something better, namely, intelligently civic.

J. H. SHRADER

AWARD FOR MERITORIOUS ACHIEVEMENT IN FOOD SANITATION

IT is well-known that a professional man is not narrowly restricted in his interests to his job. One's perspective shows whether he is a job-holder or a worker or a leader. "By their fruits shall ye know them." So, in this spirit we look at the field of milk and food sanitation. Is it of professional calibre? Has it done anything to merit this rating? Someone may say that it has done great things. How great? The reply may be made that its creativeness measures up to that of workers in other fields. Then why don't we take ourselves seriously?

This outburst is occasioned by the news release carried on page 82 of this issue. Note that a technologist in the Quartermaster Corps has been given an award. Thrice previously he has been decorated.

Has any sanitarian done anything worthy of such recognition? Certainly! We know that there are men whose accomplishments in milk and food sanitation are just as worthy of meritorious citation as those in other fields.

If we do not take our work seriously, who will do it for us? If we act as though we have not professionally arrived, then others will agree with us. In this connection we do not plead for recognition by pinning labels onto our coats. We present our work itself to the world. We do it in no spirit of strut nor vainglorious display. We do maintain that recognition of good work is rewarding to the worker and stimulating to all who attend. We are not referring to a reward of money or other such intrinsic values. We do refer to the encouragement that comes to a fellow when he has done a good job out of interest in the work itself and finds that his colleagues and the public recognize it. The artist gets the plaudits of the audience, the military receive their medals and ribbons, the scientist receives his decorations. What does the milk and food sanitarian receive? He is not asking for anything. We are hereby asking something for him.

J. H. SHRADER

THE CHOLESTEROL IN FOODS—IS IT A THREAT TO HEALTH?

THE principles of human nutrition have been founded on scientific studies of human dietary needs and the nutrient content of foods. These principles met a challenge when cholesterol, present in the fat portion of eggs, meat, and milk became suspect number one as a causative agent in the development of arteriosclerosis, a disease of the human arteries in which a chemical combination of cholesterol and protein becomes deposited in the inner wall of blood vessels.

These principles had a reprieve recently when it was demonstrated that in normal human diets cholesterol has little to do with the amount of that material in the blood. The disclosure came from a study conducted by Dr. Ancel Keys, Director of the University of Minnesota Laboratory of Physiological Hygiene, with 482 men, varying in age from 18 to 80 years, as subjects. The relationship between the cholesterol in their blood and such factors as age, dietary habits, state of health, and consumption of dairy foods were determined.

This research shows that eating dairy products, meat, and eggs, all foods high in cholesterol content, does not lead to increased cholesterol in the blood. It further shows that even foods which contain no cholesterol may raise the cholesterol level of the blood. One subject showed an immediate and continued rise in blood cholesterol when changed from a diet completely free of both cholesterol and all fats to one containing vegetable fats (no trace of cholesterol).

Cholesterol content of food appears to be relatively unimportant because the body manufactures this material at a rapid rate and because substances other than cholesterol appear to influence its level in the blood. By reducing or eliminating the consumption of such foods as milk, butter, cheese, eggs, ice cream, and meat, the diet is robbed of many essential nutrients. Nutrition scientists are agreed that an adequate diet should include plenty of dairy foods and generous supplies of fruits, meats, fish, eggs, vegetables, and cereals.

Dr. Keys' research, which was aided in part by grants from the National Dairy Council, acting on

behalf of the American Dairy Association, was cited in a recent editorial appearing in the *Journal of the American Medical Association*. This editorial states, "Since dietary cholesterol occurs in foods of animal origin with particularly desirable nutritional value (e.g., meat, eggs, and milk), it seems unwise to condemn use of these foods if there is risk of sacrificing the foundations of sound nutrition unless clearest evidence is obtainable to establish the usefulness of such procedure. . . . Evidence is accumulating which indicates that obesity is associated with abnormalities of cholesterol metabolism, perhaps far more so than the dietary intake of cholesterol."

MILTON HULT, *President*
National Dairy Council

**EVERY MILK SANITARIAN SHOULD
HAVE, FOR READY REFERENCE, A
COMPLETE SET OF 3-A SANITARY
STANDARDS FOR MILK-HANDLING
EQUIPMENT PUBLISHED TO DATE.**

Reprints of published sanitary standards may be obtained from George A. West, Secretary-Treasurer of the Association, 44 Marshall Street, Rochester 2, N. Y.

At \$1.25 per set of eleven

Thirty-eighth Annual Meeting

GLENWOOD SPRINGS, COLORADO, Sept. 26-29, 1951

A COMPARATIVE STUDY OF STAINS PROPOSED FOR THE DIRECT MICROSCOPIC EXAMINATION OF MILK

A REPORT OF THE COMMITTEE ON APPLIED LABORATORY METHODS*

JOSEPH C. OLSON, JR.

Associate Professor of Dairy Bacteriology, University of Minnesota, St. Paul, Minnesota,†

AND

LUTHER A. BLACK

Chief, Milk and Food Sanitation Section, Environmental Health Center, U. S. Public Health Service, Cincinnati, Ohio ‡



DR. OLSON'S early youth was spent on the farm in Iowa and Minnesota. He received the B.S. degree in dairy products, the M.S. degree in dairy bacteriology, and the Ph.D. degree in bacteriology, all from the University of Minnesota. During World War II his principal assignment was in the production of typhoid vaccine at the U. S. Army Medical Department vaccine laboratory in Lansing, Michigan, where he was in charge of production. His present position is Associate Professor of Dairy Bacteriology, University of Minnesota.

Five stains which have been proposed as substitutes for stains now specified in Standard Methods were compared by means of a collaborative study involving nine different laboratories. Stain I was the present Standard Methods alcohol-containing methylene blue stain; Stain II was a potassium-dichromate-sulfuric acid polychrome methylene blue stain; Stain III was an acid- and water-free methylene blue stain; Stain IV was a modification of Stain III containing hydrogen peroxide; Stain V was a methylene blue stain, the use of which was accompanied by a modification in fixation of the milk film; and Stain VI was a modified two color stain, details of which were not supplied. Examination of weighted averages of all samples from all laboratories showed that Stain III yielded the highest average count. Unfavorable comments pertaining to all stains except Stain III were received. Great variation in the results between laboratories was evident. One stain might show superior results in one laboratory and give inferior results in another laboratory. In general, Stain III showed the least variation in results among the collaborating laboratories, although it obtained the highest score in only one laboratory. The study pointed up the need for uniformity in laboratory procedure among different laboratories, particularly as regards the direct microscopic counting procedure.

INTRODUCTION

ONE of the basic procedures used in the bacteriological control of milk is the direct microscopic examination of samples. In recent years several new stains have been

* Presented at the Thirty-seventh Annual Meeting of the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC., Atlantic City, New Jersey, October 16, 1950.

† Scientific Journal Series Paper No. 2612, Minnesota Agricultural Experiment Station.

‡ The splendid cooperation of the following laboratories who participated in this study is gratefully acknowledged: Bureau of Laboratories, State Department of Health, Jacksonville, Fla.; Division of Laboratories, State Department of Public Health, Chicago, Ill.; Caddo Branch Laboratory, Division of Laboratories, State Department of Health, Shreveport, La.; Division of Dairy Husbandry, University of Minnesota, St. Paul, Minn.; Laboratory Section, Division of Health, Department of Public Wel-

proposed as substitutes for the stains now in Standard Methods. Last year the Committee on Applied Laboratory Methods of the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC. arranged for nine laboratories to cooperate in a study of several stains proposed for the direct microscopic examination of milk. This report summarizes the results obtained by the laboratories participating in this preliminary study.

PROCEDURE

Unless otherwise specified in the directions for an individual stain, the milk films were prepared in accordance with the Ninth edition of *Standard Methods for the Examination of Dairy Products* (Section 2.48) using a 0.01 ml pipette, and were defatted and fixed (Section 2.49). In addition to the alcohol-containing methylene blue¹ stain now in Standard Methods (Stain I) five additional stains[§] were supplied to each participating laboratory through the courtesy of several bacteriologists, who also supplied any special instructions for use of their stain.

Each laboratory was requested to prepare six slides from each milk sample to allow staining of every sample by each stain. It was suggested that the preparation stained with Stain I be counted first, and

fare, St. Louis, Mo.; Division of Laboratories, State Department of Health, Bismarck, N. D.; Department of Health, Steubenville, O.; Bureau of Laboratories, State Department of Health, Austin, Tex.; Hygienic Laboratory Division, State Department of Health, Charleston, W. Va.

§ Stain II was a potassium-dichromate-sulfuric acid Polychrome Methylene Blue² supplied by Difco Laboratories; Stain III was an Acid- and Water-Free Methylene Blue,³ and Stain IV a modification containing hydrogen peroxide, supplied by B. S. Levine of the F.S.A. P.H.S. Environmental Health Center, Cincinnati, Ohio; Stain V was supplied by E. K. Borman of the State Department of Health, Hartford, Connecticut, in connection with a staining procedure which entailed a modification in the fixation of the milk film; and Stain VI was a modified two-color milk film stain supplied by F. W. Barber, National Dairy Research Laboratories, Oakdale, Long Island, New York.

that the number of fields required to be counted with this stain also be used in counting the remaining five preparations. Although in some instances this might result in counting more or fewer fields than required by Standard Methods, this uniformity was necessary for any statistical analyses of the results. Slides were to be counted in a routine manner with all counts reported to be clump counts as defined by Standard Methods (Section 2.45c). Each laboratory was requested to report upon 50 samples of raw milk.

EVALUATION OF DATA

Several procedures were used in evaluating the data. The first consisted of observing the comments about the various stains which were submitted from certain of the laboratories participating in the study. This was followed by calculating the logarithmic average counts as obtained in the nine laboratories. A third method of evaluation consisted of assigning a score to each stain based on the frequency with which each stain yielded the highest count, second highest, third highest, etc. From the information obtained by the application of the above procedures to the data, it was evident that an extensive statistical examination of the data was unwarranted. However, for reasons which will be pointed out later, a test for the significance of the difference between the mean count obtained with Stain I and Stain III was made.

TABLE 1
COMPARISON OF LOGARITHMIC AVERAGE DIRECT MICROSCOPIC CLUMP COUNTS
OBTAINED IN NINE LABORATORIES USING SIX DIFFERENT STAINS

Laboratory	Number of samples and average counts obtained with stain											
	I		II		III		IV		V		VI	
	No. of samples	Count (,000 omitted)	No. of samples	Count (,000 omitted)	No. of samples	Count (,000 omitted)	No. of samples	Count (,000 omitted)	No. of samples	Count (,000 omitted)	No. of samples	Count (,000 omitted)
A	50	62	50	45	50	190	50	150	50	210	50	200
B	51	180	51	220	51	190	51	170	51	150	51	170
C	50	120	50	190	50	180	50	210	50	210	50	170
D	55	350	55	290	55	340	55	290	55	350	55	240
E	47	93	48	140	46	170	50	160	49	150	49	120
F	50	300	50	370	50	470	50	430	50	330	50	430
G	18	230	19	510	20	330	20	300	18	320	20	190
H	48	58	48	62	48	59	48	65	46	56	48	36
I	50	1,800	50*	...	50	1,900	50	1,400	49	1,300	50	1,500
Weighted log. av. of all samples	419	190	371	160	420	260	424	240	418	240	423	210
Placing of stains	6		5		1		2		2		4	

* 50 smears prepared but counts not obtained due to loosening of smears during washing.

DIFFICULTIES REPORTED

Unfavorable comments about the various stains were received from three of the participating laboratories. These are given below as they pertain to each stain.

Stain I.

1. "Background cloudy and quite dark; bacteria and leucocytes in several focusing planes, requiring constant focusing up and down on each field. Considerable eye strain."

Stain II.

1. "Smears washed off. Totally unsatisfactory for that reason."
2. "Washed off too easily."
3. 24 of 55 counts submitted from one laboratory were designated as questionable because smears were partially washed off.

Stain III.

1. No unfavorable comments.

Stain IV.

1. "Background cloudy and blurred; poor defatting. Outline of organisms not clear. Strain to read."

Stain V.

1. Sponsor of this stain anticipated difficulty with loosening of smears from the slide. To correct for this it was recommended that exposure time in solution A be increased from 2 to 5 minutes.
2. "Background poor; constantly showed a queer 'leaf shadow' sort of pattern, causing severe eye strain and a feeling of inaccuracy in counting."
3. "Background very light, found difficulty in being certain whether or not the smear was actually in focus or in the microscopic field."
4. "We had difficulty reading #V smears because of too intensive staining."

Stain VI.

1. "We were unable to obtain uniformly satisfactory smears with stain #VI and had difficulty in distinguishing bacteria from background on many smears."
2. Twelve of 55 counts submitted from one laboratory were designated questionable because of difficulty in distinguishing bacteria from background.

The value of the above comments is necessarily limited due to the

fact that they are representative of only three of the nine cooperating laboratories. Nevertheless, some indication of the personal impressions of technicians who used the stains may be gained.

LOGARITHMIC AVERAGE COUNTS

The logarithmic average counts, as obtained in the nine laboratories, of samples stained with the six stains are presented in Table 1. These counts are based on all samples for which a count was reported. Laboratory accidents, for the most part, accounted for the variation in number of counts submitted from the various laboratories. No count for Stain II from Laboratory I is recorded because the milk smears washed off during the staining procedure. As mentioned above, other laboratories had similar difficulties with this stain.

It may be observed that there was considerable variation among labo-

TABLE 2
FREQUENCY OF RANK AND POINTS SCORED BY EACH OF SIX STAINS ACCORDING
TO THE ABILITY OF THE RESPECTIVE STAINS TO YIELD MAXIMUM COUNTS

Stain No. →	I		II		III		IV		V		VI	
	f*	No. of points †	f	No. of points	f	No. of points	f	No. of points	f	No. of points	f	No. of points
1st	62	372	105	630	101	606	93	558	106	636	66	396
2nd	58	290	73	365	92	460	84	420	68	340	65	325
3rd	31	124	56	224	67	268	61	244	61	244	61	244
4th	53	159	43	129	52	156	57	171	52	156	56	168
5th	79	158	50	100	34	68	40	80	38	76	53	106
6th	75	75	31	31	12	12	23	23	33	33	57	57
Total points of score	1178		1479		1570		1496		1485		1296	
Rank	6		4		1		2		3		5	

* f = frequency or number of times the respective stain gave the highest count, 2nd highest, etc.
† points = frequency × inverse of rank, for example, in case of Stain I $62 \times 6 = 372$ points.

laboratories in the ability of the various stains to provide maximum counts. For example, Stain V showed the highest average count for Laboratory A, yet it showed the lowest average count for Laboratory B. An examination of the weighted averages of all samples from all laboratories showed that Stain III yielded the highest average count and Stain II the lowest. In the case of the latter, it should be pointed out that no counts were reported from Laboratory I for this stain. Since the samples examined in Laboratory I showed considerably higher counts than those reported from other laboratories, lack of data for Stain II from this laboratory makes any comparison on the above basis relative to Stain II unfair. If Stain II is eliminated from comparison, Stain I showed the lowest average count.

RANK OF STAINS

The third method of evaluating the data consisted of ranking each stain according to the frequency with which each yielded the highest count, second highest, third highest, etc. This was done utilizing counts from each individual laboratory only, and also by combining the counts from all laboratories. In this procedure only samples for which a count was reported by the use of each stain were used. Three hundred and fifty-eight samples were involved. Results from Laboratory I necessarily were eliminated due to lack of data for Stain II. The frequency tabulation using counts from all laboratories is shown in Table 2. When this tabulation was completed, the frequency of rank for each stain was multiplied by the inverse of the stain rank. Thus, each stain received a score based on the number of points received. The magnitude of score for each stain also is shown in Table 2.

To illustrate, it may be observed that Stain I provided the highest count for 62 of the 358 samples, and was in second place 58 times; third, 31 times; fourth, 53 times; fifth, 79 times; and 6th, 75 times. Multiplying each of these rank frequencies by the inverse of the rank, for example, $62 \times \frac{1}{6}$, $58 \times \frac{1}{5}$, etc. and thence summing these points, a total score for Stain I of 1,178 points is obtained. From Table 2 it may be observed that Stain III scored the highest, showing a considerable margin over Stain IV which received

the second high score. This method of evaluation resulted in rather close agreement with the rank of the stains according to the logarithmic average counts.

In Table 3 the rank of each stain within the nine laboratories is presented. It is quite evident that considerable variation occurred between laboratories with respect to the ability of the various stains to yield maximum counts. It is interesting to note that Stain III obtained the highest score in only one laboratory, yet when counts from all laboratories were combined it showed the highest (see Table 2). This is accounted for by the fact that Stain III showed the least variation in score among the eight laboratories. This may be shown more clearly in Table 4 which shows the frequency with which each stain scored first, second, third, etc., among the eight laboratories.

TABLE 3
RANK OF SIX STAINS WITHIN NINE LABORATORIES

Laboratory	Rank placing for stain					
	I	II	III	IV	V	VI
A	6	5	4	3	1	2
B	4	1	2	5	6	3
C	6	4	3	2	1	5
D	3	4	2	5	1	6
E	6	4	2	1	3	5
F	6	4	1	3	5	2
G	5	1	2	4	3	6
H	4	1	2	3	5	6

TABLE 4
FREQUENCY WITH WHICH EACH OF SIX STAINS RECEIVED THE HIGHEST SCORE, SECOND HIGHEST, ETC., AMONG EIGHT LABORATORIES

Stain	1st	2nd	3rd	4th	5th	6th
I	0	0	1	2	1	4
II	3	0	0	4	1	0
III	1	5	1	1	0	0
IV	1	1	3	1	2	0
V	3	0	2	0	2	1
VI	0	2	1	0	2	3

STATISTICAL COMPARISON OF LEAST AND MOST FAVORABLE STAINS

The method of evaluating the stains described above indicated that the data available did not warrant detailed examination by statistical significance tests. The extreme variation within laboratories with respect to results obtained by use of the various stains would seem to indicate that such an effort would be extremely limited in value. Undoubtedly quite different results would be obtained were the data from each laboratory treated separately in the application of signifi-

cance tests. However, it was thought advisable to test the significance of the difference between the weighted means of all counts obtained by use of Stains I (Standard Methods Alcohol-Containing Methylene Blue) and III (Acid-and-Water-Free Methylene Blue). On the basis of the data available, these two stains represented the least favorable and most favorable stains respectively according to the previous methods of evaluation. Counts from all laboratories were included in the analysis which involved 415 samples, this being the number of samples for which a count was obtained by each of the two stains. The results of the significance test is shown in Table 5. It may be observed that the probability of obtaining the difference in means shown due to pure chance would be less than one time per thousand. The difference in means, therefore, is highly significant.

TABLE 5
DISTRIBUTION OF COUNTS, STAIN I AND III, ACCORDING TO MAGNITUDE OF COUNT; AND TEST OF SIGNIFICANCE OF DIFFERENCE BETWEEN MEANS

Class center (log. Count)	Frequency Stain I (x)	Frequency Stain III (y)
3.795	2	0
3.995	41	39
4.195	6	3
4.395	45	40
4.595	18	13
4.795	42	34
4.995	38	36
5.195	16	26
5.395	22	26
5.595	31	25
5.795	25	28
5.995	34	36
6.195	17	26
6.395	28	24
6.595	14	23
6.795	11	10
6.995	12	14
7.195	7	4
7.395	2	4
7.595	2	3
7.795	2	1
N	415	415

$$\begin{aligned} \bar{x} &= 5.36 \\ \bar{y} &= 5.45 \\ S_x &= 0.92 \\ S_y &= 0.91 \\ r &= 0.95 \\ t &= \frac{(\bar{x} - \bar{y})}{\sqrt{\frac{S_x^2 + S_y^2 - 2rS_xS_y}{N}}} = 6 \end{aligned}$$

P = < 0.001

(Continued on page 64)

DESTRUCTION OF LACTIC ACID STREPTOCOCCUS BACTERIOPHAGE BY HYPOCHLORITE AND QUATERNARY AMMONIUM COMPOUNDS*

R. B. PARKER AND P. R. ELLIKER

Oregon Agricultural Experiment Station, Corvallis, Oregon

A modification of the Weber and Black method was employed to compare rate of destruction of lactic streptococcus bacteriophage by sodium hypochlorite and quaternary ammonium compounds. At concentrations of 50 and 100 ppm, the hypochlorite exhibited faster destruction of phage than did the quaternary ammonium compounds. At 200 ppm both quaternaries and hypochlorites completely inactivated the phage in a 15-second exposure period. Results indicated that an active hypochlorite should be preferable to quaternary compounds for destruction of bacteriophage on dairy equipment. Different phage strains for both *Streptococcus lactis* and *Streptococcus cremoris* showed marked variations in resistance to quaternary ammonium germicides.

DESTRUCTION of lactic acid bacteria by bacteriophage now is recognized as one of the most important causes of starter failure and lack of acid development in manufacture of certain cheeses and cultured milks. This knowledge has emphasized the importance of methods of destruction of bacteriophage by germicides in the dairy plant.

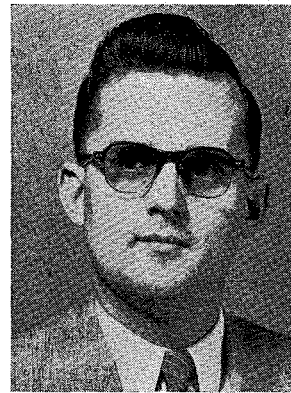
Hypochlorites, in the form of either mists or solutions, have been found to be effective in destruction of phages of lactic acid streptococci.^{5, 11} Recently the widespread use of quaternary ammonium compounds has prompted studies on their effect on different strains of bacteriophage and viruses. It has been found that the bacteriophage homologous for *Escherichia coli* can be isolated from sewage without filtration by use of a 1:5,000 dilution of certain quaternaries to destroy bacteria present.⁶ Bacteriophages active against *Staphylococcus*, *Salmonella*, and *Shigella* species have been reported to be insensitive to a number of anionic detergents.¹ However, it has been observed that certain strains of *Staphylococcus* and *Shigella* phage were inactivated by both anionic and cationic detergents.⁷ A phage strain active against lactic streptococci was inactivated in 11

out of 16 trials by exposure to 40 ppm alkyl dimethyl benzyl ammonium chloride for 2 minutes.⁹ A similar concentration of diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride inactivated all bacteriophage present in 8 of 10 trials with 2 minutes exposure.

No data comparing rate of destruction of phages for lactic streptococci by quaternaries and hypochlorites has come to the authors' attention. In view of the confusion prevalent regarding application of quaternaries and hypochlorites for various dairy sanitizing operations, it was considered advisable to compare rates of destruction of these compounds on various strains of lactic streptococcus phage. A summary statement based on this work has been published.³ This paper presents techniques employed and data not previously published.

METHODS

Bacteriophage preparations for this study were obtained by propagating the phage in skim milk cultures of sensitive strains of lactic streptococci. Following growth of the phage-culture mixture, a bacteria-free filtrate was prepared as follows: Sufficient sterile 10 percent lactic acid was added to coagulate the milk. The curd was then removed by straining the coagulated milk through sterile cheese cloth. The resulting whey was filtered through a Selas candle. In the germicidal trials 1 ml of this filtrate was diluted with 99 ml of sterile distilled water just before exposure to germicide. Phage preparations were obtained from milk rather than broth cultures because preliminary trials indicated the phage in the milk filtrates to be more resistant than that in broth filtrates of the same strain. A highly resistant strain of phage was selected by exposing a number of *Streptococcus lactis* and *Streptococcus cremoris* strains to 100 ppm QAC at pH 7.0. The strain finally selected for most of the studies required an exposure of 120 seconds while most of the others re-



MR. PARKER served in the U. S. Army Air Corps, 1943-46. He attended Boise Jr. College, 1947, and received his B.S., Oregon State College, June 1950. He now is Graduate Research Assistant, Oregon Agricultural Experiment Station, 1950-. Recipient 1950 Phi Sigma award. Sigma Xi research honorary.

quired about 30 seconds for complete destruction.

The quaternary compounds studied were: alkyl dimethyl benzyl ammonium chloride (QAC 1), diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride (QAC 2), and a detergent sanitizer containing QAC 2 as the germicidal agent. The hypochlorite selected for these studies was a liquid sodium hypochlorite preparation. Previous studies have shown its germicidal activity to be comparable to a number of sodium and calcium hypochlorite preparations on the market. All germicides employed were prepared in concentrations double that desired in the final test. Concentrations were standardized by QAC⁴ and hypochlorite² test methods, respectively. Since preliminary data suggested hypochlorites to be definitely more active in destruction of phage than QAC preparations, a number of steps were taken to insure that any QAC preparations used would be employed under conditions of maximum activity. QAC preparations were diluted in buffered solutions of pH 7.0 and 9.5. The detergent sanitizer was diluted in distilled water. The hypochlorite was buffered to pH 9.5. The pH 9.5 buffer represented a 1 percent solution of about equimolar concentrations of sodium carbonate and sodium borate. The pH 7.0 buffer was 1 percent sodium carbonate solution adjusted with lactic acid.

The procedure used in determining rate of destruction of phage was a modification of the Weber and Black method for testing effective-

* Published as Technical Paper No. 653 with the approval of the Director of the Oregon Agricultural Experiment Station. Contribution of the Department of Bacteriology.

ness of germicides against bacteria.¹⁰ All trials were run at 25° C. The bacterial-free phage filtrate standardized to a titer of 10⁸ was exposed to germicide in the same manner as is done with bacterial suspensions in the Weber and Black method. Great care was observed to prevent contamination of the sides of this tube with phage. Following exposure to germicide, 1 ml of the phage-germicide mixture was transferred to 9 ml of either thiosulfate or lecithin-Tween 80 inhibitor solution and, after mixing, 1 ml of this transferred to a tube of culture sensitive to the phage. This tube was prepared from sterile skim milk to which sterile resazurin was added for indicator. All tubes were incubated at 30° C for at least 12 hours. Phage-free control tubes showed reduction and coagulation by the end of 12 hours. Tubes showing retardation of growth under the same circumstances contained phage that survived the exposure to germicide. Two controls carried out with each test included one in which the bacteriophage filtrate was omitted and a second in which the phage was exposed to sterile buffer solutions which contained no germicide.

RESULTS

Table 1 representing results of six different trials indicates complete inactivation of phage by 50 ppm hypochlorite in 15 seconds exposure time. It required 300 seconds to

inactivate the same phage using 50 ppm of the most active QAC (the detergent sanitizer). At a concentration of 50 ppm both QAC 1 and QAC 2 at pH 9.5 required 450 seconds, and at pH 7.0, 600 seconds for phage inactivation. In spite of the lower pH of the diluted detergent sanitizer (pH 8.6), this germicide showed some superiority over the plain QAC germicides at pH 9.5.

Exposure to 100 ppm hypochlorite (Table 2) again inactivated the phage within 15 seconds. At a concentration of 100 ppm the most

active QAC preparations (the detergent sanitizer and QAC 1 at pH 9.5) required 30 seconds to destroy all phage. The least active compound at 100 ppm was QAC 2 at pH 7.0 which showed inactivation in 5 out of 6 trials at 120 seconds, but required 300 seconds for positive destruction. The increase in activity of the QAC with increase in pH is very evident at 100 ppm concentration. For example, QAC 1 at the lower pH required 120 seconds as compared to only 30 seconds at pH 9.5. As might be expected in such trials, skips were observed in some samples. Nevertheless, the results in general are fairly consistent. With one exception, at 200 ppm complete destruction of phage was accomplished by all germicides with 15 seconds exposure. The one exception was a positive skip in only one of three trials at 30 seconds exposure to QAC 1 at pH 7.0.

DISCUSSION

In selecting compounds for this study the hypochlorite was representative of several of the more active sodium and calcium hypochlorites on the market. The QAC 1 and QAC 2 and the detergent sanitizer represented the most active QAC preparations. A pH higher than 9.5 might have increased QAC action somewhat, but some disadvantages would attend practical usage of a product at such high pH levels.

TABLE 2
RATE OF DESTRUCTION OF S. CREMORIS STRAIN W BACTERIOPHAGE BY 100 PPM QUATERNARY AND HYPOCHLORITE SOLUTIONS AT 25° C

Germicide	pH	Seconds of Exposure				
		15	30	60	120	300
Detergent sanitizer	9.2	+-	---	---	---	---
QAC 1	7.0	++	++	+-	---	---
QAC 1	9.5	+-	---	---	---	---
QAC 2	7.0	++	++	++	---	---
QAC 2	9.5	++	+-	---	---	---
NaOCl	9.6	---	---	---	---	---

- indicates bacteriophage destruction
+ indicates bacteriophage survival
Each "+" or "-" represents the results of one trial

TABLE 1
RATE OF DESTRUCTION OF S. CREMORIS STRAIN W BACTERIOPHAGE BY 50 PPM QUATERNARY AND HYPOCHLORITE SOLUTIONS AT 25° C

Germicide	pH	Seconds of exposure						
		15	30	60	120	300	450	600
Detergent sanitizer	8.6	++	++	++	---	---	---	---
QAC 1	7.0	++	++	++	++	+-	---	---
QAC 1	9.5	++	++	++	+-	---	---	---
QAC 2	7.0	++	++	++	++	++	+-	---
QAC 2	9.5	++	++	++	++	+-	---	---
NaOCl	9.5	---	---	---	---	---	---	---

- indicates bacteriophage destruction
+ indicates bacteriophage survival
Each "+" or "-" represents the results of one trial

Results of all trials at 50 and 100 ppm greatly favored the hypochlorite for destruction of bacteriophage in the dairy plant. This was true even though the QAC was used under more favorable conditions at a high pH and in a fortified preparation (detergent sanitizer), and the hypochlorite was used at a high rather than a lower pH. It is logical to assume that the hypochlorite would have shown greater activity at pH 7.0 than at 9.5 on the basis of past studies. At 200 ppm the QAC with one exception, destroyed the phage in 15 seconds, but the hypochlorite undoubtedly maintained a greater margin of safety.

Judging from these results a recommendation of 200 ppm of an active hypochlorite solution as a sanitizing rinse for destruction of bacteriophage on dairy equipment should be sound. Where the exposure period on some types of equipment is short, 400 to 500 ppm hypochlorite doubtless would provide a greater margin of safety. All of these recommendations assume application on a clean surface. Neither QAC nor hypochlorite would be likely to destroy phage on a dirty equipment surface. Other considerations favoring hypochlorites over QAC for this sanitizing operation are: (a) inhibition of lactic acid starter bacteria by concentrations as low as 5 to 10 ppm of QAC in milk⁸; and (b) inhibition of QAC action by certain hard water salts.

The variation in resistance of different phage strains to QAC and the

potentiating action of certain detergent sanitizer salts on QAC action against the virus are significant factors to consider in such a comparative study between two different germicides. They also may aid in throwing some light on mechanism of action of these germicides on bacteriophage and microorganisms.

CONCLUSIONS

1. A representative commercial sodium hypochlorite destroyed lactic streptococcus bacteriophage at a faster rate at 50 and 100 ppm concentration than did a number of quaternary ammonium preparations used.

2. Complete inactivation of phage preparations was attained with 200 ppm concentrations of both quaternary ammonium and hypochlorite germicides, and this concentration should be sufficient for normal sanitization of dairy equipment for phage destruction.

3. Results indicate that an active hypochlorite should provide a more effective agent than quaternary solutions for bacteriophage destruction on dairy equipment.

4. There appears to be considerable variation between different phage strains with respect to their susceptibility to destruction by germicides such as quaternary ammonium compounds.

REFERENCES

1. Burnet, F. M., and Lush, D. The Action of Certain Surface Active Agents on Viruses. *Austral. J. Exp. Biol. and Med. Sci.*, 18, 141-150 (1940).

2. Elliker, P. R. *Practical Dairy Bacteriology*. McGraw-Hill Book Co., New York, N. Y. 1949. pp. 346-347.

3. Elliker, P. R. The Problem of Bacteriophage in the Dairy Industry. *Proc. Eleventh Annual Biology Colloquium*, Oregon State College, April 29, 1950.

4. Harper, J. W., Elliker, P. R., and Moseley, W. K. Quaternary Test—Sensitive Method for Testing Concentration of Quaternary Ammonium Type Germicides. *Soap and San. Chem.*, 24, 159-160 (1948).

5. Hunter, G. J. E., and Whitehead, H. R. The Action of Chemical Disinfectants on Bacteriophages for the Lactic Streptococci. *J. Dairy Res.*, 11, 62-66 (1940).

6. Kalter, S. S., Mordaunt, V. D., and Chapman, O. D. The Isolation of *Escherichia coli* Phage by Means of Cationic Detergents. *J. Bact.*, 52, 237-240 (1946).

7. Klein, M., Kalter, S. S., and Mudd, S. The Action of Synthetic Detergents upon Certain Strains of Bacteriophage and Virus. *J. Immunol.*, 51, 389-396 (1945).

8. Miller, D. D., Elliker, P. R., Cornett, J. A., and Streiff, R. Inhibition of Lactic Acid Starter Bacteria by Low Concentrations of Quaternary Ammonium Compounds in Milk. *Proc. Thirtieth Annual Meeting, Western Div. Amer. Dairy Sci. Assn.* 120-122. (1949).

9. Prouty, C. C. Inactivation of Bacteriophage of the Lactic Acid Streptococci of Starters by Quaternary Ammonium Compounds. *J. Milk and Food Technol.*, 12, 214-218 (1949).

10. Weber, G. R., and Black, L. A. Laboratory Procedure for Evaluating Practical Performance of Quaternary Ammonium and Other Germicides Proposed for Sanitizing Food Utensils. *Amer. J. Pub. Health*, 38, 1405-1417 (1948).

11. Wolf, J. A.; Nichols, A. A., and Ineson, P. J. Mists Containing Hypochlorite as Germicides in the Destruction of Air-borne Bacteriophages Attacking Lactic Streptococci. *J. Dairy Res.*, 14, 291-315 (1946).

Thirty-eighth Annual Meeting

GLENWOOD SPRINGS, COLORADO, Sept. 26-29, 1951

THE OCCURRENCE AND SURVIVAL OF *BRUCELLA ABORTUS* IN ITALIAN CHEESE CURD MADE FROM RAW AND PASTEURIZED MILK*

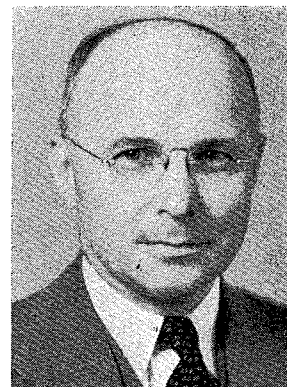
HERBERT L. GILMAN

New York State Veterinary College,
Ithaca, New York

AND

J. C. MARQUARDT

Assistant Director in Milk Control, Department of Agriculture and Markets,
Albany, New York



DR. HERBERT L. GILMAN, D.V.M., M.S., Ph.D., Professor of Bacteriology, New York State Veterinary College, Cornell University, Ithaca, N. Y. He was graduated from Cornell in 1917 and served 18 months in the Army Veterinary Corps, 1917-1918. Since 1919 he has been a member of the faculty of the Cornell University Veterinary College. He has been interested in research on diseases of the genital organs of animals, mostly cattle, and brucellosis of animals, and has done some work on the survival of *Br. abortus* in cheese. He has written many articles on these subjects, and published a Cornell bulletin on *Bovine Brucellosis*.

Br. abortus was recovered from five out of six Italian cheese curds made from raw milk. *Br. abortus* was recovered from three out of four samples of batch milk from a plant making the curd. After pasteurization, the authors were unable to recover the organism from either the milk or the curd made from this milk. The organism apparently is able to survive the usual manufacturing process for this type of cheese when made from raw infected milk.

Br. abortus consumed in raw or improperly pasteurized dairy products has been proved capable of causing brucellosis in man. While no case of human brucellosis has so far been definitely attributed to the consumption of cheese containing viable *Br. abortus*, it has been established that the organisms survive ordinary cheese manufacturing methods. For that reason, any cheese containing viable *Brucella* is a potential source of danger to the consumer. This is particularly true of cheeses that are not subject to ripening for at least 60 days. Italian cheese sold under the trade name of Mozzarella, because of the short ripening period and the fact that much of the product is still made from unpasteurized milk, is an example.

In New York State, about 30 percent of Italian cheese curd is still made from raw milk, much of which undoubtedly contains viable *Brucella*. The remainder is made from milk that has been heat-treated to control gas formation. During the past six months it has been made from properly pasteurized milk at one plant. While ripening is delayed in cheeses made from pasteurized milk the flavor has proved to be of good quality. At the plant making pas-

teurized milk curd, a factor has been adopted to compensate for the delayed ripening. Public Health officials feel that all cheese curd to be safe for human consumption should be made from pasteurized milk. It is believed that the hot water treatment used in molding this type of cheese is insufficient to prevent viable *Br. abortus* from reaching the consumer.

In an effort to determine the livability of the organisms in the cheese, these studies were initiated.

LITERATURE

There is no evidence to indicate that brucellosis has been attributed to the consumption of cheese made solely from cow milk. All Italian cheese curd manufactured in New York is made from cow milk alone. It is not made from milk derived from several species as is done in some countries. The survival of *Brucella* as well as other bacteria, is influenced markedly by such factors as duration of storage, temperature, and acidity. Gilman *et al.*¹ showed that when Cheddar cheese was made from milk produced by reacting cows selected because they eliminated large numbers of *Br. abortus*, the organism remained viable in all the cheeses made from such milk for six months. It could not be demonstrated in some cheeses after six months, and it was negative in all tests made after a storage period of one year. Tests were conducted on ten vats of commercial milk made into Limburger cheese, and fifteen vats made into Cheddar cheese produced in New York areas selected at random. There were two vats of Limburger-cheese milk positive for *Br. abortus*. None of the Cheddar-cheese milk tested was positive. The Limburger curds made from the positive milks were negative and the cheese was

negative on first test after 57 days. Data on 59 vats of milk used for cheese production showed 11 were positive for *Br. abortus*. Three vats of positive milk gave negative fresh curds. Cheddar cheeses made from the nine positive milks were negative on first examination for periods varying from 41-84 days. No *Brucella* were recovered from any sample of commercial cheese. An aging period of 60 days was considered reasonable assurance against the presence of viable *Br. abortus*. Lerche² found that the viability of *Brucella* is influenced markedly by acidity and temperature. The organism died rapidly in acid cheese. Drescher and Hopfengartner³ demonstrated that the organism survived 35 days in cheeses made from milk heavily seeded with the organism. Lichtenstein⁴ called attention to the destructiveness of acid and temperature on survival of the organism in milk and milk products. Thompson⁵ stated that *Br. abortus* will survive in cheese for two months. Yale and Marquardt⁶ reported that *Streptococcus pyogenes* survives in raw milk curds for long periods of time.

Generally, the production of all cheese from properly pasteurized milk would seem advisable from the public health standpoint to prevent the survival of *Brucella* as well as all other pathogens.

* Approved for Publication by Cornell University and the New York State Department of Agr. and Markets.

COMMERCIAL PRODUCTION
METHODS

The curds are made from milk containing 1, 2, and 3 or more percent of fat. The milk is set at 86° F with 3 ounces of rennet per 1,000 pounds of milk. The curd is cut with regular cheese knives and stirred. The setting time is usually about 30 minutes. When the whey starts to flow freely, it is then separated from the curd which is then packed in large cloths. It is cooled and shipped to plants in cities. This procedure may vary slightly. During shipment the curd is packed in ice. On arrival, it is allowed to ripen at room temperature or above. When regarded as fully ripe and workable, it is heated in water at about 180° F and molded into the desired shape. This is done rapidly. The temperature of the molded cheese may be as low as 125° F. The product is then marketed at once under the trade name Mozzarella.

TABLE 2
SURVIVAL OF *Brucella abortus* IN RAW AND PASTEURIZED MILK AND ITALIAN CHEESE CURD MADE FROM PROPERLY PASTEURIZED MILK

Sample	Product	Phosphatase Test	Animal Inoculations
13R *	Raw milk	Not pasteurized (3) **	Positive
13P	Pasteurized milk	Properly pasteurized (3)	Negative
13C	Pasteurized curd	Properly pasteurized (3)	Negative
14R	Raw milk	Not pasteurized (3)	Negative
14P	Pasteurized milk	Properly pasteurized (3)	Negative
14C	Pasteurized curd	Properly pasteurized (3)	Negative
15R	Raw milk	Not pasteurized (3)	Positive
15P	Pasteurized milk	Properly pasteurized (3)	Negative
15C	Pasteurized curd	Properly pasteurized (3)	Negative
16R	Raw milk	Not pasteurized (3)	Positive
16P	Pasteurized milk	Properly pasteurized (3)	Negative
16C	Pasteurized curd	Properly pasteurized (3)	Negative

* R = raw milk.

P = pasteurized milk.

C = pasteurized curd.

** Refers to numbers of laboratories reporting.

immediately shipped to each of three laboratories for the phosphatase test, and to the brucellosis laboratory for animal inoculation for *Brucella* determination. The results are shown in table 2.

that the milk curd had not been pasteurized. Of the six samples studied, *Br. abortus* was definitely present in four of the curds, one was negative, and in the other, guinea pig infection was only weakly positive.

The results of survival of the organism in raw milk, the same milk after proper pasteurization, and curd made from this milk are shown in table 2. In three of the four raw milk samples, *Br. abortus* was recovered. In no instance did the organism survive pasteurization, nor was it present in the curd made therefrom.

TABLE 1

SURVIVAL OF *Brucella abortus* IN ITALIAN CHEESE CURD MADE FROM RAW MILK

Sample	Phosphatase Test	Animal Inoculations
1	Not pasteurized (2) *	Positive
2	Not pasteurized (2)	Positive
3	Not pasteurized (2)	Positive
4	Not pasteurized (3)	Positive
5	Not pasteurized (3)	Negative
6	Under pasteurized (3)	Weakly positive

* Refers to number of laboratories reporting.

EXPERIMENTAL PROCEDURE

On February 20, 1950, six raw cheese-curd samples made from raw milk were collected from a single plant. Samples 1-5 inclusive had not been subjected to the final molding process under water. Sample number six had been processed under water, molded, and was ready for release. It therefore had been subjected to a further heat treatment than that accorded the first five samples. Immediately after collection, a portion of each sample was sent to two or more laboratories for the phosphatase test. Samples were also shipped special delivery to the brucellosis laboratory of the New York State Veterinary College at Ithaca for animal inoculations to determine the presence of *Br. abortus*. The results are shown in table 1.

Samples of raw milk, the same milk after pasteurization, and curd made from this milk were collected from four different batches at a single plant. Portions of each were

When milk was received at the brucellosis laboratory it was placed in the refrigerator overnight to permit creaming. The next morning each of two guinea pigs was injected subcutaneously with 5 ml of the gravity cream. The cheese was prepared by placing 25 grams of the curd in a sterilized Waring Blendor with 100 ml of sterile physiological saline solution and agitated for ten minutes to produce a smooth creamy mixture. The mixture was then filtered through one layer of cheesecloth, and 2 ml amounts were injected subcutaneously into each of two guinea pigs. Positive tests were those in which the guinea pigs, five weeks after injection, gave positive blood agglutination reactions, characteristic lesions in the spleen, and recovery of *Br. abortus* from the spleen.

RESULTS

The results of raw milk curd studies are given in table 1. In each instance, the phosphatase test showed

CONCLUSIONS

Br. abortus was recovered from five out of six Italian cheese curds made from raw milk.

Br. abortus was recovered from three out of four samples of batch milk from a plant making the curd. After proper pasteurization of this same milk we were unable to recover the organism from either the milk after proper pasteurization or from the curd made from this milk.

Inasmuch as viable *Brucella* have been found to survive the manufacturing process when raw milk is used, it would seem advisable from the public health standpoint that all such milk should be pasteurized before manufacture into cheese.

ACKNOWLEDGMENTS

The authors are indebted to the following for their cooperation: Emil Ludewig of the New York City Department of Health, F. W. Gilcreas and Clarence Weber of the New

(Continued on page 60)

EXIGENT PROBLEMS IN THE USE OF QUALITY APPRAISAL STANDARDS IN THE PROCUREMENT OF DAIRY PRODUCTS FOR MILITARY REQUIREMENTS*

ROBERT J. MILLER, MAJOR VC

Army Medical Service, Chicago Quartermaster Depot, Chicago, Ill.



MAJOR ROBERT J. MILLER was graduated from Iowa State College, Division of Veterinary Medicine, in 1938, and employed by the U. S. Department of Agriculture, Bureau of Animal Industry Disease Eradication Program, from 1938 to 1941, in Minnesota. He served in the army as Assistant Station Veterinarian in charge of Dairy and Poultry Inspection at Fort Snelling, Minnesota, from 1941 to 1949. At present he is Dairy Products Instructor at Meat and Dairy Hygiene School, Chicago, Illinois.

The relationship of the Veterinary Corps to the Surgeon General and the Quartermaster General; a discussion of the types of milk provided under the newly revised Federal Specification C-M-381e; coliform requirements of this new specification as they will apply to military purchases of fresh milk; other specification changes concerned with analytical, processing, and procurement provisions; estimate of the effect of emergency procurement on existing milk supplies; personal observations in uncontrolled milk areas; military use of frozen homogenized milk; and the relationship of sanitary requirements to the quality of butter and cheese.

It is considered a privilege to appear before this Association as a representative of the Veterinary Corps, United States Army Medical Service. On behalf of the Office of the Surgeon General, I wish to thank all the members of the civilian milk control agencies for their excellent cooperation in assisting the Armed Forces with their dairy product procurement programs both in the past and at the present. The generous assistance which members of this organization have rendered has been of immeasurable value in making it possible to provide the soldier with a safe and wholesome addition to his ration in the form of dairy products.

PROCUREMENT QUALITY SPECIFICATIONS

As you know, the procurement of milk and milk products, in addition to other food items is the responsibility of the Office of the Quartermaster General. The Quartermaster Corps will initiate bidding and subsequently award contracts to the successful bidders, anticipating that the product desired will be prepared in compliance with the applicable Federal Specifications. It is at this point that the Office of the Surgeon General enters the picture. The Army Medical Service through the Veterinary Corps must ascertain

that the product is prepared under the best sanitary procedures and under acceptable standards of processing control so that there is no possibility of the product adversely affecting the health of the troops. There is also the additional responsibility of determining that contract requirements have been fulfilled and that the product has not been fraudulently manufactured from inferior grade, low cost raw materials.

Due to be released shortly is a recently revised Federal Specification for Fresh Whole Milk, C-M-381E. This specification contains some changes in which I am sure you will be interested and which should stimulate the revision of local ordinances in areas that are not governed by the *United States Public Health Service Milk Ordinance and Code*. Some of these changes are minor in nature whereas others may be expected to assume a role of major importance.

The specification provides for three types of milk. Type I is Certified Pasteurized Milk (Certified raw milk has been withdrawn from this specification). Type II is Pasteurized Milk and consists of three sub-types; No. 1, No. 2 and No. 3. Type III is Pasteurized, Homogenized milk consisting of the same sub-types.

The Type I certified pasteurized milk is not intended for general purchasing except as authorized by the Quartermaster General, the Medical Department, or Headquarters of the United States Air Force. When it is deemed advisable to purchase Certified milk, the specification states that it is to be prepared and processed in conformity with the current requirements of the American Association of Medical Milk Commissions as has been the practice heretofore.

The bulk of the milk purchases, therefore, fall into the Type II and Type III categories. Whether or not No. 1, 2, or 3 are purchased depends entirely on their availability. No. 1 milk, for example, is not always available in sufficient quan-

ties to meet military needs. For milk to meet this No. 1 classification, it must be produced in an area that has and enforces an ordinance that conforms to the Grade A requirements of the latest revision of the *United States Public Health Service Milk Ordinance and Code*. The description of No. 1 milk also contains a statement to the effect that milk from other localities may be accepted when it is of at least equal quality. Some localities feel that their milk should be rated of at least equal quality when their logarithmic average bacteria counts read:

200,000 per cc or less on raw milk as delivered to the plant.

400,000 per cc or less on raw milk just prior to pasteurization.

30,000 per cc or less on the pasteurized product.

Managements making this assumption are not interpreting the specification correctly. This milk cannot be judged to be of equal quality on the basis of bacteria counts alone. The dairies, the processing plant, and equipment shall also meet the Grade A pasteurized milk requirements as set forth in the *U. S. Public Health Service Milk Ordinance and Code*. It is unfortunate that many areas in the United States are not capable of supplying the Armed Forces with milk of this quality. Local and state milk ordinances are so divergent in character that it is not possible to obtain a sufficient quantity of this kind of

* Presented at the Thirty-seventh Annual Meeting of the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC., Atlantic City, New Jersey, October 13-16, 1950.

milk to meet national or, sometimes, even local Armed Forces needs.

Restrictions like this have led the Army milk procurement program into the No. 2 milks. Such milk is produced in areas having less stringent ordinances than those recommended by the U. S. Public Health Service. The maximum logarithmic average bacterial count shall not exceed 500,000 per cc. The maximum logarithmic standard plate count on the pasteurized product is 30,000 per cc. This is the kind of milk which is most commonly purchased for the use of the Armed Services. It is less restrictive on the dairies, the raw milk, and plant facilities than is No. 1 milk, but is equally rigid as far as the design and operation of the pasteurization apparatus is concerned. Even though No. 2 milk is a reasonable kind of milk to expect, far too many localities are unable to produce it. For that reason it is frequently necessary to draw No. 2 milk from other sections and ship it by carload quantities into these deficient areas.

In times of stress and emergency, such as during World War II, it became necessary to relax the standards in order to meet military needs. This led to No. 3 milk, a milk which corresponds somewhat to Grade B pasteurized milk. It shall be produced under conditions which will assure it wholesomeness. The logarithmic average raw count shall not be in excess of 1,000,000 per cc. The design and operation of the pasteurization apparatus shall be in compliance with the *U. S. Public Health Service Milk Ordinance and Code*, however, the logarithmic average standard plate count on the pasteurized product may be as high as 50,000 per cc.

At first glance it might seem strange that a single specification should in itself contain as wide a range as just outlined. This has been brought about by the necessity of trying to make the specification fit the diversity of the industry.

NEW COLIFORM REQUIREMENTS

On all types of pasteurized milk there is now inserted a coliform requirement. It reads like this:

"pasteurized milk, after pasteurization and until delivery shall not have a coliform count exceeding 10 per ml in more than one sample in each series of four, each sample to be taken on separate days."

This requirement, used in conjunction with the phosphatase test equalizes any divergence of thought that may be implied elsewhere in the specification. Perhaps the first reaction to the new coliform requirements might be that a plant need not exercise a great deal of sanitary control in order to meet a specification that allows as many as 10 coliform organisms per ml. However, Armed Forces purchases are frequently written calling for inspection of the milk at either origin or destination with final acceptance of the product being determined at destination based at the time of delivery. If acceptance of the milk was based on coliform series drawn immediately after pasteurization or before shipment, then it is admitted that the new requirements should not be hard to meet. Considering, though, that the coliform series may be conducted at destination 48 hours away from origin puts the new requirement into an entirely different light.

The specification requires that milk shall be cooled to 40° F or lower immediately after pasteurization and shall be held at temperatures of 50° F or lower until delivery. Deliveries that are only a short period of time away from origin should not be troubled with the coliform count even though the milk may arrive at temperatures approaching 50° F. On the other hand those shipments that are delivered within 48 hours as the specification reads, or are covered by contract exception which permit delivery at 72 hours or longer should find the new coliform requirements quite restrictive. This is especially true if the in-transit milk temperature should be in excess of 45° F. Considering that coliform bacteria multiply more rapidly at temperatures between 45° F and 50° F than do other milk-borne bacteria, it is conceivable that a shipment of milk transported within this temperature range could meet the coliform requirements at origin but would not be able to meet them at the point of final acceptance. Contracts covering shipments involving late deliveries consider these facts and are now bearing a clause which limits bottling temperatures at origin as well as arrival temperatures to a maximum of 45° F. This of course places a greater stress on adequate refrigeration both in the pasteurizing plant and the carrier. By the same

token it also places a greater stress on plant sanitation.

The basic thought behind the adoption of the coliform requirements just listed is exactly for that purpose, to place greater stress on plant sanitation. The coliform test used in conjunction with the phosphatase test should be more indicative of an adequately processed, properly handled milk supply. These two tests are much more revealing than a standard plate count on the pasteurized milk. There is no intent to use the coliform test to imply pathogenic significance, especially at such low levels. Instead, repeated counts higher than those specified may result in the discontinuance of a plant as a source of supply on the basis of inadequate sanitation. Likewise, failure on the part of the plant management to correct such non-compliance certainly suggests lack of interest in producing a quality product.

ADDITIONAL CHANGES IN SPECIFICATIONS

Other additions and changes in the new specification are:

Provision permitting the addition of Vitamin D in amounts equivalent to 400 USP units per quart.

A requirement that dairy herds shall in any event be tested for tuberculosis once every six years. Raising the minimum percentage of milk solids not fat from 8.0 to 8.25 percent.

Raising the minimum temperature for short-time pasteurization from 160° F to 161° F.

Provisions stipulating that inspection may be performed at dairy or milk plants, both during and after processing, at any suitable point in transit and/or at time of delivery to the point of destination.

New provisions are introduced whereby the purchasing agency has the option of asking for pre-award surveys or bid samples prior to the awarding of the contract. This clause will be of particular value especially when expanded procurement may encompass new areas. The spot checking of plant facilities and the surveillance of the raw and pasteurized milk quality before the awarding of the contract should be of considerable value to the procuring agency, the contractor, and the inspector. Minor discrepancies can be detected and corrected before

the start of the contract. Otherwise correction of defects while a contract is in progress is liable to incur stress on all parties concerned.

PROBLEMS FROM EXPANDED PROCUREMENT

Foremost in thought, at the present, is the effect which a national emergency might have on the fluid milk industry. It is logical to assume that expanded milk procurement may result in the same difficulties encountered during the World War II period, namely, a general reduction in overall milk quality. That is the end point of course brought about by a complexity of circumstances. It is logical to assume that there will again arise the problem of providing suitable equipment for the dairy and the processing plant. Experienced plant personnel may gradually be replaced by untrained help. As a result processing control as well as sanitary operations will undoubtedly suffer. Farm employees will not be able to maintain the customary control over their milk supply. This same condition will be reflected in quality control programs. Replacement programs will have to be inaugurated in order to keep such containers as the forty-quart milk can in suitable condition. Pasteurizing plants may reach out for milk beyond their normal channels, and unless they exercise care and forethought, they will find themselves struggling with an unsatisfactory milk supply. The same plant may also find that they have overtaxed the capacity of the plant. It may be necessary to set up dual intakes to meet military needs. Acceptable and unacceptable milk may have to be diverted at the platform and the two supplies later handled separately. Milk control officials may undoubtedly find it more difficult to exercise suitable control measures in the larger milk sheds. All of these conditions will combine to make it more and more difficult for many plants to produce an acceptable end product.

I believe that these points could best be brought out by citing an example with which I had contact a little less than three years ago.

This particular plant was located in an area that did not come under the control of any milk ordinance and was beyond the reach of civilian milk control officials. The milk arrived at this fluid milk plant at an

average temperature of seventy degrees. Direct microscopic examinations of the raw milk which had been held in storage as long as 18 hours before pasteurizing was in excess of twenty million. When the milk was finally pasteurized, it was brought to 155° F and held there for 45 minutes. Milk temperatures were reduced to 68° F by use of a very small cabinet cooler. From this point the milk again went in storage where it was held as long as 18 hours before bottling. Bottling temperatures ranged from 68° F to 70° F. Since refrigeration facilities were completely overtaxed there was no attempt made to place the bottled milk in a cooler; instead, it was hauled to the retail outlets on an uncovered truck. Standard plate counts read at 24 hours showed an excess of 150,000 bacteria per cc. Observation of equipment at the time of breakdown showed a very generous deposit of milk stone on each piece of equipment.

On one other occasion I had the opportunity to visit a plant which was the sole source of milk for a community of approximately 1,000 people. In this plant the milk was pasteurized and cooled in a coil vat without the benefit of any time or temperature devices other than a dairy thermometer carried in the pocket of the plant operator.

Needless to say, I was somewhat taken aback by the conditions noted in these two plants. I do believe that anyone could have gained by those experiences. Could there be a better plea presented to substantiate the promulgation of uniform milk laws and consistent enforcement of those laws?

FRAUDULENT PRACTICE

There is one other subject which I would like to present at this point. Instances are known wherein an inferior grade of raw milk is partially pasteurized until the bacteria count is reduced to the point where it will pass as Grade A raw milk. Sometimes the practice is modified by completely pasteurizing the product and then adding a quantity of raw skimmed milk so that the milk will yield a positive phosphatase test. In some areas this practice has come into such general use that it has become routine procedure. Personally, I believe that such practices are nothing short of fraud and are a means of expressing utter dis-

regard for the basic concepts of all milk laws and ethical competition, and as such, steps should be taken to correct these practices.

NON-FLUID MILK PRODUCTS

Thus far I have stressed only the fluid milk side of the discussion. In some instances when it is not possible to supply troops with fluid milk, it can be given to them in the form of frozen homogenized milk. Frankly, this program cannot claim 100 percent success. As you know part of the low acceptability of frozen milk is its tendency to develop an oxidized flavor and to flake upon defrosting. In an effort to overcome the flaking of this product, attempts are being made to freeze it faster, that is, in periods under forty-eight hours, and to hold it at uniform storage temperatures. More stress is being placed upon the refrigeration of the carrier between points of origin and destination. At the present time the milk is not considered frozen at origin if its temperature has not been reduced to 10° F or below within forty-eight hours after entering the freezer. Likewise, a milk temperature above 10° F at destination makes the shipment subject to rejection. Experimental studies on the use of ascorbic acid gives hope that its incorporation could greatly reduce the development of oxidized flavors.

BUTTER AND CHEESE

Many people fail to realize that many of the Armed Services procurement programs are based on long storage acceptance. A product must be sound at the time of purchase, and it must not possess inherent qualities which will tend to lower its acceptability upon storage. The prime examples of these kinds of products are butter and cheese. These products, soon after manufacture, may have every appearance of a quality product, but because of insanitary plant practices, unsatisfactory equipment, or improper processing procedures, they may deteriorate very rapidly upon storage. All of these conditions may be grouped under the heading of general plant sanitation.

Butter contaminated with proteolytic types of bacteria during its manufacture and receiving processing treatments that are not sufficient to destroy these organisms cannot be expected to hold its grade after pro-

longed storage. Equipment with exposed copper surfaces or difficult to clean surfaces cannot help but have a deleterious effect on the storage of the butter. Off flavors can develop in cheese as a result of impurities both chemical and bacterial incorporated into the product at the time of manufacture. Both of these products rate high as potential public health hazards, especially if they have been subjected to insufficient pasteurization methods.

Special contract clauses now applicable to butter procurement state that butter offered shall be not more than 30 days of age. Since the Armed Forces normally purchased butter in print form, this statement has been inserted into the contract to prevent the butter being printed out of storage stock. This, of course, is a standard industry practice but when the industry prints butter out of storage stock, it is aware of the very short shelf life of the prints and markets them as soon as possible. Butter printed out of storage stock for military needs cannot normally enjoy the advantage of fast disposition, but instead may be subjected to prolonged storage periods.

Cheese purchased for use by the Armed Forces may be manufactured from raw or pasteurized milk. No distinction is made between them, though, after they have been placed in storage. Both kinds of cheese are treated equally, that is, they will not be issued to troops until they have undergone at least a 90-day storage period and can be considered free of pathogenic bacteria.

As stated previously, many of these concepts are based on general plant sanitation, and because of this, notice has been circulated among the butter and cheese industry, that effective 1 March 1951, no product shall be offered for Veterinary Corps inspection unless it can be definitely established that the product originated in the plant that was inspected and approved by the Veterinary Corps.

This means of course that vendors offering butter or cheese for Veteri-

nary inspection must purchase these products from only Veterinary approved sources and must be able to identify the product as to its origin. This may cause some temporary restrictions on a great many vendors. Contractors interested in supplying the Armed Services with butter or cheese should familiarize themselves with the status of the plants from which they are now purchasing these products.

State and local regulations controlling sanitary conditions in butter and cheese plants vary so markedly that it may be anticipated that a number of plants cannot be approved at the time of initial inspection but may be approved after remedial corrections have been made. This of course will vary according to the standards under which the plants operate and the type of enforcement to which they have been subjected.

It has been these two conditions that have made it necessary to insert these contract provisions in order to standardize the procurement of butter and cheese.

It can be anticipated that Veterinary Corps personnel when requested to conduct origin sanitary inspections of butter and cheese will place stress on:

- a. The type of vehicle in which the raw product is transported to the plant.
- b. The suitability and cleanliness of wall, floor, and ceiling surfaces.
- c. The adequacy of lighting facilities from the standpoint of cleaning the plant and preparing and examining the final product.
- d. The efficiency of ventilating systems in regard to odors and condensates.
- e. The source and potability of water supplies especially when water contacts or is incorporated into the product.
- f. The manner in which waste materials are removed from the premises.
- g. The condition, repair, and construction of equipment and utensils.

- h. The efficiency of sanitizing operations.
- i. The degree and control of processing procedures as they apply directly to applicable Federal Specifications.
- j. The degree and efficiency in which the plant operates a program designed to control the quality of the raw material.
- k. The adequacy and cleanliness of refrigerated and dry storage facilities.
 1. The effectiveness of programs or methods designed to control vermin.
- m. The facilities available for the health and comfort of plant employees including toilets, dressing room, and hand washing facilities.

***Br. abortus* in Cheese**

(Continued from page 56)

York State Department of Health, Professor Frank V. Kosikowsky of Cornell University, and the Chaplin Dairy Products Company of Rochester, New York.

REFERENCES

1. Gilman, H. L., Dahlberg, A. C., and Marquardt, J. C. The Occurrence and Survival of *Brucella abortus* in Cheddar and Limburger Cheese. *J. Dairy Sci.* 29, 71-85 (1946).
2. Lerche, Abortus-bang-bakterien in Milch und Milchprodukten vom Rind. *Ztschr. f. Infektionskrankh.* 38, 253-328 (1931).
3. Drescher und Hopfengartner, Die Haltbarkeit der Bangschen Abortusbazillen in Milch und Milchprodukten. *München Tierarztl. Wchschr.* 81, 564-568, 485-488, 496-500, 507-511, 519-522, and 533-536 (1930).
4. Lichtenstein, G. P. Das Verhalten des Erregers die Seuchenhaften Verwerfens (*Bact. abortus* Bang) in der Milch und Einigen Milcherzeugnissen. *Milchw. Forsch.* 19, 241-259 (1938).
5. Thompson, R. The Isolation of *Brucella abortus* from Ice Cream. *Canad. Med. J.* 29, 9-11 (1933).
6. Yale, M. W., and Marquardt, J. C. Factors Affecting the Survival of *Streptococcus pyogenes* in Cheese. *J. Milk Tech.* 3, 326-333 (1940).

longed storage. Equipment with exposed copper surfaces or difficult to clean surfaces cannot help but have a deleterious effect on the storage of the butter. Off flavors can develop in cheese as a result of impurities both chemical and bacterial incorporated into the product at the time of manufacture. Both of these products rate high as potential public health hazards, especially if they have been subjected to insufficient pasteurization methods.

Special contract clauses now applicable to butter procurement state that butter offered shall be not more than 30 days of age. Since the Armed Forces normally purchased butter in print form, this statement has been inserted into the contract to prevent the butter being printed out of storage stock. This, of course, is a standard industry practice but when the industry prints butter out of storage stock, it is aware of the very short shelf life of the prints and markets them as soon as possible. Butter printed out of storage stock for military needs cannot normally enjoy the advantage of fast disposition, but instead may be subjected to prolonged storage periods.

Cheese purchased for use by the Armed Forces may be manufactured from raw or pasteurized milk. No distinction is made between them, though, after they have been placed in storage. Both kinds of cheese are treated equally, that is, they will not be issued to troops until they have undergone at least a 90-day storage period and can be considered free of pathogenic bacteria.

As stated previously, many of these concepts are based on general plant sanitation, and because of this, notice has been circulated among the butter and cheese industry, that effective 1 March 1951, no product shall be offered for Veterinary Corps inspection unless it can be definitely established that the product originated in the plant that was inspected and approved by the Veterinary Corps.

This means of course that vendors offering butter or cheese for Veteri-

nary inspection must purchase these products from only Veterinary approved sources and must be able to identify the product as to its origin. This may cause some temporary restrictions on a great many vendors. Contractors interested in supplying the Armed Services with butter or cheese should familiarize themselves with the status of the plants from which they are now purchasing these products.

State and local regulations controlling sanitary conditions in butter and cheese plants vary so markedly that it may be anticipated that a number of plants cannot be approved at the time of initial inspection but may be approved after remedial corrections have been made. This of course will vary according to the standards under which the plants operate and the type of enforcement to which they have been subjected.

It has been these two conditions that have made it necessary to insert these contract provisions in order to standardize the procurement of butter and cheese.

It can be anticipated that Veterinary Corps personnel when requested to conduct origin sanitary inspections of butter and cheese will place stress on:

- a. The type of vehicle in which the raw product is transported to the plant.
- b. The suitability and cleanliness of wall, floor, and ceiling surfaces.
- c. The adequacy of lighting facilities from the standpoint of cleaning the plant and preparing and examining the final product.
- d. The efficiency of ventilating systems in regard to odors and condensates.
- e. The source and potability of water supplies especially when water contacts or is incorporated into the product.
- f. The manner in which waste materials are removed from the premises.
- g. The condition, repair, and construction of equipment and utensils.

- h. The efficiency of sanitizing operations.
- i. The degree and control of processing procedures as they apply directly to applicable Federal Specifications.
- j. The degree and efficiency in which the plant operates a program designed to control the quality of the raw material.
- k. The adequacy and cleanliness of refrigerated and dry storage facilities.
 1. The effectiveness of programs or methods designed to control vermin.
- m. The facilities available for the health and comfort of plant employees including toilets, dressing room, and hand washing facilities.

***Br. abortus* in Cheese**

(Continued from page 56)

York State Department of Health, Professor Frank V. Kosikowsky of Cornell University, and the Chaplin Dairy Products Company of Rochester, New York.

REFERENCES

1. Gilman, H. L., Dahlberg, A. C., and Marquardt, J. C. The Occurrence and Survival of *Brucella abortus* in Cheddar and Limburger Cheese. *J. Dairy Sci.* 29, 71-85 (1946).
2. Lerche, Abortus-bang-bakterien in Milch und Milchprodukten vom Rind. *Ztschr. f. Infektionskrankh.* 38, 253-328 (1931).
3. Drescher und Hopfengartner, Die Haltbarkeit der Bangschen Abortusbazillen in Milch und Milchprodukten. *München Tierarztl. Wchschr.* 81, 564-568, 485-488, 496-500, 507-511, 519-522, and 533-536 (1930).
4. Lichtenstein, G. P. Das Verhalten des Erregers die Seuchenhaften Verwerfens (*Bact. abortus* Bang) in der Milch und Einigen Milcherzeugnissen. *Milchw. Forsch.* 19, 241-259 (1938).
5. Thompson, R. The Isolation of *Brucella abortus* from Ice Cream. *Canad. Med. J.* 29, 9-11 (1933).
6. Yale, M. W., and Marquardt, J. C. Factors Affecting the Survival of *Streptococcus pyogenes* in Cheese. *J. Milk Tech.* 3, 326-333 (1940).

THE PROBLEM OF ANTIBIOTICS IN MILK*

H. E. CALBERT, PH.D.

Department of Dairy Industry, University of Wisconsin, Madison, Wisconsin

The antibiotics used in the treatment of mastitis are very effective inhibitors of starter culture organisms. When very small amounts of these antibiotics get into the milk supply, the milk is unfit for use. There is no practical method by which the dairy plant operator can overcome the presence of these "wonder drugs." A comprehensive education program must be instituted to inform the dairy farmer of the dangers of allowing these antibiotics to get into the milk supply. He must be taught methods of avoiding this hazard. This program must be accompanied by legal action when necessary.

DURING the past years, much emphasis has been placed on increasing the production of the dairy cow. The breeding and selection of our herds have reflected this philosophy. As a result, we have today an animal that is capable of producing a much greater amount of milk than her ancestors. No doubt this places a strain on the milk producing organs, leaving them more susceptible to infection and disease.

The removal of this milk from our animals requires considerable labor. To solve this problem we have developed milking machines and have concentrated our producing animals into larger herds. These advancements reduced the amount of labor necessary to produce a given amount of milk. However, progress in greater milk production created new problems. One of these is the prevalence of mastitis in milking herds.

ANTIBIOTIC TREATMENT

Some progress is being made in combating mastitis. The main weapon used in this fight is antibiotics. These substances are sometimes referred to as the new "wonder drugs." Antibiotics have the ability to halt the growth or in some cases to kill some of the organisms that cause mastitis. The use of these antibiotics has enabled many dairy farmers to halt the ravages of mastitis in their herds.

The more common antibiotic substances used in the treatment of mastitis are penicillin, streptomycin,

and aureomycin. Some of the other antibiotics that have been used to a lesser extent for this purpose are chloromycetin, subtilin, and bacitracin. Sometimes a sulfa drug, *i.e.* sulfamethazine, is used in conjunction with penicillin in the treatment.

There are various ways that these antibiotics may be administered to the animal. Some are given orally. Others are injected as saline or water solutions. A very common method of treatment is by the use of small tubes called bougies. These bougies contain the antibiotic suspended in an ointment or oil base. They are inserted into the teat canal and thus the antibiotic is infused into the udder. These bougies are readily available to the dairy farmer. A prescription is not required for their purchase. Seldom are they administered under the guidance of a qualified veterinarian.

The dosage of antibiotic used in the treatment of mastitis varies. When penicillin is used, the dosage may be anywhere from 25,000 to over 100,000 units. Roughly defined, the unit of penicillin represents approximately 0.6 microgram of the substance. A microgram is one millionth of a gram. Therefore the normal dosage represents about 0.02 to 0.06 gram of penicillin. These extremely small amounts of penicillin are most helpful in treating mastitis and reducing infection.

ANTIBIOTICS DECREASE BACTERIA COUNT IN MILK

The dangers caused by the increased use of these "wonder drugs" often confronts the dairy processor as a bolt from the blue. Many dairy technologists have been introduced to the problem by a hurried phone call from a worried dairy processor. The stories may vary. As a rule they may be summarized by any of these statements of exasperation. "My starter will not develop acidity." "I'm having trouble, I can't get any acid development in my cultured buttermilk." The problems all have this in common. They are associated with dairy processors that are using starter cultures in the preparation of their dairy products.



DR. HAROLD E. CALBERT spent his boyhood on a midwestern dairy farm and thus secured at first-hand a good background for his dairy quality improvement work. Much of his time now is spent on college extension work in addition to his teaching and research. His principal work is in farm and dairy plant sanitation. Dr. Calbert's research is in the field of cheese manufacturing and ripening. At present he is Assistant Professor of Dairy Industry at the University of Wisconsin.

Troubles of this sort have been reported by processors of cottage cheese, cultured buttermilk, and other fermented dairy beverages. This unwanted experience is also being shared by cheesemakers of most all types of cheese. The magnitude and extent of this trouble is increasing daily.

Those doing laboratory control work on raw milk supplies have had their attention called to this problem by sudden drops in plate counts or by undue lengthening of methylene blue or resazurin reduction times of a certain producer's milk.

For the past several years the presence of small quantities of antibiotics in our raw milk supplies has been increasingly responsible for problems of this sort. It is alarming to note the number of instances wherein difficulties with starter cultures and the production of cultured dairy products can be traced to the presence of these so-called "wonder drugs."

STARTER DIFFICULTIES

Many of the bacteria used in starter cultures possess some characteristics similar to those organisms that cause mastitis. Therefore, the antibiotics that have been so effective in combating the organisms that cause udder infections have also been quite effective in inactivating the desirable types of bacteria that are responsible for the action of our cultures. Recently much time and effort have been spent by several

* Presented at the Annual Conference, Associated Milk Sanitarians (Illinois), Chicago, Illinois, December 11, 1950.

groups of investigators to determine the critical amount of an antibiotic that must be present in the milk to inhibit the action of starter organisms. The results of these investigations indicate that in numerous instances some of the bacteria commonly used in starter cultures are more sensitive to such antibiotics, as penicillin, than are the organisms that cause mastitis. It has been revealed that extremely small amounts of penicillin in the milk or starter cultures will inhibit the growth and activity of the acid-producing organisms.

Krienke¹⁵ has reported that as little as 0.1 unit of penicillin per ml of milk can retard acid production to a great extent. He found that a sample of milk containing this small amount of penicillin would develop only 0.45 percent acidity when inoculated with a good starter culture and then incubated at the proper temperature for 16 hours. A control sample of good milk under the same conditions would develop 0.75 percent acidity. When the penicillin content of the milk was increased to just 0.25 unit per ml, the acid production under the same conditions was reduced to only 0.27 percent. Similar results to those of Krienke have been obtained by Katznelson and Hood,¹¹ Hunter,⁹ and others. It is true that different bacteria vary in their sensitivity to the antibiotics. In fact there is probably a difference in sensitivity of the various strains of the same organisms. Yet, all of the more common types of starter organisms are inhibited by very small amounts of these antibiotics.

To illustrate this difference in sensitivity, Hunter⁹ has reported that to obtain the same degree of inhibition produced by 0.1 unit of penicillin per ml of milk on *Streptococcus cremoris* requires 0.25-0.30 unit on *Streptococcus lactis*. Hargrove⁷ and co-workers have shown that marked inhibition on the growth of *Streptococcus thermophilus* is obtained by as little as 0.01 unit of penicillin per ml of milk. To obtain the same results with *Lactobacillus bulgaricus* and *Propionibacterium shermanii* required 0.1 unit. Of the antibiotics previously mentioned, penicillin seems to be the most effective in inhibiting starter bacteria. Katznelson and Hood¹¹ indicated that chloromycetin was the least potent. The critical amounts

of sulfamethazine and aureomycin that inhibit acid production by lactic starters has been discussed in a recent publication by Krienke.¹² Though there is a difference in the potency of these antibiotics, remember, the amounts are all relative and even with the least potent, an extremely small amount in the milk can ruin the best starter.

ANTIBIOTICS AFFECT QUALITY CONTROL

As further evidence that antibiotics will inhibit the growth of bacteria in milk, several studies have been made concerning the feasibility of their use as milk preservatives. The advisability of this practice is quite doubtful. In a recent publication, Foley and Byrne⁴ suggested the use of penicillin for this purpose. Curran and Evans² have concluded that penicillin has no application in the preservation of food even though it might be used in certain non-food materials. In discussing the possibility of the preservation of foods with antibiotics, Anderson and Michener¹ stated that the possible physiological effects of continued use of foods containing antibiotics has not been determined. They believed that much more information is needed on the subject.

If antibiotics are present in a raw milk supply, they may influence the results of some of the milk quality tests. Johns and co-workers¹⁰ have reported a concentration of penicillin as low as 1 part in 167,000,000 parts of milk may retard the dye reduction. It is their opinion that this may not be as serious in the resazurin test as in the methylene blue test. According to Ruehe,¹⁷ the presence of penicillin in milk prolonged the methylene blue time to some extent but in most cases not enough to change the general quality classification of the milk.

DURATION OF BACTERICIDAL EFFECT

When an antibiotic has been infused into an udder it would seem natural that the milk drawn from this udder would contain a certain amount of antibiotic. With this thought in mind, various research workers have sought to determine the amounts of antibiotics that will be present in a milk after treatment. Also they have tried to determine the time it will require after treat-

ment until the milk will be free of the antibiotic or when its content in the milk will be of no significance. It is difficult to summarize the findings of the research workers on this subject. None has arrived at an exact conclusion as to how long after treatment the milk will contain critical amounts of the antibiotic. Some cows retain the antibiotics longer than others. This might be caused by the differences in the udder structure of cows. It is quite evident that when the antibiotic is administered in an ointment or oil base, it is retained for a longer period of time. Krienke¹⁴ has calculated that it is possible for the milk from one treated quarter to render unfit the mixed milk of 20 cows. This would be the case if one quarter is treated with 75,000 units of penicillin and the milk drawn at the first milking after treatment is mixed with the herd milk. Even with this dilution the milk would not be suitable for use in cultured dairy products. Thus a cow treated in all four quarters would render unfit the milk from 80 normal cows. He further concluded that after two milkings (36 hours after treatment) the milk from one quarter would ruin the milk from 5 cows.

Ruehe¹⁷ has reported an experiment in which 10 ml of an aqueous solution of 200,000 units of penicillin was injected into each quarter of the udders of two cows. His results indicated that under these conditions the milk produced three hours after treatment contained considerable amounts of penicillin. However, there was not enough penicillin retained in the milk after the third milking (27 hours after treatment) to inhibit his starter.

Hansen, Wiggins, and Boyd⁶ have shown that there was no diffusion of antibiotics from the treated quarters to the untreated quarters. Therefore, they recommend that the milk from the treated quarters be discarded for three days or six milkings after treatment.

Fuller⁵ has studied the treatment of mastitis by the combined use of sulfamethazine and penicillin. He reports that the milk was not available for use until 3-5 days after treatment.

From the above reports it is obvious that the milk from a treated cow should not be used for at least several days after treatment. Yet, many conscientious farmers discard

only the first milking after treatment. Needless to say what happens in the case of those who are not so conscientious.

When a cow is treated with an antibiotic and her milk included in the milk supply too soon after treatment, then the milk will be contaminated with the antibiotic. Doan⁹ has listed the following items as being responsible for the amount of penicillin in herd milk: number of quarters treated, number of cows in herd, vehicle carrying the antibiotic, time elapsing after treatment, and level of production.

EFFECT ON OTHER DAIRY PRODUCTS

The effects of antibiotics in dairy products other than fresh raw milk have been studied by Krienke and Fouts.¹⁶ They added penicillin at the rate of 1 unit per ml to whole milk. This milk was then made into evaporated and condensed milk. Portions of these products were inoculated with 3 percent starter culture and incubated at 95° F for 7-8 hours. The acid production was compared to that of a control or penicillin-free sample. They found that when the evaporated milk containing the penicillin was held for 9 days at room temperature, then subjected to this treatment, its acid production was about normal. Acid production could not be obtained in the condensed milk even after it was held for 13 days before being subjected to the above treatment. In the same series of experiments, 1 unit of penicillin per ml was added to skim milk. The skim was then dried. Acid development could not be obtained in this reconstituted product even after 10 weeks of storage in the dry form. This was still true when the non-fat, dry milk solids were diluted 50 percent with a normal product. All of these experiments point to the conclusion that the presence of antibiotics in milk is a definite hazard to several phases of the dairy industry.

ATTEMPTED NEUTRALIZATION OF ANTIBIOTIC EFFECTS

Several attempts have been made to overcome the presence of antibiotics in milk. The great difficulty to this problem is to detect their presence. As a rule, we do not know that a milk supply contains these "wonder drugs" until it is too late. The cottage cheese already has been set or the culture added in the

preparation of buttermilk. Then we wait for the acid development that never comes. Tests have been proposed to detect the presence of these antibiotics.^{13, 17} Many of the tests that have been advanced are too time-consuming. Their results are not available soon enough to be of practical help to the dairy processor. Recently a test based upon the principle that the activity of the phosphatase enzyme in raw milk is retarded in the presence of antibiotics has been proposed by Stoltz and Hankinson.¹⁸ If further work confirms the preliminary reports, then this test will be quite helpful. Its main advantage is that its results can be obtained in less than an hour.

Heat treatments of milk containing antibiotics have little effect in reducing their inhibitory action on starter cultures.^{3, 9} Heat treatments that are common in the dairy industry such as pasteurization, auto-claving, and steaming have little effect on the antibiotics. The addition of various oxidizing or reducing compounds or the use of surface active agents in milk containing the drugs are of little help.³

The use of the enzyme penicillinase has been suggested. This would be a means of destroying the penicillin that might be present in a milk supply.^{7, 8, 10, 11, 12} However, it would be difficult to calculate the amount to use unless the penicillin content of the milk was known. In many cases, the cost of the penicillinase needed to treat a milk would be greater than the value of the milk.¹²

The use of larger amounts of starter may overcome the inhibitory effects of penicillin. Krienke¹² suggested this remedy but points out that this will work only when the amount of penicillin in the milk is relatively small. Furthermore, he questioned the quality of the finished dairy product. The possibility of developing starter organisms that are resistant to the action of antibiotics has not been overlooked. Katznelson and Hood¹¹ developed a penicillin-resistant starter culture which coagulated milk in the presence of 3 units of penicillin per ml of milk. This starter retained its resistance after 20 passages in absence of penicillin. While this approach to the problem of antibiotics in milk may have possibilities, actually it has undergone little practical progress.

It may seem after this discussion of the problem of antibiotics in milk that the case is hopeless, that there is nothing that can be done. This need not be true. Time and time again the dairy industry has been faced with quality problems that have seemed insurmountable. Again this appears to be the situation. What can be done about it?

EDUCATIONAL PROGRAM

One solution to the problem would be to establish a long-range educational program. This has been done to solve other quality problems. Educational programs on such subjects as sediment control are now bearing fruit. Why would it not work on this problem?

Any educational program on the control of antibiotics in milk must involve the help of all veterinarians, sanitarians, dairy processors, leading dairy farmers, dairy schools, and appropriate governmental agencies. Each of these groups could assist by giving proper instructions and demonstrations of methods for preventing mastitis. The elimination of mastitis would do wonders to improve our milk supply. If we can reduce or do away with mastitis we will also have eliminated the need for antibiotics. This approach to the problem may be idealistic, but it is logical and wholly in accord with existing legal definitions of milk.

Another and more immediate approach would be to tell the story of the effects of antibiotics in milk where it would do the most good. Most of our dairy farmers would cooperate if they had the facts. Teach them the necessity of discarding milk that may contain antibiotics. Make the dairy farmer aware of the fact that the loss of a small amount of milk from a few cows may save the milk from many cows.

LEGAL ACTION

Some consideration should be given to the desirability of invoking existing legal regulations to meet this problem. The definition of milk points out that the milk must be obtained from a *healthy* cow. A cow with mastitis is not healthy. Therefore, her lacteal secretion does not fulfill the definition of milk. It cannot legally be placed in the commercial milk supply. Legal action should be pressed to keep mastitic milk out of the public milk supply.

Also, we must keep in mind that when milk contains antibiotics such as penicillin, streptomycin, aureomycin, etc. it is adulterated. The legal machinery for action against producers of adulterated milk has been functioning for some time.

Steps should be taken to control the indiscriminate use of antibiotics. They should be administered only upon the advice and under the direction of a qualified veterinarian. Antibiotics should be made unavailable to the layman except by prescription.

EDUCATIONAL PROGRAM VS. LEGAL ACTION

It would seem most desirable that, if possible, the problem should be solved by an education and information program rather than by one involving legal action. A good educational program backed by legal action, when necessary, would probably solve the problem. Whatever approach is taken must be started soon. We who are interested in the progress of the dairy industry must do all within our power to help keep antibiotics out of the milk supplies.

REFERENCES

1. Anderson, A. A., and Michener, D. Preservation of Foods with Antibiotics. I. The Complimentary Action of Subtilin and Mild Heat. *Food Technol.*, 4, 188 (1950).
2. Curran, H. R., and Evans, F. R. The Activity of Penicillin in Relation to Bacterial Spores and the Preservation of Milk. *J. Bact.*, 52, 89 (1946).
3. Doan, F. J. Antibiotics in Milk. *Milk Plant Monthly*, 39, 9, 28 (Sept., 1950).
4. Foley, E. J., and Byrne, J. W. Penicillin as an Adjunct to the Preservation of Quality of Raw and Pasteurized Milk. *J. Milk Food Technol.*, 13, 170 (1950).
5. Fuller, R. W. Preliminary Report on Use of Sulfamethazine and Penicillin in Bovine Mastitis. *Vet. Med.*, 44, 103 (1949).
6. Hansen, H. C., Wiggins, G. E., and Boyd, J. C. Modern Methods of Mastitis Treatment Cause Trouble in the Manufacture of Fermented Dairy Products. *J. Milk Food Technol.*, 13, 359 (1950).
7. Hargrove, R. E., Walter, H. E., Malkames, J. P., and Maskell, K. The Effect of Penicillin and Streptomycin on Swiss Cheese Starters. *J. Dairy Sci.*, 32, 401 (1950).
8. Hood, E. G., and Katznelson, H. The Effect of Penicillin on the Acid-producing Ability of Starters. *Can. Dairy Ice Cream J.*, 28, 3, 32 (Mar., 1949).
9. Hunter, G. J. E. Effect of Penicillin on Lactic Streptococci. *J. Dairy Res.*, 16, 39 (1949).
10. Johns, C. K., and Katznelson, H. Penicillin and Dye Reduction Tests for Milk Quality. *J. Milk Food Technol.*, 12, 133 (1949).
11. Katznelson, H., and Hood, E. G. Influence of Penicillin and Other Antibiotics on Lactic Streptococci in Starter Cultures Used in Cheddar Cheese Making. *J. Dairy Sci.*, 32, 961 (1949).
12. Krienke, W. A. Effects of Acid Production by Lactic Starters of Various "Drugs" in Milk from Mastitis Treated Cows. *Milk Plant Monthly*, 39, 4, 32 (Apr., 1950).
13. Krienke, W. A. Tests for Penicillin and Other "Drugs" in Milk Resulting from Treatment of Cows Having Mastitis. Unpublished report, March 21, 1950, Fla. Agri. Expt. Sta., Gainesville, Fla.
14. Krienke, W. A. Penicillin vs. Cheese. *Hoard's Dairyman*, 95, 180 (1950).
15. Krienke, W. A. Penicillin in Milk. *Milk Plant Monthly*, 38, 12, 44 (Dec., 1949).
16. Krienke, W. A., and Fouts, E. Effects of Storage on Penicillin in Dairy Products. *J. Dairy Sci.*, 33, 403 (1950).
17. Ruehe, H. A. Penicillin and Other Starter Inhibitors. *Milk Plant Monthly*, 39, 3, 36 (Mar., 1950).
18. Stoltz, E. I., and Hankinson, D. J. A Test for the Detection of Antibiotics in Milk. *Am. Milk Rev.*, 12, 12, 60 (1950).

Comparative Study of Stains

(Continued from page 51)

DISCUSSION

When the data from all laboratories were combined and analyzed by the procedures described above, it was evident that the results obtained by use of Stain III were the most favorable. This general impression should be modified considerably because of the great difference in results from the various laboratories. These differences were such as to raise rather serious questions regarding the validity of the data for any type of analysis. One might rightfully raise the question as to the extent to which each of the cooperative laboratories followed standard procedures in obtaining the count data. Furthermore, the results of the study indicate that some preliminary preparation, prior to a comparative study of stains, might be advisable in each cooperating laboratory. This would be of considerable aid in assuring uniformity of procedure.

CONCLUSIONS

This study was extremely valuable in emphasizing the availability of improved milk stains, the variation which can occur in their use, and the need for extensive ground work prior to conducting a comparative study in order to assure uniformity in methods of procedure.

The results reported in this preliminary trial by nine laboratories show that improved stains have been developed, that they can be expected to yield higher clump counts than the present Standard Methods stain, and may possess other desirable characteristics resulting in less fatigue to the laboratory workers and in more accurate results.

The results show that the Acid-and-Water-Free Stain (Stain III) yielded the highest average count, ranked highest when scored according to the frequency of yielding the highest count; second highest, etc.;

and showed least variation in score among eight laboratories.

Until such time as further comparative studies conclusively demonstrate the relative merits of stains proposed for the direct microscopic examination of milk, the results presented suggest that the Acid-and-Water-Free stain should replace the Alcohol-Containing Methylene Blue Stain (Stain I) now recommended in Standard Methods, which showed the lowest average count.

REFERENCES

1. *Standard Methods for the Examination of Dairy Products*, 9th ed. New York. American Public Health Association, 1948. p. 116.
2. Anderson, C. W., Moehring, R., and Gunderson, N. D. A New Method for Fixing, Defatting and Staining Milk and Cream Films. *J. Milk and Food Technol.*, 11, 352-357 (1948).
3. Levine, B. S., and Black, L. A. Newly Proposed Staining Formulas for the Direct Microscopic Examination of Milk. *Amer. J. Pub. Health*, 38, 1210-1218 (1948).

MISSOURI'S PLAN FOR MILK ANALYSTS IN THE STATE AND LABORATORY CERTIFICATION

MRS. IRMA C. ADAMS

Director, Bureau of Laboratories, Missouri Division of Health,
Jefferson City, Mo.



IRMA COMSTOCK ADAMS (Mrs. Charles Frederick Adams) was born in Fond du Lac, Wisconsin, February 19, 1905. She graduated from the University of Missouri with B.S. degree in Zoology in 1930, and took graduate study in bacteriology at the Johns Hopkins School of Hygiene and Public Health in 1938. After taking special studies in food and milk analysis at the Environmental Health Center, Cincinnati, Ohio, she was employed in the Division of Health of the Missouri Bureau of Laboratories where she became Director in 1950.

The objectives of a milk workshop has been outlined and the technic of handling it was covered. There were twelve laboratories in the State that participated with six staff members conducting the week's work. The agenda dealt with the fundamentals of milk bacteriology and adhered completely to *Standard Methods for the Examination of Dairy Products*, Ninth Edition, 1948. Where alternate procedures were allowed the most practical method was agreed upon and accepted as Missouri's Standard Procedure.

Details of certification of milk laboratories were developed.

THE National Conference for Interstate Milk Shipments recommended* in June 1950 that states shipping and receiving milk may accept results from state official laboratories and local designated laboratories which have been approved as complying substantially with the American Public Health Association's Standard Methods and checking closely with the results obtained at least twice per year on split samples. The state approval of local laboratories should include an annual visit to the laboratory at which time evaluation of the quarters, equipment, procedures, results, and records shall be made on appropriate survey forms of the United States Public Health Service or the equivalent.

To insure uniformity, the United States Public Health Service shall spot check the laboratories of the state agencies participating in the certification of milk for interstate milk shipments and certify their compliance with Standard Methods.

In an effort to comply with the recommendation of the National Conference for interstate milk shipments, Missouri held its first milk workshop for milk analysts in Columbia, Missouri, November 27 through December 1, 1950. The University of Missouri, Department of Dairy Husbandry, Bacteriology Sections; the Environmental Health

Center of the United States Public Health Service; and the Bureau of Laboratories, Missouri Division of Health, cooperated in planning and conducting this workshop. The purpose of such a workshop was to bring the milk analysts in the State together in order to have definite understanding and correct interpretation of *Standard Methods* for milk examinations and to establish standard methods for Missouri where alternate methods are given in *Standard Methods for Examination of Dairy Products*, Ninth Edition, 1948.

A questionnaire was submitted to at least thirty milk laboratories in the State which might be involved in checking milk for interstate shipments. These laboratories included local, county, and state public health as well as milk industry laboratories. From this questionnaire there were fourteen favorable replies with twelve laboratories participating. However, they represented areas in the State from where the greatest amount of fluid milk is being handled. This was the first time industry and control laboratories had been asked to work together in standardization of technics used in determining the sanitary quality of milk.

The workshop was conducted in the Dairy Bacteriology Laboratory of the University of Missouri where ample table space, necessary equipment, and glassware were available.

The staff of the University Department of Dairy Bacteriology including Professor J. E. Edmondson, Mr. Kenneth Tallman, Instructor, and Mr. Robert Jensen, Assistant Instructor, and Mr. William J. Beck, Bacteriologist, and Mrs. Irma C. Adams, Director of the Bureau of Laboratories, State Division of Health, conducted the workshop giving the lecture work, demonstrations, and assistance in the laboratory procedures. Dr. Robert A. Myers, Bacteriologist of the Section of Environmental Sanitation, United States Public Health Service, acted in the capacity of consultant lecturer and coordinator for the discussion periods.

The entire schedule for the week workshop dealt with the fundamentals of milk bacteriology and adhered completely to *Standard Methods for Examination of Dairy Products*, Ninth Edition, 1948. Where Standard Methods allowed alternate procedures the most practical method was agreed upon after careful consideration, and accepted as Missouri's Standard Procedure.

The following made up the curriculum of the week workshop:

Basic Objectives of Quality Tests on Milk; Sampling Equipment and Procedure; Media Preparation; Apparatus and Technic for Making Plate Counts of Milk and Cream; Laboratory Practice of Agar Plate Count; Dye Reduction Tests on Raw Milk; Microscopic Counts on Milk; Laboratory Practice of Calibration of Microscope; Preparation and Staining Films, Counting and Reporting; Laboratory Practice of Counting Plate; Discussion of Spreaders; Pinpoint Colonies; Crowded Plates; Sterility Tests on Containers and Equipment of Milk Plants; Coliform Tests for Milk, Cream, and Chocolate Milk.

It was emphasized that the actual practice of routine tests and checking results against one another were considered of utmost importance. The first plate counts and direct microscopic counts showed upon tabulation a wide deviation and certainly did not check closely or

(Continued on page 84)

* This Missouri plan for milk analysts is an outgrowth of the National Conference on Interstate Milk Shipments. This Journal, 13, 194 (1950).

DETECTION OF HORSE MEAT BY THE BIOLOGICAL PRECIPITIN TEST

EMANUEL KAPLAN AND T. C. BUCK, Jr.

*Baltimore City Health Department, Bureau of Laboratories,
Baltimore, Maryland*

The fraudulent substitution of horse meat for beef stimulated interest in methods of horse meat detection. A precise method is described for the preparation of anti-horse rabbit serum and the use of the serum in the recognition of horse meat, particularly in sausage.

DURING the past year regulatory officials in many parts of the country have been confronted with the problem of fraudulent substitution of horse meat for beef. The detection of such deception is not an easy matter if the horse meat is ground up in admixture with the meat of other animals, particularly in the form of sausage. Texts on food analysis^{1, 2, 3} generally describe such physical characteristics of horse meat as its color, odor, texture, and taste as an aid in the differentiation of bulk meats. Frequent reference is made to the test for glycogen since this substance is present to a much greater extent in horse flesh than in the meat of other domestic animals. However, the glycogen test is neither specific nor wholly conclusive.⁴ Recently⁵ a somewhat laborious method was proposed which was based on the hexabromide value of the extracted fat. Isolation of sufficient horse fat for test is not always possible.

Authorities^{6, 7, 8} regard the biological precipitin test as a precise and reliable method for the detection of horse meat. The most popular application of the precipitin test is in the forensic detection of human blood in stains. The method is approximately fifty years old and has been applied to food mostly in foreign countries where large amounts of sausage are eaten or where horse flesh is used for human food. The precipitin test is based upon the formation of precipitins in the blood serum of animals, such as rabbits, which have been repeatedly inoculated with blood serum or tissue extract of another animal (horse). Mixture of the blood serum of the sensitized rabbit with the foreign blood serum or tissue extract (horse) will result in a precipitation. The reaction is a specific

precipitation, since the serum of the rabbit blood (known as anti-horse rabbit serum) will react only with the serum or tissue extract (antigen) of the species of the animal (horse) used in sensitizing the rabbit.

Since the conducting of the precipitin test has been considered within the province of the serologist, food chemistry books generally refer the reader to original works for a description of the method. The actual performance of the test is not difficult, although numerous techniques have been proposed.^{6, 7, 8} Inasmuch as the preparation of antiserum takes approximately six weeks, the test has not been thought practicable unless a problem involving the detection of horse flesh is anticipated, or unless a stock of antiserum is available. Actually, a suitable serum can be prepared by any laboratory having facilities for the injection and bleeding of rabbits.

Because of the importance of horse meat detection in current regulatory work, and since the necessary antiserum is not now commercially available, it is the purpose of this paper to describe briefly the method successfully used in this laboratory for the preparation of anti-horse rabbit serum and the use of the serum in the recognition of horse meat.

PREPARATION OF ANTI-HORSE RABBIT SERUM

Inoculate several large adult rabbits intravenously through the marginal ear vein every fifth or sixth day with sterile horse serum free of preservative. The horse serum may be obtained from any manufacturer of biological products. The first injection is 0.5 ml with subsequent injections of 2.0 ml each for a total of 10.5 ml of serum in six injections. With this injection schedule, fatalities are not usually encountered. Four days after the last injection a trial bleeding is made from the ear. The animals should be bled only after a period of approximately twelve hours of fasting. The blood is permitted to clot and is then

centrifuged and the serum removed.

The titer of the serum or its sensitivity is determined in the following manner: Prepare a series of dilutions of normal horse serum (antigen) with 0.85 percent sodium chloride solution: 1:100, 1:500, 1:1,000, 1:2,000, 1:5,000, 1:10,000. Transfer 0.5 ml of each dilution to a separate serologic test tube. Tubes (93 mm x 11 mm) must be chemically clean, crystal clear, and unetched. Incline the rack holding the tubes to an approximate 30° angle and by means of a graduated 1.0 ml pipette allow 0.1 ml of the antiserum to run slowly down the side of each tube. Set the tubes upright, and within approximately fifteen minutes note the presence of a precipitate at the interface between the antigen and the antiserum. The tubes are then shaken, and the presence of a visible turbidity noted after approximately fifteen minutes more. An adequate antiserum will be of such strength as to produce a positive reaction with a 1:1,000 dilution of the horse serum. The serum should also be specific and should not react with control extracts of beef and pork (see below).

If the trial bleeding fails to show a sufficient titer, several additional inoculations are indicated. If the titer is satisfactory, the rabbits may be bled from the heart. Aseptic technique must be used. It is important to rinse the bleeding syringe with sterile 0.85 percent sodium chloride solution to prevent hemolysis. Approximately 50 ml of blood is obtained from each rabbit and transferred to sterile centrifuge tubes. The blood is immediately refrigerated, and after several hours the clot is separated from the sides of the tube. The blood is centrifuged at 2500 rpm for twenty minutes in an International, size I, type SB centrifuge. The anti-horse serum of each animal is kept separately and is removed to a series of sterile ampules, each containing 1.0 to 5.0 ml. No preservative is added. The anti-horse serum is stored in a deep freeze cabinet. Prior to using, a portion of the antiserum should be centrifuged at 2500 rpm to insure clarity. Serum prepared by the above technique was satisfactorily used in this laboratory seven years after its preparation. It was necessary to remove a deposit of fat and cholesterol by centrifugation.⁹

PREPARATION OF EXTRACT OF SUSPECTED MEAT (ANTIGEN)

Transfer 10 grams of the suspected meat sample to a Waring blender containing 90 ml of 0.85 percent sodium chloride solution. Mix for approximately one minute. Transfer the emulsion to a glass container and place it in the refrigerator. After several hours, preferably overnight, decant approximately 30 ml of the supernatant liquid to a centrifuge tube (6 x 1 inch). Centrifuge at 2500 rpm for ten to fifteen minutes. Filter the extract by suction through a 9.0 cm double-thickness Whatman # 42 filter paper, using a CS&S # 123 cloth filter support. Filtration is accomplished by means of a 500 ml suction bottle equipped with a 2.5 inch funnel having a 6 inch stem projecting through a No. 7 one-hole stopper. Inside the filter bottle place a test tube (6 x 3/4 inch) to receive the filtrate. Before filtering, wash and "seat" the filter with salt solution. Discard the salt solution. Collect approximately 15 ml of the antigen extract. To 10 ml of the filtered extract, add about 0.8 gram of diatomaceous silica filter-aid (Johns-Manville Celite Analytical Filter Aid). Shake and refilter by the same technique in order to obtain a sparkling-clear filtrate. The extract should be tested immediately. If a delay occurs, the extract should be refrigerated and reclarified if necessary. Properly clarified antigen extracts of suspected meats have been successfully tested after having been kept frozen for more than four months.

Sausage samples usually contain an excessive amount of fat which may interfere with the test. A preliminary defatting procedure is therefore required. Transfer to a glass container approximately 25 grams of sausage previously passed through a meat grinder. Cover the sausage with a mixture of equal parts of ethyl ether and chloroform. Let stand overnight and pour off the solvent. Rinse the meat twice with portions of solvents and then rinse twice with 0.85 percent saline. Squeeze out the excess liquid by means of a glass stirring rod. Transfer 10 grams of the defatted sausage to a Waring blender containing 90 ml of 0.85 percent salt solution and continue in the same manner as described above for the preparation of the meat extract.

Necessary negative and positive controls in the precipitin test for horse meat are antigen extracts separately prepared by the above method from beef, pork, and known horse meat. Instead of meat extracts, dilutions of beef, pork, and horse serum may be used. Furthermore, a supply of normal rabbit serum is needed as a negative control.

PERFORMANCE OF THE BIOLOGICAL PRECIPITIN TEST

All antigen extracts and antisera used should be crystal clear. The antigen extract prepared from the suspected meat or sausage, as well as the controls, are each tested in the following manner against anti-horse rabbit serum, normal rabbit serum, and a saline control: To a series of clear serologic test tubes, add 0.5 ml of appropriate antigen extract. Incline the rack of tubes at an approximate 30° angle across a 1 5/8 inch wood block, and allow 0.1 ml of anti-horse rabbit serum, control normal rabbit serum, or saline control to run slowly down the side of the tube. The tubes are then set upright. The presence of a precipitate at the interface between antigen and antiserum is noted after approximately fifteen minutes. A dark background is helpful. The tubes are then shaken and kept at room temperature and the presence of a visible turbidity is noted after approximately fifteen minutes more. To be significant, a positive reaction should be obtained within the approximate thirty minute period. In most instances, positive tests are apparent in about five minutes. The tests and controls

used in a typical trial are summarized in table 1.

A marked precipitate or cloudiness (positive reaction) is obtained in tubes 1 and 10, while the other tubes remain clear. Accordingly, the suspected meat used in the preparation of the antigen extract in tube 1 is judged to be horse meat. The test is used in qualitative fashion. No attempt is made to determine the amount of horse meat present.

SUMMARY

A reliable method for the preparation of anti-horse rabbit serum is given. Treatment of suspected meat and sausage samples for the detection of horse meat by the biological precipitin test is described.

REFERENCES

1. Jacobs, M. B. *The Chemical Analysis of Foods and Food Products*. 427 (1938). D. Van Nostrand Company, Inc., New York, N. Y.
2. Leach, A. E., and Winton, A. L. *Food Inspection and Analysis*, 4 ed. 232 (1920). John Wiley & Sons, N. Y.
3. Martin, C. R. A. *Practical Food Inspection*, Vol. I, *Meat Inspection*. 3 ed. (1947). H. K. Lewis & Co. Ltd. London.
4. Edelmann, R., Mohler, J. R., and Eichhorn, A. *Textbook of Meat Hygiene*, 8 ed. 82 (1943). Lea and Febiger, Phila.
5. Crowell, G. K. Detection of Horse Meat in Admixtures With Pork or Beef. *J. Assoc. Off. Agr. Chem.*, 27, 449-51 (1944).
6. Kolmer, J. A. *Infection, Immunity and Biologic Therapy*. 329 (1923). W. B. Saunders Co., Phila.
7. Tanner, F. W. *The Microbiology of Foods*. 2 ed. 902 (1944). Garrard Press, Ill.
8. Medical Research Council. *A System of Bacteriology in Relation to Medicine*. Vol. 6, 437 (1931). His Majesty's Stationery Office, London.
9. *Ibid.* Vol. 9, p. 195.

TABLE 1

DATA ILLUSTRATING TESTS IN A TYPICAL TRIAL

Tube No.	Antigen extract	Anti-horse rabbit serum	Normal 0.85 percent rabbit serum	0.85 percent sodium chloride solution
1	0.5 ml antigen extract from suspected meat	0.1 ml	—	—
2	same	—	0.1 ml	—
3	same	—	—	0.1 ml
4	0.5 ml control antigen extract from beef	0.1 ml	—	—
5	same	—	0.1 ml	—
6	same	—	—	0.1 ml
7	0.5 ml control antigen extract from pork	0.1 ml	—	—
8	same	—	0.1 ml	—
9	same	—	—	0.1 ml
10	0.5 ml control normal horse serum 1:100*	0.1 ml	—	—
11	same	—	0.1 ml	—
12	same	—	—	0.1 ml
13	Anti-horse rabbit serum	—	—	0.1 ml
14	Normal rabbit serum	—	—	0.1 ml

* or control antigen extract from known horse meat.

MILK and FOOD SANITATION

COMMON CAUSES OF OFF-FLAVORED MILK AND THEIR CONTROL

C. J. BABCOCK

Dairy Manufacturing Technologist, Dairy Branch, U. S. Department of Agriculture, Washington, D. C.

FLAVOR AND CONSUMPTION

THE flavor of milk and milk products has a marked influence on the quantities consumed. This statement requires no amplification. We establish its truth daily by our individual eating habits. In choosing our foods, we choose those which appeal to our palates. We form certain eating habits which we follow rather consistently from day to day. We may try something new or something different but if we do not like it, we do not try it again. We include milk in our daily diet but the quantity we consume depends largely upon its flavor. The need for improving its flavor is well recognized. The flavor of the milk not only affects the quantity consumed as fluid milk, but is reflected in the products made from such milk. Physicians and nutritionists advise a quart of milk a day for every child and nearly as much for adults. Are you following that advice? The daily per capita consumption of milk and milk products indicates that a large percentage of our population is not following it.

High-quality milk and milk products have a fine, pleasing flavor. Unfortunately we spend but little time discussing this great asset of dairy products. Today is no exception. We are mainly interested in the abnormal flavors that are sometimes found in these products. The topic assigned to me is "Common Causes of Off-Flavored Milk and Their Control." We must know the cause of these abnormal flavors before we can hope to control them. A brief review of these flavors should enable us to comprehend better the enormity of the problem confronting the dairy industry in preventing abnormal flavors in milk and milk products.

Abnormal flavors in milk are caused by: the physical condition of the individual cow; highly flavored feeds and weeds; biological, chemical, and enzymatic changes in the milk; and sometimes by odors absorbed by the milk during or after milking. For the purpose of determining the source of

abnormal flavors, these four causes may be divided into two groups. Those flavors caused by the physical condition of the individual cow and by highly flavored feeds and weeds are present as soon as the milk is drawn. Those caused by biological, chemical, or enzymatic changes, and by absorbed odors, usually do not appear until some time has elapsed after the milk has been produced.

FEEDS

Of these four causes of abnormal flavors in milk, strongly-flavored feeds and weeds are the cause of a large percentage of the off flavors found in milk as delivered by producers. There are a great number of feeds and weeds that impart their flavor to milk. Experimental work has brought out several interesting facts concerning the transmission of feed and weed flavors to milk.

It has been shown that most feed flavors are more pronounced in the cream than in the milk from which the cream is taken. Proper aeration reduces strong off flavors and odors in milk caused by feeding highly flavored feeds, and some of the slight off flavors and odors may be eliminated. Feed flavors generally are less pronounced in pasteurized milk than in the same milk before pasteurization. Of greater importance, however, is the fact that feed flavors are transmitted to milk mainly through the body of the cow, and as a rule, only for a few hours after the cows consume the feed. Because of this fact, most highly flavored feeds can be fed immediately after milking without affecting the flavor of the milk produced at the next milking. In fact, in the case of green alfalfa it has been shown that changing the time of feeding from one hour before milking to three hours before milking, decreased the intensity of the abnormal flavor, and feeding five hours before milking practically eliminated it. On the other hand, large quantities of feeds like cabbage and turnips even though fed immediately after milking, may at times slightly taint the flavor of the milk



MR. C. J. BABCOCK, In Charge Standards Section, Research Division, Dairy Branch, P.M.A., with the Dept. of Agriculture 30 years, author of more than 70 technical publications, received B.Sc. Agr., Ohio State University 1916. Was discharged as a sergeant from Chemical Warfare Services, U. S. Army, World War, I. During World War II, he served as Officer in Charge of Milk and Milk Products Inspection, Office of the Surgeon General, U. S. Army, and was awarded the Legion of Merit. He was relieved from active duty as a Lt. Col. He is a member of the Advisory Board, Milk and Food Section, U. S. Public Health Service; a member of the Judging Committee, American Dairy Science Association; represents the Food and Nutrition Board, National Research Council, on its committee on Milk Production, Distribution, and Quality. He is chairman, Committee on Milk Regulations and Ordinances, INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, and of the Technical Committee on Dairy Processing, Dairy Industries Society International.

produced at the next milking. These taints, however, are slight and would seldom be noticed by the average consumer. Feeds that had only a slight effect when fed before milking, had no detrimental effect when fed after milking.

Feeding experiments with garlic showed conclusively that feed flavors enter milk mainly through the body of the cow. These experiments also showed the time required for flavors to enter the milk. Garlic flavor and odor can be detected in the milk when the milk samples are taken one minute after garlic is fed. The intensity of the garlic flavor increases and at 10 minutes after feeding a high degree of intensity is reached. Garlic flavor is present to a very objectionable degree in milk from cows that have consumed one-half pound of garlic four hours before milking. Milk drawn seven hours after the cows consume one-half pound of garlic is practically free from garlic flavor. Strong garlic flavor is found in milk drawn two minutes after the cows inhale garlic odor for 10 minutes, and practically disappears in 90 minutes after such

inhalation. Garlic odor is readily perceived in samples of blood drawn 30 minutes after the cows are fed two pounds of garlic tops, and strong garlic odor is present in the blood drawn 45 minutes after such feeding, indicating that the flavor is transmitted by the blood to the udder where it is absorbed by the milk.

Work with bitterweed further confirmed the fact that flavors enter milk mainly through the body of the cow. This weed is frequently found in southern pastures and although it is practically odorless, it imparts its flavor to the milk when the cows eat it. Work with this weed also showed it to be an exception to the usual rule that "feed flavors are more pronounced in cream than in the milk from which the cream is taken." The flavor produced by bitterweed is more pronounced in skim milk than in whole milk and much less pronounced in the cream than in the skim milk. In this connection, it is interesting to note that the bitter principle seemed to be in solution or in fine suspension in the water of the milk. Removal of practically all the fat, casein, albumin, and milk sugar still left the bitter principle in the serum. This weed further showed that there also may be exceptions to the rule that "feed flavors are not imparted to milk except for a few hours after feeding." When cows consume 10 pounds of bitterweed, the flavor is present in the milk produced 24 hours later, but milk produced 27 hours later is practically free from a bitter flavor.

ODORS

The absorption of odors as a source of abnormal flavors in milk has probably been overemphasized. Warm milk apparently absorbs odors more readily than cold milk. When milk at 40°F and 90°F was placed in open containers in a refrigerator containing freshly sliced onions, an onion flavor could not be detected after 24 hours in the milk that was cold whereas it was readily identified in the milk that was warm at the time it was placed in the refrigerator. However, data recently reported from West Virginia University indicate that the absorption of flavor in the home refrigerator is quite important because milk is often held for extended periods of time and often in atmospheres saturated with odors. Also, the milk bottles are frequently left uncapped, improperly capped, or with holes punched in the caps. Experimental work has shown that even under extreme conditions, milk pro-

duced in a silage-permeated atmosphere is seldom sufficiently tainted so that a silage flavor can be detected in the milk. If under extreme conditions sufficient silage is not absorbed so that it can be identified in the milk, it appears as though we should encounter but little trouble from this source when milk is produced under normal conditions. This does not mean, however, that we should neglect this source of abnormally flavored milk, for under certain conditions, milk may absorb odors.

PHYSICAL CONDITION OF COW

The physical condition of the individual cow may be the source of various abnormal flavors in milk. One such flavor is usually referred to as "cowy." It is rather difficult to describe this flavor. It resembles the odor of a wet cow. Experience is the only way one can become familiar with this odor. A salty taste is frequently observed in milk from cows that are advanced in lactation and also from one or more quarters of udders previously affected with mastitis. Saltiness of milk resulting from the latter is more easily detected from the appearance of the milk itself and it goes without saying that milk from cows affected with mastitis should be eliminated. We seldom find mixed milk with a salty taste because of the dilution of abnormal with normal milk.

RANCIDITY

Rancidity frequently develops in the milk of individual cows. This is usually milk from cows which have been milked for longer than the usual lactation period, but occasionally it develops in the milk produced during the first month of lactation. This rancidity is caused by the enzyme lipase. Cows producing such milk should be detected and removed from the herd, for, unlike salty milk, which loses its identity, such milk when mixed with other milk, will cause a much larger volume of milk to become rancid.

Lipase influences the processing of milk, especially homogenized milk. When raw milk is homogenized the action of this enzyme on the finely divided fat globules causes the milk to become rancid within two hours. The enzyme must, therefore, be inactivated by proper pasteurization either before or immediately after homogenization, and care must be taken to prevent contamination with raw milk. Surveys of consumer preference indicate that homogenization improves the flavor of

milk. The additional precautions necessary to prevent enzymatic action in the milk may be a contributing factor.

BIOLOGICAL ACTION

Biological action is the source of more abnormal flavors in milk than the physical condition of the individual cow. The flavors produced, however, are similar in that they vary over a wide range and it is impossible to tell what flavor may be expected from this cause. The flavors most frequently produced by biological action are usually termed "bitter," "unclean," and of course, "sour." The "bitter" and "unclean" flavors are most frequently due to the action of the proteolytic organisms that find their way into the milk from unclean utensils or through other insanitary methods of production or handling. These organisms do not reproduce rapidly in the presence of the lactic acid formers; their action is, therefore, more noticeable when they are present in pasteurized products. As pasteurization kills a high percentage of the lactic-acid formers, the proteolytic organisms are responsible for the fact that pasteurized milk frequently becomes putrid before it sours, whereas raw milk sours before it becomes putrid.

OXIDIZED FLAVOR

The oxidized flavor frequently found in milk and milk products is of importance. It is seldom found in milk as delivered by the producer. It is one of those flavors that develop after the milk has been produced or even processed. It may not develop until after it has been delivered to the consumer. Milk of low bacterial count is more susceptible to its development than milk of high bacterial count. Several years ago when our milk supplies had a high bacterial count, oxidized flavor was no problem. Therefore, you, as Sanitarians, are partly responsible for its development.

Time does not permit a full discussion of this flavor. Several theories have been advanced as to its cause. Speculation has been made from time to time that a relationship might exist between the oxidase-producing bacteria and the oxidized flavor. Freshly pasteurized milk was inoculated with nine different strains of oxidase-producing gram-negative bacteria. The genus *Pseudomonas* was represented by four strains and the remaining five strains probably belonged to the genus

Alcaligenes or the genus *Achromobacter*. There are probably many species of oxidase-producing bacteria that may gain access to milk but the cultures used were undoubtedly sufficiently representative to show that these organisms do not contribute to the development of oxidized flavor in pasteurized milk. In fact, no inoculated sample developed greater intensity of oxidized flavor than that of the corresponding uninoculated control. When large inoculations were used the development of oxidized flavor was markedly or completely inhibited.

Enzymatic action has also been advanced as a cause for the development of oxidized flavor, but the chemical oxidation theory is more widely accepted at the present time. The conditions under which the flavor develops are those that promote oxidation, such as the presence of air and contamination by metals that are known to be oxidation catalysts. The factor most often encountered in the milk industry that causes the oxidized flavor to develop is contamination with copper.

The milk from different cows varies in copper tolerance, from 0 to at least 1.0 ppm. The milk from individual animals may vary as much as 0.1 ppm from one milking to the next. The cause of this variation has frequently been referred to as the poisoning action in milk. Several factors have been reported to cause a change in the poisoning action. The one most frequently mentioned is the feed of the cow. Some research workers have reported that they could produce a spontaneous oxidized flavor almost at will by changing from green to dry feed. Three cows producing milk with a copper tolerance of 0.05 ppm, were fed only corn fodder and cottonseed hulls into the third lactation period. As a result the copper tolerance of the milk was not changed nor was a spontaneous oxidized flavor developed. Experimental work also showed that the feeding of molasses alfalfa silage, straight alfalfa-silage or corn-silage had no significant effect on the copper tolerance of the milk produced. All reports indicate, however, that oxidized flavor is more prevalent during the

winter months than during the summer months.

Numerous methods have been suggested for preventing the development of this flavor. The first step, however, should be to prevent contamination with copper on the farm and in the plant.

Aeration and deaeration have been used to prevent or inhibit the development of oxidized flavor. It has been stated that the copper tolerance of milk after deaeration will be at least 0.2 ppm. It is my belief that the mixed milk as delivered to our plants will usually have a copper tolerance in excess of this quantity. If so, more efficient deaeration than reported will be necessary before this method will be of practical value. The addition of antioxidants has also been suggested. Among others, pancreatic enzyme, ascorbic acid, and oat flour have been used experimentally as antioxidants. Our milk ordinances usually forbid, directly or indirectly, the addition of any of these materials to milk. Nevertheless, reports have been received where the pancreatic enzyme and ascorbic acid have been successfully used on a commercial scale. The addition of ascorbic acid to homogenized milk in a concentration of 0.1 gram per liter doubled the time the milk could be stored in a frozen condition without the development of an oxidized flavor.

After eliminating contamination with copper, probably the most satisfactory method of preventing oxidized flavored milk is to homogenize the milk. Homogenization increases the copper tolerance of milk practically ten to one. That is, milk which becomes oxidized upon the addition of 1 ppm of copper prior to homogenization will require approximately 10 ppm to produce the flavor after homogenization. Furthermore, as previously pointed out, consumer preference polls indicate that homogenization improves the flavor of the milk.

EFFECT OF LIGHT

One flavor which should be mentioned is the so-called "sunshine flavor," caused by the action of light, especially diffused light, on milk. The exact cause is apparently not known. It is

probably associated with the oxidized flavor as it closely resembles the flavor produced by mild oxidation and is evidently associated with the fat. Homogenized milk is much more subject to the development of this flavor than unhomogenized milk. Experimental work has shown that when exposed to light the flavor will develop in homogenized milk in one-fourth the time required for it to develop in unhomogenized milk. The flavor is easily prevented by keeping the milk, especially bottled milk, away from light.

SUMMARY

Briefly summarizing, those abnormal flavors that are present in milk as delivered by the producer may be largely prevented by milking only healthy cows, using proper feeding practices, and by milking and handling the milk under sanitary conditions. Those flavors due to biological or enzymatic action are, however, also processing problems and care to prevent or control them, must be exercised in our processing plants. I mentioned control because some of our products depend on biological or enzymatic action for their flavors. Oxidized flavors in milk and milk products are probably most frequently due to chemical action. They can be largely prevented by preventing contamination with copper. Milk should not be exposed to light and especially to bright sunlight if it is to remain of good flavor. Future research work may show that chemical action may be associated with many abnormal flavors in milk. If so, this may lead to more simple methods of control. It may also lead to methods of measuring the intensity of abnormal flavors which will be much more accurate than can be obtained organoleptically.

In conclusion, milk sanitarians should be vitally interested in the flavor of milk. Flavor controls to a large extent the quantity consumed. Public health officials and dieticians agree that the per capita consumption of milk and milk products is lower than it should be from a health standpoint. By improving the flavor of milk, you can, therefore, improve the efficiency of our people and the health of the nation.

Thirty-eighth Annual Meeting

GLENWOOD SPRINGS, COLORADO, Sept. 26-29, 1951

PROBLEMS OF MIDWEST PRODUCERS IN INTER-STATE SHIPMENT OF MILK*

J. C. OLSON, JR.

Dairy Division, University of Minnesota, St. Paul, Minn.

THE problems which have arisen relative to interstate shipment of milk have become the subject of a tremendous amount of discussion throughout the nation. We can pick up almost any dairy trade journal and find not one, but several articles or reports dealing with some phase of this subject.

Due to the nature of and the economic factors governing the production of milk, we find that the midwest region of the United States is the major area of milk production. Events which have taken place over the years have resulted in a situation which places the midwest producers of milk at a tremendous disadvantage in marketing fluid milk products outside of the production areas.

In consideration of this problem, it seems evident that certain basic or fundamental factors with respect to the free flow of milk into the various markets of the country have emerged quite clearly and distinctly. It will be impossible for me to consider all of these in any detail. I shall try, however, to outline what appear to be basic factors in the overall problem, but shall confine the discussion only to those which may be of interest principally to milk sanitarians.

BASIC DIFFICULTIES ENCOUNTERED

The first fundamental factor which underlies all others, as regards the interstate milk shipment problem, is that milk production in the midwest is far above the consumption of milk and milk products in that area. This means, of course, that outside markets are needed. There is no question of the existence of markets.

The difficulty lies in the barriers of economic and public health nature which serve to exclude from these markets milk produced in the midwest. This discrimination is the second major factor involved in the problem, and at least three developments have been advanced as contributing toward its perpetuation. Briefly, the first of these is that fed-

eral milk marketing orders effective in certain large consuming areas have affected the price structure in such a way that local production has been increased greatly. This has served to exclude milk produced in the midwest from those markets, and further it has added measurably to the surplus of certain manufactured dairy products. The importance of this situation is attested by the great amount of attention and discussion devoted to it at the present time. A second development which has been advanced as contributing to the discrimination against milk produced in the midwest is that, under the federal milk marketing orders which are effective in certain cities, the local health department milk regulations are tied in with the definition of Class I milk in such a way as to limit the supply only to those producers which are under the supervision of the local health department. The third development is similar in nature. In many cities, the milk supply is limited only to those producers who come under the inspection of the local health department. Under this situation there is no recognition of reciprocal inspection. This latter condition exists quite apart from any connection with a market order. Furthermore, it is an effective barrier both to inter- and intrastate milk marketing. In fact, it is common knowledge that the objective of incorporating such restrictive clauses into the ordinances in question was, in many instances, devoid of any concern for public health safety.

The third basic factor which operates to inhibit the flow of milk from areas of plentiful production is that, when markets are available, producers often are confronted with a variety of stipulated specifications for the production of milk. These differ from market to market to such an extent that it is practically impossible to conform to them all. The effect of this one factor has been the bone of contention in many controversies and is in large measure responsible for the great cry of "uniformity" which is sweeping the country. This factor has resulted in

an extremely annoying situation, and it illustrates the lack of and the decided need for uniformity in our thinking and application of what should be required in the production of milk for human consumption. This is the primary factor which has led a number of leaders in the dairy industry to advocate a single standard for milk quality, and in addition it has contributed much toward the possibility of federal intervention in an attempt to bring about uniformity in milk regulations. The desirability of these two eventualities becoming realities is questioned by many. There may be no alternative if the present situation continues much longer.

The last basic factor which seems to contribute to the problem facing midwest producers is that, when markets are available and regulations governing milk production are met, producers are confronted with the problem of obtaining a certification, which is acceptable to the receiving area, that the milk has been produced in full compliance with the regulations specified.

As we segregate these various factors, which together comprise the problem which so vitally affects midwest milk producers, and as we look at them objectively, none appears to be so impossible of elimination that we need despair. Already, considerable progress has been made. The factors of the problem attributable to the discriminatory effects of federal milk marketing orders have been and at the present time are being vigorously studied. We see today on all sides a greater recognition of the need for uniformity in regulations, and in their interpretations, governing the production and processing of milk. It is inconceivable that such recognition soon will not take the form of concrete application.

ST. LOUIS CONFERENCE

One of the really important steps toward a solution of the problem of midwest producers, as well as others, was the National Conference on Interstate Milk Shipments, which was held in St. Louis, Missouri, June 1, 2 and 3, 1950. As stated in the report of the conference, it was a planning conference which "strived to reach basic conclusions which could be used as guide lines in the organization and administration of state programs which would be in

* Presented at the Thirty-seventh Annual Meeting of the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC., Atlantic City, New Jersey, Oct. 16, 1950. Miscellaneous Journal Series, Paper No. 731, Minnesota Agricultural Experiment Station.

agreement with one another." A plan evolved from this conference which embodied a frame work on which a uniform national program could be built, and which would allow milk to be moved through the nation unhampered by multitudinous production requirements, many of them conflicting and many of them ridiculous. The operation of this plan is being watched closely and its success or failure would seem to depend largely upon the leadership under which it is to function, and to the extent of the cooperation which will be given to it from regulatory officials and from the dairy industry. Its success or failure would appear to depend also upon the extent to which improvements, as they become evident, are incorporated into the plan.

You have heard this plan for facilitating interstate shipment of milk discussed previously. Let me emphasize that the component-parts of the plan are specific. They hardly could be otherwise. Because they are specific it means that considerable give and take must occur with respect to many of the items in order for this plan to function successfully.

Since the plan as worked out in the St. Louis Conference directly concerns the problem facing midwest producers of milk, and since it does provide a plausible mechanism for alleviating many of the difficulties mentioned above, it is logical to discuss briefly certain aspects of the plan.

Uniform Standards

In the first place this plan predicates the recognition of uniform standards for milk production and processing. It specifies the 1939 edition of the *United States Public Health Service Milk Ordinance and Code* as the basic regulation. In doing so it specified an ordinance which originated in 1923, one which has been revised nine times, adopted in 34 states, 360 counties, and more than 1,470 municipalities. In terms of population it is estimated that forty million Americans might be included under this ordinance.

The choice of this ordinance as the standard seems wise; however, it brings forth some problems. In order for the plan to be effective this ordinance must be accepted. Differences of opinion with respect to its provisions must be laid aside for the time being. On the other hand,

those who are willing to declare conflicting requirements and interpretations inoperative have every right to expect an active, vigorous, and concerted effort toward evolution of a new edition of the ordinance which will resolve the differences of opinion with respect to the various items constituting the present edition. The question of water supply, animal diseases, and the variety of applications of accreditation procedure are but three of many items about which there is lack of general agreement.

In all due respect to the great contributions which have been made by the U. S. Public Health Service and the work of various committees that have existed from time to time in connection with the development of standards and regulations, it seems evident that to resolve these differences an effort greater than ever before is needed; a united effort in which representatives of all the major interests should take part—state health departments, state departments of agriculture, municipal health departments, the dairy industry, agricultural colleges, and the United States Public Health Service. Anything which is as important and as far reaching as a nationally recognized standard ordinance governing the sanitary production and processing of milk deserves the best in the way of leadership toward its accomplishment.

System of Supervision

The St. Louis plan for facilitating interstate shipment of milk specifies a system of supervision. Further, it recognizes three agencies, local health departments, state agricultural departments, and state health departments as having the authority of supervision.

There is the aspect of cost of this supervision that may warrant some consideration. According to one plan for defraying the cost of supervision, a fifteen-dollar-per-farm-per-year charge and a \$250-per-year-per-plant charge is proposed. Let us for a moment analyze this cost.

Suppose we assume a thirty-percent increase in price for milk shipped interstate. This would mean that the additional return from the sale of 5,000 pounds of milk or the milk production of one cow, based on the approximate figure of

the national average production per cow, would need to be received to defray the inspection cost per farm. It would require the additional return from the sale of milk produced by a herd of almost 17 cows to defray the inspection cost per plant. Suppose now we consider this cost in the light of only a three month market rather than a year round one. In this instance the above figures would need to be quadrupled. Looking at it in another way and figuring on the same basis as before, and assuming only a three month market, a ten cow herd would return \$37.50 above what otherwise might be received. From this must be subtracted the fifteen dollar inspection fee leaving \$22.50 for the effort. We still have not considered the other costs to the producer which would be involved. These in many instances would be much greater than the inspection fees.

I do not criticize this plan. The point I wish to make is that there is every reason to give consideration to possible ways of reducing costs of supervision. There is at least one way which I believe this may be done. It is by the recognition of a combination of government and industry supervision. In this way a greater utilization of the field service forces of the dairy industry—the fieldmen and laboratories—would be brought about. It would seem that serious consideration should be given toward a recognition of some combination of government-industry supervision. There are working precedents for this. Furthermore, it is recognized in Section 5 of the April, 1949 revised U.S.P.H.S. Milk Ordinance.

Certification of Area

The St. Louis plan provides for a certification to the receiving area by two agencies, the United States Public Health Service or state health departments, that the milk supply is as stated by the supervising authority. State agricultural departments are not recognized as certifying agencies. This seems incongruous in light of the fact that in 21 of the 48 states the law enforcement agencies involved are agricultural departments. In 22 states, the health departments are involved. In each of the other five states, some combination of the two or other agency is operative. The situation as it

(Continued on page 74)

SUMMARY REPORT OF COMMITTEE'S FINDINGS UP TO DATE*

FREDERICK L. ZIMMERMANN

*Research Director, New York State Joint Legislative Committee on Interstate
Co-Operation, New York, New York*

ON behalf of the New York State Joint Legislative Committee on Interstate Co-Operation, I do wish to express its appreciation of the opportunity to discuss this problem with you, namely, the political processes by which it can try, at least, to get some reciprocity among the states in this matter of milk inspection, or to relieve the burden of the dual inspection that troubles the Governor and other farmers. . . .

One thing the Committee has discovered for a certainty, and that is that milk, politically, like liquor, internally, is a very volatile and powerful fluid. . . .

As you know, in this state, legislation was introduced at the last session of the legislature which proposed a method for implementing interstate cooperation, by authorizing the Commissioner of Public Health when he found equivalent standards of inspection in other states, to enter into an administrative agreement with the proper officials in those other states by which we could accept their inspection. The bill was safeguarded by provision that he could, at any time, terminate such an agreement.

Now the Committee with which I am associated, as your President has told you, is the official legislative agency in this state for interstate and federal-state cooperation, and when a matter of legislation comes up, both at the federal and state levels, or when a matter comes up in which it has to deal with other states, it sort of acts as the foreign ministry of the State of New York in trying to secure action in a number of legislatures at the same time.

In order to secure integration within the state government to the degree that that is possible between the executive, the administration, and the legislature, the Committee is comprised of a number of members of the House and a number of members of the Senate, appointed by their presiding officers, and by administrative members appointed by

the Governor. Moreover, I think I should point out to you that the Committee is paralleled by other similar agencies of interstate and federal-state cooperation in other states, that we try to work together and that the collective whole, including the Conference of Governors in the United States, is called the Council of State Governments. . . .

Some indication of the success of the Council of State Governments is seen in the improvement in interstate cooperation there has been in many fields.

A fellow political scientist once remarked that it was easier—this was some years ago before this movement had started—for the Government of the United States to get in touch with the Government of Great Britain than it was for the Government of the United States to get in touch with one of the states of the Union. Similarly, up until the establishment of these organizations, there was no machinery on the state level for cooperation with other states. . . .

We have been successful in solving or at least mitigating many problems. For instance, we do have now on every coast of the United States, and our Committee started it, a compact on fisheries. Fish were proving very difficult to deal with. They paid no attention whatsoever to state lines, and we had to get some integration of state government in this field. . . .

We have been dealing recently with reciprocal non-support legislation so that a husband who leaves the state can be compelled to support his wife whom he left behind. We have been quite successful in securing, in the highway field, and in the automotive field, in which you probably are interested, some good legislation. For instance, in the north-eastern region, we did succeed, some years ago, in effectuating a flooring on the permissible state weights—maximum state weights—for trucks, so as to permit a free flow of truck traffic between the states.

But, I suppose, of principal interest to you is that we have been



very active in the field of trade barriers. Now it is not easy to point to tangible results. This I will say: we have prevented any new trade barriers from being put into effect in this state, generally. We have succeeded in getting other states to eliminate some of theirs. . . .

Now, the process of interstate cooperation, like the process of international cooperation, I should warn you, is a long and continuous one. . . . We have had a very minor liquor dispute with Pennsylvania for some years. We started in working on that dispute in 1939. This year, we think, it is going to be solved finally and completely.

The parole compact, providing for out-of-state supervision of parolees from this state and our supervision of parolees from another state, is now accepted by 46 states and is probably one of the best examples of effective interstate cooperation in the recent history of the states of the Union, but it took from 1936 to 1950.

I can only say that you may feel somewhat optimistic about the fact that at least we can get results in a shorter time than it took the State of Connecticut to ratify the Bill of Rights. I believe it ratified it a few years ago.

Now another factor that I want to point out is that it is a continuous problem. Quite often you do not get a final solution. You have to keep coming back and adjusting and adjusting, because the things in which you are trying to get cooperation and uniformity, are dynamic. So, you have a process of constant adjustment, just as you do in international relations. . . .

We did, some years ago, try to do something about reciprocity in inspection. We were interested in the proposal of the Commonwealth of

* Condensation of address presented at Fourth Annual Meeting, Dairy Products Improvement Institute, Inc., Hotel Commodore, New York City, January 11, 1951.

Massachusetts to try to help it with respect to establishing some machinery to fix prices of out-of-state milk in non-federal market areas. We did have some concern with the recent proposal for an interstate milk compact to provide supplementary machinery in certain instances for the present milk marketing agreement. We have had enough experience to be very respectful of milk.

We are well aware that the milk field is alive with pressures, and the producers, the distributors, and the consumers supply these pressures. Not only do these groups occasionally disagree with each other, but also there is some disagreement within the groups, as we understand it.

So, it is like the little boy right before Christmas. We feel sort of like that little boy. He was very, very quiet and his mother got worried. It is a bad sign when a little boy is quiet and she wondered what mischief he was up to. So, she shouted up the stairs,

"Willie! Are you there? What are you doing, Willie?"

"Nothing, Mother."

And that still was too quiet, so she said again, "Willie! What are you doing?"

"Nothing, Mother."

"Are you sure, Willie?"

"Oh, yes, Mother. What could I do with you, Santa and Jesus all watching me?"

Now we will be frank to admit that the Committee has been somewhat delayed in its consideration of this problem. . . . I can say this to you, however, the Committee's consideration of this subject has taken the following lines of approach. *First*, we have been trying to investigate the amount of New York milk that goes to neighboring states and the amount that is subjected to duality of inspection. *Second*, we have undertaken to investigate the situation in neighboring states, whether, if a law such as is proposed is passed, it would be effective in itself in bringing about reciprocity, or whether legislation would be necessary in neighboring states. *Third*, we have been studying the method itself, as to whether this method is the only method or as to whether there are other possible methods of doing it. . . .

We find that Pennsylvania's and New Jersey's laws, if such an enactment were made in New York, would permit them to enter into such an agreement.

However, on the north and east,

the laws of our New England neighbors do not indicate that they would be able to enter into an agreement and their commissioners . . . think legislative action would be necessary.

As the Governor pointed out after his attempt to do something, it is going to necessitate legislative action, and seemingly not only in New York State, but in others, in order to set up the proposed method of getting reciprocal acceptance. . . .

This much may be true. While the present proposal is limited to neighboring states, it would at least in the immediate future practically solve the milk inspection conflict that has gone on and the criticism of the state governments in connection therewith.

The Committee at the present time, has made no definite conclusion, except to pursue these lines of inquiry. I think, however, that I can say to you on behalf of the Committee that this Committee has a long record of being willing to work in the elimination of trade barriers, and in being willing to undertake and help in all projects of interstate cooperation. . . .

I think, however, that you realize that it is essential that the dairy industry itself aid as much as possible by securing as much as possible agreement amongst itself.

Midwest Shipping Problems

(Continued from page 72)

now exists, provides in effect for one state department to check another. Certainly, this does not make for a harmonious situation.

The portion of the St. Louis plan dealing with laboratory examination appears to be in conflict with the basic regulation to the extent that the methylene blue test is not authorized. The standard ordinance specifies any one of three methods

for the bacteriological examination of milk, the standard plate count, direct microscopic count, or the methylene blue test. It may be quite desirable to exclude the methylene blue test as now provided in the plan, for if we are interested in bacterial population, we ought to use methods which measure the number of bacteria rather than their activity.

Laboratory Recognition

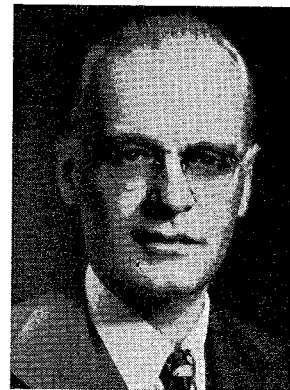
In connection with laboratory examination, it is reassuring to see a provision which provides for the acceptance of laboratory results from officially designated laboratories. This recognition of laboratory work done in other than government laboratories should be followed up by whole-hearted support and ex-

(Continued on page 80)

ESCHERICHIA COLI AS AN INDEX TO SANITATION*

R. W. NEWMAN

Dairy Bacteriologist, Bureau of Dairy Service Laboratory, Sacramento 14, Cal.



MR. NEWMAN graduated from George Washington University with B.Sc. in bacteriology. He served 19 months in World War I, U. S. Department of Agriculture, U. S. Hygienic Laboratory (U.S.P.H.S.) both in Washington. He returned to California in 1921 as Dairy Bacteriologist, Bureau of Dairy Service Laboratory, California Department of Agriculture. He has studied particularly the simplification of staining and other procedures of Breed direct count method, first routine procedure for the bacteriological examination of frozen desserts and ingredients, procedures for isolating and identifying food poisoning and other organisms in dairy products, etc.

The validity of the coliform test as an "index to sanitation" is open to question. The presence of *E. coli* in pasteurized milk can mean so many things including survival of pasteurization, growth, contaminated equipment, etc., that its mere presence in milk does not and can not mean anything unless it is traced back to its source and its significance, if any, determined. Otherwise, the test is not an "index to sanitation" but only an index to coliform contamination.

PROBABLY no innocent bacterium in all history has been so thoroughly glamorized as has *Escherichia coli* and its group of relatives commonly referred to as "coliforms."

COLIFORMS AS INDICATORS OF POLLUTION

The pampering of *E. coli* began around the turn of the century, and its use as an indicator of possible pollution in water supplies was officially adopted in 1904 with publication of the first edition of Standard Methods of Water Analysis.¹ It was selected for this purpose not because it is of itself harmful but because it commonly is found in the human intestine (among other sources) and is one of the predominating flora of sewage. Therefore, it was reasoned, if *E. coli* is consistently present in considerable numbers in a water supply, theoretically it is possible that human intestinal pathogens might also be present. Countless bacteriologists and public health workers have been brought up on this theory.

This concept conceivably might hold for a water supply but it certainly can not reasonably hold for a milk supply which normally may become contaminated with coliforms from sources other than the human intestine. In milk, its presence implies no such public health significance and its presence therein never yet has served as a dependable indicator of an impending outbreak of disease.

Somewhat later in the present century, an attempt was made to enlist the services of *E. coli* in yet another field and, for well over a decade, its proponents advocated its use as an indicator of improper pasteurization of milk. As the thermal death time-temperature of *E. coli* is lower than that commonly used in the pasteurizing process, it was postulated that the mere presence of *E. coli* in pasteurized milk indicated improper pasteurization.

Immediately, the question of possible resistant strains arose to plague advocates of this idea. The introduction of the phosphatase test^{2, 2a, 2b} put an end to efforts in that direction, but the controversy over resistant strains still continues.

COLIFORMS AS INDICATORS OF POST-PASTEURIZATION CONTAMINATION

Proponents of the coliform creed next turned to another and even more fasci-

nating idea. Now, it seemed, the presence of *E. coli* in milk no longer indicated the survival of *E. coli* in an improperly pasteurized product but, rather, a contamination introduced after pasteurization! "Excessive coliform organisms in pasteurized products" (milk, ice cream, etc.) "indicates contamination after pasteurization."³ The presence of coliforms "in the pasteurized product should be interpreted on the basis that they got in there after the heating. This means unclean equipment or improper protection of the product against drip contamination, hand contact, etc. . . . The coliform count is an index to sanitation in the plant particularly in the handling after pasteurization."⁴ These are examples of typical statements made by this school of thought.

Just how valid are claims made for this "index to sanitation"? Just how much reliance should be placed on this latest phase of coliform infallibility and should it fare any better than the former which it contradicts? In short, is there any real reason why this one particular organism should be singled out from Bergey and appointed for so much attention in the sanitary world?

Obviously, as "the test is predicated on the destruction of practically all coliforms in raw milk in the heating process"⁵ again the question of resistant strains enters (or should enter) the picture. However, its advocates have been reassured by laboratory tests which show that *E. coli* is destroyed by the pasteurizing time-temperature when suspensions of *E. coli* are placed in sealed tubes and completely immersed in a constant temperature bath.

Actually, the controversial question of whether there are resistant strains of *E. coli* is of little moment when the evidence pro and con is confined to laboratory test tube determinations. However valuable the resulting information, the evidence so secured is valid only for test tube cultures pasteurized in the laboratory. The conditions under which those tests were made, and the results, can not be expected to be comparable to, much less to duplicate, those obtained in commercial pasteurizing operations. The survival of *E. coli* in commercially pasteurized milk depends not so much upon the predictions of smug laboratory data as upon the operation of the pasteurizer under practical plant conditions. When pasteurizing equipment is efficiently and properly operated, the number of coliforms in milk can be reduced to the vanishing point; but this does not always occur.

NON-RELIABILITY OF COLIFORMS AS INDICATORS

In the familiar vat type pasteurizer, we have been able to recover large numbers of viable *E. coli*, *A. aerogenes* and coliform intermediates in the foam while none could be recovered from the underlying milk. The organisms in the milk had been killed off during pasteurization but those in the surface foam had survived. This foam was the source of

viable coliforms in some of the pasteurized milk drawn from this vat and was the means of seeding subsequent lots of milk pasteurized in the same vat. Our findings also indicated that *A. aerogenes* and some of the intermediates survived the destruction of *E. coli*.

Even with the newer HTST type pasteurizers where, presumably, one would expect little difficulty with foam, destruction of coliforms would depend upon whether every drop of milk invariably is exposed to the necessary temperature for at least the minimum time. Unfortunately for theory, tests on such equipment show that this happy ideal is not always realized.

Thus it is evident that a "resistant strain" of *E. coli* in a raw milk supply is not necessary to account for viable coliforms surviving in the pasteurized product. On the contrary, it is quite possible for mechanical as well as human failure or aberrations during the operation of pasteurizing equipment to permit ordinary "non-resistant" strains of *E. coli* to survive in considerable numbers.

Again, it is unfortunate that many of us have forgotten, or elect to ignore, certain very pertinent facts pointed out by Ayers and Johnson¹² as long ago as 1924. In their paper they call attention to "the important significance of the difference between 'majority' and 'absolute' thermal death-points of (coliform) bacteria. The 'majority' thermal death-point (in milk) was found to be 'below 135° F and the 'absolute' thermal death-point a little above 150° F when the temperature was maintained for a period of thirty minutes." "When 100 cc of infected milk (*A. aerogenes*) was heated to 135° F surviving cells could be detected by examining 1 cc," or 1 percent of the total volume of milk. "When heated to 140° F it was necessary to examine 2 percent of the milk to find surviving cells. At 145° F

* Reprinted from Bull. Dept. Agri. California, 39, No. 3 (1950).

for thirty minutes no living organisms could be detected when 1 percent (1 cc) was examined nor when in addition 14 percent of the total volume of milk was examined, but there were surviving cells in the remaining 85 percent of the total volume." When calculated on the basis of 1,000 pounds of milk, the utter futility of relying on the customary laboratory sample is apparent. Ayers and Johnson conclude "that no reliance can be placed on negative tests which show the absence of the test organism in the relatively limited amount of milk which can be conveniently examined." Further, when we consider the very rapidity of growth^{13, 14} of coliforms in milk even at low temperatures, these findings take on added significance.

The point is that the presence of *E. coli* in milk can mean a great many things including survival of pasteurization, growth, contaminated equipment, etc., and therefore its mere presence in milk does not and can not mean anything until and unless *E. coli*, when found, is traced back to its source and shown to be significant of something. And there are so many chances that bacterial contamination will occur *without the presence of E. coli* that it would seem unwise and unsafe to rely alone upon its presence or absence as an "index to sanitation." One certainly would hesitate to ignore gross contamination of equipment simply because *E. coli* was absent.

E. coli was selected for this purpose "because of their wide spread distribution, their lack of ability to resist pasteurization, except as mentioned" (resistant strains) "and because they grow readily on laboratory media and in the presence of certain substances which inhibit many other less easily recognized species of bacteria, thus permitting a relatively large sample to be used in making the count."⁴

The use of tracer organisms for trouble shooting on the dairy or in the plant is not new. Thermodurics are used for tracing the source of the thermiduric trouble in the pasteurizing plant; thermophilic organisms for thermophiles; *Streptococcus mastitidis* for sources of infection in the herd or as a possible source of high counts in milk; *Staphylococcus aureus* as a source of infection in dairy cows or as a means of discovering its probable source in food poisoning cases; proteolytic organisms which may affect milk quality; *Pseudomonas* as a source of bitter milk; and even *Streptococcus lactis* has been suggested as an indicator of milk quality. *Serratia marcescens* at one time was used as an indicator of effective pasteurization "because of . . . their lack of ability to resist pasteurization, . . . because they grow readily on laboratory media" and because it is an "easily recognized species of bacteria."

All of these tests have been used at one time or another, some of them over a period of many years. Yet, the results of tests for thermidurics are considered valid only for thermidurics; thermophiles for thermophilic contamination; staphylococci for staphylococci; streptococci for streptococci, etc. Likewise, results on tests where *E. coli* is used as a tracer are valid only for *E. coli*; i.e., for discovering the source of coliform contamination

only. As in the case of these others, its presence or absence should not be interpreted in the light of a universal cure-all, but simply, and only, as evidence of the presence or absence of coliform contamination.

NON-SPECIFICITY OF COLIFORMS

Acceptance of its presence or absence as "an index to sanitation in the plant" might be given serious consideration if it could be shown that it is invariably present in contaminated plant equipment and invariably absent in clean equipment; but its use for this purpose would appear to be of questionable significance when we consider that it is not always present in contaminated equipment and that its actual presence does not necessarily indicate post-pasteurization contamination. "Its use" (coliform test) "by the Army showed that the presence of coliform organisms is not always due to contamination after pasteurization. At times their presence, in detectable numbers, was found to be due to improper pasteurization, presence of heat-resistant strains, or growth, and there were indications in a few instances that they were apparently due to gross contamination of the raw milk."⁶

The usefulness of the coliform test is complicated further by findings which show "that there is no correlation between the results of the coliform test and the standard plate count of pasteurized milk. Positive and negative coliform results are obtained on both low and high-count milk."⁶ "There was no definite parallel between plate counts and the percentage incidence of coliform positive tests."⁷

In other words, the presence of *E. coli* in the milk did not affect the plate counts (i.e., total bacterial contamination) which, normally, provide our first evidence of plant trouble. Consequently, it would seem that the coliform test is useful, not so much for discovering or correcting a sanitary problem, but only for ridding the plant of coliform contaminants.

"Defective or improperly cleaned coolers and lines were found to constitute the greatest problem."⁷ So, too, we have discovered by means of swab or rinse tests which indicate not merely coliform contamination but total contamination by all bacteria; tests which also provide some measure of the amount of contamination, and which are at all times definite, efficient and rapid.

"From plants which were experiencing difficulty with a high percentage of positives, consecutive negatives were prone to occur. In such instances it was found necessary to require that consecutive negatives over a period of at least two weeks should be obtained before concluding that correction had been accomplished."⁷ This statement, it is believed, emphasizes the danger of falling into the habit of being conscious of, or on the lookout for only one type of bacterial contamination. In other words, if *E. coli* is absent, plant equipment would be given a clean bill of health whereas sterility tests might indicate a high count of non-coliforms. Other bacterial contaminants are important, too. It is essential to keep all equipment clean and to reduce all bacterial contamination to the vanishing point; not just one kind of bacterial con-

taminant, but all kinds of bacterial contaminants. Contaminated equipment, whether ante- or post-pasteurization, is not contaminated with coliforms alone. Therefore, it would seem logical to use tests or methods for this purpose which are designed to reveal all kinds of contaminants and not just one kind. Swab or other standard sterility tests are directly efficient for this purpose and their use certainly would have eliminated the delays and uncertainties described in the last quotation.

The significance of the presence of coliforms is not always to be taken for granted. It should not be assumed off-hand that the presence of *E. coli* always represents post-pasteurization contamination or that its presence should be deplored as inimical to the virtue of a product. In some products, such as powdered eggs and in some ice creams or mixes into which these powdered eggs have been incorporated, the presence of coliforms actually may serve as a badge of quality. For example: During the late war when the Army was concerned with the appearance of coliforms in dairy products, one particular type of ice cream from one particular factory was found to contain these organisms. One of the ingredients of this ice cream was powdered marshmallow. This powder, on laboratory examination was found to contain more than one and less than 10 *E. coli*, and more than 100 and less than 1,000 *A. aerogenes* per gram. The ice cream in which this marshmallow was used contained more than 10 and less than 100 *A. aerogenes* and no *E. coli* per gram. Another ice cream containing no powdered marshmallow, made at the same factory and at the same time as the other sample, was negative for both *A. aerogenes* and *E. coli*.

It was evident from our work that this coliform contamination originated in the marshmallow into the manufacture of which enters a considerable amount of egg white.

Stuart and Goresline,^{8, 9} of the Agricultural Chemical Research Division of the U. S. Department of Agriculture, writing of their work on "Bacteriological Studies on the 'Natural' Fermentation Process of Preparing Egg White for Drying," state that they found "bacteria of the genera *Aerobacter* or *Escherichia* in such predominating numbers as practically to exclude other bacterial types. . . . Batches of fermented egg white in which *Aerobacter* and *Escherichia* types predominated during fermentation were found to yield a bright, crystalline, granular product on drying. Batches of fermented egg white in which such proteolytic bacteria as strains of the genera *Proteus*, *Serratia*, and the *Pseudomonas* persisted throughout the fermentation period, yielded a dull, dingy, and amorphous product upon drying. . . . One surprising feature of these studies was the absence of true fecal types of the *Escherichia* genus in this group" . . . and that, instead, "all should be classified as strains of *Escherichia freundii*." "There can be no doubt, therefore that these" (*A. aerogenes* and *E. freundii*) "are the important organisms from the standpoint of normal, natural, commercial fermentations." They also reported find-

ing no trace of "*Salmonella* and *Eberthella* types." These statements accord with the findings of Colien¹⁰ and others for fresh or frozen egg white, egg yolk and whole eggs.

As these statements indicate that *Escherichia* and *Aerobacter* are predominant flora in good quality egg white and as egg white enters into the manufacture of marshmallow preparations, it seems reasonable to expect coliform contamination of both the marshmallow itself and of frozen products into which it is incorporated. Therefore, laboratory reports indicating the presence of coliform contamination in these products should be interpreted with caution.

CONCLUSIONS

After examining the rather profuse literature on the subject together with the reasoning, both loose and serious, offered in support of statements that "the coliform count is an index to sanitation in the plant, particularly in the handling after pasteurization,"⁴ we have come to the conclusion that such claims should be viewed with considerable caution. Certainly available evidence does not seem sufficiently conclusive to warrant consideration of the test as a useful aid in regulatory-control work at this time. We are led to this conclusion because:

1. Such a test is based upon the recovery of a specific type of organism, i.e., coliforms.

2. It is questionable whether sufficient reliance can be placed on coliform determinations based solely on the appearance of gas in one or two or even five or more lactose tubes unsupported by confirmatory tests which also differentiate them into fecal and nonfecal types. This requires considerable time and effort.

3. This test, in order to be useful for any such purpose, must be shown to invariably indicate post-pasteurization contamination and also invariably to be negative when no such contamination is present. These qualifications have not been demonstrated.

4. Species of coliforms may or may not be present.⁶ Yet, in the event of a negative coliform test, adherence to this test alone would give equipment grossly contaminated with other bacteria a clean bill of health.

5. Coliforms may be absent both in low- and in high-count milk.

6. Their presence in milk or in a frozen dairy product merely indicates the presence of coliforms. They are significant of nothing else until and unless they are traced to their source and their significance, if any, determined. We and others⁶ have found that their presence certainly cannot be interpreted nor taken for granted as meaning post-pasteurization contamination unless this actually is shown by subsequent follow-up work.

7. Plant equipment, before and after use, is contaminated not with coliforms alone but with as many different kinds of bacteria as conceivably may be found in milk and which may or may not include coliforms. Hence, the coliform test is not

an "index to sanitation" but only an index to coliform contamination.

8. A test for contamination should indicate total bacterial contamination, rather than one which ignores or suppresses all bacteria except a few harmless enteric species.

9. While not wishing to imply that it is impossible for the coliform test to indicate post-pasteurization contamination (i.e., it is conceivable that in some cases, by coincidence, the two conditions might coexist), it is felt that there are other and more specific, efficient, reliable ways of demonstrating it.

10. The swab test¹¹ is simple, direct, and remarkably efficient in revealing all bacterial contaminants,—not just one organism, but all organisms present.

It is felt that the time and attention of control officials could be more profitably spent in concentrating on the fundamental problem of reducing bacterial populations of milk and milk products which have become contaminated by careless methods or insanitary equipment on the dairy or at the plant, rather than by frenzied search for some indirect and hypothetical cure-all. There is no substitute for honest sweat, common sense and, occasionally, tears.

Over a period of some 25 years we have been able to reduce bacteria counts on both market and manufacturing milk in California to a level so very low that it is questionable whether it is desirable to push them down to even lower levels.

But low counts do serve one useful purpose. By continuing to keep the total count low, the coliform count also will be low, and therefore, of no significance. The cause of an undue rise in the total count may be discovered quickly and effectively by means of standard sterility tests, by inspection, or a combination of the two. This system has been found to be so particularly effective that we have found it unnecessary to resort to coliform tests as an "index to sanitation." It is for this reason that the Agricultural Code of California recognizes only the total count of all bacteria. It does not recognize, dignify, nor emphasize the relative importance of any one organism.

REFERENCES

1. *J. Infect Dis.*, Supp. 1, 1904.
2. Kay, H. D., and Graham, W. R. Phosphorus Compounds of Milk. VI. The Effect of Heat on Milk Phosphatase. A Simple Method for Distinguishing Raw from Pasteurized Milk, Raw from Pasteurized Cream and Butter Made from Raw Cream from that Made from Pasteurized Cream. *J. Dairy Res.*, 5, 63-74 (1933).
- 2a. Kay, H. D., and Graham, W. R. The Phosphatase Test for Pasteurized Milk. *Ibid.*, 6, 191-203 (1935).
- 2b. *Standard Methods for the Examination of Dairy Products*. 7th ed., 1939.
3. Shadwick, G. W. Coliform, Their Significance and Control in Ice Cream Making. Reprinted from Production and Laboratory Council, Vol. 2, *Proc. 44th Ann. Convention, Internat. Assoc. Ice*

Cream Manufacturers, Atlantic City, N. J., October 25-27, 1948.

4. Baker, M. P. Significance of Coliform Bacteria in Pasteurized Milk and Milk Products. *Milk Plant Monthly*, 37, 82-84 and 95 (August, 1948).

5. Buchbinder, L., and Alff, E. C. Studies on Coliform Organisms in Dairy Products. The Practical Significance of So-Called Heat Resistant Coliform Organisms in the Coliform Testing of Pasteurized Milk. *J. Milk and Food Tech.*, 10, 137-148 (1947).

6. Babcock, Lt. Col. C. J. Developments in the Market-Milk Industry During World War II. *Ibid.*, 10, 345-349 (1947).

7. Delay, Capt. P. D. The Significance of the Coliform Test in Pasteurized Milk. *Ibid.*, 10, 297-299 (1947).

8. Stuart, L. S., and Goresline, H. E. Bacteriological Studies on the "Natural" Fermentation Process of Preparing Egg White for Drying. *J. Bact.*, 44, 541-549 (1942).

9. Stuart, L. S., and Goresline, H. E. Studies of Bacteria from Fermenting Egg White and the Production of Pure Culture Fermentations. *Ibid.*, 44, 625-632 (1942).

10. Colien, F. E. The Microbiology of Frozen Eggs. I. Presence and Significance of Coliform Organisms in Frozen Eggs. *Ibid.*, 43, 47 (1942).

11. *Standard Methods for the Examination of Dairy Products*. 9th ed., 1948.

12. Ayers, S. H., and Johnson, W. T. Jr. Studies on Pasteurization. XI. The "Majority" and "Absolute" Thermal Deathpoints of Bacteria in Relation to Pasteurization. *J. Bact.*, 9, 279-284 (1924).

13. Smith, E. van D. The Incidence and Types of Coliform Organisms in Pasteurized Cream. *J. Milk and Food Technol.*, 7, 338-340 (1944).

14. Robinton, E. D., and Genung, E. F. The Effect of Temperature on Coliform Organisms in Milk and Cream. *Ibid.*, 8, 97-100 (1945).

First Annual Report, by Charles Wesley Dunn, President of the Food Law Institute, Inc., New York, N. Y. 1950.

In this first report of the Food Law Institute, Inc., the president outlines the results of the first completed year of its operation. After describing its organization and objectives as a non-profit corporation wholly public in character and directed by officers who receive no financial remuneration, he reported a broad plan of basic legal research in food laws that has enlisted the interest of several research scholars, and much progress in getting several outstanding law schools to inaugurate lecture and other special training in the food law field.

New Books and Other Publications

Continuous Butter Making, by S. G. Wiechers and B. deGoede. Published by North-Holland Publishing Co., Amsterdam. 1950. vii + 103 pages. \$3.00.

The authors present a detailed documented survey of continuous butter making by the following six processes

1. Based on churning process: Senn and Fritz;
2. Based on special treatment of the cream:
 - a. Alfa (German)
 - b. Butter direct from machine: Cherry-Burrell, Creamery Package, and Kraft (also briefly the van der Menlen-Levowitz process).

Each process is illustrated with line drawings of equipment and with flow charts. The advantages and disadvantages of each are discussed and compared. They point out that the study of phase conditions in emulsions lies in the field of physical chemistry and that much research must be done there.

The author states that "Up to the present the result is a product which more or less resembles butter but which is not what of old has been considered natural butter". They grant that possibly "In a country like America it may be possible that the normal butter will be completely ousted from the market because of the better keeping quality of continuous butter. In the long run the consumer will adapt himself to the use of this new product and in that case the normal churning process will become history."

Quality Milk—a Symbol of Democracy, James A. King. A 40 page bulletin No. 1-E published by the National Sanitation Foundation, Ann Arbor, Mich.

This well printed and illustrated bulletin tells the story of milk in terms that are easily understood. It is designed for use by health departments or others in disseminating information to the general public about the food value of milk and to explain the team work between the dairyman, pas-

teurizing plant operator, laboratory worker, and sanitarian in maintaining the daily supply of high quality milk. An attempt is made to arouse the interest of the general public in support of this program. The goodness and availability of quality milk and milk products to all are said to be achievements of free enterprise working in cooperation with people and to symbolize the American way of life.

Many bulletins have been written about milk but few have covered the field as comprehensively yet briefly in as interesting and easily readable style.

Veterinary Bacteriology and Virology, by I. A. Merchant. Fourth Edition. Published by The Iowa State College Press, Ames, Ia. 885 pages. 1950.

This new edition is a reprinting and an enlargement of the third edition. Most noteworthy in the additions is the expansion of the chapter on "Antibiotic Agents" from 10 to 16 pages with 68 references. The entire section on "The Filtrable Viruses and Bacteriophage" has been rewritten and expanded from 71 pages to 180 pages, written by R. A. Packer. The whole book now runs 885 pages as compared with 683 pages in the previous edition.

In the page of Contents, the page numbers of the chapters need checking. The binding does not seem to be as durable as the size of the book might need.

Effectiveness of Penicillin in Eliminating Mastitis Infections in the Bureau of Dairy Industry Herd

U. S. Dept. Agr. Bull. 1027, Dec. 1950
W. W. SWETT, L. A. BURKEY, CECILIA R. BUCKNER, P. C. UNDERWOOD, C. A. MATTHEWS, AND M. H. FOHRMAN

Bureau of Dairy Industry, Agricultural Research Administration

THE purpose of this report is included in the introduction which also carries a review of the literature. The outline of the methods and material used, the methods of taking milk samples, the diagnosis of mastitis, and the administration of treatment, etc. are all explained in detail.

A discussion of the results: The procedure followed in analyzing results and effectiveness of the penicillin treatment are explained. A portion of the experiment divided the dosage of penicillin into two types. In one type the total dosage was 50,000 units in each treatment. In the other type, the dosage was divided into two treatments of 25,000 units each. Although the number of cases compared was small, the effectiveness seemed to be definitely higher in the cases where the total dosage was divided into two infusions and extended through a two-day period. The total number of infections treated in this experiment were 337. Unlike the findings reported from many sources, *Streptococcus agalactiae* accounted for only about ten percent of all infections in the Beltsville herd during this twenty-one month period in which the study occurred. *S. uberis*, however, accounted for twenty-five percent. *Streptococci* of all kinds accounted for fifty-four percent, *Staphylococci* for thirty percent, and *Coliform* bacteria, *Pseudomonades* and other bacteria for the balance. Penicillin administered as four infusions, twice daily for two days, eliminated ninety-seven percent of the *Streptococcus agalactiae* infections, eighty-six of the *S. uberis* infections, and ninety-one percent of all *Streptococcus* infections. It eliminated eighty-five percent of the *Staphylococcus* infections, ninety-three percent of the *Coli* infections and seventy-six percent of the *Pseudomonades* infections and eighty-eight percent of all kinds of infections treated. Of all infections effectively treated, 98.8 percent of the *Streptococcus* infections and 98.3 percent of the infections of all kinds were eliminated by the first, second or third treatment. It appears that little is to be gained by administering more than three treatments of penicillin. Increasing the number of infusions at each treatment from one or two to four and raising the dosage from 50,000 units to 100,000 units or more increased the effectiveness of penicillin in treating infections of all kinds from 57.4 to 87.3 percent. A comparison of percentages of effectiveness in treating infections 77.6 for sulfanilamide-sulfadiazine preparations, 68.2 for sulfanilamide-urea preparation and 87.8 for penicillin—indicates that penicillin therapy was more effective than the sulfa drugs used. Moreover the penicillin was prepared and administered much more easily than either of the sulfanilamides.

This study also points out that infusion of infected udders with antibiotics or other preparations is not the entire answer to the problem of mastitis control. Effective herd management—including milking methods—must be stressed as of even greater importance. Those persons engaged in this study feel as though if they could have maintained the desired standards of management during the period represented by this study a number of infected quarters requiring treatment undoubtedly would have been very much smaller and the condition of the herd with reference to mastitis could have shown greater improvement.

Association News

Affiliates of

INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS

ASSOCIATED ILLINOIS MILK SANITARIANS
 President, D. B. Morton.....Springfield
 Vice-President, James A. Meany.....Chicago
 Secretary-Treasurer, P. E. Riley, Illinois Dept. of
 Public Health, Chicago
 Sergeant-at-Arms, Dr. L. E. Booth.....Gardner
 Executive Board Members:
 G. G. Gibson.....Chicago
 Dr. W. H. Haskell.....Beloit
 Auditors:
 F. V. Lee.....Elgin
 H. B. Richie.....Chicago

DUBUQUE DAIRY TECHNOLOGY SOCIETY
 President, John Stanton.....Dubuque
 Vice-President, Fred Ament.....Dubuque
 Secretary-Treasurer, Ralph Howard.....Dubuque

FLORIDA ASSOCIATION OF MILK SANITARIANS
 President, P. D. Shirley.....Tampa
 Vice-President, L. T. Smith.....Jacksonville
 Secretary-Treasurer, H. H. Wilkowske.....Gainesville
 Members of Executive Committee:

R. R. Hood.....Pensacola
 L. L. Chaffee.....St. Petersburg
 L. A. Scribner.....Orlando

IOWA ASSOCIATION OF MILK SANITARIANS
 President, F. J. Donovan.....Webster City
 Vice-President, A. T. Getz.....Ames
 Secretary-Treasurer, M. E. Held, Iowa Department
 of Health, Des Moines, Iowa

KANSAS ASSOCIATION OF MILK SANITARIANS
 President, Roy Mitchell.....Arkansas City
 First Vice-President, Ray Fair.....Parsons
 Second Vice-President, Grove Gilliland.....Dodge City
 Secretary-Treasurer, Ivan Van Nortwick, Chief
 Milk Sanitarian, State Board of Health, Topeka
 Auditors:
 Don Reed.....Coffeyville
 Wilbur Palmer.....Wichita
 Public Relations, Gene K. Lockard.....Topeka

MICHIGAN ASSOCIATION OF SANITARIANS
 President, Vernon Wait.....Pontiac
 1st Vice-President, Milo Wilson.....Ludington
 2nd Vice-President, J. L. Littlefield.....Lansing
 Secretary-Treasurer, Cranston Wilcox, 35 S.
 Sprague St., Coldwater
 Assistant Secretary-Treasurer, Morton Hilbert,
 Eloise
 Directors:
 Hugel Leonard.....Lake City
 C. V. Roose.....Hillsdale
 Bert Churchill.....East Lansing

Associations Which Have Designated the JOURNAL OF MILK and FOOD TECHNOLOGY As Their Official Organ

**CALIFORNIA ASSOCIATION OF DAIRY AND MILK
 SANITARIANS**

President, B. Q. Engle, San Francisco 21, California
 First Vice-President, Robert L. Clayton, San Diego,
 California

Second Vice-President, E. H. Biles, Sr., Oakland 9,
 California

Secretary-Treasurer, D. A. Cordray, California
 State Department of Agriculture, Bureau of
 Dairy Service, 1035 Jennings Avenue, Santa
 Rosa, California

Auditors, Earl Eichner, State Department of Agri-
 culture, San Francisco, California
 J. R. Foster, Los Angeles, California

CENTRAL ILLINOIS DAIRY TECHNOLOGY SOCIETY
 President, L. P. Harder.....Decatur
 Vice-President, M. B. Burwash.....Peoria
 Treasurer, Robert Johnston.....Pontiac
 Secretary, P. H. Tracy, Dept. of Food Technology,
 University of Illinois, Urbana, Ill.
 Corresponding Secretary, J. W. Hayes.....Princeton
 Sergeant-at-Arms, Paul Lierman.....Champaign

CHICAGO DAIRY TECHNOLOGY SOCIETY
 President, Adolph Brunner.....Chicago
 Vice-President, Paul Pertz.....Chicago
 Treasurer, Robert W. Atkins.....Gary, Ind.
 Secretary, P. H. Tracy, University of Illinois,
 Urbana
 Sergeant-at-Arms, Dave Oatman.....Chicago

**CONNECTICUT ASSOCIATION OF DAIRY AND FOOD
 SANITARIANS**
 President, H. D. Neumann.....New Haven
 Vice-President, L. R. Dowd.....Storrs

MINNESOTA MILK SANITARIANS ASSOCIATION
 President, Owen Owens.....Rochester
 Vice-President, Thomas Stibal.....Hutchinson
 Secretary-Treasurer, Dr. J. C. Olson, Jr., Associate
 Professor of Dairy Bacteriology, Dairy Divi-
 sion, University of Minnesota, St. Paul 1, Minn.
 Board of Directors: Ruben W. Koivisto, Leonard
 G. Sinton, Robert R. Dalton, C. H. Mattson,
 Reuben M. Olander, A. L. Sjowall.

**MISSOURI ASSOCIATION OF MILK AND FOOD
 SANITARIANS**
 President, G. F. Reeves, Director of Food Control,
 St. Louis, Mo.
 Vice-President, J. H. Barlow, Pulaski County Health
 Dept., Waynesville, Mo.
 Secretary-Treasurer, J. L. Rowland, Director,
 Bureau of Food and Drugs, Jefferson City, Mo.

**NEW YORK STATE ASSOCIATION OF MILK
 SANITARIANS**
 President, A. B. Quencer.....New York City
 Vice-President, Claude Woodward.....Utica
 Secretary-Treasurer, C. W. Weber, 18 Dove St.,
 Albany 6, N. Y.

**OKLAHOMA ASSOCIATION OF MILK AND FOOD
 SANITARIANS**
 President, Harper Orth.....Shawnee
 First Vice-President, Clyde Harris.....Oklahoma City
 Second Vice-President, D. C. Cleveland.....Durant
 Third Vice-President, R. Kay Matthews.....Wewoka
 Secretary-Treasurer, R. L. Howell.....Tahlequah

VIRGINIA ASSOCIATION OF MILK SANITARIANS
 President, H. C. Mitchell.....Richmond
 Vice-President, J. D. Hanbury.....Portsmouth
 Secretary-Treasurer, A. W. Petty, Town Hall,
 Virginia Beach
 Auditors:
 F. J. Bell.....Pulaski
 S. H. Hutcherson.....Petersburg

WISCONSIN MILK SANITARIANS' ASSOCIATION
 President, Palmer Welsh.....New Glarus
 Vice-President, Myron L. Clark.....Oshkosh
 Secretary-Treasurer, L. W. Brown, Wisconsin State
 Department of Agriculture, Madison
 Directors:
 George E. Carroll.....West Allis
 Leo W. Neitzel.....Wisconsin Rapids
 Auditors:
 C. A. Mohr.....Madison
 Vivian G. Rowley.....Madison

Committees on Arrangements for
 the 38th Annual Meeting of
 IAMFS, Glenwood Springs,
 Colorado, September 26-29

General Chairman of Local Arrange-
 ments

Mr. Harold Barnum, Chief of
 Milk Sanitation Division, Bureau
 of Health and Hospitals, City and
 County of Denver, Denver

Chairman of Finance Committee

Ward K. Holm, Secretary, Colo-
 rado Dairy Products Assn., Denver

Chairman of Ladies' Entertainment
 Committee

Mrs. Nevin Kilpatrick, Director
 of Denver Dairy Council, Denver

Chairman of Attendance Committee

O. J. Weimann, Chief Food Sani-
 tarian, Colorado State Health Dept.,
 Denver

Chairman of Entertainment Com-
 mittee

Howard M. Weindel, Training
 Officer, Rocky Mountain Training
 Center, Denver

Chairman of Reception Committee

J. E. Dolan, Milk Sanitarian,
 Colorado State Health Dept., Denver

Metropolitan Dairy Technology Society

That the cryoscopic examination is still the best objective method of determining whether water has been added to fluid milk was the basic point made by Dr. A. H. Robertson, director of New York State Food Laboratory, Department of Agriculture and markets, Albany, N. Y., in his talk before the members of the Metropolitan Dairy Technology Society at the March meeting. He gave -0.530 as the freezing point below which herd milk samples would seem to contain added water in about one out of three cases.

Dr. Robertson cautioned, however, that since several varying factors can and do influence the freezing point of cow's milk one must use extreme care in the application and interpretation of cryoscope data and that in no case should a definite statement be made as to the exact percentage of added water. Because of the variable factors involved, any such definite statement could never be fully substantiated by fact.

Associated Illinois Milk Sanitarians

The Associated Illinois Milk Sanitarians are planning to hold their annual spring conference at the Oak Park Arms Hotel, Oak Park, Illinois, on Monday, May 28, 1951. The theme of the conference program will be "Civilian Defense."

As a result of a recent referendum, the Constitution of the Association was amended to permit an increase in the annual membership dues in accordance with the actions of the parent association taken at the annual meeting in Atlantic City last October.

Central Illinois Dairy Technology Society

The March Meeting of the Central Illinois Dairy Technology Society was held on March 14, 1951 at Murphy's, Farmington Road, Peoria.

Prior to the meeting members were conducted on a tour of the Northern Regional Research Laboratory in Peoria.

The speaker of the evening, R. T. Milner, Director of the Northern Regional Research Laboratory, gave a very interesting talk on the purpose, organization, and achievements of the Laboratory. Research at this laboratory and the work of its pilot plant developed the medium and micro-organisms necessary to produce penicillin on a commercial basis.

The next meeting was scheduled for April 11, 1951 at the Orlando Hotel, Decatur, Illinois.

JOHN W. HAYES,
Corresponding Secretary

Washington State Milk Sanitarians Association

Dr. K. G. Weckel, President of the International Association of Milk and Food Sanitarians, was a guest of the sanitarians of the Pacific Northwest at a dinner meeting held at Pullman, Washington on March 15, 1951. The dinner meeting was held in conjunction with the Institute of Dairying of The Washington State College at Pullman.

Dr. Weckel presented a review of the organizational activities of the Association, of the projects now under study by the Committees, and of the activities enlargement of the services of the "Journal of Milk and

Food Technology" by the Journal Management Committee.

The meeting was the first of The Washington State Milk Sanitarians Association. The newly elected officers of the Association are:

President: Leslie E. Jenne, State Department of Agriculture, Olympia, Washington

Vice-President: David Jones, Seattle King County Health Department, Seattle, Washington

Secretary-Treasurer: L. O. Tucker, State Department of Health, South Tower, Seattle, Washington

Missouri Association of Milk and Food Sanitarians

April 23, 24 and 25 were the dates selected for the 1951 annual Milk and Food Short Course and Seminar, held for the 15th time under the auspices of the College of Agriculture, the Missouri Division of Health and the Missouri Association of Milk and Food Sanitarians. Columbia is the place.

While following the traditional pattern in general, several innovations were introduced, designed to enliven the meetings, to keep content in step with today's needs and to make the program generally practical, streamlined and useful. Speakers, panel members and discussants will represent a balanced selection of distinguished representatives from the fields of public health, teaching, research, and industry.

The program planning committee feels that we have in the past, perhaps unwittingly, fostered the impression that these meetings were of interest only to public health personnel. The committee has sought to correct this impression by giving industry's problems full consideration, and by extending a cordial invitation to representatives of all branches of the food and dairy industries and to the various lines of business servicing them. Helpful cooperation between business and official agencies is rapidly replacing the mutual hostility which once ruled these relationships. It is through meetings of this kind that better understanding is achieved.

Registration was Monday Morning, April 23 and the first session started at 1:30 p.m. We closed at noon April 25.

GEORGE F. REEVES, *President*

Midwest Shipping

(Continued from page 74)

pansion of present efforts of, the United States Public Health Service in bringing about uniformity in laboratory procedure.

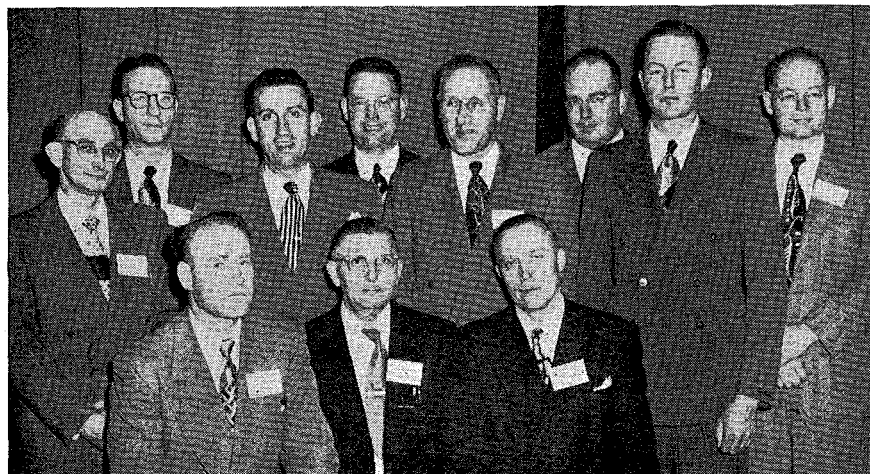
GOOD START MADE

The channels for requesting and reporting information are clear and the operation of this portion of the plan seems to be functioning smoothly. In this regard it would be extremely helpful if the armed forces will avail themselves of the opportunity of obtaining reliable information regarding milk procurement which this plan offers. This would eliminate needless duplication of inspection and analyses by military personnel.

The role of the United States Public Health Service is clear. The exemplary manner of this agency's policy of the past seems assured for the future. The initiative and a good share of the leadership in seeking the solutions to problems in the free flow of milk across the borders of states and municipalities needs to be in the hands of an agency whose interest lies in effort for the good of all. I do think, however, that the Public Health Service needs to apply even greater effort in providing the initiative in marshalling together all interested groups for the purpose of working out the ways and means by which uniformity in regulations affecting milk production may be effected. This will contribute greatly to unrestricted interstate milk commerce.

Now in conclusion, while midwest milk producers are primarily involved in the problem of interstate milk shipments, they are by no means the only ones involved. The four basic factors to the problem, namely, milk production in excess of local needs, discriminatory effects of economic and public health nature, the variety of stipulated specifications for the production of milk throughout the country, and the general aspects of obtaining certifications acceptable to receiving areas, affect to a greater or less extent all milk producers. A realistic attitude and a willingness to work together unselfishly in a coordinated effort under sound leadership inevitably will eliminate these problems. All must work together toward their solution.

News Items



OREGON DAIRY MANUFACTURERS' ASSOCIATION

OFFICERS: F. A. Kesey, *president*; Eugene Guerrettaz, *vice president*; F. F. Moser, *treasurer*; G. H. Wilster, *secretary*
 DIRECTORS (present): P. A. Bails, R. W. Bloom, William Cavett, William Fletcher, Gordon K. Long, R. W. Stein, R. W. Van Auker

Mid-Century Oregon Dairy Industries Convention

The 40th annual meeting of the Oregon Dairy Manufacturers' Association was held at Oregon State College, February 20-22. Previous attendance records were broken with a total of about 500 persons attending the three-day meeting. The 32-page illustrated brochure, which was published especially for the convention, discussed the Oregon dairy industry—its progress, present status, future development, and continuing role in agriculture.

A very comprehensive program for the educational phase of the meeting was prepared, with the presentation of about twenty-five talks and several sound movies. The Association members and guests were shown the large, partly completed new building on the college campus that will house the dairy manufacturing and technical dairy products laboratories. This ultra-modern and practical building will be finished in about six months.

Officers elected to serve during 1951-52 were: *President*, F. A. Kesey, Eugene Farmers' Creamery, Eugene; *Vice-President*, Eugene Guerrettaz, Lucerne Milk Company, Portland; *Secretary*, G. H. Wilster, Oregon State College, Corvallis; *Treasurer*, F. F. Moser, Medo-Land Creamery, Corvallis.

Among the resolutions adopted were the following: that young high school graduates be encouraged to study dairy manufacturing; that the Oregon Agricultural Experiment Station expand its dairy research program to find new uses and markets for milk and its products; and that the Association approves the grades for manufacturing milk proposed by the Production and Marketing Administration of the USDA.

Particularly outstanding was an address by O. K. Beals, chief, Division of Foods and Dairies, Oregon State Department of Agriculture, entitled "Interstate Shipments of Milk." He pointed out that none of the Pacific coast states were represented at the St. Louis national conference on interstate milk shipments* held June 1, 1950, but these are expected to be represented at the 1951 meeting. He emphasized that the present procedure of collaborative certification is cumbersome and wasteful, as illustrated by the case of one plant "which is still being inspected and reported to the USPHS because of 6 half pints of milk."

The speaker explained that the requirement that inspections of supplies for interstate carriers and in-

* "National Conference on Interstate Milk Shipments," this *Journal*, 13, 194 (July-August 1950).

terstate milk shipments as per the St. Louis agreement be made under the supervision of the USPHS operates to "nullify the effects of the Oregon fluid milk law because our staff would in effect be working for, and under the direction of, officials of the USPHS. . . . Because of this trend of federal encroachment upon enforcement activities delegated to the states and through the activities of this same federal agency working through the cities on a voluntary program which results in having these same cities look to the USPHS rather than to the laws as prescribed by the state legislature, your organization—the ODMA—and the Oregon Dairymen's Association requested the department to contact other Pacific coast states in an effort to obtain state certification of milk supplies rather than having a federal code forced upon all of us. Some contacts have been made and it is believed that some progress may be made this year. It is too soon, however, to predict success in this endeavor. I mentioned a moment ago that the Oregon fluid milk act was passed originally in 1945 and amended in 1949. Your organization, the ODMA, with the Oregon Dairymen's Association cooperating, is asking the legislature to amend that act again in this session. . . . I hope that you all will examine House Bill 319 which contains the amendments to the fluid milk act. This bill is still in the Food and Dairies Committee of the House."

New Dairy Technology Society at Rockford

A new society was formed on January 17th in the Rockford, Illinois, vicinity. It has been named the "Ill-Wis Dairy Technology Society." Officers for this society are as follows:

President—N. O. Gunderson, Health Dept., Rockford
Vice-President—Ross Speicher, Our Own Dairy, Poplar Grove
Secretary—Willard Corbett, Dean Milk Co., Rockford
Recording Secretary—S. J. Goldschmidt, Health Dept., Beloit, Wis.
Treasurer—Alvin Alton, Wright & Wagner, Beloit, Wis.
Sergeant-at-Arms—John Holmes, Holmestead Dairy, Beloit, Wis.

Baking Industry Sanitation Standards Committee

A meeting of the Baking Industry Sanitation Standards Committee was held at the Edgewater Beach Hotel in Chicago on March 2 and 3, presided over by Chairman A. T. Prosser.

Members of the Central Committee representing the American Bakers Association, the American Institute of Baking, American Society of Bakery Engineers, Associated Retail Bakers of America, Bakery Equipment Manufacturers Association and the Biscuit and Cracker Manufacturers Association were in attendance, and also several chairmen and members of task group committees who are developing standards for various types of equipment.

The Chairman reported that the proposed standards for flour handling equipment had been approved by the task group, by the editing committee and by the central committee itself, and that the proposed standards had been referred to the six member organizations with a sixty day time limit for further suggestions.

On other proposed standards submitted by task group chairmen the following actions were taken:

- Pan, Rack, and Utensil Washers—referred back to Task Group;
- Proofers—referred to the Editing Committee;
- Dough Troughs—referred to the Editing Committee;
- Ingredient Containers — referred back to the Task Group;
- Mixers-Horizontal — referred back to the Task Group;
- Cake Depositors, Fillers, and Icing Machines — referred to Editing Committee.



EQUIPMENT REPORTS MADE AT CHICAGO MEETING OF BAKING INDUSTRY SANITATION STANDARDS COMMITTEE

NYQMPA Inspection Technologist Wins Award for Development of QMC Radiological Unit

Albert Wiebe, 1831 E. 38th St., Brooklyn, the Quartermaster Corps Inspection Service technologist responsible for the development of a radiological unit used for the mass inspection of non-perishable subsistence, food stuffs, and many other commodities procured by the Quartermaster, was presented an award for his suggestion at a ceremony held at the New York Quartermaster Procurement Agency. The award was made by Brig. General H. L. Peckham, Commanding NYQMPA. Mr. Wiebe received \$275 for his idea under the Department of Defense's Suggestion Program, the object of which is to encourage employee contribution to the improvement of operations. Mr. Wiebe designed a mobile unit, officially known as the Quartermaster Corps Mobile Radiological Subsistence Inspection Unit, which has already been put into use at various depots. The equipment is housed in a semi-trailer and employs a powerful X-ray apparatus to detect defects in cans or other containers and deterioration of their contents.

The X-ray process is many times faster than visual inspection and requires only a fraction of the man-hours necessary with former inspection methods because it is not necessary to remove cans from their cases or cartons. The entire inspection operation is carried out on an automatic self-contained conveyor system. The method not only reveals bulging cans and external can defects, but also indicates the presence and degree of deterioration of the content, as well as corrosion,

other defects, and the presence of foreign matter inside the can. Although primarily designed for inspection of canned foods, the unit has been used successfully on many other kinds of commodities.

President's Water Resources Policy Commission Report Completed

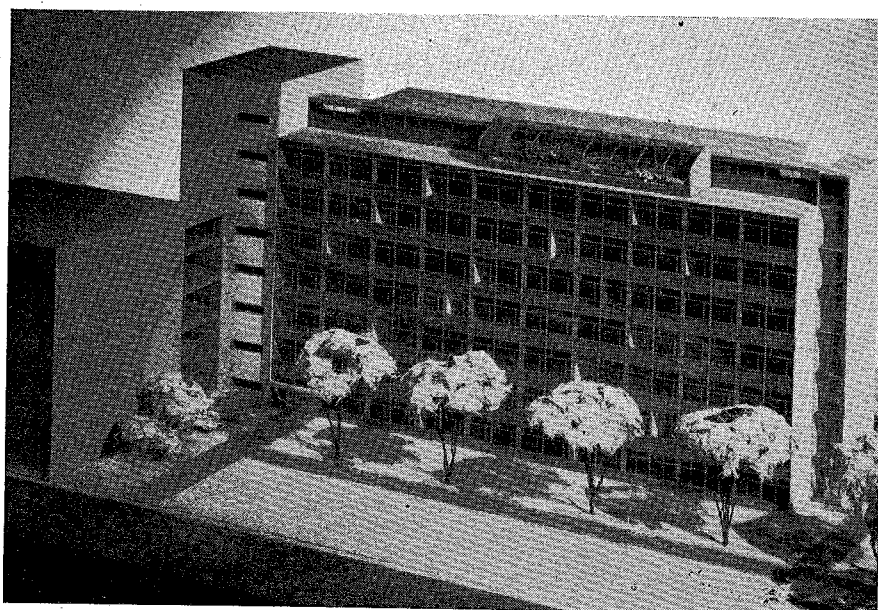
The President's Water Resources Policy Commission, which was appointed in January, 1950, to study and make recommendations on policies in the field of water resources, together with existing legislation, has just released to the public the last of its three-volume report and having completed its assignment has gone out of business, Chairman Morris L. Cooke announced today.

The Commission's main report, Volume 1 entitled "A Water Policy for the American People," offers a coordinated national program for the development of water resources, together with specific recommendations on policy. Volume 2, "Ten Rivers in America's Future," is a study of 10 river basins in different parts of the country and includes a detailed discussion of the problems of each basin with a mass of pertinent material never heretofore published. Each of these basin studies has been published as a separate. The third volume, "Water Resources Law," summarizes Federal law concerned with the nation's water resources.

A 24-page pamphlet containing the Commission's summary of recommendations, reprinted from Volume 1, gives a concise idea of the scope and content of the report. Copies of each volume, the Summary of Recommendations, and the 10 river basin studies, may be purchased from the Superintendent of Documents, Washington 25, D. C., at the following prices:

Volume 1, "A Water Policy for the American People"	\$3.25
Volume 2, "Ten Rivers in America's Future"	6.00
Volume 3, "Water Resources Law"	2.25
Summary of Recommendations....	0.15

The separate sections of Volume 2 may be had for prices varying from 50 cents to \$1.00. The series includes the Columbia, Missouri, Rio Grande, Colorado, Connecticut, Alabama-Coosa, Potomac, Ohio, and Tennessee Rivers and the Central Valley of California.



M.I.T. Food Technology Summer Course

A three weeks special course in food technology, from June 25 to July 13, a feature of the 1951 Summer Session at the Massachusetts Institute of Technology, has been announced by Professor Walter H. Gale, in charge of M.I.T. summer session activities.

To be given under the direction of Dr. Bernard E. Proctor, professor of food technology at the Institute, the intensive course will give particular emphasis to recent developments in food manufacture and control. In addition to lectures, demonstrations, and conferences at M.I.T. there will be opportunities for group visits to representative food industries throughout Greater Boston.

The course, intended principally for those having some knowledge of the basic sciences pertinent to food technology, should prove valuable to advanced students in other sciences as well as to executives and employees in food industries, according to Dr. Proctor.

Only a limited enrollment will be accepted, and preference will be given to those applicants having a background of technical or executive experience in food industries, faculty members of other schools, government workers in food control or nutrition, and advanced students in chemistry and engineering. Letters of application, giving the applicant's experience and background,

should be sent to Professor Gale at Room 3-107, M.I.T., Cambridge 39.

Tuition for the three-week course will be \$100; academic credit will be given for satisfactory completion of the course only to those who elect to take a final examination.

The John Thompson Dorrance Laboratory now under construction at the Massachusetts Institute of Technology will provide critically needed facilities for the Departments of Biology and Food Technology. Made possible by a gift of \$1,000,000 from the Campbell Soup Company, the new building is expected to be ready for occupancy early in 1952.

APHA Study in Sanitation Administration

More than 40 full time health departments, scattered from Connecticut to California, and serving more than five and a half million people, are engaged in a cooperative study with the American Public Health Association in sanitation administration, conducted by the Engineering Section of that organization.

The object of the study is to increase the efficiency of sanitation personnel and of sanitation services in local health departments.

Included in the study are measurements of the work load in each participating community, measurements of the time devoted to each program, and a study of the qualifications needed by sanitation personnel to carry on modern sanitation activities efficiently.

The work is being directed by I. M. Fisher, formerly with the U. S. Public Health Service, assisted by a small staff and guided by a special committee of experts in sanitation administration, personnel practice, and statistical analysis.

Sanitation Supply Service for Interstate Carriers

Five consolidated listings showing the sanitary status of sources from which United States railroads, airlines, buses, and ships normally obtain milk, ice cream, and drinking water supplies for their passengers when travelling in this country and Canada were released today by the Public Health Service of the Federal Security Agency.

Prepared by the Division of Sanitation of the Public Health Service, the listings contain the names, locations, and sanitary classification of 1,652 vessel watering points, 1,423 railroad watering points, 179 airline watering points, two bus watering points (New Orleans and Houston), 558 milk and fluid milk product sources, and 286 frozen dessert sources. The latter two lists appear under one heading.

The classifications were made by the Public Health Service on the basis of reports from State health departments. Carriers, in turn, are required by Interstate Quarantine Regulations to indicate annually which sources they use and to use only those then approved by the Surgeon General of the Public Health Service. Prior to the classifications issued today, the sanitary status of these sources was established whenever individual carriers submitted them for approval.

Future editions of the classifications will appear three times a year and will be dated January 1, May 1, and September 1.

Copies may be obtained from the Federal Security Agency's regional offices in Boston, New York, Washington, Cleveland, Chicago, Atlanta, Kansas City (Mo.), Dallas, Denver, and San Francisco.

Position Open in Milk Control

Dr. Edwin M. Knights, Deputy Health Officer, Providence, R. I., announces that there will be a position open in Providence in the field of milk quality control. The position is that of Director of Quality Control Program, Rhode Island Quality Milk Association, P. O. Box 830, Providence, R. I. Anyone interested is invited to apply to the Association.

The position will be open about July 1, 1951, with a starting salary of approximately \$6,000, which might be increased slightly for an exceptional candidate. The Association's Board of Directors consists of twelve members, with three each representing milk producers, milk distributors, consumer interests, and public health officials.

The following qualifications, suggested by this office, govern the position:

Citizenship: Citizen of the United States.

Education: (1) Bachelor's degree from a recognized institution of learning in one or more fields in the biological, chemical, or physical sciences; including, but not necessarily limited to, an undergraduate degree in one of the

following: dairy science, veterinary medicine, sanitary engineering, or bacteriology.

(2) Master's degree from an accredited school of public health or in one of the sciences listed in (1) above; provided, that two years of additional experience in milk control practice, public health practice, or dairy science will be accepted in lieu thereof.

Experience: (1) A minimum of eight years of experience in the field of milk sanitation, public health, or dairy science, at least 5 years of which should be in the field of public health control of milk supplies in the employ of a State, large municipality, or the Federal Government.

(2) At least two years of the public health milk control experience indicated in (1) above to be in an administrative or supervisory capacity with a State, municipality or the Federal Government.

Personal Characteristics: Personal qualities should include ability to deal with people, initiative, good judgment, industriousness, integrity, enthusiasm, and good habits.

laboratories will be visited annually and evaluated upon the quarters, equipment, procedures, results, and records. The checking of the performance will be undertaken by shipping split-samples at least twice a year with a total of not less than 50 specimens. The exact handling of these split-samples is in the process of being formulated. It is hoped that a method can be devised of freezing samples in small tin cans and shipped in boxes containing dry ice. Other methods for shipping split-samples such as glass containers will be given careful consideration, and it is hoped that a fair and adequate routine can be established.

The Bureau of Laboratories of Missouri will be evaluated by the United States Public Health Service and shall comply to all standards outlined. By the certification plan as outlined, many laboratories in Missouri will be delegated the responsibility of certifying shipments of milk leaving Missouri.

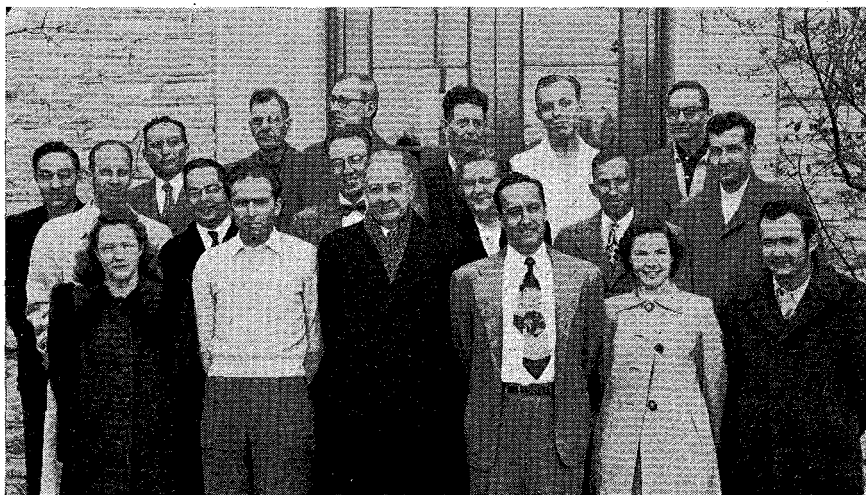
It is felt that with this beginning and constant vigilance of all, a shipment of milk leaving Missouri will be in close agreement in its bacterial count when received at its point of destination. The same high quality of milk will flow from state to state giving the "Best Quality of Milk for All."

Missouri Laboratory Certification

(Continued from page 65)

within the desired goal of 10 percent agreement. This was anticipated, and therefore a second day had been scheduled for the agar plate and direct microscopic count technics. The results from these procedures on the second day were exact and in complete agreement on the low count milks and within the 10 percent limit on high count milk.

The plan for certification for milk laboratories in the state has evolved from this working together. Rules and regulations by the Missouri Division of Health will be filed with the Secretary of State. These rules and regulations will cover type of personnel, standard equipment, and the volume of bacteriological milk work necessary to comply. All lab-



ATTENDANTS AT MISSOURI COOPERATIVE MILKSHOP

Third row, left to right: N. Ferraez, _____, Thomas Larsen, Dr. I. H. Baird, Robert G. Jensen, Burdet Heinemann
 Second row: Kermit Goddard, William J. Beck, Charles H. Harp, Irma C. Adams, _____, L. O. Shaffer
 Front row: Coialeen Monday, Joseph Edmondson, Dr. Robert Meyers, Kenneth L. Tallman, Wilma Zongker, C. H. Kearney

Industrial Notes

Klenzade Field Test Sets



pH Test Set

For determining the effective acidity of detergent solutions.

Alkaline Detergent Test Set

Checks concentrations of alkaline detergent solutions.

Chlorine Test Set

Ranging from 12 to 400 p.p.m., the use of this test is essential in checking the chlorine concentration of sanitizing solutions.

Quaternary Test Set

The expanding use of quaternary ammonium compounds has dictated the necessity for the development of a quaternary test set for testing concentrations of quaternary ammonium sanitizing solutions.

Water Hardness Test Set

Determination of water hardness is frequently used as a guide in products selection for chemical cleaning.

ABCB Caustic Test Set

Testing the caustic concentrations in bottle washing is an essential procedure for both industry and official control agencies.

Combination Field Test Kit

This kit contains, in the handy carrying case, all material necessary to make each of the six foregoing described tests.

Taylor Midget Testers

A. Contains standards for testing both low chlorine concentrations and pH.

B. Contains standards for testing low chlorine concentrations only.

Swimming Pool Test Set—Model H

More inclusive than the midget testers described above, and providing for wider test ranges.

Test for Quaternary Ammonium Compounds in Milk

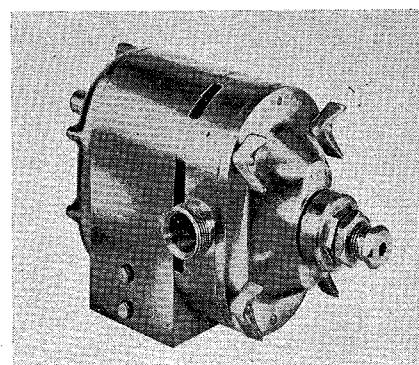
While not a field test, the determination of the presence of "quats" in milk is of considerable importance.

Inspecting the Brown H.T.S.T. Control System

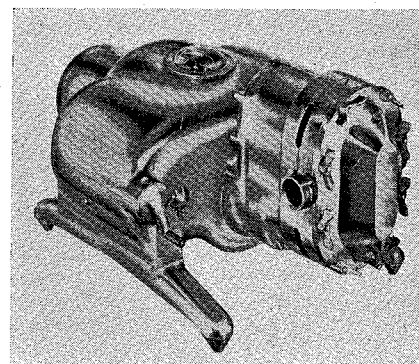
(Made by The Minneapolis Honeywell Regulator Company)

This booklet, for health authorities and technical plant personnel, describes and explains the installation, operation and maintenance of the Brown H.T.S.T. Control System. It treats the highly technical subject in a way that can be clearly understood by those involved in its use. It explains how the *Electronik* thermal limit controller is designed to give the food industry the advantages of more accurate temperature measurements and more positive control action, with a greater degree of protection and speed of response. The *Flo-Guard* diversion valve is designed to incorporate the improvements suggested by sanitarians and

dairymen to set a higher standard in safety, performance and appearance. W. T. F.



New Waukesha P.D. Sanitary Pump of Corrosion-Resistant "Waukesha Metal"



New Waukesha Shiftspeed Sanitary Pump showing speed change adjustment, indicator dial, high speed stop, and external sealing device



This is the new and completely modern plant of The Diversey Corporation (Canada) Ltd., Port Credit, Ontario, a subsidiary of The Diversey Corporation, Chicago. The building, which stands on 12 acres of land, contains 20,000 square feet of floor space, of which 6,300 are devoted to office, the balance to laboratory, manufacturing and warehousing.

Butter Industry Conference
University of Illinois, Urbana, Ill.
May 1-2, 1951

- Symposium: Butter Merchandising.
 Theme, "Let Us Sell More Good Butter." Chairman—
 I. C. Hochstrasser
1. Super Market Merchandising of Butter—Charles Brock
 2. More Butter for Bakers—Orval Aulse
 3. Selling Butter of Fine Flavor—John J. Wirt
- Factors Affecting the WIA Values—F. J. Babel
- Butterfat, Cholesterol, and Arteriosclerosis—F. A. Kummerow
- The Copper Content of Butter from Continuous Operations—Donald E. Miller
- The Outlook for the Butter Industry—Russell Fifer
- Continuous Butter Making—Sidney Quam
- The Butter-Pat as a Merchandising Feature Demonstration—J. W. Kalina
- The Armed Forces Requirements for an Edible Fat Spread—Carl A. Vorhes
- Conference Program Committee:
 General Chairman—P. H. Tracy;
 S. L. Tuckey, chairman; F. C. Fairchild, R. Robichaux.

Extent of Adoption of USPHS Milk Ordinance

The so-called Standard Milk Ordinance that is recommended by the U. S. Public Health Service, is in effect in 1,468 municipalities and 367 counties and districts, located in 38 states and 1 territory. It has also been adopted as state law or regulations in 32 states and 2 territories, in 13 of which it is enforced state-wide. Included are 55 cities of over 100,000, and 38 cities between 50,000 and 100,000 population. It is in effect in areas with a total population of over 58,000,000.

Included are 4 states, 10 counties, and 392 municipalities with compulsory pasteurization of all market milk or all except certified; in addition, the list of adoptions includes 36 counties and 269 municipalities with 100 percent pasteurization on a voluntary basis. There are 13 counties and 76 cities without any pasteurized milk.

Chronological and geographical summaries of adoptions are tabulated in a report just issued by the Federal Security Agency. Copies of the full report may be secured by writing to the Division of Sanitation, Milk and Food Branch, U. S. Public Health Service, Washington, D. C.

Calendar

- | | |
|----------------|---|
| April 23-25 | Missouri Milk and Food Short Course and Seminar, Columbia, Mo. |
| April 26-27 | Ohio Association of Public Health Sanitarians, Ohio Departments Bldg., Columbus Ohio. |
| May 7-11 | National Restaurant Convention and Exposition, Navy Pier, Chicago, Ill. |
| May 21-25 | Association of Food and Drug Officials, Hotel Adelpia, Philadelphia, Pa. |
| June 3-6 | National Sanitary Supply Association Convention and Exhibit, Hotel Hollenden, Cleveland, Ohio. |
| June 13-15 | Massachusetts Public Health Conference, Univ. of Mass., Amherst, Mass. |
| June 17-20 | Institute of Food Technologists, Convention and Exhibit, Hotel New Yorker, N. Y. |
| Aug. 21-25 | 15th National Convention, National Association of Sanitarians, Miami Beach, Florida. |
| Sept. 3-7 | Diamond Jubilee Meeting, American Chemical Society, New York, N. Y. |
| Sept. 26-29 | 38th Annual Convention, INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC., Glenwood Springs, Colorado. |
| Oct. 17-18 | 30th Annual Conference for Vermont Dairy Plant Operators and Milk Distributors, Burlington, Vt. |
| Oct. 29-Nov. 2 | American Public Health Association, San Francisco, Cal. |

Partial List of Films Relating to Milk and Food Sanitation

The Milk and Food Branch, Division of Sanitation, U. S. Public Health Service, has issued a list

of films relating to milk and food sanitation. It gives the sources from which films may be bought or rented, film catalogues, and a breakdown of films according to subjects, as follows: general restaurant sanitation, bacteriology and communicable disease, flies, milk, nutrition, rodent control, refrigeration, and water and plumbing. This list may be secured by writing to the above agency.

FEDERAL SECURITY AGENCY
 Public Health Service
 Washington, D. C.

Division of Sanitation
 Milk and Food Branch July 1950

Improved Synthetic Rubber from Milk

A new synthetic rubber, superior for certain uses to both natural rubber and other synthetic rubbers, has been developed by the U. S. Department of Agriculture.

This new rubber, known as "Lactoprene BN," has outstanding resistance to dry heat, water, oils, below-zero temperatures, and aging.

The improved rubber is made from butyl acrylate and acrylonitrile, compounds which can be produced from agricultural materials (milk or corn sugars). The rubber composition can be changed by varying the proportions of the two chemical ingredients. By this method, its swelling in oil can be modified without affecting its resistance to heat, a desirable advantage for uses involving exposure to oil.

Detailed information on the new rubber was published in the March issue of *Rubber Age*, in the Article "Butyl Acrylate-Acrylonitrile Rubbers Resistant to Heat, Oils, and Low Temperatures," by T. J. Dietz and J. E. Hansen. This information is also available in a new Bureau of Agricultural and Industrial Chemistry publication, AIC-302, which may be obtained from the Bureau in Washington, D. C., or from the Eastern Regional Research Laboratory, USDA, Philadelphia 18, Pa.

Roccal Reg. U. S. Pat. Off. and Canada SANITIZING AGENT

BRAND

Measures up in every way as the quaternary of choice

In the Dairy Industry, more than any other industry, the importance of using only the best in sanitizing methods cannot be over-emphasized.

In Roccal, the *original* quaternary ammonium germicide, the dairy industry is offered a product that is laboratory controlled and tested. The uniform quality of Roccal means uniformly good results in doing a proper sanitizing job.

Roccal is a powerful germicide. In recommended dilutions, it is non-poisonous, non-irritating to the skin, virtually odorless and tasteless.

In the dairy, Roccal can be used for every sanitizing job. For tank trucks, weigh tanks, pasteurizers, separators, bottle filling and capping machines, to keep walls and floors sanitary.

Try Roccal for just one week and watch your bacteria counts go down . . . down . . . down! Write us for new booklet describing Roccal's uses in the dairy plant and on the producing farm.

USES IN DAIRY INDUSTRY

To Sanitize:

- MILKING MACHINES
- TEAT CUPS
- COOLING TANKS
- TANK TRUCKS
- BOTTLE FILLING MACHINES and AS HAND and TEAT WASH
- MILK CANS
- WEIGH TANKS
- PASTEURIZERS
- SEPARATORS

In recommended dilutions Roccal is:

- POTENT**
- NON-POISONOUS**
- TASTELESS**
- ODORLESS**
- STAINLESS**
- NON-IRRITATING**
- NON-CORROSIVE**
- STABLE**



Insist on Genuine **Roccal** Reg. U. S. Pat. Off. and Canada SANITIZING AGENT

BRAND

Distributor of the products formerly sold by Special Markets-Industrial Division of Winthrop-Stearns Inc., and Vanillin Division of General Drug Company.

Sterwin Chemicals INC. 1450 Broadway, New York 18, N. Y.

SUBSIDIARY OF STERLING DRUG INC.

Distributed in the Dairy Field by Cherry-Burrell Corp. and other leading dairy supply houses.

FORTIFY ALL YOUR MILK WITH DELTAXIN® THE PUREST KNOWN FORM OF VITAMIN D₂



**perfect protection for
nature's most perfect food**

A L U M I N U M C O M P A N Y O F A M E R I C A

1742 Gulf Building, Pittsburgh 19, Penn.

BETTER
ALL 'ROUND
SANITATION
WITH THE



Dairyman Moldenhauer (left) shows his son how to sanitize a milk can with B-K Powder solution while Fieldman Zierow looks on.

B·K PATRON RELATIONS PLAN

This plan stresses the importance of a strict sanitation program on the dairy farm. Fieldmen for dairy plants from coast to coast are using this plan to encourage their patrons, the dairy farmers of America, to employ accepted sanitary practices that result in better quality milk.

Under this plan, the makers of B-K cleansers and sanitizers offer a variety of aids to the fieldman for his use with dairy farmers . . . all in the interest of better dairying practices and more strict sanitation.

Here are the types of free materials offered each month:

- Helpful leaflets explaining quality milk production.
- Informative letters dealing with seasonal and regional farm problems.
- Film strips, motion pictures and assistance in planning meetings.

Fieldmen and plant owners everywhere tell about the effectiveness of this plan.

Health officers and sanitarians who would like to review the materials offered each month are invited to write: Dept. 33, Pennsylvania Salt Manufacturing Company, Philadelphia 7, Pa. Extra copies of material will be gladly furnished upon request.

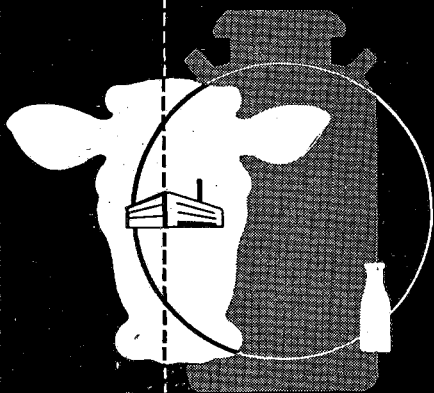


PROGRESSIVE CHEMISTRY FOR OVER A CENTURY

DIVERSEY

Planned Sanitation

helps you attain correct, year-around sanitation



— especially designed and easily applicable to all dairy plants

— gives plant operators a logical plan for assuring complete, easy, economical cleaning and disinfecting

— provides training in correct sanitation procedures for plant clean-up crews

— aids in the production of higher quality dairy products

Complete information and technical data . . . compiled especially for you are available upon request. We will be pleased to help you with your problems. Your inquiry is invited.

THE DIVERSEY CORPORATION

1820 Roscoe St., Chicago 13, Ill.

In Canada: The Diversey Corporation (Canada) Ltd., Lakeshore Road, Port Credit, Ontario

Index to Advertisers



Crown Cork and Seal Co.....II
 Schwartz Mfg. Co.....III
 Cherry-Burrell Co.....IV
 Johnson & Johnson.....VI
 Corn Products Refining Co.....VII
 American Can Co.....VIII
 The Borden Co.....IX
 Creamery Package Mfg. Co.....X
 Sterwin Chemicals, Inc.....XI
 Aluminum Company of America.....XII
 Penn Salt.....XIII
 Diversey Corp.....XIV
 Klenzade Products, Inc.....XIV, XV
 Oakite Products, Inc.....XVIII
 American Seal-Kap Corp.....XV
 Sunbeam Corp.....XVI
 Sealright Co.....XVII
 Waukesha Foundry Co.....XVIII
 Bowey's, Inc.....XIX
 Difco Laboratories.....Back Cover

MINERALIGHT Ultra-Violet Light
FOR DETECTING MILKSTONE, FATS AND OTHER SOILS

For Sanitarians, Field Men and Inspectors

Mineralight is a compact portable long wave ultra-violet light which causes fluorescence in milkstone, fats, and other soils not readily seen by the eye. Used like a flashlight. Operates 110 V-AC or batteries. Adapter available for 110 V-DC. Carrying case optional, but necessary for battery operation. Moderate cost. Valuable aid to any size plant. Indispensable in improving sanitary standards. Write for literature



KLENZADE PRODUCTS, INC., BELOIT, WIS.

WANTED

January 1948 copies of the Journal *if in good condition.*

Mail to

MR. WILLIAM B. PALMER

Journal of Milk and Food Technology
 29 North Day St. Orange, New Jersey

Will pay 30¢ per copy.

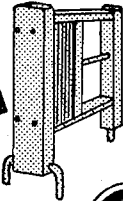
Protect YOUR HIGH TEMPERATURE EQUIPMENT

HTST PASTEURIZERS

VACUUM PANS

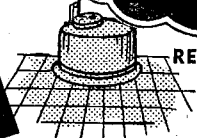
HOT WELLS

TUBULAR HEATERS



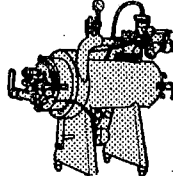
REMOVES BAKED-ON DEPOSITS

DISSOLVES LIME



RESTORES SPARKLE

QUICK GENTLE EFFICIENT



Better KLENZADE CLEANING METHODS

Klenzade products, Flash-Klenz, Flash-Kleen and Brite-Klenz, all specially developed for these tough cleaning jobs, keep high temperature equipment sparkling clean.

Complete methods and procedures have been scientifically worked out for each high temperature cleaning job. All are being practiced successfully in the field.

Stop harsh methods. . . . It costs no more to protect quality and equipment investment with Klenzade products and methods of cleaning high temperature equipment.

KLENZADE PRODUCTS, INC.
BELOIT, WISCONSIN

STOP HARSH METHODS Get the Facts!

Klenzade Products, Inc.
Beloit, Wisconsin

Please send complete details on Klenzade High Temperature Equipment Cleaning Methods for:

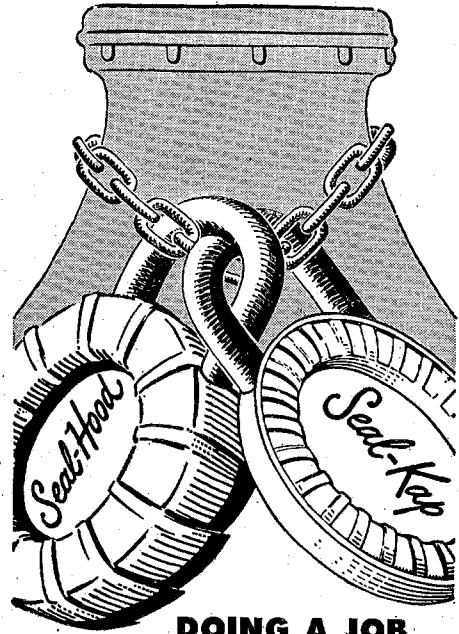
- HTST Pasteurizers
- Vacuum Pans
- Hot Wells
- Tubular Heaters

Name

Company

Street

City..... Zone..... State.....



DOING A JOB

Completely

Many bottle caps serve equally well in guarding milk against contamination until it reaches the consumer. But none offer more complete protection *after delivery* than Seal-Hood and Seal-Kap.

Both closures are easily removed. No special tool or prying fork is required. The hand need never touch the pouring lip. And once removed, both Seal-Hood and Seal-Kap snap snugly back on, as often as necessary, for maximum protection till the bottle is emptied. Being one-piece caps, they also obviate the tendency to discard a separate hood.

In every respect . . . wherever they're used . . . Seal-Hood and Seal-Kap are doing a job of protecting milk—*completely*. (And dairymen like the single-operation *economy* of these two closures.)

AMERICAN SEAL-KAP CORP.
11-05 44th DRIVE, LONG ISLAND CITY 1, N.Y.

COW CLIPPING TIME IS HERE

... the first step in the production of quality dairy products

Sunbeam
STEWART
ELECTRIC
CLIPMASTER

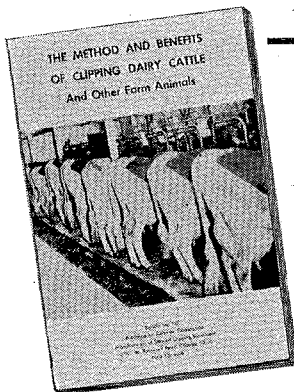
When cows are stabled, good sanitary practice calls for a regular clipping program. Clipped cows are easier to keep clean. Clean cows mean less sediment and a lower bacteria count. Milk with a lower bacteria content is more desirable.

Leading health authorities say: "A regular clipping program means more wholesome milk. It is an essential step in the production of quality dairy products." Emphasize the advantages of regular clipping. It reduces sediment; lowers bacteria, avoids contamination and increases profits from production of cleaner, higher quality milk.



Powerful air-cooled ball bearing motor inside the handle

Encourage this good dairy management practice. Educational helps, circulars, and visual aids are available to help you in your program.



NOW AVAILABLE . . . Bulletin 100—Simple 5-step method of clipping. Free upon request.

This handy manual graphically illustrates the simple steps that can be easily and quickly learned by anyone. Contains no advertising.

NAME _____

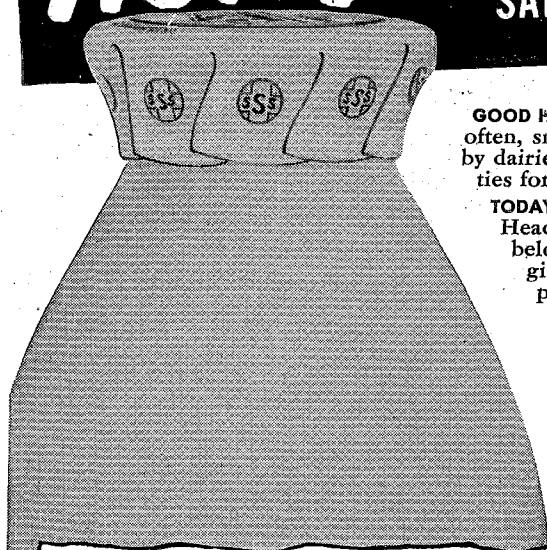
ADDRESS _____

CITY _____ ZONE _____ STATE _____

Mail to
Sunbeam CORPORATION (formerly Chicago Flexible Shaft Co.)
Dept. 142, 5600 West Roosevelt Road, Chicago 50, Illinois

NOW!

**SMALLER COMMUNITIES,
TOO, CAN HAVE SEALRIGHT
SANITARY PROTECTION**



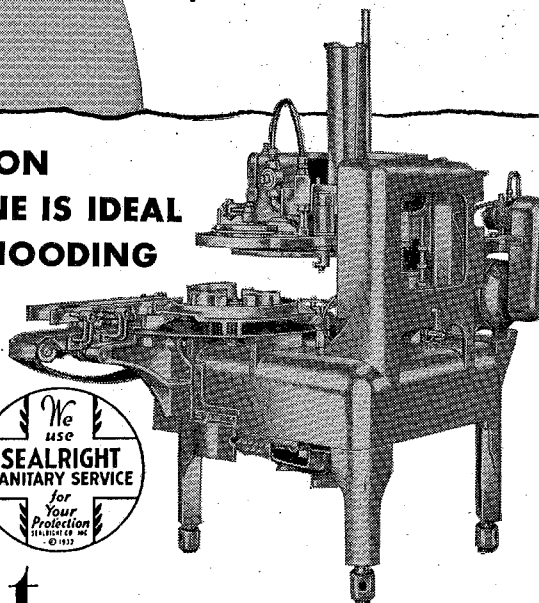
GOOD HEALTH IS EVERYBODY'S BUSINESS! All too often, smaller communities have been served by dairies which lack the most modern facilities for health protection.

TODAY THINGS ARE DIFFERENT! The new Single Head Sealon Applying Machine (shown below) has been expressly designed to give smaller communities the same milk protection found in the most progressive larger cities.

Because the **SEALON HOOD** protects the milk bottles' pouring surface all the way, *it has been found eminently acceptable to ALL Boards of Health!*

**NEW SEALON
APPLYING MACHINE IS IDEAL
FOR SPECIALTY HOODING**

Many dairies have found this machine particularly adaptable for specialty hooding. Famous Sealright Sanitary Protection is now possible for gallon milk containers, cottage cheese jars and even two-quart rectangular bottles.

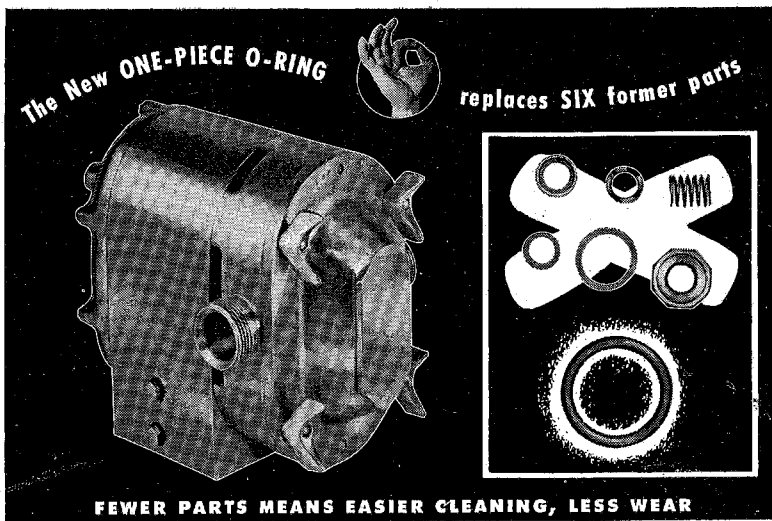


Sealright SEALON HOOD CLOSURES

SEALRIGHT CO., INC., Fulton, N. Y.; Kansas City, Kansas; Sealright Pacific Ltd., Los Angeles, Calif.;
CANADIAN SEALRIGHT CO., LTD., Peterborough, Ontario, Canada.

Simpler Sanitation...

Instead of 12—Just 2 Rotary Seal Parts to Clean



An important new development in sanitary pump design, the new Waukesha One-Piece O-RING Rotary Seal eliminates the complicated parts of old-fashioned rotary seals. In each New Waukesha Pump, you have only TWO of these rings instead of the usual twelve parts. These rings flip out easily, and snap back with a simple finger pressure — for time-saving disassembly and assembly. Already proven superior after thousands of hours of plant service, these O-Rings show no sign of leakage or wear. Replacement, if ever necessary, costs only a few cents.

The new One-Piece O-RING ROTARY SEAL is only one of many great advantages in the new Waukesha "P.D." Sanitary Pump. Get the whole story of really modern pump performance today. Write for latest bulletins and prices.

*P.D. — Positive Displacement for smooth flow.

- Super-streamlined compact design.
- Sanitary Corrosion-Resistant "Waukesha Metal" throughout requires no painting, refinishing.
- Handles all liquids and semi-solids.
- New adjustable ball feet — for easy floor sanitation.
- Completely sanitary.
- Fewer Bearing surfaces for longer wear.
- Every pump "performance tested" before shipment.
- Positive Displacement pumping.
- No-agitating—No-aerating—No-crushing—no battering of products.

WAUKESHA FOUNDRY CO.
WAUKESHA, WISCONSIN

Waukesha 100%
SANITARY PUMPS

Dependable Product of a Responsible Manufacturer

FREE—
Booklet Tells How
to Remove Milkstone

HERE'S the story on Oakite Compound No. 36, the acidic liquid detergent that removes milkstone and milk residues—fast. Booklet tells how Oakite Compound No. 36 cuts daily clean-up time . . . helps keep bacteria counts low . . . eliminates tedious brushing. **FREE** copy sent on request. Write today—

OAKITE PRODUCTS, INC.
386 Thames Street, NEW YORK 6, N. Y.
*Technical Service Representatives Located in
Principal Cities of United States and Canada*

OAKITE *Specialized* **CLEANING**
MATERIALS • METHODS • SERVICE

KEEP ABREAST

of the new developments in milk
and food technology through the

Journal of
Milk and Food Technology

Join the

International Association of
Milk and Food Sanitarians, Inc.

*Write the Association Secretary-Treasurer
for an application form.*

George A. West

44 Marshall Street, Rochester 2, N. Y.



Thanks! Inspector ...

**... FOR THE JOB YOU HAVE
DONE... AND FOR YOUR
CONTINUING EFFORTS TO
KEEP QUALITY FIRST!**

In our business, sanitation is a most vital aspect of quality. While we as manufacturers undertake the necessary research and inspection to keep DARI-RICH at the top in quality . . . it is your important function to *maintain* such standards in the field.

And these efforts over the years have greatly increased the quality of dairy products, including the nationally-famous DARI-RICH Chocolate Flavored Milk and Drink. For your help, we thank you—and endorse your constant vigilance to protect the health of our nation.





Culture Media for Examination of **MILK and DAIRY PRODUCTS**

for Plate Counts

BACTO-TRYPTONE GLUCOSE EXTRACT AGAR is recommended for routine plate counts of bacteria in milk. This medium conforms to all requirements of "Standard Methods for the Examination of Dairy Products" of the American Public Health Association, except that it does not contain skim milk.

BACTO-PROTEOSE TRYPTONE AGAR is recommended for determinations of the total bacterial plate count of certified milk. This medium is prepared according to the specifications of "Methods and Standards for Certified Milk" of the American Association of Medical Milk Commissions.

for Detection of Coliform Bacteria

BACTO-VIOLET RED BILE AGAR is widely used for direct plate counts of coliform bacteria. Upon plates of this medium accurate counts of these organisms are readily obtained.

BACTO-BRILLIANT GREEN BILE 2%

BACTO-FORMATE RICINOLEATE BROTH are very useful liquid media for detection of coliform bacteria in milk. Use of these media is approved in "Standard Methods."

for Detection of Molds

BACTO-POTATO DEXTROSE AGAR is an excellent medium for detection and enumeration of molds and yeasts in butter and other dairy products. The formula of this medium corresponds exactly with that specified in "Standard Methods."

BACTO-MALT AGAR is also widely used for determinations of the mold and yeast count of dairy products and for control of the sanitary conditions of manufacture.

for Cultivation of Lactobacilli

BACTO-TOMATO JUICE AGAR

BACTO-TRYPSIN DIGEST AGAR support luxuriant and characteristic growth of *Lactobacillus acidophilus*, and are well adapted for use in establishing the number of viable organisms in acidophilus products. These media are also widely used for estimation of the degree of implantation of *L. acidophilus*.

Specify "DIFCO"

The Trade Name of the Pioneers in the Research and Development
of Bacto-Peptide and Dehydrated Culture Media

DIFCO LABORATORIES

DETROIT 1, MICHIGAN