NOVEMBER, 1965
Vol. 28 P. 333-366 No. 11

Journal of

MILK and FOOD TECHNOLOGY

Official Publication

International Association of Milk, Food and Environmental Sanitarians, Inc.

The only transfer you'll ever have to make

. . . with Fargo® the only frozen starter concentrate for direct vat inoculation

No question about it! Now . . . you can eliminate those troublesome transfers with conventional cultures . . . and still maintain perfect product uniformity.

FARGO,® the new frozen starter concentrate, is designed for *directly inoculating* buttermilk, sour cream and cottage cheese. Each FARGO® culture contains billions of viable flavor and fast acid producing organisms in critically balanced proportions. There's no chance for a shift in strain balance. This unique, exclusive process eliminates mother cultures and bulk starters . . . improves flavor and aroma . . . does away with contamination and phage problems . . . reduces labor costs . . . increases curd yield!

Available in two convenient series and sizes, FARGO® is running up an unbeatable score with dairies who go for its winning combination of consistent quality with cost savings. Let FARGO® score in your plant. Clip the attached FARGO® FACTS coupon and mail it today.

DAIRYTECHNICS
2200 Glendening Street
Kalamazoo, Michigan

Please rush me your FARGO Fact File for direct vat inoculation in making cottage cheese, buttermilk and sour cream.

NAME _____

ADDRESS _____

CITY _____

STATE _____

JMT

ATTACH THIS COUPON TO YOUR LETTERHEAD

MANUFACTURED BY
dairytechnics
OF KALAMAZOO, MICHIGAN

DAIRYTECHNICS

2200 Glendening Street / Kalamazoo, Michigan

THE ONLY *Approved* SANITARY METHOD OF APPLYING A U. S. P. LUBRICANT TO DAIRY & FOOD PROCESSING EQUIPMENT

Haynes Spray

U. S. P. LIQUID PETROLATUM SPRAY

U.S.P. UNITED STATES PHARMACEUTICAL STANDARDS

CONTAINS NO ANIMAL OR VEGETABLE FATS. ABSOLUTELY NEUTRAL. WILL NOT TURN RANCID – CONTAMINATE OR TAINT WHEN IN CONTACT WITH FOOD PRODUCTS.

SANITARY—PURE

ODORLESS—TASTELESS

NON-TOXIC

This Fine Mist-like **HAYNES-SPRAY** *should be used to lubricate:*

SANITARY VALVES
HOMOGENIZER PISTONS – RING
SANITARY SEALS & PARTS
CAPPER SLIDES & PARTS
POSITIVE PUMP PARTS
GLASS & PAPER FILLING MACHINE PARTS
and for ALL OTHER SANITARY MACHINE PARTS which are cleaned daily.

The Modern HAYNES-SPRAY Method of Lubrication Conforms with the Milk Ordinance and Code Recommended by the U. S. Public Health Service

The Haynes-Spray eliminates the danger of contamination which is possible by old fashioned lubricating methods. Spreading lubricants by the use of the finger method may entirely destroy previous bactericidal treatment of equipment.

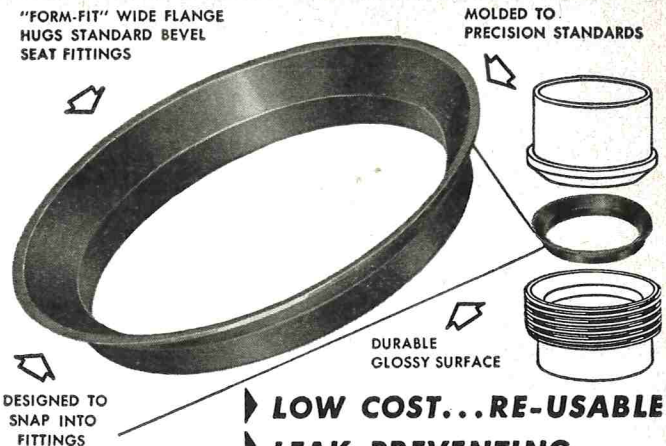
PACKED 6-12 oz. CANS PER CARTON
SHIPPING WEIGHT—7 LBS.

THE HAYNES MANUFACTURING CO.
4180 Lorain Avenue • Cleveland 13, Ohio

HAYNES-SPRAY INGREDIENTS CONFORM WITH FDA REGULATIONS AND CAN BE SAFELY USED AS A SANITARY LUBRICANT FOR FOOD PROCESSING EQUIPMENT WHEN USED IN COMPLIANCE WITH A EXISTING FOOD ADDITIVES REGULATION.

INDEX TO ADVERTISERS

HAYNES SNAP-TITE GASKETS



LOW COST...RE-USABLE
LEAK-PREVENTING
NEOPRENE GASKET for Sanitary Fittings

Check these SNAP-TITE *Advantages*

Tight joints, no leaks, no shrinkage
Sanitary, unaffected by heat or fats
Non-porous, no seams or crevices
Odorless, polished surfaces, easily cleaned
Withstand sterilization
Time-saving, easy to assemble
Self-centering
No sticking to fittings
Eliminate line blocks
Help overcome line vibrations
Long life, use over and over

Available for 1", 1½", 2", 2½" and 3" fittings.
Packed 100 to the box. Order through your dairy supply house.

THE HAYNES MANUFACTURING CO.
4180 Lorain Avenue • Cleveland 13, Ohio

A HEAVY DUTY SANITARY LUBRICANT

Available in both
SPRAY AND TUBE

All Lubri-Film ingredients are approved by F.D.A. and can be safely utilized as a lubricant for food processing equipment when used in compliance with an existing food additive regulation.

ESPECIALLY DEVELOPED FOR LUBRICATION OF FOOD PROCESSING AND PACKAGING EQUIPMENT

For Use in Dairies — Ice Cream Plants — Breweries — Beverage Plants — Bakeries — Canneries — Packing Plants

SANITARY • NON TOXIC • ODORLESS • TASTELESS

SPRAY — PACKED 6 — 16 OZ. CANS PER CARTON
TUBES — PACKED 12 — 4 OZ. TUBES PER CARTON

THE HAYNES MANUFACTURING CO.
CLEVELAND 13, OHIO

DIFCO

Detection of the

SALMONELLA - SHIGELLA

Group

BACTO- S S AGAR

a selective medium designed for isolation of fastidious *Shigella* and *Salmonella* strains. The selective action of the medium restrains development of coliform bacteria with minimum restriction of the pathogens.

BACTO-BISMUTH SULFITE AGAR

a high selective medium for isolation of *Salmonella typhosa*. The unusual selective properties permit inoculation of the medium with large amounts of suspected material.

BACTO-MacCONKEY AGAR

an excellent differential medium for use in conjunction with Bacto- S S Agar and Bacto-Bismuth Sulfite Agar.

BACTO-TETRATHIONATE BROTH BASE
BACTO-SELENITE BROTH

enrichment media for isolation of intestinal pathogens. These are excellent aids in the detection of carriers and examination of other materials for members of the *Salmonella Shigella* group.

Specify "DIFCO"

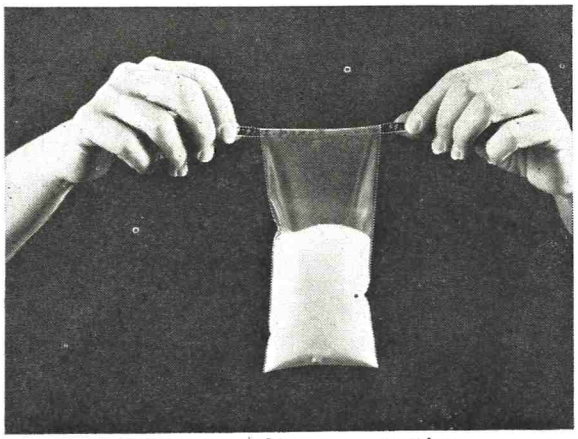
DIFCO LABORATORIES
DETROIT 1, MICHIGAN

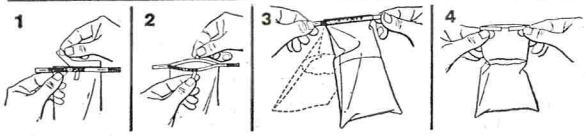
When little things mean a lot

S/P

scientific products

GENERAL OFFICES:
1210 LEON PLACE
EVANSTON, ILLINOIS





Simply whirl tab closed, unfold to open.

Because they mean a lot to you, they mean a lot to us. That's why S/P maintains 16 distribution centers, offers more than 30,000 items. For example—sterile, ready-to-use, polyethylene Whirl-Pak Bags with pull-tab closures. They hold liquid, solid or granular samples safely and conveniently, discard after use. They can mean a lot in your laboratory.

S/P Whirl-Pak Bags

No.	Dimensions	Each	Pkg. of 500
B1205-6X	7¼" x 3"	3¢	$15.00
B1205-18X	9" x 4½"	4¢	20.00

Send for your free copy of the S/P 1965 catalog of plastics and disposables.

OFFICERS AND EXECUTIVE BOARD

President, FRED E. UETZ, 395 Maitland Ave., West Englewood, N. J.

President-Elect, PAUL R. ELLIKER, Dept. Microbiology, Oregon State University, Corvallis, Oregon.

First Vice-President, A. N. MYHR, Dairy Science Dept., Ontario Agric. College, Guelph, Ontario, Canada.

Second Vice-President, SAMUEL O. NOLES, Dairy Division, Florida State Board of Health, Jacksonville, Florida.

Junior Past-President, W. C. LAWTON, 2424 Territorial Rd., St. Paul, Minnesota.

Senior Past President, JOHN H. FRITZ, 2904 62nd Ave., Riverdale, Maryland.

Publication Board

DR. J. C. OLSON, JR. H. L. THOMASSON
KARL K. JONES

Editors

DR. J. C. OLSON, JR., *Editor,* Dept. Dairy Industries, University of Minn., St. Paul 1, Minn.

W. J. DIXON, *Ass't. Editor,* 1667 Royce Ave., Beloit, Wisconsin 53511

H. L. THOMASSON, *Executive Secretary and Managing Editor,* Box 437 Shelbyville, Indiana

Editorial Board

C. A. ABELE ---------Chicago, Illinois
H. S. ADAMS ----Indianapolis, Indiana
F. W. BARBER ------Glenview, Illinois
L. A. BLACK ---------Cincinnati, Ohio
J. C. FLAKE ----------Chicago, Illinois
L. G. HARMON ---East Lansing, Mich.
E. K. HARRIS ---------Cincinnati, Ohio
R. P. HAYWARD ----------Bowie, Md.
C. A. HUNTER ---------Topeka, Kansas
C. K. JOHNS --Ottawa, Ontario, Canada
O. W. KAUFMANN --East Lansing, Mich.
W. C. LAWTON ----St. Paul, Minnesota
P. W. PURDOM ------Philadelphia, Pa.
G. E. REINBOLD ----------Ames, Iowa
W. S. MUELLER -------Amherst, Mass.
K. G. WECKEL ----Madison, Wisconsin
J. C. WHITE ---------Ithaca, New York

The Journal of Milk and Food Technology is issued monthly beginning with the January number. Each volume comprises 12 numbers Published by the International Association of Milk, Food and Environmental Sanitarians, Inc. with executive offices of the Association, Blue Ridge Rd., P. O. Box 437, Shelbyville, Ind.

Entered as second class matters at the Post Office at Shelbyville, Ind., March 1952, under the Act of March 3, 1879.

EDITORIAL OFFICES: J. C. Olson, Jr., Editor, Dept. Dairy Industries, University of Minn., St. Paul, Minn.; H. L. Thomasson, Managing Editor, P. O. Box 437, Shelbyville, Ind.

Manuscripts: Correspondence regarding manuscripts and other reading material should be addressed to J. C. Olson, Jr., Editor, Dept. Dairy Industries, University of Minn., St. Paul, Minn.

"Instruction to Contributors" can be obtained from the editor for the use of contributors of papers.

Journal of

MILK and FOOD TECHNOLOGY

INCLUDING MILK AND FOOD SANITATION

Official Publication

International Association of Milk, Food and Environmental Sanitarians, Inc.

REG. U. S. PAT. OFF.

Volume 28 November, 1965 Number 11

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

Subscription Rates: One volume per year, Individual non-members, Governmental and Commercial Organization subscription.

1 yr. ---------- $ 8.00
Public and Educational Institution Libraries, 1 yr ---------- $ 6.00
Single Copies ---------- $ 1.00

Orders for Reprints: All orders for reprints should be sent to the executive office of the Association, P. O. Box 437, Shelbyville, Ind.

Membership Dues: Membership in the International Association of Milk, Food and Environmental Sanitarians, Inc., is $7.00 per year, which includes annual subscription to the **Journal of Milk and Food Technology.** All Correspondence regarding membership, remittances for dues, failure to receive copies of the **Journal,** changes in address, and other such matters should be addressed to the Executive Secretary of the Association, H. L Thomasson, Box 437, Shelbyville, Indiana.

COPYRIGHT 1965 INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS, INC.

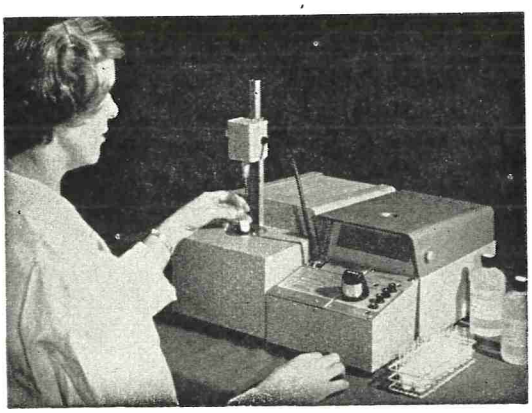
Q. *Why is the* ADVANCED MILK CRYOSCOPE *the recognized leader in cryoscopy?*

A. Here are a few user reasons:

1. First in Sales.
2. Most Official & University users.
3. Easiest and most Accurate to operate.
4. Only Advanced Milk Cryoscopes follow the AOAC & APHA Methods (details on request).
5. First "Hot-Line" Customer service:
   - Collect telephone — user to factory expert
   - Largest stock of parts for same-day shipment
   - Only modular design for unplug-&-replace service
   - Largest team of local sales and service engineers
   - Most complete User's Guides
   - First and Most Regional Schools and Workshops — continued technician training and certification
6. Publishers of *Milk Cryoscopy News*.
7. Only Cryoscope continually improved for performance — not just style. Always follows Uniform Universal Thermodynamics.

For 15 other exclusive features, write or call collect today.

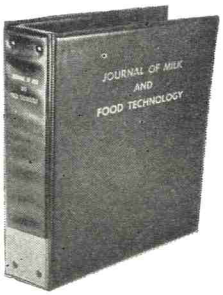
Complete details on the Advanced Milk Cryoscope are presented in this brochure. Write today for your copy.



ADVANCED INSTRUMENTS, INC.
43 Kenneth Street / 617 DEcatur 2-8200
Newton Highlands, Massachusetts, 02161

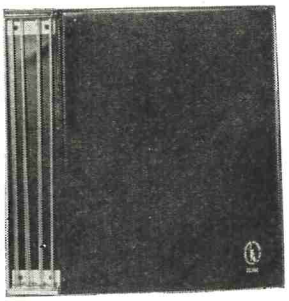
SPECIAL JOURNAL BINDER AVAILABLE

Keep each volume of your Journal of Milk and Food Technology intact in this new especially designed binder.



1 Binder—$3.75 Postpaid
2 Binder—$3.50 Postpaid
3 Binder—$3.25 Postpaid

4 or more—$3.00 ea.
F.O.B. Shelbyville, Indiana
(Shipping Weight—1 lb. 10 oz. each)



HAS INDEX SLOT ON BACK EDGE — BINDER MADE OF BLACK PLASTIC. JOURNALS EASILY INSERTED AS PUBLISHED.

IAMFES, Inc., P.O. Box 437, Shelbyville, Ind.

PRESIDENTIAL ADDRESS[1]

W. C. LAWTON

President, International Association of Milk, Food, and Environmental Sanitarians

President, W. C. Lawton, delivers Presidential Address.

It has traditionally been the privilege of your president to address this opening day session of the annual meeting, and I would like to take a few minutes to assess some Association affairs, as is customary for each president. I will then take the liberty of outlining several controversial areas, and present my views. I do this in the hope that it will provide each of you with at least one side of a number is issues that vitally affect the status of your Association, and so stimulate consideration of the many aspects of Association problems.

In looking over the program, I recognize the names of people I know and have heard give talks, and realize you are deeply fortunate in having a very great amount of information brought to you during the next few days. However, I hope you will have some time during this busy period to discuss some of the problem areas of the Association that has made this fine program possible.

Progress has been made during the past year in several areas, although I am sure not enough to satisfy all persons. Last year in Portland, the Journal Management Committee made extensive recommendations for the improvement of the Journal. These proposals are in the process of being implemented, and the employment of Mr. Bill Dixon, as assistant editor, was the first step. Bill has made great strides in developing sources of material of a popular nature that have been much in demand by many members. Developing such material is a slow and laborious process, but I believe the last couple issues reflect his efforts in this direction. I am sure he would welcome help and suggestions from all of you. It is hoped that additional steps to provide the executive secretary with more help to free him from routine duties will enable Red to devote more time to further building and strengthening the Association he has done so much to develop over the years.

The Intersociety Relations Committee presented a detailed procedure—complete with priorities—to accomplish closer working relationships with the various sanitarians associations. Your Executive Board will spend considerable time working on this report during this meeting. I believe the work of this committee can very well lead to a solution to the complex problems of multiple associations of sanitarians.

The Committee on Communicable Diseases has worked long and hard on a revision of the booklet, "Procedures for the Investigation of Foodborne Disease Outbreaks." The final manuscript has been submitted, and is presently being prepared for the printer. It should be available for sale in the very near future. This committee is another example of the valuable contributions the Association makes to the health and welfare of the entire community.

In this same category is another committee that should be mentioned, namely, the Sanitary Procedures Committee, which has continued to work diligently in the development of 3-A sanitary standards for dairy equipment.

While we single out these two committees for special mention, we should not overlook the fact that a great number of other committees and a large number of Association members have worked long and hard on other committee activities, which have contributed a great deal. Over the years the committees of International have contributed greatly to its strength and importance, and I am sure will continue to do so.

In this area of discussion on the following subjects I feel a bit like the preacher in church, as I am sure

[1]Presented at the 52nd annual meeting of the INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS, INC., at Hartford, Connecticut, September 13-16, 1965.

I am talking to the wrong audience. I have heard a considerable number of comments about the Journal of Milk and Food Technology during the past year—particularly with reference to its content. Many of these comments indicate Journal material is too technical. I believe we must have a hard look at our Journal and its purpose, as it reflects the manner in which our organization is evaluated by others.

The August issue of Food Technology carried a very fine review in its toxicology section on a paper published in our Journal during the past year. This type of review does much to enhance the prestige of our Journal, and all members of the Association.

Practically every chapter of Standard Methods for the Examination of Dairy Products relies heavily on material published in the Journal. This type of citation certainly helps to advance our Association in the eyes of the professional community.

Of course, our Journal is published primarily for the use of our members, but I refuse to believe that our membership as a whole wants a cookbook approach, listing a series of how-to-do-it projects for sanitarians. A professional publication should provide the basic information in its field, and the practitioner—if he is professionally competent—should be able to evaluate and formulate this material into a workable day-to-day program.

It is understandable that there is not sufficient material published on the many facets of employment represented by our very diverse membership, but you have a part of the remedy in your hands.

A recent conversation with our editor has revealed that there have been very few papers in the general or non-technical catagory rejected during the past few years. This means if you don't see the material you would like, persuade your colleagues who have the information to communicate with our Journal editors. I am sure Doctor Olson and Bill Dixon would welcome all material you will send, as an editor likes to be able to select the best material available for publication. During my year as president, I have not received a single comment or criticism on Journal material that has been accompanied by a concrete article or material on the subject desired. Any criticism we make should be constructive rather than destructive.

I believe we all recognize the need for more general information articles, as distinguished from purely research type papers. This is the area Bill Dixon has been striving to develop, so please give him all the help you can so we can develop a Journal that will be both professionally competent and serve the daily needs of our membership. I believe it can be done.

We hear a great deal of discussion about the professional status of sanitarians. Many sanitarians are, of course, professionals in their knowledge and approach to their jobs, but I am afraid we still have many people striving for professional recognition as a means of enhancing their incomes, rather than for any other reason.

A recent study by students at the University of Oklahoma clearly points out that the layman's knowledge of our profession and the name "sanitarian" are woefully inadequate. A summary of this brief study was published in the July issue of the Journal, and it indicates we have a long way to go in convincing the public that we are a profession, or even educating them about what a sanitarian does. After all, we can only be considered a professional group when we are so recognized by the general public.

The question of "What is a professional?" has never been clearly defined, because in many ways it is a state of mind. A recent note in a Texas health publication gave me quite a shock. This article pointed out that one requirement for membership in the American Academy of General Practice was at least 150 hours of graduate training every three years. If the members do not comply, they are dropped from membership. I wonder how many of us in this room could maintain our membership in International if this were one of the requirements. I am sure if it were, we would very quickly elevate the educational level of our membership or greatly reduce its numbers.

I think the main point I wish to get across is that we cannot beg, buy or legislate ourselves into a professional status. We must earn our way.

I now come to a most unpopular subject—the question of dues. We have a motion before this group to increase dues, which was tabled at the 1964 annual meeting. None of us likes to think about the increase in costs but if we are to increase and improve services, we must pay for them in some manner. A committee of past presidents presented several methods to increase revenues—all of which have been explored and discussed. One or more will be pursued, and will yield a modest increase in revenue, but the fact remains that the major support must come from membership dues.

The coffee break has become an American institution, and any of you that participate to the extent of one cup of coffee per day is spending more each week on coffee than he is on his professional membership for a month; one pack of cigarettes a day cost more in one month than the annual dues; the cost of membership in the American Bar Association or the American Medical Association for a year will pay most any one of our members dues for a lifetime.

I am not aware of a single national association publishing a monthly Journal that does not have dues

considerably above our own. I would like to comment on a publication of one of our affiliates that came to my attention recently, in which this affiliate is already changing its by-laws in anticipation of a dues increase by International, and they very clearly point out that—while they have no knowledge of a dues increase—they feel certain that continued service by International cannot be maintained on existing dues. I leave it to your good judgment to evaluate your position on a dues increase for your Association.

I would like to comment briefly on membership participation in our Association affairs. The opportunities are not always dramatic and important, but there are many ways in which a member can serve notice he is interested. Our first attempt at a mail ballot to elect officers for the Association returned considerably more votes than are usually cast at any annual meeting. In fact a total of 442 people cast ballots, but this still only represents about 10 percent of our total membership, and to me indicates a great lack of interest in how the organization is run. The Chairman of the Nominating Committee indicated to me he did not receive a single suggestion for nominations from any member, despite the fact a request was published in the Journal.

We have a continual struggle—despite urgent appeals—to come up with a reasonable number of nominations for the Sanitarians Award, and I know we have many sanitarians who are both worthy of this award and can use the $1,000. You can all strengthen this award by making it a real competition each year and helping in selecting and presenting nominees.

It is interesting to note that the numbers attending our annual meeting each year stay about the same, and I am sure a high percentage are those who attend year after year, but it still represents less than 10 percent of our membership. I would certainly consider attendance at an annual meeting an important aid in maintaining and developing skills, as well as participating in the affairs of the Association. I would hope that each of you here could be a missionary when you return home, and convince the people who control the purse strings—your wives or otherwise—that attendance at meetings such as this is essential among your efforts to be adequately informed.

I hope I have given you some reason to be proud of your Association and profession, some reason to be disappointed, and many reasons to strive to improve it.

PREVENTION OF ACCIDENTAL INJURIES—A PUBLIC HEALTH ACTIVITY

D. G. KURVINK

Division of Sanitary Engineering
State Board of Health
Pierre, South Dakota

Prior to consideration of the extent and possible methods of control of accidental injuries by public health programs, the fundamental relationship between this problem and public health should be reviewed. This seems especially appropriate in view of the apparent reluctance of public health agencies and personnel to include accident prevention within the realm of their routine responsibilities.

Professor C. E. Winslow provided assistance in delineating those items to be included in the public health field with his definition which states that: "Public Health is the science and the art of preventing disease, prolonging life, and promoting physical health and efficiency through organized community efforts." There may be some justification for not accepting accidental injuries as being a preventable "disease" having the traditional association with biological agents which have been experienced in the past; however, the data and information now available in regard to accidental injuries should leave little doubt as to their capacity for shortening life and destroying the health and efficiency of large numbers of people.

Aside from the academic relationships, there are also legal factors to be considered in regard to programs which can be carried out by official health agencies. Health departments are part of the executive branch of government and have been primarily concerned with carrying out those functions delegated by the legislative branch. In carrying out such responsibilities, it has been necessary in certain instances to refer to decisions of the judicial branch to establish if adequate legislative authority has actually been delegated.

Specific legislative responsibility for prevention of accidental injuries has not been delegated to the

[1]Presented at the 17th Annual Conference, South Dakota Association of Sanitarians, Yankton, South Dakota, July 13-16, 1965.

State Department of Health in South Dakota. General authority to provide for such a program is indicated within Chapter 27.0104 of the 1960 Supplement to the South Dakota Code which states: "Advisory Council: Powers. The Public Health Advisory Council shall have the power: . . . (3) To make, alter, and enforce all rules and regulations and to take such action or cause to be made such investigations as may be required in the interest of public health". A general idea of what the judicial branch may consider to be the intent of the Legislature as being in the "interest of public health" was contained in a recent Attorney Generals Opinion (Citation from Kansas court case contained in Air Pollution opinion.) which indicated that public health properly includes hazards to the health of the "community at large".

In summary, with some modification in traditional orientation of public health personnel to include other than biological hazards, accident prevention could be acceptable within the definition of public health. In addition, even though from the standpoint of authority and appropriations it may be preferable to have a specific legislative directive for an accident prevention program, sufficient legislative basis quite probably exists at present for accident prevention activities provided that adequate hazard to the health of the general public can be demonstrated.

EXTENT OF THE ACCIDENTAL INJURY HAZARD

One of the primary sources of information which can be utilized to gauge the need for preventive health programs are data regarding cause of death. Such data are contained within annual reports of the Division of Public Health Statistics of the State Department of Health. National cause of death data are also available from the National Office of Vital Statistics.

Using data available from the National Office of Vital Statistics, it has been reported that accidents were the leading cause of death in the United States in 1962 for ages 1 to 36. Cause of death reports also reveal that, during this same year in the United States, accidents were the fourth leading cause of death for all ages killing 97,451 people. Motor vehicle accidents were responsible for 40,804 of these accidental death. In other words, in 1962 accidental injuries killed a population in the United States which was greater than the combined 1960 populations of Sioux Falls and Aberdeen.

Review of cause of death data for South Dakota as published in the 1963 report of the Division of Public Health Statistics reveals the same relative position for accidental deaths in South Dakota. Accidents were the leading cause of death between ages 1 through 34 and also were fourth in the leading cause of death for all age groups. In the age group 15 through 34, accidents killed more people than all of the other causes of death combined. In this instance, accidents killed more people in South Dakota in 1963 (505) than the 1960 census population of Emery. Motor vehicle traffic accidents were responsible for 214 of these deaths.

How does South Dakota compare with other states in regard to the accidental injury hazard? The National Safety Council has used 1962 accidental death data from all states in calculating death rates which can be used for comparisons. The national accidental death rate for the United States in 1962 was 52.2 deaths per 100,000 population. In this same year, South Dakota had an accidental death rate of 71.6 per 100,000 which was greater than four of the six bordering states (Minnesota — 47.5, Iowa — 57.1, Nebraska — 63.7, North Dakota — 57.0, Wyoming — 78.9, Montana — 84.9).

It is recognized that if complete reporting were also available for morbidity from accidental injuries, further need for prevention could be demonstrated; however, the data regarding the relative ability of accidents to kill people describes a health hazard which does not appear to be in context with present public health control efforts. This is unfortunate in that public health personnel are among the few having the methodology, experience, and opportunity to reduce the accidental injury problem.

PUBLIC HEALTH CONTROL PROGRAMS

The history of public health contains several success stories involving the reduction of diseases of large populations. As indicated previously, these have been primarily associated with biological hazards. It is becoming increasingly evident that if public health workers wish to continue to contribute to the control of the leading hazards to health, they must broaden their activities to include the physical and chemical hazards.

Certain individuals concerned over this need for change have proposed that the inclusion of physical and chemical health hazards need not require an entirely new public health approach. In fact, it has been suggested that the same general methods for evaluating and controlling biological agents could also be used for physical and chemical agents.

The epidemiological approach for the control of biological hazards has been described as involving the following steps: (1) collection and analysis of data, (2) examination of apparent relationships for factors of causation, (3) establishment of a hypothesis regarding causation and testing them under controlled conditions, (4) development of control measures and testing them for effectiveness, and (5) in-

corporation of the successful control methods into programs of accidental injury control. There have been attempts to conduct certain of these steps such as the collection and analysis of accidental injury data; however, with a few recent exceptions, several of the accident prevention programs have not considered the application of the entire epidemiological approach or have failed in properly carrying out one of several of the steps necessary for success.

Public health programs usually have a portion or all of step 1 of the epidemiological method available within their present vital statistics division at least in regard to collection of cause of death data. This is not meant to indicate that a complete data collection program should be limited only to those accidental injuries which result in death. There is a need for public health agencies to accept responsibility for analysis of this data and proceed to step 2 regarding the establishment of cause for the accident.

The assignment of cause for an accident or the etiology of an accident mentioned in step 2 is very important and can be accomplished in much the same manner as was used in regard to biological hazards. This would be based upon the contention that all accidental injuries, similar to communicable diseases, result from factors associated with the host (child, farmer, salesman, etc.), agent (typhoid organism, corn picker, automobile, etc.) and environment (school, farm, highway, etc.).

For example, in an oversimplified situation it could be said that cases of typhoid fever resulted when susceptible children (host) ingested live Salmonella typhosa organisms (agent) from a contaminated school well (environment). Similarly, many South Dakota farmers (host) are seriously injured or killed by corn picker (agent) accidents in our farm fields (environment).

The primary purpose in assignment of causation factors is to determine which or how many of these factors may be subject to control as indicated in steps 3 through 5 of the epidemiological method. In the case of typhoid fever in school children, there may be some success in educating children not to drink from private wells in schools; however, it is doubtful that this would be as effective as efforts directed toward provision of a safe water supply of immunization. In certain instances, controls may be possible and necessary for all three factors of causation.

As for the corn picking accidents of farmers, it is quite obvious that education of the host about the hazard has not been entirely satisfactory. Further study of this problem would possibly reveal a critical need for radical design changes in the corn picker or agent which would enable a farmer to pick his corn safely under the variety of environmental conditions which he encounters.

Who would be responsible for determination of the need and the promotion for such changes in design? Certainly the equipment companies and farmers have an interest; however, it could not be expected that they have the source of data regarding the need or knowledge as to proper handling of health hazard data which should now be present in agencies equipped to deal with health problems of large groups of people. In any event, it would appear that little change can be expected in this particular agent until such a time as a more convincing need can be presented to justify the cost and problems involved.

WHAT CAN BE DONE NOW

Tabulation of the number of people killed by accidental injuries leaves little doubt that health of the "community at large" is in jeopardy from this problem. Attempts are being made within some public health programs as well as other groups to prevent accidental injuries; however, the contributions which could be made through application of the epidemiological method have not been generally appreciated.

Until such a time as a more inclusive accidental injury program can be formulated, individual public health workers should continue to assist in accident prevention by recognizing this program as a valid portion of their particular specialty. An example of this is the inclusion of requirements for fencing and depth markers for swimming pools. This type of operation lacks some of the statistical guidance and effectiveness of a complete accident prevention program and may neglect some of the serious accidental injury areas; however, it should help reduce several hazards and tend to orient public health people toward increased participation in this field.

A COMPARISON OF CIRCULATION CLEANING WITH LYE-FLOODING OF PIPELINE MILKING MACHINE

P. A. O'Callaghan, L. F. L. Clegg and I. Vasic

Department of Dairy and Food Science,
University of Alberta, Edmonton, Canada

(Received for publication July 30, 1964)

Although pipeline milking installations have been in use for several decades, it was not until recently that they have become widely accepted. The early pipelines were installed in milking parlors and it was necessary to dismantle them for cleaning after each milking. With the advent of cleaning-in-place (C.I.P.), dismantling after each milking became unnecessary and longer pipelines fitted around the barn became possible. Until now all C.I.P. involved movement of the solution through the pipeline milker by vacuum recirculation or vacuum and gravity or reverse direction vacuum or a pressure system. All these systems involve a short contact time with the sanitizing solution. Separate detergent and sanitizer treatments may be used or both treatments may be combined by the use of detergent-sanitizers.

A method involving a long contact time with the detergent-sanitizer solutions termed immersion cleaning was developed by Thiel et al. *(2, 3)* and involves immersion of the clusters and other suitable parts in a lye-EDTA (ethylenediaminetetra acetic acid) solution in specially designed containers for the complete time between milkings.

An analogous method termed "lye flooding" is now being developed for pipeline milkers. In this paper a comparison is made between the new method and a vacuum recirculation method using separate detergent and sanitizing solutions.

Materials and Methods

The pipeline milker used for the tests was a stanchion installation in the University of Alberta dairy barn with a round-the-barn pipeline. It consisted of 4 milking units and 250 ft of 1.5-inch diam glass line. The pipeline was connected to a 500-gal vacuum bulk milk tank. Two milking units from each of two manufacturers, Surge and De Laval, were used. The two types differed in that the Surge cluster contained a breaker cup whereas the De Laval cluster contained a claw-piece. A description of the installation as set up for circulation cleaning and as later modified for the lye flooding is given below.

Circulation cleaning

A diagram of the circulation cleaning arrangement is shown in Figure 1. The cleaning procedure was automatically controlled. The basic components of the automatic washer arrangement were the control panel and the wash unit (2-Figure 1). The control panel incorporated the electrical

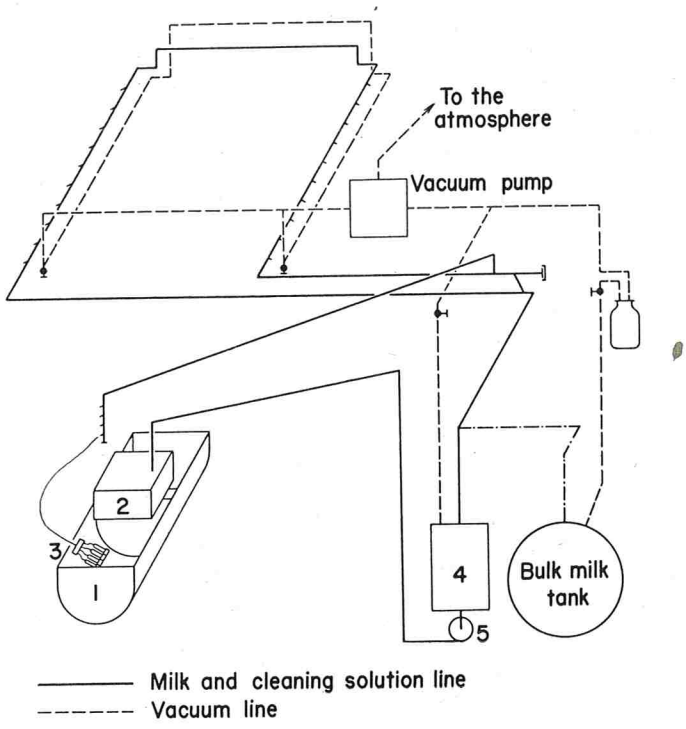


Figure 1. Circulation cleaning arrangement.

relays and timer controlling the various washing and disinfecting cycles, both of which could be varied. The wash unit held the switches, water solenoid valves, mixing valve, detergent chamber and water diversion valve.

The milking machine clusters (3) to which air bleeders were attached were placed in the wash trough (1) and connected to a manifold at the end of the milk line. The other end of the milk pipeline and the vacuum line were attached to the top of a 5-gal stainless steel receiver (4). The bottom of the receiver was connected to the wash unit (2) through a pump (5) containing a check valve. The solutions, mixed with air, were drawn by vacuum from the wash trough through the milking machine clusters and pipeline to the receiver from which they were pumped to the wash unit. During the detergent washing operation the solution was returned to the original reservoir from which it was recirculated, and during the rinsing and sanitizing operations it was run to waste.

The sequence of operations was as follows. Immediately after milking, the line and clusters were pre-rinsed with 20 gal of water at 85 F; this was followed by a recirculated wash with 0.5% trisodium phosphate for 20 min. The temperature of the detergent solution before circulation was 140 F and at the end of the 20-min period had dropped to 95 F. The line and clusters were then again rinsed with 20 gal of water at 85 F. Twice a week this post-wash rinse

was replaced by an acid rinse. Immediately before the next milking the equipment was sanitized with sodium hypochlorite (200 ppm available chlorine) at 85 F for 3 min.

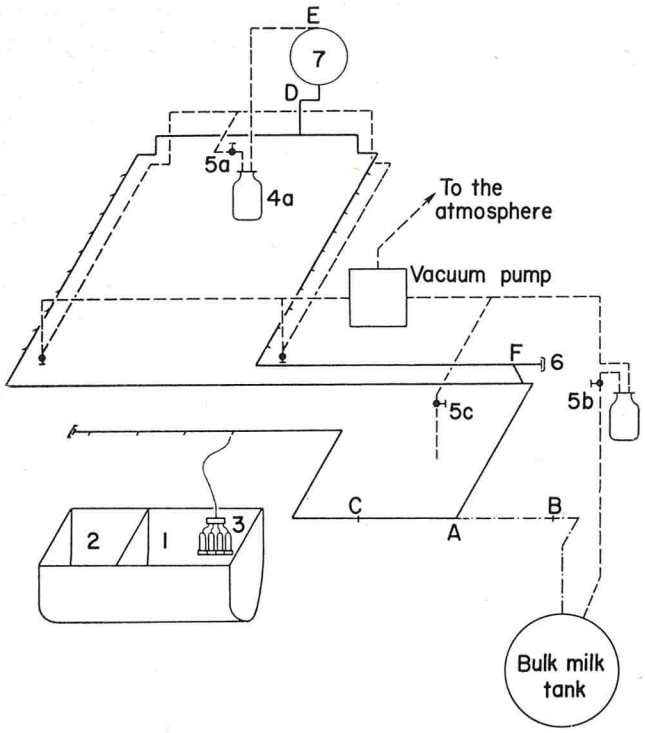


Figure 2. Lye flooding arrangement.

Once a week the clusters were disassembled and soaked in an acid solution for 4 hr after which they were brush-washed in a detergent solution[1] before being re-assembled. Two sets of inflations were used in rotation for each cluster. Each set, after being used for 1 week was immersed in a 5% solution of NaOH overnight. They were then dry-stored until the next week, this being the practice for a number of years at the University dairy barn.

Lye flooding

A diagram of the lye flooding arrangement is given in Figure 2. Immediately after milking the clusters (3) were suspended from specially designed racks in the rinsing tank (2) and connected to the milk line by means of a manifold. When the milk had drained from the line, vacuum cock 5b was closed, the coupling at point B being disconnected and the one at point A loosened. The coupling B was then connected at point C and the coupling at point A again tightened. A 1.5-inch outside diam. water hose connected to a 1-inch water main was inserted in the line at point 6 and pushed beyond the connection between the two lines (F). The installation was then rinsed for 5 min by forcing water through the line and clusters after which they were allowed to drain for 15 min.

The clusters were next suspended in the lye-EDTA solution in Tank 1. A rubber stopper was placed in the line at point 6, the vacuum cock at position 5a opened and the vacuum pump switched on. The lye-EDTA solution was drawn by vacuum through the clusters and line to receptacle 7. When this receptacle was half-full the vacuum cock 5a was closed and the vacuum pump was switched off. When the line was completely filled sufficient lye-EDTA solution remained in the tank so that the ends of the teat cups were below the surface. Thus, the line and clusters remained flooded between milkings.

Immediately before the next milking the line was drained by opening the vacuum cocks at positions 5c and 5a. This break in vacuum allowed the solution to flow back into Tank 1 and the line was drained for 15 min. Each cluster was then taken from the lye-EDTA solution, drained and suspended in the rinsing tank. The vacuum cock at 5a was closed and the line and milking machines rinsed and again drained. The coupling at position C was disconnected and the line again connected at B. The section of line from B to the bulk milk tank was brush-washed with a detergent and sanitized with sodium hypochlorite (200 ppm available chlorine) for 5 min.

Once a month the milking machines were disassembled, soaked in an acid solution for 4 hr and brush-washed in a detergent before being re-assembled. At the same time the lye-EDTA solution was renewed.

When converting the installation from circulation cleaning to the lye flooding method, it was necessary to change the type of seal on the De Laval milk inlets to the pipeline. With circulation cleaning the seal was obtained by means of a rubber plug but for the lye flooding adaptation the seal was effected by rubber caps which slide over the ends of the inlets and were clamped in position. It was also necessary to tighten the slides on the Surge inlets to the pipeline as some were not forming hermetic seals. This was not observed when the circulation cleaning system was in use as small leaks are not revealed due to the speed and turbulence of the solution and the fact that air is already incorporated in the solution through the air bleeders in the clusters.

When the installation was modified for lye flooding the receiver (7) was not installed and 1.5-inch diam line connected points D and E. This gave rise to a large air bubble remaining in the high section of the line because the sanitary trap (4a) filled with lye-EDTA solution, thus cutting off the vacuum before all the air was removed from the line.

With both C.I.P. methods the bacteriological condition of the installation was assessed by rinses and swabs. One cluster of each type was used in the test, the complete cluster being rinsed with 500 ml of 1/4 strength Ringer's solution as follows. The cluster was placed upright with the open end of the long milk tube above the level of the cluster and the inflations were held in a vertical position by means of a specially designed stand. Each inflation was rinsed twice by compressing the short milk tube, filling the inflation with the rinse solution and allowing it to empty into the claw piece or breaker cup. With the De Laval cluster the rinse solution was returned to the original bottle via the long milk tube; with the Surge cluster the rinse solution in the breaker cup was swirled before it was returned to the bottle through the long milk tube. The pipeline was tested by a combined rinse and swab method which involved swabbing the complete milk contact surface of the pipeline with a sponge. The sponge, which was wetted with 100 ml water before sterilization, was drawn through the line by vacuum. When vacuum was applied, water was extracted from the sponge before it moved through the line thus forming a small plug of water; as the sponge progressed the solution which had not drained from the line was taken up, forming a larger

[1]MSR detergent, manufactured by Babson Bros. Co., Chicago, Ill., U.S.A., used at 1 oz. of detergent in 2 gal of water.

TABLE 1. RESULTS OF RINSES AND SWABS OF PIPELINE MILKER TREATED BY CIRCULATION WITH 0.5% TRISODIUM PHOSPHATE SOLUTION FOLLOWED BY 200 PPM SODIUM HYPOCHLORITE

Date	Colony counts/article or/ml from:						
	Complete pipeline by:			Cluster rinses		Milk	Coliform organisms present (per ml)
	Rinse (10^3)	Swab (10^3)	Rinse and swab (10^3)	Surge (10^3)	De Laval (10^3)	(per ml)	
11/11/63	24	2	26	9	8		
11/12/63	32	32	64	4	22		
11/13/63	75	50	130	8	200		
11/14/63	49	10	59	11	180		
11/15/63	11	8	19	3	260		
11/16/63	21	2	23	6	190	7,100	0.1
11/17/63	18	3	21	15	200		
11/18/63	42	4	46	4	67	9,700	1.0
11/20/63	7	5	12	26	67	9,000	
11/21/63	19	29	48	27	370		
11/22/63	54	6	60	9		12,000	
11/23/63	38	6	44	9	280		
11/27/63	32	7	39	34	600		
11/28/63	50	12	62	10	120	7,500	0.1
11/29/63	15	8	23	84	920		
12/ 4/63	27	10	37	86	830	12,000	0.1
12/ 5/63	49	12	61	200	170		
12/ 6/63	21	4	25	12	400		
12/ 7/63	14	46	60	16	790		
12/ 9/63	18	8	26	2	770		
12/11/63	13	10	23	11	1,500		
12/12/63	21	11	32	6	190	7,000	1.0
12/27/63	45	2	47	400	1.800		
12/28/63	38	23	61	660	1,100	7,200	0.1
12/30/63				250	1,600	6,000	0.1
1/ 2/64	35	6	41				
1/ 6/64				180	1,600		

plug. The line thus received a rinsing and swabbing action at the same time. A specially designed stainless steel container was used to recover the rinse solution and swab. This container was 6 inches in diam and 12 inches in height and was completely enclosed except for two 2.5-inch lengths of pipe (1.5 inches in diam) welded on the top. One of these pipes contained a cross bar and was connected to the milk line at the milk discharge point by means of a rubber sleeve. The other outlet was connected to the vacuum line. The solution collected in the line was run into this container which already held 500 ml of sterile 1/4 strength Ringer's solution containing sodium thiosulphate. The sponge was trapped by the cross bar and was transferred by sterile tweezers to a further 500-ml quantity of sterile thiosulphate-Ringer's solution.

These rinse solutions were tested within 2 hr by the agar plate method *(1)* at 32 C for 48 hr using duplicate plates. Bulk milk from two milkings was periodically sampled and tested by this method and also for coliform organisms by the tube method (dilution extinction) using one ml of sample as well as dilutions of 10^{-1}, 10^{-2} and 10^{-3} in MacConkey's broth.

RESULTS

For a comparison of both the above C.I.P. methods it was for this one experiment decided to run the circulation cleaning method for a month without disassembling the milking machine clusters or changing the inflations once a week, thus obtaining conditions more closely resembling those of the lye-flooding technique. New inflations were fitted at the beginning of each method. This experiment was also used to check if and where the equipment became highly contaminated and how long the circulation cleaning method could be continued before it became necessary to disassemble the clusters because of contamination which might influence the bacteriological quality of the milk. The tests were made following the sanitizing procedure before the afternoon milking. The results for one month and for a further period of almost another month are shown in Table 1. Generally the results remained satisfactory for one month though there was a slight but discernable increase in the De Laval cluster rinses as the month progressed. However, for the second month the cluster rinses of both machines increased appreciably.

The long milk tube of the De Laval cluster incorporated an in-line filter holder which was not removed when rinsing the cluster. In order to compare the possible effect of this on the bacteriological results various parts of both makes of clusters were rinsed. The results in Table 2 taken from the second month's run show that the in-line filter is a possible source of contamination.

TABLE 2. COMPARISON OF RINSE RESULTS FROM DIFFERENT PARTS OF THE TWO TYPES OF CLUSTER

Date	Colony count (10^3)/article from: Inflations	Breaker cup or claw piece	Long milk tube	Total for cluster
Surge cluster				
12/30/63	57	35	160	250
1/ 6/64	4	100	75	180
De Laval cluster				
12/30/63	51	51	1,500[a]	1,600
1/ 6/64	150	49	1,400[a]	1,600

[a]The long milk tube of this machine contained the in-line filter holder.

The results in Tables 3 and 4 were obtained from tests made on the installation when the lye flooding technique was in use. The above-mentioned filter holder was not in the circuit with this treatment in February but was included in March. In Table 3 the colony counts of the milk increased appreciably from the middle of the month. However, this is not in keeping with the results from the pipeline and clusters and it was known that there were at least two animals with mastitis in the barn. Unfortunately these animals were removed from the herd before individual samples could be taken, but the results during the next month (Table 4) showed no such high milk count.

The higher rinse and swab results for the last three days of testing during March must not go without comment. No definite reason can be ascribed for these results but it is possible that these may be associated with a low concentration of caustic soda.

As it was considered probable that the sponge used for testing the pipeline may have had a cleaning effect, the installation was not tested in April until the lye-EDTA was due to be renewed. These results in Table 5 showed that there are moderate increases in counts from the pipeline but not from the cluster rinses or the milk, in comparison with the results in February and March.

The possible cleaning effect of the sponge was further checked in May. The lye-EDTA solution was renewed on the 5th and for the following two weeks the sponge was drawn through the line only once i.e., for the test made on the 14th. From May 19, 1964 until June 1, 1964 inclusive the sponge was drawn through the line once daily immediately before afternoon milking. The results of weekly tests are given in Table 6. From the continued decrease in the counts from the line in the last three tests it would appear that daily use of the sponge had some cleaning effect. There was no apparent explanation for the high results obtained from the Surge clusters on two occasions.

The rates of decrease in strength of the lye solution in March, April and May are given in Table 7. In order to avoid the necessity of adding NaOH solution to the tank during April the "starting" concentration of the lye was increased and water added during the month to maintain the level of solution. During May it was decided to reduce the draining time of the post-milking rinse from 15 to 5 min, the water which had not drained from the line thus maintaining the level of solution in the tank and making the manual addition of water during the month unnecessary.

DISCUSSION

The inflations are usually considered to be the most highly contaminated part of milking machine clusters but, with circulation cleaning it can be seen from Table 2 that the clusters showed less contamination than the long milk tubes. The most likely

TABLE 3. RESULTS OF RINSES AND SWABS OF PIPELINE MILKER TREATED BY LYE FLOODING, FEBRUARY, 1964

Date	Colony counts/article or/ml from: Complete pipeline by: Rinse (10^3)	Swab (10^3)	Rinse and swab (10^3)	Cluster rinses: Surge (10^3)	De Laval (10^3)	Milk (per ml)	Coliform organisms present (per ml)
1				46	6		
3	110	100	210	190	120		
4	26	2	28	1	1	7,100	1
5	910	15	930	41	5		
6	170	12	180	34	10	8,000	0.1
7	100	5	110	2	5		
17[a]	3,200	23	3,200	31	19		
18	160	10	170	42	55	19,000	0.1
19	150	22	170	48	98		
20	160	3	160	43	22	16,000	0.1
21	94	4	98	86	60		
24	170	8	180	67	83	24,000	0.1
26						21,000	0.01
27	64	7	71	200	6		

[a]Line levelled at this time which involved slackening and tightening of gaskets.

TABLE 4. RESULTS OF RINSES AND SWABS OF PIPELINE MILKER TREATED BY LYE FLOODING, MARCH, 1964

Date	Colony counts/article or/ml from: Complete pipeline by: Rinse (10^3)	Swab (10^3)	Rinse and swab (10^3)	Cluster rinses: Surge (10^3)	De Laval (10^3)	Milk (per ml)	Coliform organisms present (per ml)
3	41	8	49	35	65	5,000	0.1
10	130	3	130	20	150		
16	62	13	75	15	400		
17						2,600	1.0
20	500	33	530	210	750		
25	190	3	190	46	190	2,200	0.1
26	42	2	44	58	120		
29						5,300[a]	0.01
30	8,000	500	8,500	50	100		
31	3,000	450	3,500	250	1,000	3,500	0.1
4/1	9,000	2,500	12,000	310	1,100		

[a]Sample held in cooler overnight.

explanation for this is that during the cleaning and sanitizing operations the clusters hang inverted inside the wash trough, the inflations thus receiving the highest concentration of detergent or sanitizer solution at the highest temperature for a longer time than any other part of the system.

The comparison of the circulation cleaning with the lye flooding technique can perhaps best be seen from logarithmic means of the results in Table 8. In the case of circulation cleaning, as would be expected with the pipeline there was little if any difference between the results of one week and one month. However, somewhat higher counts were obtained from the clusters when they were not dismantled for a month.

With lye flooding, on comparing the results obtained in February and March the only part of the equipment which showed an appreciable difference is the De Laval cluster. This difference can probably be attributed to the filter holder in the long milk tube as it was included in March but not in February.

Regarding the possible cleaning effect of the sponge on the line, it would appear from the results in May and from a comparison of the last two tests in February, March and May with those in April, that the sponge may have some cleaning effect. However, there is a question as to whether frequently drawing a sponge through the line as a standard practice with the lye flooding technique is necessary, as the bacteriological quality of the milk was still excellent after four months treatment with lye flooding using the same inflations.

The only apparent overall conclusion which can be drawn from the results which are available at present is that counts from the equipment were somewhat higher with lye flooding than with circulation cleaning. This, however, did not appear to be reflected in the milk counts. This is not surprizing for the milk supply was not microbiologically identical at the time of each test.

TABLE 5. RESULTS OF NON-USE OF SWAB IN PIPELINE FOR ONE MONTH (UNTIL LYE-EDTA SOLUTION WAS DUE FOR RENEWAL) ON THE RESULTS OF RINSES AND SWABS OF PIPELINE MILKER DURING APRIL, 1964

Date	Colony counts/article or/ml from: Complete pipeline by: Rinse (10^3)	Swab (10^3)	Rinse and swab (10^3)	Cluster rinses: Surge (10^3)	De Laval (10^3)	Milk (per ml)	Coliform organisms present (per ml)
5/1	3,500	19,000	23,000	30	500		
5/4	5,600	11,000	17,000	130	20	1,700	1

TABLE 6. THE EFFECT OF USING SPONGE IN PIPELINE ONCE A WEEK FOR 2 WEEKS AND DAILY FOR 2 WEEKS DURING MAY, 1964

Date	Colony counts/article or/ml from: Complete pipeline by: Rinse (10^3)	Swab (10^3)	Rinse and swab (10^3)	Cluster rinses: Surge (10^3)	De Laval (10^3)	Milk (per ml)	Coliform organisms present (per ml)
5/14	520	70	590	2,200	25	3,000	A[a]
5/20	3,900	120	4,000	6,900	40	240	A
5/26	1,400	5	1,400	28	12	1,500	A
6/ 1	200	30	230	10	19	3,900	A

[a]Absent from 1 ml.

TABLE 8. COMPARION OF CIRCULATION CLEANING AND LYE FLOODING METHODS AS ASSESSED BY AVERAGED RESULTS

Method	Time	Logarithmic means of colony counts/article or/ml from: Pipeline by Rinse (10^2)	Pipeline by Swab (10^3)	Pipeline by Rinse and swab (10^3)	Cluster rinses Surge (10^3)	Cluster rinses De Laval (10^3)	Milk (per ml)
Circulation cleaning	1 week	27	7.7	38	7	94	7,100[a]
	1 month (22 tests)	25	8.7	37	13	220[c]	9,000
Lye flooding	Feb. (12 tests)	170	9.6	190	34	17	14,000
	Mar. (9 tests)	400	32	450	51	270[c]	3,500
	May (4 tests)	870	34	930	260	22	1,400
	Last 2 tests in February	100	7.5	110	120	22	24,000[a, b]
	Last 2 tests in March	5,200	1,100	6,500	280	1,000[c]	3,500[a]
	April 2 tests only	4,400	14,000	20,000	62	100	1,700[a]
	Last 2 tests in May	530	12	570	17	15	2,400

[a]One result only.
[b]See text.
[c]Filter holder included in circuit.

TABLE 7. LOSS OF STRENGTH OF LYE DURING USE OF ONE MONTH

Month	Day	% Free caustic	% Total alkali
	1		4.5
	9		3.5
March	19		2.8
	19	3 gal 5% NaOH added	
	23		3.2
	31		2.8
	1	5.24	5.96
	16	2 gal water added	
April	17	3.68	4.08
	22	2 gal water added	
	24	2.6	3.3
	30	1.76	2.8
	1	5.72	7.00
	10	5.48	6.04
May	16	4.00	5.04
	22	3.60	4.48
	29	3.00	3.90

CONVIENIENCE AND COST

Lye flooding affords no saving of time over the fully automatic circulation cleaning method, and we would not wish to recommend that the lye flooding procedure should be substituted for any existing automatic circulation cleaning installations. However, there is a great difference in capital outlay; the automatic circulation cleaning equipment will cost many times the cost of the extra equipment needed for lye flooding.

NOTE

Since this paper was prepared our attention was drawn to work just published in Britain by J. W. Egdell and Dorine R. Widdas in the N.A.A.S. Quarterly Review (No. 63 Spring 1964). They found that with caustic flooding "the level of milk keeping quality was not quite so high as that obtained in the circulation cleaning investigations. Nevertheless, only one sample of the 92 tested would not have passed the official clot-on-boiling test".

REFERENCES

1. American Public Health Association. Standard Methods for the Examination of Dairy Products, 11th ed. New York, N. Y. 1960.

2. Thiel, C. C., Clough, P. A., and Clegg, L.F.L. Immersion cleaning of milking equipment. J. Dairy Res. 22: 156. 1955.

3. Thiel, C. C., Clegg, L. F. L., Clough, P. A., and Cousins, C. M. Further studies of immersion cleaning of milking equipment. J. Dairy Res. 23:217. 1956.

INDICATOR ORGANISMS–A REVIEW

II. THE ROLE OF ENTEROCOCCI IN FOOD POISONING[1]

PAUL A. HARTMAN, GEORGE W. REINBOLD, AND DEVI S. SARASWAT[2]

Departments of Bacteriology and Dairy and Food Industry
Iowa State University, Ames

(Received for publication June 11, 1965)

INTRODUCTION

The first implication of fecal streptococci as a cause of food poisoning occurred in 1924 (Anon., 1924). Other similar reports soon followed (Linden, Turner and Thom, 1926; Aoki and Sakai, 1926; Anon., 1928; Nelson, 1928). Later outbreaks have been reported by Dack (1943); Dewberry (1943); Fabian (1947); Dangler and Steffen (1948); Pantaléon and Rosset (1955); Fujiwara, Sekiya and Bamba (1956); Linde (1959) and Hayashi (1960). Guthof (1957) found that a substantial portion of the streptococci of feces from persons with certain pathological conditions was composed of proteolytic types of enterococci. (See also Ehrismann, 1935 and Lieb and Chapman, 1938). Only illustrative information will be given in this review; the reader is directed to the references cited and to Dack (1943, 1949, 1953) for further details.

INCRIMINATION BY IMPLICATION

Moore (1955) summarized the first report (Anon., 1924) as follows: "In an outbreak ascribed to milk at a school in New York State, 78 of 127 children and 4 of 5 teachers were taken very ill with abdominal pain, nausea, drowsiness, vomiting and diarrhoea within 2 hr of drinking school milk. The milk consumed on the day in question was not from the regular source, and a cow from the herd that supplied the suspected batch was found to have mastitis due to a 'non-hemolytic streptococcus'. No sample of the milk consumed on the day of the outbreak was examined bacteriologically. From the clinical picture and the short incubation period, this outbreak may well have been staphylococcal. The paper of Dack et al. (1930) which first drew general attention to staphylococcal food poisoning had, of course, not been published when this outbreak occurred." The observation of Moore (1955), given in the last sentence, applies to many reported outbreaks of so-called "enterococcus food poisoning"; enterococci have been incriminated by implication only.

Table 1. NUMBER OF SAMPLES FROM WHICH SELECTED GROUPS OF BACTERIA WERE ISOLATED[a]

Group	Source		
	Food	Stomach contents	Feces
Streptococci	1/10[b]	7/10	19/24
Coliforms	0/10	5/10	20/24
Proteus spp.	0/10	1/10	13/24

[a]Data from Aoki and Sakai (1926).
[b]1/10 = number of samples positive/number of samples examined.

Another example is the outbreak reported by Aoki and Sakai (1926). A non-hemolytic streptococcus, possibly not even an enterococcus, was thought the cause of an outbreak of food poisoning in a silk-spinning mill. The "evidence" is similar to data presented by many other workers and is shown in Table 1. Streptococci were found in pure culture and in large numbers in only one food (cooked cuttlefish) ingested by all the afflicted individuals. Other foods tested were practically sterile. Streptococci also were found in a larger proportion than other microorganisms in the stomach contents of some of the victims. All tests for other bacterial groups (Table 1) were negative. The point of emphasis here is that enterococci are often present in very large numbers, frequently in apparent pure culture by the determinative methods used, in incriminated foods. Time and time again, those engaged in determining the cause of food-poisoning outbreaks have been confronted with this type of circumstantial evidence.

Table 2 contains data taken from the work of Topley (1947). Five samples of egg, associated with outbreaks of food poisoning, had high plate counts. *Salmonellae* and staphylococci were not found in any of the samples. Alpha-hemolytic streptococci were found in all five samples. Circumstantial evidence again indicates that enterococci could have caused these outbreaks of food poisoning; however, α-hemolytic streptococci also were present, frequently in high numbers, in 21 of 28 routine samples. Table 2 contains data for only 26 of these samples. Topley concluded "So far as we were able to ascertain, there was no obvious difference in the streptococcal flora of the toxic, suspected and control samples." Thus,

[1]Journal Paper No. J-5142 of the Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa. Projects No. 1050 and 1379. This work was supported in part by U. S. Public Health Service Research Grant EF-00112 from the Division of Environmental Engineering and Food Protection.
[2]Rockefeller Foundation Scholar. Present address: Rajasthan College of Agriculture, Udaipur, Rajasthan, India.

TABLE 2. PRESENCE OF ENTEROCOCCI IN "TOXIC", "SUSPECTED," AND "CONTROL" SAMPLES OF DRIED EGG[a]

Sample	No. of samples	Range of total counts	Percent of total count	
			α-hemolytic	non-hemolytic
Toxic	5	High	40-50	40-50
			40-50	40-50
			40	40
			+	+
			90-100	−
Suspected	9	8 low, 1 high	Low in 5	Low in 4
Control	26	7 low, 4 high, 15 unknown	Present in 20, low to 75%	Present in 1 of 11

[a]Data from Topley (1947).

enterococci are often present in very large numbers, frequently in pure culture, in *non-toxic* foods as well as *toxic* foods. This considerably weakens the basis for attributing food poisoning to a microorganism just because it is found in a food. The only alternative, and a reasonable one, is that toxigenicity, or virulence, or both, must be properties possessed by only a small percentage of enterococcal strains. But, just as knowledge of staphylococcal food poisoning was not generally known when early reports of streptococcal food poisoning appeared, knowledge of clostridial food poisoning was not generally known when many of the later investigations were made. It was not until 1953, (Hobbs et al., 1953), that the food-poisoning potential of *Clostridium perfringens* (*welchii*) was definitely established. (See reviews by Smith, 1963 and Riemann, 1962; also Strong, Canada and Griffiths, 1963 and Hall et al., 1963.)

Enterococci sometimes are the predominant organisms recovered on plates incubated aerobically from a suspect food, but an anaerobic count (Angelotti et al., 1962) might demonstrate the presence of large numbers of clostridia that would otherwise remain undetected. Since the symptoms of clostridial food poisoning are similar to those ascribed to streptococcus food poisoning, future diagnoses of food poisoning outbreaks will have to include procedures for elimination of clostridia as a possible cause. (See Hart, Sherwood and Wilson, 1960, and Browne et al., 1962, for illustrations of the predicament that well-qualified investigators face in attempting to determine the etiological agent of some food-poisoning outbreaks.)

FEEDING TESTS ON ANIMALS

Two outbreaks described by Linden et al. (1926) are of interest because of the animal-feeding tests conducted and because one of the two original isolates is still available. "*Streptococcus lactis*" types of streptococci were isolated from cheeses directly involved, or from the same lot of cheese involved, in two different outbreaks. One culture was later identified as S. *faecalis* by Sherman, Smiley and Niven (1943). This designation was later changed to S. *faecium* by Deibel and Silliker (1963) in accordance with more recent nomenclature (Hartman, Reinbold and Saraswat, 1965). Milk cultures of the streptococci from cheese caused diarrhea when fed to cats; doubtful reactions were obtained in dogs, and no reactions in rats, rabbits, guinea pigs and sheep (Linden et al., 1926). Carey, Dack and Myers (1931) observed no reactions in mice, guinea pigs and rabbits fed cultures of enterococci. Thus, success, when obtained, in reproducing streptococcal food poisoning in laboratory animals, has been primarily with the use of cats or kittens. With the possible exception of monkeys, other animals apparently do not respond.

Using sterile filtrates of a culture of S. *faecalis* and several non-fecal streptococci, Jordan and Burrows (1934) obtained positive reactions with monkeys. On the other hand, Dack and co-workers (Carey et al., 1931; Carey, Dack and Davison, 1938; Hunter and Dack, 1938) did not have any success in using monkeys as test animals. Similarly, conflicting data are available regarding the use of cats and kittens. Linden et al. (1926) and Sherman, Gunsalus and Bellamy (1944) has apparent success in producing positive responses in cats; the former workers, however, only when milk cultures were fed. Getting, Rubenstein and Foley (1944) also reported that kittens were made ill by two group B and one group H streptococci but only when whole cultures were fed. On the other hand, Carey et al. (1931) reported that the only observable symptom in cats fed whole milk cultures of supposedly toxigenic strains of enterococci was a slight diarrhea the day after feeding. Topley (1947) noted diarrhea in only four of 15 kittens fed cultures from egg of apparent toxigenicity to humans. Minett (1938) tested boiled filtrates of 15 β-hemolytic strains of S. *agalactiae* which elicited no response when injected into kittens. Buchbinder, Osler and Steffen (1949) mentioned that kittens were unsuitable test animals because controls also occasionally developed diarrhea. On the basis of these studies, kittens have not met with favor in subsequent researches on enterococcal food poisoning. Furthermore, except for the report of Fujiwara et al. (1956), the literature is devoid of information showing that any *severe* vomiting or diarrhea can be invoked in laboratory animals with either whole cultures of enterococci or filtrates made therefrom. There is, then, only a remote possibility that, if a very potent enterococcus preparation could be made, it would elicit a pronounced toxic response in kittens or monkeys.

FEEDING TESTS ON HUMANS

Gale (1940) noted that certain strains of enterococci decarboxylate tyrosine with the production of tyramine. The suggestion was made (Gale, 1944) that tyramine-producing enterococci may be responsible for some types of neonatal diarrhea, and Sherman et al. (1944) proposed that tyramine also could be a cause of food poisoning in adults. A fatal diarrhea in rats was produced by feeding tyrosine or tyrosine decarboxylase-producing streptococci (Gale, 1941, 1944). Sharpe (1948) reported that the fecal streptococci vary in ability to produce tyrosine decarboxylase and that S. *faecalis* and its varieties possessed the highest activties of the cultures examined. Subsequent studies, however, revealed that, although the percentage of group D streptococci was higher in the feces of infants involved in outbreaks of neonatal diarrhea than in healthy infants, the distribution of tyrosine decarboxylase activities of the organisms isolated was similar in healthy and sick infants (Sharpe, 1952). Thus, tyramine production may play a part in the cause of neonatal diarrhea (Gale, 1941; Sharpe, 1952), but tyramine did not cause symptoms when fed to adult human subjects (Dack et al., 1949) and thus is not involved in outbreaks of the true food-poisoning type.

The most convincing evidence that enterococci cause food poisoning has been obtained in various feeding tests on human volunteers. Carey et al. (1931) described an experiment wherein one laboratory worker, who drank an unsterile Berkefeld filtrate of an enterococcus isolated from toxic food, became ill. The total dose was estimated to be 11,000 cells. Belching occurred in 5 hr and nausea followed 24 hr after ingestion of the filtrate. Another worker, who drank a sterile culture filtrate, did not become ill. For this reason, it was believed that enterococci did not produce a toxin, but that the toxigenic effects were caused only by whole cultures. Carey et al. (1938) also reported that whole cultures were necessary to produce symptoms. Convincing evidence was obtained by Osler, Buchbinder and Steffen (1948), who had fair success in producing nausea and other symptoms in human volunteers when young, 5-hr-old cultures were fed. Twenty-hour cultures produced only mild symptoms in four of 21 tests. Two of the four strains of enterococcus examined were toxic when grown in each of three different foods. The short incubation time recommended by Osler et al. (1948) is of interest because Moore (1955) used a very long incubation period (3 days).

Moore (1955), Fujiwara (1956) and Fischer (1957) are the only workers to report that streptococcal filtrates were toxigenic. Moore's filtrates probably contained large numbers of cells, but the filtrates were boiled before administration. A Seitz filtrate of a starch-agar culture invoked only mild diarrhea in the test subject. Since Seitz filters reportedly adsorb enterotoxins of *Staphylococcus aureus*, the method of sterilizing filtrates for experimental work cannot be overemphasized. Moore obtained severe reactions in a human volunteer by using cultures grown in semi-solid starch agar, and it should be noted that Jordan and Burrows (1934), who were successful in producing symptoms in monkeys with a variety of streptococci, also used a starch-containing medium. Fujiwara et al. (1956) successfully produced symptoms in four adults fed cell-free preparations. Cells were removed by centrifugation and the preparations were heated to 100 C for 30 min. Fischer (1959) reported that symptoms were invoked in humans fed culture filtrates of S. *faecium;* cells suspended in physiological saline caused no enteritis.

One last piece of information that supports the thesis that fecal streptococci might cause food poisoning has arisen from studies on the build-up of strains of enterococci resistant to antibiotics when antibiotics are administered to animals. Price et al. (1947) noted that administration of streptomycin to rats resulted in early appearance of fecal streptococci highly resistant to this antibiotic. Similar emergence of resistant strains of fecal streptococci have been observed by other workers (c.f. studies on rumen bacteria by Hartman et al., 1962) who have examined the streptococcal flora during administration of various antibiotics. Stewart and Baldridge (1949) believed that, on occasion, antibiotic therapy results in an imbalance of intestinal flora and that gastrointestinal symptoms may be caused by a predominance of antibiotic-resistant strains of S. *faecalis*. Should this thesis be correct, then there is little reason why S. *faecalis* grown in vitro in food could not cause symptoms when ingested.

Contrary to the investigations cited in the preceding paragraphs, many workers have failed to obtain symptoms in human volunteers with either whole cultures or culture filtrates of enterococci isolated from foods involved in food-poisoning outbreaks and from other sources. Dolman (1943) utilized three different cultures of streptococci isolated from suspect foods. Filtrates were fed on 12 occasions. No symptoms were evoked. Likewise, Topley (1947), in her studies on toxic egg (Table 2), fed four different cultures (three from toxic egg) to six subjects without causing symptoms. Dack et al. (1949) fed cheese made with S. *faecalis* starter (Dahlberg and Kosikowsky, 1948; Kosikowsky and Dahlberg, 1948; Kosikowski, 1951; Walter et al., 1957) and broth and milk cultures of several enterococci. They (Dack et al., 1949) obtained a response on one occasion, but the incubation period was quite pro-

TABLE 3. COMPILATION OF EXPERIMENTAL CONDITIONS USED BY DEIBEL AND SILLIKER (1963) IN ATTEMPTS TO PRODUCE EXPERIMENTAL ENTEROCOCCUS FOOD POISONING

Number of strains	Culture medium	Incubation period	Number of tests
23	Milk, ham	24 hr	48
1	Milk	2, 4, 6, 8, 16, 24 hr	18
3	Broth + various carbon sources	?	60
6	Gelatin	3-6 days	12
5	Disrupted cells, grown in broth	?	15

longed, and the results were not thought significant (Niven, 1955). Finally, as shown in Table 3, Deibel and Silliker (1963) tested selected enterococci (*S. faecalis, S. faecium,* and their varieties were all represented by using a variety of culture materials (ham; milk; broth plus arginine, pyruvate, malate or gluconate; and gelatin), disrupted cells and a variety of incubation periods. Their conclusion after this comprehensive study was that enterococci do not cause food poisoning. No symptoms were invoked in the three test subjects who, on 153 different occasions, ingested whole cultures or sonicates containing large numbers of enterococci.

THE BIG QUESTION MARK

Were it not for the reports of Carey et al. (1931, 1938), Osler et al. (1948) and Moore (1955), one could readily conclude that enterococci never cause food poisoning. The successes of these workers in invoking food-poisoning symptoms in human volunteers, however, cannot be entirely discounted just because other investigators have not been able to obtain a positive response in their laboratories. If we assume that only certain strains of enterococci cause food poisoning, only if conditions are "right," then what must these conditions be?

One condition might merely be incubation temperature. As shown by Surgalla, Segalove and Dack (1944), enterococci attain as great numbers and survive longer in various foods at 22 C than at 37 C. Yet, except for the studies of Dack et al. (1949), who fed cheese inoculated with a culture of *S. faecalis* and held for periods of time (22 days at 34 C or 15 months at 16 C), the effect of incubation temperature on the food-poisoning potential of the enterococci has not been investigated. Incubation temperatures of 30 C or 45 C might yield interesting results in experimental food poisoning. The lower temperature is of special importance because many toxic foods containing large numbers of enterococci were probably not held at temperatures as high at 37 C, an incubation temperature conventionally used in the laboratory. That a slight difference in procedure makes a great difference in the virulence of an organism is illustrated in Table 4. When *Pasteurella pestis* was grown for five successive transfers at 26 and 37 C, there was a rapid loss of virulence at 37 C, but not at 26 C. Might this not happen with enterococci? As shown in Table 5, the initial pH of the medium can influence greatly the virulence of *P. pestis.* Should not variations in pH of the culture medium also be examined in experimental enterococcal food poisoning? Table 6 shows the effects of

TABLE 4. THE INFLUENCE OF INCUBATION TEMPERATURE ON THE LD_{50} OF *Pasteurella pestis* UPON SERIAL TRANSFER[a]

Transfer number	LD_{50}	
	26 C	37 C
1	21	7
2	9	52
3	22	2×10^4
4	9	2×10^6
5	9	7×10^7

[a]Data from Fukui et al. (1957).

TABLE 5. THE INFLUENCE OF INITIAL pH OF THE CULTURE MEDIUM ON THE LD_{50} OF *Pasteurella pestis*[a]

Initial pH	LD_{50}
7.1	Over 76,000
7.4	Over 34,000
7.6	23,000
7.8	6

[a]Data from Ogg et al. (1958).

TABLE 6. THE INFLUENCE OF ADDITION OF BICARBONATE TO THE CULTURE MEDIUM ON THE LD_{50} OF *Pasteurella pestis*[a]

Age, hr	LD_{50}	
	No $NaHCO_3$	0.1% $NaHCO_3$
0	43	29.0
24	13	3.9
48	1.4×10^4	2.3
72	1.3×10^6	1.5
96	8.2×10^5	52.0

[a]Data from Delwiche et al. (1959).

addition of a small amount of bicarbonate to a culture medium on the virulence of *P. pestis* grown in this medium (Delwiche et al., 1959). Surgalla, Andrews and Baugh (1964) subsequently found that growth of virulent calls was stimulated and that growth of avirulent mutants of *P. pestis* was depressed

only within a narrow range of bicarbonate levels. (See also Baugh, Lanham and Surgalla, 1964). Would fecal streptococci respond similarly? Additional examples could be cited regarding *P. pestis* (c.f. Surgalla, 1960; Brubaker and Surgalla, 1964) as well as for other pathogens.

Although the situation with enterococci may not be analogous to that with *P. pestis,* it is of interest that all workers who have successfully reproduced streptococcal food poisoning in the laboratory used cultures freshly isolated from suspect foods, while "stock" cultures were used by most investigators who obtained negative results. Both Jordan and Burrows (1935) and Moore (1955) described the loss of toxicity of enterococci after carrying cultures for several months in the laboratory, and Chapman (1946, 1947) has noted that cultures of *S. mitis* and *S. salivarius* may become nonpathogenic within a few days. The loss of other properties, such as hemolysin production (Deibel, Lake and Niven, 1963), by the fecal streptococci is well known and, on the basis of some recent studies on *Staphylococcus aureus* (Haque and Baldwin, 1964), may be related to the medium used to propagate the stock cultures.

One final observation is worthy of note. Moore (1955) first mentioned that Carey et al. (1931, 1938) reported the isolation of mixed cultures of enterococci from suspect foods. (See also Dack, 1943). Moore (1955) had a similar experience, and to this can be added the studies of Topley (1947; see Table 1 of the present review). This observation may not be of significance, but we (Hartman, unpublished data) have noted mixtures of two different enterococci when cultures from suspect foods were streaked on the Thallus acetate-tetrazolium medium of Barnes (1956a, 1956b, 1959). Furthermore, Angelotti et al. (1961) suggest that there may be synergism between enterococci and *Salmonella* in some outbreaks of food poisoning, and Lieb and Chapman (1938) have noticed competition between pathogenic streptococci and *Escherichia coli* in the intestinal tract. Browne et al. (1962) suggested that *Clostridium perfringens* and enterococci may act synergistically. Is there a synergistic action, either between two enterococcal strains or between an enterococcus and another bacterial culture, in the etiology of enterococcal food poisoning? No one has attempted feeding trials using the original mixtures, so this question remains unanswered. If changes in toxigenicity are related to physiological state of the culture, then the maintenance medium and storage conditions of stock strains may be as important as are conditions used in the production of material for toxicity tests. If synergism is involved, then one would not expect pure cultures to produce typical food-poisoning symptoms in test subjects. Slight variations in one or more experimental conditions may account for the divergent results obtained by different workers.

Streptococcal food poisoning remans a paradox. The problem is in a unique situation in that a definite answer can be obtained *only* when positive results are obtained in the laboratory. If a negative result is obtained, the results may neither represent a true picture of the food-poisoning potential of enterococci, nor indicate that the right combination of factors necessary to reproduce the syndrome was present when the experiments were conducted.

REFERENCES

Angelotti, R., Bailey, G. C., Foter, M. J. and Lewis, K. H. *Salmonella infantis* isolated from ham in food poisoning incident. Public Health Rept. 76:771-776. 1961.

Angelotti, R., Hall, H. E., Foter, M. J. and Lewis, K. H. Quantitation of *Clostridium perfringens* in food. Appl. Microbiol. 10:193-199. 1962.

Anon. Milk from sick cow made children ill. N. Y. State Health News, Albany, N. Y. 1:51. 1924; (cited in Moore, 1955).

Anon. Another milkborne gastro-intestinal outbreak among children. N. Y. State Health News, Albany, N. Y. 5:206. 1928; (cited in Dack 1943).

Aoki, K. and Sakai, K. Bakteriologische Untersuchung bei Ausbruch einer Nahrungsmittelvergiftung in einer Seidenspinnerei. Zentralbl. Bakteriol., Parasitenk., Infekt. u. Hyg., Abt. I, Orig. 98:145-148. 1926.

Barnes, E. M. Tetrazolium reduction as a means of differentiating *Streptococcus faecalis* from *Streptococcus faecium*. J. Gen. Microbiol. 14:57-68. 1956a.

Barnes, E. M. Methods for the isolation of fecal streptococci (Lancefield group D) from bacon factories. J. Appl. Bacteriol. 19:193-203. 1956b.

Barnes, E. M. Differential and selective media for the faecal streptococci. J. Sci. Food Agr. 12:656-662. 1959.

Baugh, C. L., Lanham, J. W. and Surgalla, M. J. Effects of bicarbonate on growth of *Pasteurella pestis*. II. Carbon dioxide fixation into oxalacetate by cell-free extracts. J. Bacteriol. 88:553-558. 1964.

Browne, A. S., Lynch, G., Leonard, A. R. and Stafford, G. A clostridial or enterococcal food poisoning outbreak. Public Health Rept. 77:533-536. 1962.

Brubaker, R. R. and Surgalla, M. J. The effect of Ca++ and Mg++ on lysis, growth, and production of virulence antigens in *Pasteurella pestis*. J. Infect. Dis. 114:13-25. 1964.

Buchbinder, L., Osler, A. G. and Steffen, G. I. Studies on enterococcal food poisoning. I. The isolation of enterococci from foods implicated in several outbreaks of food poisoning. Public Health Rep. 63:109-118. 1948.

Carey, W. E., Dack, G. M. and Davison, E. Alpha type streptococci in food poisoning. J. Infect. Dis. 62:88-91. 1938.

Carey, W. E., Dack, G. M. and Myers, E. An institutional outbreak of food poisoning possibly due to a streptococcus. Proc. Soc. Exptl. Biol. Med. 29:214-215. 1931.

Chapman, G. H. The isolation and testing of fecal streptococci. Am. J. Dig. Dis. 13:105-107. 1946.

Chapman, G. H. Relationships of nonhemolytic and viridans streptococci in man. Trans. New York Acad. Sci. 10:45-55. 1947.

Dack, G. M. Food poisoning. University of Chicago Press, Chicago, Ill. 1943.

Dack, G. M. Food poisoning, Revised Ed. University of Chicago Press, Chicago, Ill. 1949.

Dack, G. M. Food poisoning, 3rd Ed. University of Chicago Press, Chicago, Ill. 1956.

Dack, G. M., Carey, W. E., Woolpert, O. C. and Wiggers, H. An outbreak of food poisoning proved to be due to a yellow hemolytic staphylococcus. J. Preventative Med. 4:167-175. 1930.

Dack, G. M., Niven, C. F., Jr., Kirsner, J. B. and Marshall, H. Feeding tests on human volunteers with enterococci and tyramine. J. Infect. Dis. 85:131-138. 1949.

Dahlberg, A. C. and Kosikowsky, F. V. The development of flavor in American Cheddar cheese made from pasteurized milk with *Streptococcus faecalis* starter. J. Dairy Sci. 31: 275-284. 1948.

Dangler, G. and Steffen, G. I. Studies on enterococcal food poisoning. J. Milk Food Technol. 11:242-243. 1948.

Deibel, R. H. The group D streptococci. Bacteriol. Rev. 28:330-366. 1964.

Deibel, R. H., Lake, D. E. and Niven, C. F., Jr. Physiology of the enterococci as related to their taxonomy. J. Bacteriol. 86:1275-1282. 1963.

Deibel, R. H. and Silliker, J. H. Food-poisoning potential of the enterococci. J. Bacteriol. 85:827-832. 1963.

Delwiche, E. A., Fukui, G. M., Andrews, A. W. and Surgalla, M. J. Environmental conditions affecting the population dynamics and the retention of virulence of *Pasteurella pestis*: The role of carbon dioxide. J. Bacteriol. 77:355-360. 1959.

Dewberry, E. B. Food poisoning. Leonard Hill Ltd., London, England. 1943.

Dolman, C. E. Bacterial food poisoning. Part II. Can. J. Public Health 34:205-235. 1943.

Ehrismann, O. Die pathogenetische Bedeutung der Enterokokken. Zentralbl. Bakteriol., Parasitenk., Infekt. u. Hyg., Abt. I, Ref. 119:97-108. 1935.

Fabian, F. W. Cheese and its relations to disease. Am. J. Public Health 37:987-996. 1947.

Fischer, J. Nachweismethode für eingepfanzte körperfremde Enterokokken (D-Streptokokken) und ihre klinische Brauchbarkeit. Zentralbl. Bakteriol., Parasitenk., Infekt. u. Hyg., Abt. I, Orig. 171:264-280. 1957.

Fujiwara, K., Sekiya, K. and Bamba, K. Studies on enterotoxin. III. The production of enterotoxic substances by *Streptococcus zymogenes*. Japanese J. Bacteriol. 11:411-415. 1956.

Fukui, G. M., Ogg, J. E., Wessman, G. E. and Surgalla, M. J. Studies on the relation of cultural conditions and virulence of *Pasteurella pestis*. J. Bacteriol. 74:714-717. 1957.

Gale, E. F. The production of amines by bacteria. 2. The production of tyramine by *Streptococcus faecalis*. Biochem. J. 34:846-852. 1940.

Gale, E. F. Investigations on the diarrhoeal syndrome in infant rats. Chem. Ind. 19:721-722. 1941.

Gale, E. F. Infantile gastro-enteritis. Lancet 1:567-568. 1944.

Getting, V. A., Rubenstein, A. D. and Foley, G. E. Staphylococcus and streptococcus carriers. Sources of food-borne outbreaks in war industry. Am. J. Publ. Health. 34:833-840. 1944.

Guthof, O. Streptokokken und Dysbakterie-Problem. Zentralbl. Bakteriol., Parasitenk., Infekt. u. Hyg., Abt. I, Orig. 170:327-333. 1957.

Hall, H. E., Angelotti, R., Lewis, K. H. and Foter, M. J. Characteristics of *Clostridium perfringens* strains associated with food and food-borne disease. J. Bacteriol. 85:1094-1103. 1963.

Haque, R. and Baldwin, J. N. Types of hemolysins produced by *Staphylococcus aureus*, as determined by the replica plating technique. J. Bacteriol. 88:1442-1447. 1964.

Hart, C. J., Sherwood, W. W. and Wilson, E. A food poisoning outbreak aboard a common carrier. Public Health Rept. 75:527-531. 1960.

Hartman, P. A., Johnson, R. H., Brown, L. R., Jacobson, N. L., Allen, R. S., Shellenberger, P. R. and Van Horn, H. H., Jr. Relationship of rumen facultative anaerobes to feedlot and pasture bloat. Iowa State J. Sci. 36:217-231. 1962.

Hartman, P. A., Reinbold, G. W. and Saraswat, D. W. Indicator organisms - a review. I. Taxonomy of the fecal streptococci. Intl. Bull. Bacteriol. Taxon. Nomen. 1966.

Hayashi, K. Etiological observations on bacterial food-poisoning for a five-year period from 1955 to 1959 in Nagasaki City. Endemic Dis. Bull. Nagasaki Univ. 2:181-197. 1960. (Biol. Abstr. 36:61333. 1961).

Hobbs, B. C., Smith, M. E., Oakley, C. L., Warrack, H. G. and Cruickshank, J. C. *Clostridium welchii* food poisoning. J. Hyg. 51:74-101. 1953.

Hunter, F. R. and Dack, G. M. Failure of bacteria other than staphylococci to produce enterotoxic substance. J. Infect. Dis. 63:346-348. 1938.

Jordan, E. O. and Burrows, W. The production of enterotoxic ing. J. Infect. Dis. 55:363-367. 1934.

Jordan, J. O. and Burrows, W. The production of enterotoxic substance by bacteria. J. Infect. Dis. 57:121-128. 1935.

Kosikowsky, F. V. The manufacture of Mozzarrelle cheese from pasteurized milk. J. Dairy Sci. 34:641-648. 1951.

Kosikowsky, F. V. and Dahlberg, A. C. The growth and survival of *Streptococcus faecalis* in pasteurized milk American Cheddar cheese. J. Dairy Sci. 31:285-292. 1948.

Lieb, C. W. and Chapman, G. H. Bacteriology of the intestinal tract in certain chronic diseases. III. The possible role of upper respiratory infection. Rev. Gastroenterology. 5:306-318. 1938.

Linde, K. Über enteropathogene Darmstreptokokken. Zentralbl. Bakteriol., Parasitenk., Infekt. u. Hyg., Abt. I, Orig. 175:363-372. 1959.

Linden, B. A., Turner, W. R. and Thom, C. Food poisoning from a streptococcus in cheese. Public Health Rept. 41: 1647-1652. 1926.

Minett, F. C. Experiments on *Staphylococcus* food poisoning. J. Hyg. 38:623-637. 1938.

Moore, B. Streptococci and food poisoning. J. Appl. Bacteriol. 18:606-618. 1955.

Nelson, N. A. An outbreak of gastro-intestinal disturbance following the eating of chocolate cream pie. New England J. Med. 199:1145-1148. 1928.

Niven, C. F., Jr. Significance of streptococci in canned hams. Ann. Inst. Pasteur, Lille. 7:120-123. 1955.

Ogg, J. E., Friedman, S. B., Andrews, A. W. and Surgalla, M. J. Factors influencing the loss of virulence in *Pasteurella pestis*. J. Bacteriol. 76:185-191. 1958.

Osler, A. G., Buchbinder, L. and Steffen, G. I. Experimental enterococcal food poisoning in man. Proc. Soc. Exptl. Biol. Med. 67:456-459. 1948.

Pantaléon, J. and Rosset, R. Controle des semi-conserves de viandes dans le Département de la Seine. Ann. Inst. Pasteur, Lille. 7:221-225. 1955.

Price, C. W., Randall, W. A., Chandler, V. L. and Reedy, R. J. Observations on the in vivo and in vitro develop-

ment of bacterial resistance to streptomycin. J. Bacteriol. 53:481-488. 1947.

Riemann, H. Anaerobe toxins. *In*: Ayres, J. C. Kraft, A. A., Snyder, H. E. and Walker, H. W. (ed.) Chemical and biological hazards in food. Iowa State University Press, Ames, Iowa. 279-302. 1962.

Sharpe, M. E. Some biochemical characteristics of group D streptococci isolated from infants' faeces, with special reference to their tyrosine decarboxylase activity. Proc. Soc. Appl. Bacteriol. (J. Appl. Bacteriol.) p. 13 to 17. 1948.

Sharpe, M. E. Group D streptococci in the feaces of healthy infants and of infants with neonatal diarrhoea. J. Hyg. 50:209-228. 1952.

Sherman, J. M., Gunsalus, I. C. and Bellamy, W. D. Streptococcus food poisoning. 57th Ann. Rept., N. Y. Agr. Exp. Sta., Ithaca 1944:116. 1944.

Sherman, J. M., Smiley, K. L. and Niven, C. F., Jr. The identity of a streptococcus associated with food poisoning from cheese. J. Dairy Sci. 26:321-323. 1943.

Smith, L. DS. *Clostridium perfringens* food poisoning. *In*: Slanetz, L. W., Chichester, C. O., Gaufin, A. R. and Ordal, Z. J. (ed.) Microbiological quality of foods. Academic Press, New York, N. Y. 77-83. 1963.

Stewart, W. W. and Baldridge, O. L. *Streptococcus faecalis* reaction occurring during streptomycin therapy. J. Am. Med. Assoc. 139:579. 1949.

Strong, D. H., Canada, J. C. and Griffiths, B. B. Incidence of *Clostridium perfringens* in American foods. Appl. Microbiol. 11:42-44. 1963.

Surgalla, M. J. Properties of virulent and avirulent strains of *Pasteurella pestis*. Ann. N. Y. Acad. Sci. 88:1136-1145. 1960.

Surgalla, M. J., Andrews, A. W. and Baugh, C. L. Effects of bicarbonate in growth of *Pasteurella pestis*. I. Differential response of virulent and avirulent cells. J. Bacteriol. 88:269-272. 1964.

Surgalla, M., Segalove, M. and Dack, G. M. Growth of a food-poisoning strain of alpha-type *Streptococcus* experimentally inoculated into canned foods. Food Res. 9:112-114. 1944.

Topley, E. Further investigations on the nature of the toxic substance present in the dried egg. *In*: The bacteriology of spray-dried egg with particular reference to food poisoning. Med. Res. Coun., Spec. Rept. Ser. 260:53-57. 1947.

Walter, H. E., Sadler, A. M., Malkames, J. P. and Mitchell, C. D. Method of manufacturing cheese. U. S. Patent 2,796,351, June 18, 1957.

DISTILLED WATER SUITABILITY FOR MICROBIOLOGICAL APPLICATIONS

E. E. Geldreich and H. F. Clark[1]

Basic and Applied Sciences Branch
Division of Water Supply and Pollution Control
U. S. Department of Health, Education, and Welfare
Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

(Received for publication June 26, 1965)

Summary

Criteria for distilled water suitable for microbiological use are discussed with some observations on biological and chemical contaminants. An expanded description of a suitability test for distilled water based on growth response of *Aerobacter aerogenes* in a minimal medium is reported and selected examples of its application are given.

The quality of distilled water for laboratory use has been the subject of some confusion for many years. Theoretically, distilled water should only contain H_2O. Such a product is not usually attainable, however, because of limitations on production and storage methods that influence the amount of contamination. The cost per unit volume also limits the degree of purity and costs scale sharply upward when chemical and biological purity are required. Thus the specifications for a distilled water should be tailored to the laboratory needs.

Distilled water for microbiological use should be free of inorganic and organic substances, either toxic or nutritive, that could influence survival or growth of bacteria and viruses. For most laboratories, the distilled water supply should be free of microbiological organisms that might contribute inhibitory substances; and in laboratories producing various biologicals, the distilled water must be pyrogen free.

Many factors can influence the quality of a laboratory supply: *(a)* design of the distillation apparatus; *(b)* source of raw water; *(c)* condition of the deionizing column, if used; *(d)* use of a carbon filter; *(e)* storage chamber for reserve supply; and *(f)* temperature of stored supply and duration of storage before use. These factors may contribute varying degrees of contamination such as metal ions from the distillation system; ammonium hydroxide, hydrochloric acid, and other fumes from the laboratory; chlorine from the tap water supply; and CO_2 from the air.

The pH of distilled water is rarely 7.0. In studies of the bactericidal effect of silver, Chambers, Proctor, and Kabler *(2)* reported the pH of distilled water prepared from Cincinnati tap water averaged 6.2. The pH for distilled water supplies used in laboratories in various geographical locations ranges from 5.8 to 6.8. The pH of our laboratory distilled water, fresh from the supply line, is 6.2; after storage in a glass carboy for 1 week, 6.4; and after conversion into freshly prepared triple distilled water, 6.8. These are the pH values that would be expected if CO_2 were a major source of contamination.

Microbiological analysis of a distilled water supply may at times show large numbers of *Pseudomonas* and *Achromobacter* species. These organisms are capable of survival and growth in the presence of minimal concentrations of nutrients. Our examination of one distilled water system showed *Pseudomonas* counts ranging from 21 to 51 per ml from the building supply lines. Higher counts were observed when samples were examined from individual laboratory carboys. In one instance, several coliforms per liter were found in the distilled water supply as a result of inadequate storage tank protection from dust contamination. At other times the source of various bacterial contaminants has been demonstrated to be the deionizing column or the carbon filter used in conjunction with a given distillation system.

Once species of *Pseudomonas* have gained entry and begun to multiply in a distilled water supply, their antagonistic action toward other organisms may be a source of laboratory concern. Waksman *(10)*, in a review on bacterial antagonisms, reported that species of *Pseudomonas* can adversely affect the growth of *Escherichia coli, Salmonella typhosa, Serratia marcescens, Corynebacterium diphtheria, Mycobacterium tuberculosis,* and *Vibrio comma,* among others, and that the active substance is thermostable. Reitler and Seligmann *(7)* reported that *Pseudomonas aeruginosa* can inhibit *E. coli* in peptone water within a critical range of peptone concentration.

Algal spores can also enter the distilled water system as airborne contaminants and have often been observed in carboy water supplies in individual laboratories. This is particularly true when glass containers with loose-fitting cotton stoppers (or no stopper) are located in areas where there is intense light. Under these conditions and with infrequent

[1]Deceased.

use of the supply, a sizable growth of algae often develops within a few weeks. The necessary nutrients may come from the distilled water or dust falling into the poorly covered opening. In time, the algae may contribute organic products of their metabolism; some may be toxic to certain bacterial species, whereas others may add sufficient nutrients to stimulate multiplication of bacterial contaminants. Spoehr et al. *(8)* demonstrated that material showing antibacterical activity could be obtained from killed cells of *Chlorella.* The authors also found the antibacterial material was produced in larger quantity when killed cells were aerated than when they were placed under anaerobic conditions.

One criterion of the quality of distilled water is conductivity. Conductivity measurements can be used to indicate the presence of inorganic ions of metals, salts, and bases. The specific resistance of good quality water should exceed 578,000 ohms at 18 C (equivalent to conductivity of 0.5 ppm as NaCl). The conductivity measurement, however, does not distinguish between the presence of toxic or nontoxic metallic ions and does not reveal any organic contaminants that also may be present.

Price and Gare *(6)* reported that traces of volatile short-chain fatty acids can occur in distilled water and can be a serious source of inhibitory interference in microbiological assays. These organic contaminants may be derived from volatilized distillates of dead organisms accumulating in the distillation retort; various endogenous macromolecular constituents degradated from dead cells in distilled water supplies *(9),* volatile organic fumes in the laboratory, accumulated slugs of organic debris released by a carbon filter, solder flux and grease residuals encountered in new supply installations, or detergent residuals following flushing of the system. Thus, if only a specific conductivity measurement is used to check on water quality, these contaminants probably will not be detected.

As a result of these conditions, when any organic complexes are present in sufficient amounts to be either toxic or nutritive, the first evidence of distilled water impurities may be observed in erratic replicate pour plate or membrane filter counts and irregular growth in certain minimal nutrient culture media. Such difficulties may also be a result of improper washing procedures, which are related to detergents that leave toxic residues on glassware items. If the washing procedure and detergent are proven satisfactory, however, then the distilled water supply becomes a prime suspect and should be further investigated.

In an effort to measure possible unsatisfactory conditions associated with these water supplies, we propose a distilled water suitability test that was supplied to the committee for Standard Methods for the Examination of Dairy Products, 11th edition *(1).* This approach to a biological test for distilled water was based on a study of the growth of pure cultures of bacteria in a minimal growth medium prepared with distilled water from the source in question. The present report deals with an expanded description of the distilled water suitability test and with some examples of its application.

MATERIALS AND METHODS

A medium containing minimal amounts of nutrients was devised both to support moderate growth of *Aerobacter aerogenes* and to be very sensitive to any "foreign" additives that might be introduced by way of the distilled water used to prepare the medium. In fact, with the use of carefully selected reagents and glassware rinsed with triple distilled water, the sensitivity of the test could be extended to detect irregularities in glassware cleaning procedures that can cause difficulties in virological tissue culture studies.

A. aerogenes was chosen because it can grow in minimal nutrients and does not require the complex amino acids or other additives that are necessary for *E. coli* or *Streptococcus fecalis. Ps. aeruginosa* in particular, and possibly other pseudomads, will also grow in minimal nutrients, but they would be insensitive to any inhibiting factors from other strains of the same organism present in the unknown distilled water.

The minimal requirements for a medium to support a moderate growth of *A. aerogenes* are carbon source (citrate), nitrogen source (ammonium sulfate), salt mixture (magnesium, calcium, iron, and sodium), and a buffer (phosphate) solution to keep the pH from shifting into a lethal range. All chemicals used in preparation of these stock solutions were analytical reagent (AR) grade. This was particularly important in preparing potassium dihydrogen phosphate (KH_2PO_4) since some brands have significant amounts of chemical impurities. Garvie *(3)* found the chemical impurities in phosphate buffer and single distilled water would support the growth of *Pseudomonas fluorescens* without any other additives. Preparation of the various nutrients was as follows:

Carbon source: Dissolve 0.29 g sodium citrate ($Na_3C_6H_5O_7 \cdot 2H_2O$) in 500 ml double-distilled water.

Nitrogen source: Dissolve 0.26 g ammonium sulfate $(NH_4)_2SO_4$ in 500 ml double-distilled water.

Salt mixture: Dissolve the following mixture of electrolytes in 500 ml double-distilled water:

Magnesium sulfate ($MgSO_4 \cdot 7H_2O$)	0.26 g
Calcium chloride ($CaCl_2 \cdot 2H_2O$)	0.17 g
Ferrous sulfate ($FeSO_4 \cdot 7H_2O$)	0.23 g
Sodium chloride (NaCl)	2.50 g

Buffer: Use a 1 to 25 dilution of stock phosphate buffer solution that is prepared by dissolving 34 g of potassium dihydrogen phosphate (KH_2PO_4) in 500 ml of distilled water, adjusting the pH to 7.2 with 1N NaOH solution, and making up to 1 liter with distilled water.

All nutrient stock solutions must be boiled 1 to 2 min to kill vegetative cells. Then these solutions are stored in sterilized glass stoppered bottles at refrigerator temperatures (5 C) for a period not exceeding 2 weeks to avoid any significant volatile contamination from the air. The salt mixture stock solution will develop a slight turbidity within 3 to 5

TABLE 1. PREPARATION OF TEST MEDIA FOR GROWTH RESPONSE OF *aerobacter aerogenes*

Medium reagents	Basic test		Optional tests			
	Flask A Control	Flask B Unknown distilled water	Flask C Food available	Flask D Nitrogen source	Flask E Carbon source	Flask F Toxic control
	(per ml)	*(per ml)*	*(per ml)*	*(per ml)*	*(per ml)*	*(per ml)*
Citrate	2.5	2.5		2.5		2.5
Ammonium sulfate	2.5	2.5			2.5	2.5
Salt mixture	2.5	2.5	2.5	2.5	2.5	2.5
Phosphate buffer (7.2 ± 0.1)	1.5	1.5	1.5	1.5	1.5	1.5
Water, 1 mg per liter Cu						21.0
Unknown water		21.0	21.0	21.0	21.0	
Redistilled water	21.0		5.0	2.5	2.5	
Total volume	30.0	30.0	30.0	30.0	30.0	30.0

days as ferrous salt converts to the ferric salt. This reaction becomes very pronounced when the stock solution is exposed to sunlight, and the exposed solution is undesirable. Such solutions with a heavy chemical turbidity should be discarded and a new stock solution prepared. Bacterial contamination may also cause turbidity in the buffer solution, and this solution should likewise be discarded.

All glassware utilized in this procedure should be borosilicate and must receive a final rinse in freshly redistilled water from a glass still prior to dry heat sterilization. This is necessary because the sensitivity of the test depends upon the cleanliness of the sample containers, flasks, tubes, and pipettes.

Collect 150 to 200 ml of the unknown distilled water in a borosilicate glass flask and boil 1 minute to kill all vegetative bacteria. Overheating at this point might destroy some inhibitory agent present or permit some chemical compounds to recombine into different, unknown complexes. Sterilization may also be by membrane filtration. Label 6 sterile flasks or test tubes A, B, C, D, E, and F. Prepare the individual minimal growth medium in each flask as presented in Table 1. Use aseptic technique to avoid contamination with unknown organisms. Test flasks C, D, E, and F are optional but can give additional information on possible sources of contamination. Only test flasks A and B, however, are essential for a basic biological evaluation of the unknown distilled water.

TABLE 2. TEST RESULTS FROM NINE DISTILLED WATER SAMPLES

Source	Test count	Control count	Ratio	Interpretation
	(per ml)	*(per ml)*		
1	<10	580,000	—	Toxic (Cl−)
2	<100	120,000	—	Toxic (Cl−)
3	74,000	170,000	0.4	Toxic (Cu++)
4	150,000	250,000	0.6	Electrolytic corrosion
5	20,000	22,000	0.9	Excellent water
6	18,000	14,000	1.3	Excellent water
7	21,000	14,000	1.5	Excellent water
8	310,000	60,000	5.2	Growth substance
9	850,000	37,000	22.9	Growth substance

On the day before performing the biological test for distilled water, inoculate a culture of *A. aerogenes* onto a nutrient agar slant with a slope approximately 2-1/2 inches long in a 125 by 16 mm screw cap culture tube. Any *A. aerogenes* (−−++ IMViC type) may be used in this procedure; repeat tests with a variety of strains have given similar results. The entire agar surface should be streaked with inoculum to develop a continuous growth film. This culture is incubated for 18 to 24 hr at 32 or 35 C.

Upon completion of the media preparation, add a suspension of the pure culture to each flask in a dilution that will result in a colony count of 25 to 75 per ml of medium. This can be done by pipetting 1 to 2 ml of sterile dilution water from a 99-ml dilution water blank onto the 18- to 24-hr old culture. Emulsify the growth on the slant by gently rubbing the bacterial film with a pipette, being very careful not to tear the agar, and then pipette the contents back into the original 99-ml water blank. After vigorously shaking the suspension, prepare serial dilutions through two other 99-ml dilution blanks. Then add 0.1 ml of the third serial dilution to each of the media flasks.

Variations among strains of *A. aerogenes*, media, and surface area of agar slopes will possibly necessitate adjustment of the dilution procedure to arrive at a specific density range of 7,500 to 22,500 organisms per ml in the third dilution of the culture. The numerical growth range of a specific organism and medium can be established by preparing a series of plate counts from 1.0 ml amounts of the fourth serial 99-ml dilution to determine bacterial density. Once this has been determined, choose the proper volume (generally 0.1 ml) from the suspension in the third serial dilution so that, when diluted by the 30 ml of medium in the flasks, it will

yield 25 to 75 viable cells per ml. With standardization of surface slant in the culture tube, agar medium, and a specific strain of *A. aerogenes*, it is possible to get reproducible results on repeated experiments.

An initial bacterial count is made by plating 1 ml of medium from each flask. Such a count will verify that the initial cell densities are in a satisfactory range for concluding the experiment on the succeeding day and will rule out gross contamination of the sample or media. All flasks are incubated 24 hr at 32 or 35 C; after incubation, plate counts on Standard Methods Plate Count agar (tryptone glucose yeast extract agar) or tryptone glucose beef extract agar are made at suggested dilutions of 1, 0.1, 0.01, 0.001, and 0.0001 ml. Because of some biological variations among different strains of *A. aerogenes*, the magnitude of growth response may necessitate a slight shift in the selection of dilutions chosen from those suggested. Pour plates are incubated 24 hr at 32 or 35 C, and bacterial densities are determined.

RESULTS AND DISCUSSION

After the bacterial density for each flask is determined from a selection of plate counts within the 30 to 300 colony range, a series of ratios is calculated to evaluate the growth results. For indication of growth-inhibiting substances, the ratio is:

$$\frac{\text{Colony count per ml, Flask B}}{\text{Colony count per ml, Flask A}}$$

Any ratio value between 0.8 and 1.2 indicates no toxic substances present; whereas values below 0.8 are positive indication of biological toxicity. When the ratio exceeds 1.2, it may be assumed that growth-stimulating substances are present. The procedure, however, is an extremely sensitive test, and ratios up to 3.0 would have little significance in actual practice.

The colony density after 24 hr of incubation in a given flask can be influenced by the strain of *A. aerogenes* employed and by the number of organisms initially added at the start of the experiment. For this reason, it is essential to include control flask A for each individual series of tests. Repeated experiments with various strains of *A. aerogenes* indicate that the 24-hr final count of this organism will be reasonably constant when the initial number of cells added to the minimal growth medium is similar. If the initial cell density of one flask is 25 per ml and the other flask receives 75 organisms per ml, there will be about a threefold larger final count after 24 hr incubation in the second flask. This assumes that both flasks contain identical minimal growth media and both have the same incubation time and temperature. Thus, it is important that the initial cell density for each flask in the experiment be essentially the same to secure growth responses that are comparable.

When the optional tests are performed on a distilled water sample, the following ratios can be developed:

1. For nitrogen and carbon sources that promote growth:

$$\frac{\text{Colony count per ml, Flask C}}{\text{Colony count per ml, Flask A}}$$

2. For nitrogen sources that promote growth:

$$\frac{\text{Colony count per ml, Flask D}}{\text{Colony count per ml, Flask A}}$$

3. For carbon sources that promote growth:

$$\frac{\text{Colony count per ml, Flask E}}{\text{Colony count per ml, Flask A}}$$

4. For positive toxic control:

$$\frac{\text{Colony count per ml, Flask F}}{\text{Colony count per ml, Flask A}}$$

Usually the colony count in Flask C will be very small, and Flasks D and E will have a ratio of less than 1.2 when the ratio of Flask B/Flask A is between 0.8 and 1.2. The factors that limit growth in Flask A are the nitrogen and organic carbon present. A relatively large concentration of ammonia nitrogen with no organic carbon could increase the ratio in Flask D above 1.2, whereas the absence of nitrogen combined with a large carbon concentration could give ratios above 1.2 in Flask E, with a Flask B/Flask A ratio between 0.8 and 1.2.

Data recorded in Table 2 present results from nine different distilled water supplies at laboratories in different geographical locations. In the first two examples, tap water with high chlorine content was used as a source of input water resulting in chlorine vapors being circulated in the distillation system and added to the finished product. The distilled water from the first source contained in excess of 2 mg per liter of free chlorine. Morgan and Gubbins (5) found that chloramines were selectively removed by distillation from their tap water supply containing 0.52 mg/liter of combined chlorine. Removal of free chlorine by such distillation was more difficult, however, because it apparently forms an azeotrope with water at pH values greater than 5.5.

The distilled water source for the third example was from a distillation apparatus that originally was tin-lined. After a period of years, the tin plating had begun to erode; the exposed copper base-metal became the source of metal ion toxicity. The use of dissimilar metal parts in the construction of the distillation system for the fourth water source resulted in electrolytic corrosion with associated metal ion toxicity.

Examples of excellent distilled water suitable for microbiological applications are found in sources 5, 6, and 7. These distillation sources represent a commercial, compact, all glass unit connected to a single distilled water intake; a small capacity laboratory unit for double distillation, built from standard glass

items; and a large capacity tin-lined still of commercial manufacture used in conjunction with a carbon filter and deionizing column.

Water sources for examples 8 and 9 both had high growth-promoting residuals. One was a result of excessive solder flux used in connecting pipes; the other, a result of a slug of material released from an exhausted carbon filter in the system.

In an entirely different application of this test, Jones and Greenberg *(4)* used the procedure to show presence of growth-stimulating substances in redwood storage tanks. These examples indicate that a test procedure can be developed to provide additional information about the quality of distilled water with particular emphasis on its suitability for microbiological uses.

REFERENCES

1. American Public Health Association. Standard Methods for the Examination of Dairy Products. 11th ed. Am. Public Health Assoc. New York, N. Y. 1960.

2. Chambers, C. W., Proctor, C. M., and Kabler, P. W. Bactericidal Effect of Low Concentrations of Silver. J. Am. Water Works Assoc. 54:208-216. 1962.

3. Garvie, E. I. The Growth of *Escherichia coli* in Buffer Substrate and Distilled Water. J. Bact. 69:393-398. 1955.

4. Jones, F. E. and Greenberg, A. E. Coliform Bacteria in Redwood Storage Tanks. J. Am. Water Works Assoc. 56:1489-1493. 1964.

5. Morgan, G. B. and Gubbins, P. Occurrence of Chloramines in Buffered Bacterial Dilution Water. Health Lab. Sci. 2:6. 1965.

6. Price, S. A. and Gare, L. A Source of Error in Microbiological Assays Attributable to a Bacterial Inhibitor. Nature. 183:838-840. 1959.

7. Reitler, R. and Seligmann, R. *Pseudomonas aeruginosa* in Drinking Water. J. Appl. Bacteriol. 20:145-150. 1957.

8. Spoehr, H. A., Smith, J. H. C., Strain, H. H., Milner, H. W., and Hardin, G. J. Fatty Acid Antibacterials from Plants. Carnegie Institution of Washington, Publication No. 586. Washington, D. C. 1949.

9. Strange, R. E., Dark, F. A., and Ness, A. G. The Survival of Stationary Phase *Aerobacter aerogenes* Stored in Aqueous Suspension. J. Gen. Microbiol. 25:61-76. 1961.

10. Waksman, S. A. Antagonistic Relations of Microorganisms. Bact. Reviews. 5:231-291. 1941.

SANITATION STANDARDS–A BRIEF HISTORY OF THEIR DEVELOPMENT[1]

SAMUEL W. HOOVER

U. S. Public Health Service
Atlanta, Ga.

Man has equated his needs to dependency upon common denominators in all fields of human endeavor: language, law, folkways, taboos, moral codes, ceremonies, religious rituals, educational procedures, social and business customs, and industrial practices. The process whereby these have become standards have involved establishing through authority, custom or general consent, a rule or model to be followed.

In developing standards, human need is the stimulus. English common law is perhaps the best example of how this should be effected. The establishing of law by this method has been one of the strongest and most fundamental forces in the development of our society. It is slow but it requires that each law reflect the concensus of all that will be concerned with its subject matter, and thus it provides for a more gradual transition than other systems of legal jurisprudence.

Modern society has removed much of the opportunity for the close association that development of laws or standards under this system originally required. Recourse, by necessity, has been to decisions by highly specialized groups but, unless representative individuals with backgrounds or contact understanding of the areas to be standardized are included, the results often assume the nature of autocratic decrees. There is nothing more useless than a standard or parts of a standard that attempt to answer needs by the decree method. Questions settled by this method do not remain settled because they have not been solved but only decided.

History is replete with notable failures in standardizations because the human element was ignored. Shih Huang-Ti was a founder of the Chinese Empire and under him was built the Great Wall. In his design for Chinese unity he created one law, one weight, and one measure. The Great Wall stood, but not his weights and measures. He had ignored social standards and customs which rendered his design impractical. Sanitation standards must be compatible with existing social standards such as manners or customs; otherwise they become square pegs in round holes and the resulting irritations render them impractical.

[1]Presented at Annual Meeting of the Mississippi Association of Sanitarians, May 7, 1965 at Jackson, Mississippi.

The rapid advance of technology has resulted in the bringing of more and more people together into cities, factories and other groupings. Attendant needs for the development of sanitation standards along with other standards has accelerated accordingly. This situation has been viewed by many with increasing fear of the consequences. They fear that the world will be reduced to dull mediocrity through increasing standardization. One school goes so far as to predict that the machine age through technologic development, specializations and standardization will either destroy the race or reduce it to a completely static condition similar to the communal life of ants and bees.

This fear is based upon an underlying misconception of standardization as a static solution to a problem. "Once solved, forever solved" is not a truism. A contemporary standard merely represents the best way to do a thing—at the moment. When the future uncovers a better method, it will be incorporated into a new standard. Today, scientific research is the important ingredient in this process and one which we will place increasing dependence upon in the development of future standards.

EARLY SANITARY STANDARDS

The origin of sanitary standards predates man's written history. The books of Leviticus and Deuteronomy in the Old Testament contain some of the earliest written laws on sanitation. These laws evolved around the disposal of human wastes and the use of certain foods. In Deuteronomy, one finds the first mention of excreta disposal: "Thou shalt have a place also without the camp, whither thou shalt go forth abroad. And thou shalt have a paddle upon thy weapon: and it shall be when thou wilt ease thyself abroad, thou shalt dig therewith, and shall turn back and cover that which cometh from thee."

The Jewish people of that period determined that sanitation was a way of life necessary to their survival. Their consideration of these laws as moral codes resulted in their incorporation into Jewish religious law.

As communities developed and problems in water supply and waste disposal multiplied, there were many trial and error attempts to solve them. At Bismya an ancient Symerian or pre-Babylonian city estimated to have been inhabited over 4,500 years ago, excavations have uncovered cess-pool like arrangements beneath the houses. These consisted of holes dug in the ground some 45 feet in depth with the periphery having numerous clay drains. Holes were cut into these drains and the entire system packed with sand.

Water sanitation during the Roman period involved the use of the settling principal at the source of water by use of a reservoir. Intermediate sediment basins are found throughout the aquaducts. The final reservoir greatly resembled many of the covered slow-sand filters used in this country during the early 20th century. Roman engineers were aware that the absence of light prevented or altogether checked the growth of algae and other objectionable forms of water vegetation. This visible era of sanitation was productive of many useful sanitary standards that are still applicable today.

The Romans in their water delivery system used pipes of lead, burned earthenware and bored-out blocks of stone. Burned earthenware was used more frequently because records indicate that the Romans were aware of the injurious effects of lead and looked with suspicion on water that had been conducted through lead pipes.

The quantity of water supplied in Rome compared favorably with the per capita water allowances provided in the principal cities of the United States during the first two decades of this century. It was far in excess of the per capita water allowance supplied to British and European cities at this time. The Roman standard for water per capita was about 100 United States gallons per day. This quantity of water being poured into a limited area daily, created a need for some system of disposal. The resulting drains were constructed according to standards supervised by Roman civil authorities.

The Cloaca Maxima, constructed during the period 735 to 510 B.C., was initially intended to drain the low, swampy area about Rome to the Tiber river but, prior to its completion, need for a waste disposal carrier facility caused it to be used as a sewerage system for the city. Eventually every street in Rome was drained by a branch of this system.

In passing, it is interesting to note that every house or building in Rome was required to be connected to the sewer system. Unfortunately drainage systems did not extend above the first floor, and since many of the houses and buildings were multistoried and inhabited near the top by the poor, these people had no access to the public sewer. They resorted to the practice of throwing liquid and solid waste materials from windows and balconies, oftentimes to the discomfort or injury of the pedestrians.

Conditions became so bad that the Roman Senate passed the *dejecti effusive* act, which gave damages against a person who threw or poured anything from a place or upper chamber upon a road or street frequented by a passerby, or on a place that people used for standing. The act was limited to damages for personal injury, and strangely enough, applied only during the day and not at night which was the most dangerous time. This act was the first written

legal instrument to deal with sanitary nuisiances.

Standards for personal hygiene originated with the practice of bathing. At first it was done for pleasure, cleanliness and health. The practice was later incorporated into a daily religious ritual and required the drawing up of facility standards in order that the populace could be accommodated. According to Pliny, Rome needed no medicine but the public baths for 600 years.

THE DARK AGES

With the fall of Rome, development of sanitary standards came to a standstill and existing standards regressed to an unbelievable point. The following 1000 years produced nothing except scourge upon scourge of filth diseases. It is estimated that 40,000,000 victims died during this period from filth diseases alone which could have been prevented by application of the sanitary standards employed by the Romans.

The brotherhood of knights, noted for their skill in combat, adopted a creed of *un*cleanliness as being next to godliness. Clergy and laymen vied to see who could live in the most filthy manner. Filth was considered as an outward indication of inward piety and sanctification.

By the late 16th century, the impact of these filth diseases upon human life stirred the sleeping giant of compassion in men's minds in the Christian world and resulted in the creation of a movement for improvement in sanitary manners. The Spaniards repaired the Roman aquaducts in their country and utilized them, the teachings of Hippocrates and other ancients were rediscovered, but the exercise of their application in terms of the existing folkways and religious beliefs made for slow progress.

In 1665 when plague exacted its terrible toll of human life in London, much blind effort was directed toward establishing standards to improve the sanitary environment. Most were standards deducted from erroneous concepts of disease, such as the burning of pitch to purify the air, the firing of cannon to drive miasma away, and the wearing of amulets. John Cay, an English physician, had earlier written a pamphlet advising the people to take away the cause of disease by ditches, burying of dead bodies, removing dung hills, avoiding carrions and letting in open air.

Quarantine was recognized as an old principle of preventing the spread of disease even during this period. Watchmen were mobilized for posting at infected households to prevent exit and entry. This type of quarantine was complete, and the misery of the shut-ins was terrible with no food, water or care. There were 100,000 deaths in London during this epidemic and the type of quarantine employed possibly contributed materially to this total.

A NEW DAY DAWNS

With the industrial revolution which began about 1750, the need for sanitary standards increased as populations became more concentrated in cities. This situation initiated the search for scientific knowledge in developing standards. By 1832 the literature makes reference to orders by English boards of health for sanitary measures against cholera. The order had to do with the continual burning of pitch and tar and the strewing of lime throughout the streets.

In 1848 a public health act for England was passed, establishing a general board of health. It was given the authority to provide measures of protection against the epidemic of cholera and the board's first action was the establishment of "systems" of precautionary measures. These were directed toward the improvement of environmental conditions in depressed and "offensive" localities. It provided in part, "to keep the persons and the dwelling place clean, to allow of no sinks close to the house, to admit of no poultry or animals within the house, to keep every apartment as airy as possible by ventilation and to prevent crowding wherever there are sick."

These board action "systems" had the effect of law with penalties for noncompliance. The severity of the penalties depended upon the period and the conditions under which the violations occurred. When epidemics were raging the magistrate counts meted out severe penalties but, during those periods without epidemics the charges were usually dismissed, creating caution on the part of the health officials and limiting their effectiveness. Present day counterparts to this situation are frequently experienced by the public health profession.

Although the historic stink of the Thames in 1858, resulting from the dumping of raw sewage from 3,000,000 London inhabitants, did not produce the predicted epidemic, its offensive nature moved parliament to action in demanding investigations into sewage handling methods. These provided important information for the later control of sewage wastes.

During this period, the United States was considerably behind the Europeans in sanitary methodology. In 1857 Julius W. Adams was commissioned to prepare plans for sewering the city of Brooklyn, New York. He found the engineering profession of that day wholly without data of any kind to guide in proportioning sewers. Construction was haphazard and failures commonplace. Failures were given wide publicity and consequently the engineering profession was not highly regarded as a reliable source for corrective measures during that period. Most of the

real accomplishments in sanitary science during that period came from isolated investigations by individuals in the medical profession.

The period between 1850 and 1900 produced more research in the field of sanitation than had been produced during the previous eighteen centuries. England developed the slow sand filter and in looking for chemicals to destroy sewage they discovered those substances which we employ today in water purification.

In 1887, a Mr. Dibden presented a paper before the English Institute of Civil Engineers, discounting the use of chemicals for sewage destruction. He pointed out that the use of the bacterial organisms in sewage was a method whereby its organic matter could be made innocuous. This turned the investigations in the right direction and the Massachusetts State Board of Health perfected this method of sewage treatment.

Air ventilation standards for industry and public places were developed during this time. Strangely enough they were first applied to prisons in an effort to revive the miasma theory. Every scientific method known at that time was applied to the analysis of air in such places and, although they failed to substantiate the miasma theory, their results became the base-line for ventilation standards. Medical authorities of the British Army devised the first scientific garbage and trash disposal methods about 1860 and in 1885 Lieutenant H. I. Reilly, United States Army, built the first American garbage furnace. Known as the "garbage destructor", many of these were still being used in 1944.

Development of Milk and Food Sanitation

Standards for the heat destruction of organisms in foods were referred to in 1848 by Robert Angus Smith, M.D. in his report to the English Metropolitan Commission of Inquiry. This report in part read: "This I find has been stated by Dr. Playfair in his evidence. That violent organic which has killed so many in Germany, sausage-poison, is destroyed by hot water. Although perhaps we do not boil or heat meat at all times to the temperature necessary, the uneven part of a piece of beef is frequently red, a color which is removed according to Liebig, at a temperature so low as 140 degrees Fahrenheit. This is the temperature at which, if I recollect, Dr. Henry said that the pestilential matter was removed, showing that at about this point a change occurs in organized matter, making it incapable of its former decompositions." It is interesting to note that this 140°F., which later became incorporated by Pasteur in his pasteurization process, indicates that much of Pasteur's findings were based on earlier work.

Attempts to establish milk sanitation standards originated about 1857 in certain English communities where epidemics of typhoid fever were traced to milk supplies. Doctor Michael Todd, an epidemiologist of that period, not only established that milk was the vehicle in these particular epidemics but in 1867 showed that milk was a vehicle in a scarlet fever epidemic. In 1877 an epidemic of diphtheria was traced to a milk supply. These were notable contributions because bacteriology was as yet an undeveloped science.

Koch devised his method of solid cultures for bacteria in 1881. This opened the door to the investigative measurement of the bacterial quality of milk which could be interpreted in terms of environmental conditions surrounding its production and handling. This method along with epidemiological reports were laid before the International Medical Congress in 1881 and drew universal attention to milk as a vehicle of infectious disease, creating pressure for the adoption of standards. The first standards had been incorporated in the form of regulations for the production and handling of milk in 1879 by a committee in the Board of Health for England. Known as the "dairies, cowsheds and milk shops order of July 1879," it was amended in 1885 and 1886.

In the United States standards for milk evolved from fundamental investigations on the sources of bacteria in the food product by H. S. Conn at Middletown, Connecticut in 1889. In 1892, Sedwick and Batchelder reported on a laboratory method used in examining Boston milk which brought to the public's attention the importance of dairy sanitation.

Development of Regulatory Action

In 1893 sanitary control of certified milk based on laboratory methods was initiated by Dr. H. L. Coit and Stephen Francisco at Montclair, N. J. and in 1894-1895 H. L. Russel at Madison, Wisconsin, established definitions of the sanitary quality of milk through the use of laboratory methods. By 1896 the New York City Board of Health established a permit system governing the sale of milk. Its right to enforce the attendant rules and regulations of this permit system was challenged in 1905. The case eventually reached the United States Supreme Court, which sustained their action and thereafter established the right of officially constituted boards of health to control the sanitary quality of municipal milk supplies. This right has never been successfully opposed.

The publicity given to this case resulted in accelerated regulatory activity in the sanitary control of milk. Between that time and the 1920's many cities adopted milk sanitation ordinances which were as varied in their methods as they were in their effectiveness. It remained for Leslie Frank and Urban

Davis Franklin to develop in 1924 a standard milk ordinance that would establish effective uniform standards.

Food standards originated through a legal relationship with nuisances. The Nuisance Removal Act of 1855 in England sets forth extensive powers of medical officers of health and their representatives who were designated inspectors of nuisances in the condemning and seizing of unwholesome food or food products. It was this act that originated the right of officials to inspect "at all reasonable times." The criteria for condemnation and seizure was based on the appearance of the meat of food and stated, "If any of the substances mentioned appear diseased or unsound or unwholesome, or unfit for the food of man, he may seize and carry away the same himself or by an assistant, in order to have the same dealt with by justice." Justice included destruction, payment of a penalty or confinement, the decision resting with the magistrate.

It was not until 1878 that the United States developed any quantitative standards for food. In that year, the Commissioner of Agriculture reported on the examination of sophisticated tea. Ths was followed by many others until in 1883 the initial bulletin of the Chemical Division of the Department of Agriculture was issued to the public. From that time the Chemical Division began to assume responsibility for the development of standards for foods.

In 1889 Congress appropriated funds directly to the Chemical Division and authorized them to extend their investigations to drugs and liquors. American foods at that time were extensively adulterated with physically damaging substances. Control measures were inadequate and Congress passed an act in 1896, providing for general publicity of the Chemical Division's findings. Food manufacturers strenuously objected and later appropriations carried the requirement that, before publication of adverse findings, an opportunity be afforded the manufacturer to appear before the Secretary of Agriculture for a hearing. This was the progenitor of hearings provided for in later laws prior to punitive action or criminal prosecutions.

From 1902 to 1907 the Department of Agriculture carried out the historic experiment that was to result in effective food and drug laws. Doctor Harvey W. White, then head of the Chemical Division, conceived and directed the famous poison squad service of experiments. These experiments were performed upon twelve young male volunteers who subjected themselves to a diet designed to determine the safety of preservatives. The results indicated that many substances were injurious to human health.

These findings received much publicity and occurred in conjunction with a growing resentment by farmers over the adulteration of market milk, butter, lard, meat and other foods by the food industry. Public clamor for standards was so great that by 1906 most of the states had passed pure food laws. Despite these laws, manifold abuses developed more rapidly. Articles by Samuel Hopkins Adams, Edward Bok, Mark Sullivan and Upton Sinclair along with support from the National Association of State Dairy and Food Departments and the American Medical Association, resulted in President Theodore Roosevelt forcefully calling for food and drug legislation. After considerable debate the Food and Drugs Act of 1906 was passed.

The Division of Chemistry of the Department of Agriculture became the Bureau of Chemistry. It continued under this title until 1927 when it was separated from the Department of Agriculture and was renamed as the Food, Drug and Insecticide Administration. In 1930 the designation was shortened to the Food and Drug Administration.

In the broad field of sanitation as it now exists, I have attempted to cover the origin of those standards in the areas upon which the science was built. Future standards and the future development of sanitary science itself rests upon these foundations.

These future standards will have to keep pace with the impact of technology upon the environment. Space travel, atomic industrial processes, modern agricultural methods and food processing procedures along with metropolitanism are but a few of the developing aspects in our civilization. In our time we shall be required to provide standard solutions to the problems engendered by their impact upon the environment.

BIBLIOGRAPHY

1. Black, L. A. The History, Current Status and Future of Standard Methods for the Examination of Dairy Products. Am. Pub. Health Assn. Nov., 1960.

2. Blyth, A. W. A Manual of Public Health. McMillan and Co. London, 1890.

3. Chambers, Wm. and Robt. Sanitary Economy, Its Principles and Practice, and its Moral Influence on the Progress of Civilization. Published by Wm. and Robt. Chambers, Edinburgh, 1850.

4. Cosgrove, J. J. History of Sanitation. Published by Standard Mfg. Co., Pittsburg, Pa. 1909.

5. Encyclopedia Britannica. Encyclopedia Britannica Inc., Univ. of Chicago Press. 1948. Index Vol. 21.

6. Hanlon, J. H. Principles of Public Health Administration. C. V. Mosby Co., St. Louis, 1960.

7. Herrick, A. C. Food Regulation and Compliance. Cornwall Press, New York, 1944.

8. Hope, M. C. and Mallory, B. C. An Approach to Metropolitanism. Publ. Health Rep., 75:9 1960.

9. Infant Milk Reports and Their Relation to Infant Mortality. The N. Y. Milk Committee of the N. Y. Assn. for Improving the Conditions of the Poor, 1908.

10. Perry, John. The Story of Standards. Funk and Wag-

nalls Co., New York, 1955.

11. Rosenau, M. J. Thermal Death Points of Pathogenic Microorganisms in Milk. U. S. Govt. Printing Office Hygiene Lab. Bul. No. 42, Jan., 1903.

12. Sedwick, W. T. Principles of Sanitary Science and the Public Health. McMillan Co., London. 1903.

13. Shull, I. F. Personal Correspondance. Kansas St. Bd. of Health, Topeka, Nov., 1960.

14. Simon, John. Filth Diseases and Their Prevention. John Campbell, Boston, 1876.

ASSOCIATION AFFAIRS

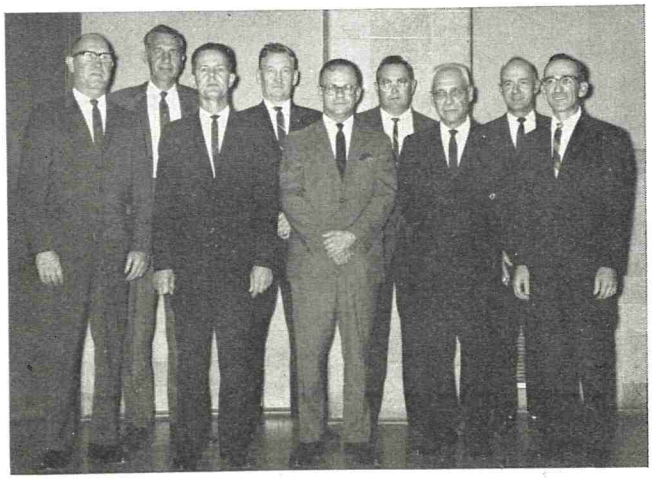
CERTIFICATES OF REGISTRATION ISSUED AT INDIANA SANITARIANS ANNUAL MEETING

Indiana Sanitarians Registration Board, left to right; Ed Riley, Paul Welch, Chairman; Tom Snider, Ray Gauthier, Sam Elder, Karl Jones, Secretary.

Highlighting the annual meeting of the Indiana Association of Sanitarians, Inc., on October 5-7, 1965, was the awarding of certificates of registration to 172 Professional Registered Sanitarians under the Acts of 1963 of the Indiana General Assembly. Mr. Paul Welch, Chairman of the State Board of Registration for Professional Sanitarians, presented the certificates to the newly registered sanitarians.

During the two day program the general session topics included a very interesting report by James H. McCoy, Past President of the Association, and Administrative Assistant, Special Health Services, Indiana State Board of Health, on the 1965 Indiana Law concerning the enabling of county boards of health throughout the state. Aimed at better administration of local county health departments this legislaion should have a decided effect on the tax base for the support of local departments and the salaries of local public health personnel, including the public health sanitarian. Mr. James E. Goodpasture, Director of Environmental Health and Preventive Medicine, Student Health Service, Indiana University told of his role as member and chairman of the Monroe Board of Health and the upgrading of that county's health and environmental sanitation services including the challenge posed by the new Monroe Reservoir, the largest man-made lake in Indiana.

Sectional educational sessions included topics such as Sanitary Control of the School Environment, Private Waste Disposal, Private Water Supplies, New Developments in the Painting of Retail Food Establishments, Procedures for Evaluating Food Service Sanitation Programs, Salmonellosis Related to Eggs and Egg Products, Major Changes in the Public Health Service Milk Ordinance and Code, Liquid Manure Handling Systems, New Methods of Waste Disposal by Deep Well Injection, Industry Looks at the Sanitarian, and A Physician's Opinion of Public Health. A unique presentation was the reading of



Executive Board, Indiana Association of Sanitarians left to right; Eugene Blades, Auditor; Charles Lukemeyer, Pres-Elect; Karl K. Jones, First Vice-Pres.; James Nix, Second Vice-Pres.; Robert Nelson, Past Pres.; Tom Snider, Past Pres.; John Schlegel, Secretary; James Goodpasture, Treasurer; Ray Gauthier, Pres.

reports by various members of the Farms Methods Committee of the Indiana Association on Animal Diseases, Cleaning of Equipment, Personal Relations between Producer and Inspector, Pesticides, and Nitrate Poisoning.

At the Annual Business Meeting an amendment proposed by one of the members which would enable members of the Indiana Association of Sanitarians to belong to the state organization only, or either to the International Association of Milk, Food, and Environmental Sanitarians, Inc. or to the National Association of Sanitarians, was defeated by a membership vote of two to one. This had the effect of retaining full membership affiliation with the International Association. Mr. Harold S. (Dick) Adams, Director of Sanitary Science Courses, School of Medicine, Indiana University and member of the Executive Board of the I.A.S., Inc., explained the situation concerning the possible merger of the International Association, the National Association, and the Society of Professional Sanitarians and the implications of the current discussions among the three sanitarian associations.

Dr. T. M. Folkerts, Manager of Technical Animal Products, Eli Lilly and Company, was the banquet speaker. Among the notable speakers on the program were Louis W. Spolyar, Director of Preventive Medicine, and Robert O. Yoho, Director of Health Education, Indiana State Board of Health; Otis Bowen, M.D., member of the Indiana House of Representatives and a practicing physician; Dr. Richard N. Collins, Public Health Service, Atlanta, Georgia; Mrs. Sarah Hathaway, Executive Director, Indiana Health Careers, Inc., and John Heckard, Chief, Ground Water Section, Indiana State Department of Natural Resources.

INDIANA ASSOCIATION SPONSORS MILKING CONTEST AT STATE FAIR

Interest in proper milking methods runs high among 4-H exhibitors at the Indiana State Fair. At least a part of this zeal is traceable to a milking methods contest to which contributions are made by the Indiana Sanitarians Association and interested dairy groups.

Rules of the contest specify udder cleaning at each milking, mastitis free milk as evidenced by use of the strip cup, and milk with a low sediment content. Milk straining is prohibited. Since cows are milked at the stall on straw bedding, there is a challenge in producing milk with an acceptable sediment content, not to mention winning the contest. Indiana 4-Hers, however, have more than met the challenge, much to the dismay of contest judges in their deliberations to select the winners. Milk produced during the Fair is inspected by sanitarians of the State Board of Health and the Marion County Health and Hospital Corporation and is bought by an Indianapolis dairy.

Each year the Indiana Association donates an engraved plaque and the State Dairy Association a $25 savings bond for the first place winner. Second through fifth prizes which consist of show halters, grooming brushes, and cow blankets are donated by the Central Indiana Dairymen's Association, the Indianapolis Division of Miami Valley Milk Producers Association, the Golden Guernsey Association, and Wayne Cooperative Milk Producers, Fort Wayne. Eighty-eight youngsters competed in the contest and, in addition to the five principle prizes, eighteen blue ribbons were issued for honorable mention.

Mr. Lee Vining, formerly with Purdue University and now with the Indianapolis Federal Milk Market Administrator's Office, serves as contest coordinator and has been its inspiration since the origin of the contest in 1960. If the enthusiasm with which this contest has been received is any indication, Indiana's dairymen of the future should be pretty adept at producing high quality milk.

PAPERS PRESENTED AT AFFILIATE ASSOCIATION MEETINGS

Editorial Note: The following is a listing of subjects presented at recent meetings of Affiliate Associations. Copies of papers presented may be available through the Secretary of the respective Affiliate Association.

SOUTH DAKOTA ASSOCIATION OF SANITARIANS

Seventeenth Annual Conference
Yankton, South Dakota
July 13-16, 1965

(*Secretary,* Edward P. Michalewicz, State Board of Health, Pierre, South Dakota.)

Design and Construction of Private and Semi-Public Wastewater Disposal systems—*Floyd Matthew*
Design and Construction of Private and Semi-Public Water Supply Systems—*Darrell Bakken*
Prevention of Accidental Injury—*Don Kurvink*
The Chromotographic Method for Detecting Pesticide Residue in Food—*Don Mitchell*
Chemistry of Cleaning—*L. W. Rather*
Sanitation Program for Beverage Plants—*R. S. White*
Fungous Diseases and Public Health—*Gordon Roberstad*
The Importance of Fungal Toxins in Agriculture Products—*Paul R. Middaugh*
Problems and Possible Solutions in Disposal of Whey—*E. C. Berry and Lloyd Bullerman*
Presence, Prevention and Removal of Radionuclides in Food Stuffs—*K. R. Spurgeon*

GEORGIA SOCIETY OF REGISTERED PROFESSIONAL SANITARIANS

Annual Meeting
Jekyll Island, Georgia
August 12-13, 1965

(*Secretary,* J. J. Sheuring, Dairy Science Bldg., University of Georgia, Athens, Georgia)

Status and Development of the Professional Sanitarian—*Gilbert Kelso*
Panel: Outdoor Recreation Development—
Sanitation and Related Aspects—*Roy J. Boston and W. A. Hansell*
State Parks—*Horace Caldwell and Malcolm Edwards*
Federal Aspects—*Jerome Anderson*
Public Relations—Being Human on the Job—*James Murray*
Environmental Health Surveys, Technique and Values—*David S. Maney*
Panel: Inter-Professional Relationships and Communications—*Craig Gay, Mike Bender, Tom Gregory, Ben Boswell, Ed England and Dexter Gatehouse*

MINNESOTA SANITARIANS ASSOCIATION

Dairy Products Institute and Sanitarians Conference
St. Paul, Minnesota
September 14-16, 1965

(Sponsored jointly with the Department of Dairy Industries and the School of Public Health, University of Minnesota)

(*Secretary,* O. M. Osteen, Minn. Dept. of Agriculture, State Office Bldg., St. Paul, Minn.)

GENERAL SESSIONS

The Dairy Industry in a Changing Environment—*H. C. Trelogan*
Dairy Industries in a Food Science Department—*S. O. Berg and S. T. Coulter*
New Product Possibilities: Spray-dried Fruits and Vegetables—*W. M. Breene*
New Product Possibilities: Low-fat Spreads—Other Butter Programs—*H. E. Calbert*
New Product Possibilities: Cheese Products Including Low-fat—*H. A. Morris*
New Product Possibilities: Sterile Products—*F. M. Johnson*
Progress in Continuous Churn Operations—*V. S. Packard, Jr.*
Skim Milk Testing—Fat and Solids-not-fat—*H. A. Morris*
Future Role of the Sanitarian—*J. J. Jezeski*
The Problem of Salmonella Foodborne Infection—*R. Angelotti*

DRY MILK SECTION

Microbiological Problems in Dry Milk Manufacture—*J. J. Jezeski*
Tests for the Evaluation of Heat Treatment—*A. M. Swanson*
Bulk Density and Flow Characteristics of Powder—*S. T. Coulter*
Stack Losses in Spray Drying—*O. D. Turner*
Processing Dry Milk Products for Specific Uses—*R. W. Mykleby*
Dry Milk in Continuous Breadmaking—*A .M. Swanson*

MARKET MILK SECTION

Impact of the Pasteurized Milk Ordinance—1965 Recommendations of the Public Health Service on Market Milk Operations—*H. E. Thompson Jr.*
Factors Affecting the Flavor of Low-fat and Skim Milk Products—*W. C. Winder*

ICE CREAM SECTION

Physics for the Ice Cream Plant Operator—*W. C. Winder*
The New Minnesota Frozen Dairy Foods Standards—
Regulatory Viewpoint—*G. H. Steele*
Industry Compliance—*A. L. Ratzlaff*

LABORATORY SECTION

What's Involved in Minnesota's Laboratory Certification Program—*Peter Patrick*
Salmonellae in Foods-Detection and Control—*R. Angelotti*
Problems With the Catalese Test—*J. C. Olson, Jr.*

DAIRY FIELDMEN

Interpretation of the Minnesota Milkhouse Law and Regulations—*G. H. Steele*
Present Concepts of Ventilation for Dairy Barns, Milking Rooms, and Milkhouses—*Marvin Nabben*
If I Were Building a Milkhouse in Minnesota—*V. S. Packard, Jr.*
Liquid Manure Disposal Systems—*J. W. Crowley*
The 1965 National Conference on Interstate Milk Shipments—A review of the Basic Agreements—*H. E. Thompson, Jr.*

FOOD AND ENVIRONMENTAL SANITATION

Panel: The Influence of the Community on Environmental Health Planning—
The Influence of Man's Culture and Beliefs on his Actions—*Norman A. Craig*
Community Opinions and Environmental Health Planning—*Lester A. Sanger*
The Seeds of Success or Failure—*Zane B. Mann*
Be a Safety Consultant to Food Service Operators—*Norman Steere*

WISCONSIN ASSOCIATION OF MILK AND FOOD SANITARIANS

Twenty-first Annual Meeting
Madison, Wisconsin
September 8, 1965

(*Secretary,* L. Wayne Brown, 4702 University Ave., Madison, Wis. 53705)

Sediment Testing in Farm Bulk Milk Tanks—*Elmer Kihlstrum*
Recommended Guidelines for Liquid Manure Handling—*E. G. Bruns*
Panel: Progress Report on Wisconsin Mastitis Control Program—*C. W. Burch, A. A. Erdmann, James Meany, Robert Parker, Alvin Schroeder and Donald Thompson*
Significance of Bacterial Counts in Food Evaluation—*E. M. Foster*
The Importance of an Educational Program in a Pesticide Control Program—*Ellsworth Fisher*

NEW YORK STATE ASSOCIATION OF MILK SANITARIANS

Forty-second Annual Conference and Thirteenth Joint Conference with Department of Dairy and Food Science, Cornell University
Syracuse, New York
September 27-29, 1965

(*Secretary,* R. P. March, 118 Stocking Hall, Cornell University, Ithaca, N. Y.)

GENERAL SESSION

The Future of Agricultural Business in New York State—*Morton Adams*
Panel: Sterile Milk in the Northeast—
Producing Sterile Milk—*Sol Zausner*

Classification and Pricing of Sterile Milk Under Marketing Orders—*Alfred R. Place*
Legal Aspects—*Dermot C. Reilly*

Objectiveness of the State and National Sanitarians Association—*Ralph Adams.*

FOOD SESSION

Voluntary Compliance—*Allen T. Retzlaff*
Microbiological Hazards Related to Synthetic Fillings for Pies and Pastries—*Francis D. Crisley*
Two Sides of the Coin, The Food Industry Today and Tomorrow—*A. C. Peterson*
Sanitation in a Chocolate Manufacturing Plant—*Michael DeBenedictis*
The AMFare Automatic Restaurant System—Sanitary Aspects—*Norman Potter*
The Physical Chemistry of Plant Sanitation—*Malcolm C. Bourne*
Food Adulteration in New York State—*Elmer George, Jr.*

LABORATORY SESSION

Standardization and Acceptance of Laboratory Glassware—*Elmer George, Jr.*
The Present Significance of Psychrophiles—*H. Brooks Naylor*
Manufacturing, Standardization and Certification of Dehydrated Media—*C. W. Christensen*
Panel: Proper Use and Maintenance of Laboratory Instruments—*Richard A. Ledford, W. Frank Shipe, John W. Sherbon, and Joseph E. Nowrey.*

FIELDMEN SESSION

Fieldmen's Responsibility for the Modified Whiteside Test—*R. P. March*
Fieldmen's Responsibility in Sampling—*F. C. White*
What a State Rating Officer Looks for in Rating Supplies under U.S.P.H.S. Code—*William Y. Perez*
Location and Construction of Farm Water Supplies—*Heinz Russelman*
Water Treatment for Removal of Chemical Impurities—*Frank Liguori*
Bacteriological Purification of Water—*Edwin Keating*
Emergency and Supplemental Supplies—*Carl S. Winkelblech*
Panel: Modern Housing Systems—
Environmental Control—*W. W. Irish*
Fluid Manure Handling—*Charles A. Bauer, Jr.*
Experimental Farm—*Gordon C. Perry*

PLANT SESSION

Plant Requirements in the 1965 U.S.P.H.S. Code—*Robert W. Wilson*
Panel: Milk Plant Waste Disposal—
New York State Control—*Joseph J. Kosman*
Design—*William E. Standeven*
Operational Use—*H. G. Harding*
Inside Information on the Dairymen's League Plant at Goshen, New York—*H. F. Hollenbeck*
Plant Maintenance and Sanitation—*Richard C. Shuler*
The Future in Plastic Milk Containers—*Fred W. Barhoff and Charles E. Thompson*

MINUTES OF THE AFFILIATE COUNCIL MEETING

Hartford, Connecticut
September 13, 1965

O M. Osten, Presiding, appointed R. E. Stedman as Acting Secretary for the meeting. The Secretary read the minutes of the previous year's meeting and it was moved by R. P. March and seconded by L. W. Brown that they stand approved as read.

There followed a discussion on having an Executive Board member present at the Affiliate Council meetings. R. M. Parry offered and Charles Walton seconded a motion that a representative of the Executive Committee meet with the Council to discuss the problems of the organization. Upon passage of the motion Dr. Parry agreed to contact the Board to arrange for a representative to meet with the Affiliate Council at 9 P.M.

The following discussions then ensued. It was Mr. March's belief that the Affiliate Council is not being given due recognition as to its purpose. Mr. Walton stated that the Chairman of the Affiliate Council should be invited to sit at the head table at the Annual Banquet to give recognition to the Affiliate Council. Mr. Brown then suggested that the Chairman of the Council present the feelings of the Affiliate Council at the annual business meeting and further stated that the Chairman should report to the full membership at the business meeting.

Mr. Walton moved, and Mr. March seconded, that an affiliate award be established and that criteria for the award be established by the Committee on Recognitions and Awards of the Association. Mr. March urged that all affiliates send suggestions to the Chairman on subjects and possible speakers for future annual meetings. No further action on the awards was taken by the Affiliate Council.

Mr. J. H. Fritz representing the Executive Board reported on discussions by the Board on the matter of raising dues, asking for donations from affiliates, selling advertising, etc. Mr. Fritz stated that additional sources of revenues had been explored, such as selling the booklet "Food Borne Epidemics". It was the Board's feeling that a fee of $8.00 for affiliate membership and a $10,00 direct fee be established. There followed a lengthy discussion on the problem of raising dues. State representatives expressed the opinion that there may be some loss of members of the organization. Mr. Fritz stated that the Executive Board believes that we can best raise dues by convincing the membership of the necssity of it. Mr. March moved that the Council recommend a $2.00 increase in International dues and this was seconded by Mr. Brown.

Mr. March made the recommendation that the registration desk be held open until 9 P.M. on the first night of the convention so as to allow late arrivals to register. He also recommended that the organization change its name back to "International Association of Milk and Food Sanitarians" by eliminating the word "Environmental".

It was moved by Mr. March, and seconded by Mr. R. E. Stedman that the meeting of the Affiliate Council for 1965 be adjourned.

Those in attendance and their affiliation were:

O. M. Osten	Minnesota
R. E. Stedman	Iowa
Ben Luce	Washington
Curtis Chaffee	Connecticut
Joseph H. Peterson	Illinois
L. W. Brown	Wisconsin
R. P. March	New York
K. Ray Minert	Michigan
R. M. Parry	Connecticut
Charles Walton	R.M.A.M. & F.S.

A LETTER FROM FRED BASELT

Mr. H. L. Thomasson, Ex. Sec.
International Association of Milk, Food, & Environmental Sanitarians
Shelbyville, Ind.

Dear Red:

As events of the past year have shown, I never wanted to leave the IAMFES. Last year in a retirement mood I bailed out of all societies. But something was wrong and it took a move on your part to bring it to a head. Hence the contribution to the wear and tear fund.

The Honorary Life Membership told me the IAMFES wants me to stay with them. Could any thing work out better? To say "thank you" seems a bit of an understatement. The plaque resides in the den where all can see and I make sure they do see.

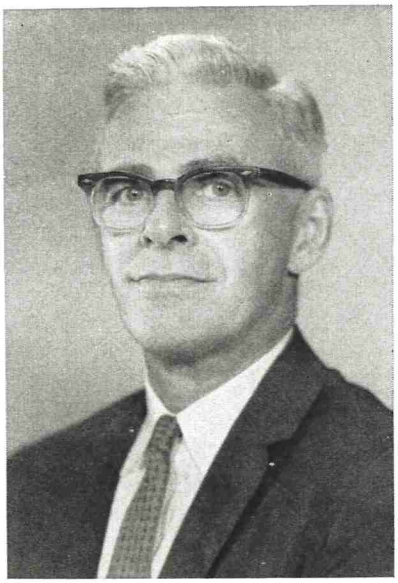
To all of you "Greetings" and to the committee my gratitude and the assurance that the latch is out for all who wander into vicinity. And don't forget your promise to stop in and see us.

Our best to you all,

Wilma and Fred Baselt

NEWS AND EVENTS

DR. F. W. BARBER RECEIVES PROMOTION



Dr. Franklin W. Barber has been promoted to Manager of Patents & Regulatory Compliance of the National Dairy research center in Glenview, Illinois, it was announced by Dr. Arnold H. Johnson, President of Research and Development Division, National Dairy Products Corporation.

Barber joined the company as a dairy technologist and recently was honored for twenty years of service. He received his B.S. degree from Aurora College and his M.S. and Doctorate in 1944 from the University of Wisconsin, where he majored in Bacteriology. He is a member of Sigma Xi, the American Dairy Science Association, the Institute of Food Technologists, the American Society of Microbiology and the World Health Organization.

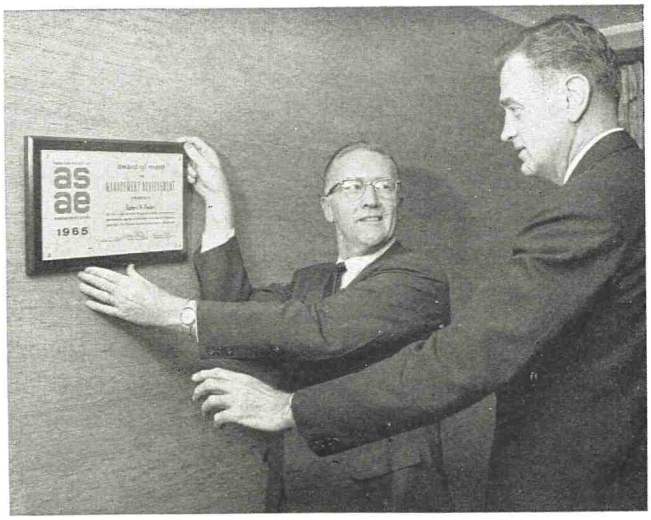
Dr. Barber has long been a member of the International Association of Milk, Food and Environmental Sanitarians, Inc. and is a Past President of the organization.

PAPER CUP AND CONTAINER INSTITUTE WINS AWARD FOR PUBLIC HEALTH PROGRAM

A program in the public health field has caused the Paper Cup and Container Institute to be honored in the annual management achievement competition sponsored by the American Society of Association Executives. The Samuel J. Crumbine Awards Program, established by the Public Health Committee of the Institute for the improvement of local health programs was singled out for a special award.

An Award of Merit plaque was presented to the Institute, at ASAE's 46th Annual Meeting (August 15-18,) held at the Greenbrier Hotel, White Sulphur Springs, W. Va.

The purpose of the ASAE Awards is to recognize association project achievement of exceptional quality. Each contestant must select and describe the program which is considered a most successful contribution to the association. Why the program was



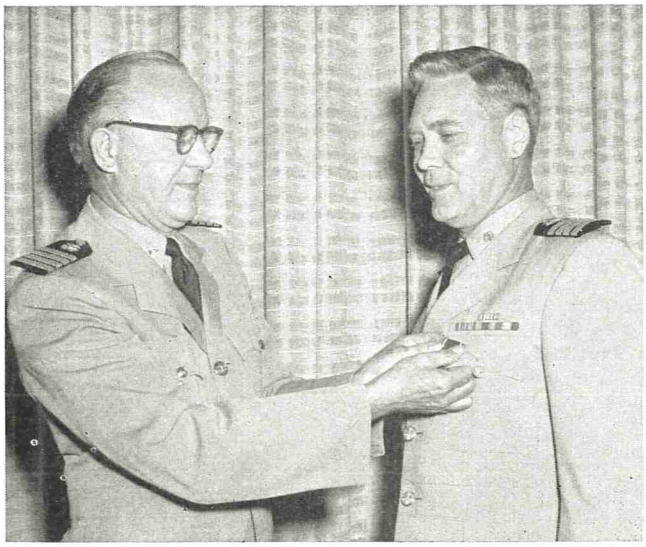
Howard E. Hough (left), Secretary of the Paper Cup and Container Institute's Public Health Committee, and Robert W. Foster, Executive Director of the Institute, hang an Award of Merit plaque.

needed, how it was carried out, and the resulting benefits to the association and the public must also be explained.

The Samuel J. Crumbine Awards Program, sponsored annually by the Paper Cup and Container Institute, Public Health Committee, of which Howard Hough is secretary, involves contact with some 1,200 local health departments across the nation. Two Crumbine awards are made, one for outstanding achievement in the development of a comprehensive program of environmental health, and the other for outstanding achievement in the development of a program of public food and drink sanitation. The Crumbine Awards Program has gained national recognition and prestige among public health officials and is highly coveted by community leaders.

The Awards, now in their 11th year, honor the late Dr. Crumbine, pioneer leader in the field of public health, and are designed to bring recognition to the local public health officials who work to keep their communities free of disease and contamination. The programs of the award-winning departments often serve as models for other departments seeking ways to improve their own activities.

DAROLD W. TAYLOR AWARDED USPHS COMMENDATION MEDAL



Darold Taylor receives medal from Wesley Gilbertson

Darold W. Taylor, a sanitarian director in the Public Health Service, was awarded the Service's Commendation Medal on September 22 in recognition of his "high level of performance and dedication to duty in the milk and food sanitation fields." The citation, which recognizes outstanding performance and competence, was awarded by Wesley E. Gilbertson, Chief, Division of Environmental Engineering and Food Protection, on behalf of Dr. Luther L. Terry, Surgeon General of the Public Health Service.

In 1963, Mr. Taylor was named the Service's Liaison Officer to professional sanitarian organizations in the United States. In 1958 he was named chairman of a task force developing criteria used in guiding appointments to the sanitarian category of the Service's Commissioned Corps. In 1954, a United States District Judge, after hearing a public health case in which Mr. Taylor testified, was moved to include as a footnote to his formal decision praise for Mr. Taylor's efficiency and devotion to science and public service.

Mr. Taylor, whose current assignment is Chief, Milk Sanitation Section, Milk and Food Branch, Division of Environmental Engineering and Food Protection, obtained his Bachelor of Science degree from Kent State University in 1939 and his Master of Public Health degree from the University of Michigan in 1949. During the period 1941-1943, Mr. Taylor was the chief milk and food sanitarian for the Portage County Health Department, in Ohio. In 1944 he was appointed to the Public Health Service's Commissioned Corps. Tours of duty included the United Nation's Relief and Rehabilitation Administration in North Africa and Greece, a number of regional offices of the Public Health Service, and the Service's Washington headquarters.

CHARLES A. FARISH APPOINTED EXECUTIVE DIRECTOR OF N.S.F.

Charles A. Farish has been named by the Board of Directors of the National Sanitation Foundation to be the Executive Director of the Foundation, succeeding the late Walter F. Snyder. The election took place on June 4, 1965. Mr. Farish will continue to serve as the Director of National Sanitation Foundation Testing Laboratory.

The program established through Mr. Snyder's efforts will be continued, according to Mr. Farish, and it is anticipated that the overall efforts of the Foundation will be further expanded through the cooperation of industry, official agencies, user groups and the communications media.

EQUIPMENT FOR MALECKI METHOD OF RAPID COUNTING OF VIABLE BACTERIA

Malecki Laboratories, Inc., in response to considerable interest shown in their method for rapid counting of viable bacteria described in the *Journal of Milk and Food Technology* (October, 1963, Vol. 26, No. 10, Page 327), have begun manufacture and distribution of microplates and an incubation unit designed especially for the procedure. Some modifications have also been made to improve the tech-

nique.

Information on cost and availability of the microplates and the incubation unit may be obtained by writing Malecki Laboratories, Inc., 418 N. State St., Chicago, Ill. 60610

INFORMATION FROM INDUSTRY

Editorial Note: Following are items of information on products, equipment, processes and literature based on current news releases from industry. When writing for detailed information, mention the Journal.

PENNSALT BROCHURE

Long known for its cleaning and sanitizing compounds associated with the brand name, B-K, Pennsalt supplies a wide range of chemicals and equipment to the dairy and food industry. A new brochure highlighting innovations and pinpointing facilities and services for the industry is available from Pennsalt Chemicals Corp., Dept. D-2, Three Penn Center, Philadelphia, Pa. 19102

NEW WAUKESHA PUMPS

Three pumps of interest to the dairy and food field are described in current information from the Waukesha Foundry, 4600 Lincoln Ave., Waukesha, Wis. The "Aseptic" pump is designed to help extend product shelf life and to enhance flavor and taste by preventing bacterial contamination of the product. Live steam is circulated throughout the pump and around the seals and is directed at the inlet and outlet connections and other points where bacteria could enter. The unit, meeting 3A requirements, is described in Bulletin P-352.

The Waukesha "Meter Flow Control" pump measures and transfers simultaneously liquid and semi-liquid products. A high degree of precision is suited for accurate batch measurement or continuous flow control and the unit has a wide range of applications in automated and semi-automated operations.

The Waukesha "Shear/Pump" is capable of transferring and treating a product simultaneously. Utilizing a controllable stator-rotor arrangement properly balanced with a desired pump RPM, the unit is able to perform such functions as texturizing, emulsifying, blending, whipping and mixing.

MILKHOUSE PANEL

The Perfection Milkhouse Panel is a preassembled, self-contained unit adaptable to any milker system and ready to connect to existing equipment. All parts and controls are mounted on a stainless panel and a manifold provides for handling up to eight milkers. Operations can be switched from milking to the wash cycle in seconds and thorough pipeline cleaning and draining is assured. Unit meets 3A standards and requirements of major milk markets.

Information on the panel and on a complete line of milker systems, transfer stations, vacuum pumps and accessories is available from Perfection Dairy Div., Sta-Rite Products, Inc., Delavan, Wis.

CLASSIFIED ADS

POSITIONS AVAILABLE

Sanitarian — $497.25-$616.28 per mo. Minimum two year college with courses in Chemistry, Physics, Bacteriology with three years experience or the equivalent combinations of education and experience. New car furnished; retirement and hospitalization benefits. Inquire: Fred J. Siebenmann Jr., Health Officer, Health Department, Moline, Illinois. 61265

MICROBIOLOGIST

BS or MS Degree

Permanent position with research organization performing consulting services to food packaging industry. Involves frequent travel to sponsors' plants. Experience in public health or bacteriology required.

Comprehensive employee benefit programs including support for further education and relocation assistance.

Send detailed resume in confidence to

Personnel Officer
Syracuse University Research Corporation
P.O. Box 26, University Station
Syracuse, New York 13210

AN EQUAL OPPORTUNITY EMPLOYER

DISTRIBUTOR WANTED

No Competition. To service and set up new accounts in exclusive territory. Investment secured by fast moving inventory of amazing plastic coating used on all types of surfaces interior or exterior. Eliminates waxing when applied to any type of floor. Eliminates all painting when applied to wood, metal or concrete surfaces.

Minimum Investment—$500

Maximum Investment—$12,000

For details write or call:

Phone: 314 AX 1-1500

Merchandising Division
P. O. Box 66
St. Ann, Missouri 63074

FOR SALE

Single Service milk sample tubes. For further information and a catalogue please write, Dairy Technology, Inc., P. O. Box 101, Eugene, Oregon.

SYMPOSIUM ON TRANSMISSION OF VIRUSES BY THE WATER ROUTE

A three day symposium on the transmission of viruses by the water route will be held in Cincinnati, Ohio on December 6-8, 1965. The meeting is sponsored by the Microbiology Section, Basic and Applied Sciences Branch Division of Water Supply and Pollution Control, U.S. Public Health Service.

Discussions will cover such topics as: Transmission of Viral Diseases by Drinking Water; Transmission by Recreational Water; Viruses in Abattoir Effluents; Origin of Microbial Pollution in Streams; Virus Survival in Sewage Purification Processes; and Enteric Viruses in Estuary Waters and in Shellfish.

Information on the Symposium arrangements may be obtained from Dr. Gerald Berg, Public Health Service, R. A. Taft Engineering Center, 4676 Columbia Parkway, Cincinnati, Ohio. 45226

"PLANS AND PROGRESS" IS THEME OF FDA-FLI ANNUAL CONFERENCE

"Plans and Progress in Industry Information and Consumer Education" will be the theme of the Ninth Annual Conference sponsored by the Food and Drug Administration and the Food Law Institute. The all-day conference will be held at the Mariott Twin Bridges Motor Hotel in Washington, D.C., Monday, December 6, 1965.

The purpose of the joint conference is to promote understanding of and voluntary compliance with the Federal Food, Drug, and Cosmetic Act. Speakers from both FDA and FLI will be featured. Secretary of Health, Education and Welfare John W. Gardner will present the welcoming address.

FAST-ACTING IODINE CLEANER-SANITIZER

for Bulk Tanks, Milking Machines, Utensils and Udder Wash

- Excellent wetting, penetrating and cleaning action.
- Strong bactericidal action.
- Effective in waters up to 117 grain hardness.
- Detects and removes milkstone.
- Mild to hands and udders.

PLEASE SEND ME NOVADINE SANITATION LITERATURE

NAME_____

STREET OR RFD_____

CITY_____ STATE_____ ZIP_____

Cowles Chemical Company

CLEVELAND, OHIO 44120

Facts for the Sanitarian about

THE MILKING MACHINE AND ITS RELATIONSHIP TO MILK QUALITY

VACUUM CONTROLLERS OR REGULATORS

W. T. "Bill" Pickavance
Sales Engineer and
Sanitation Coordinator
Universal Milking Machine Division

Vacuum Controllers or Regulators are precision instruments that control the milking vacuum or the vacuum to which the teat is exposed. There is a mistaken notion by many that vacuum controllers or regulators can increase the capacity of the vacuum pump. Not true!

The purpose of the Vacuum Controller is to admit air, or to close off admittance of air to maintain the proper vacuum level recommended by the machine's manufacturer. It must be given proper maintenance and kept clean. Sticky or worn out vacuum controllers, or those which are improperly located, are as much a problem as inadequate vacuum pumps.

The greater the distance air must travel from the controller to the pump, the greater the friction the air encounters. Consequently, it takes longer for the pump to remove air from the system and create proper milking vacuum. When this happens, the milking machine is not efficient and is subjecting the dairy herd to possible udder injury and can affect the quality of the milk.

Universal recognizes the wide variety of problems faced by the dairyman, sanitarian and manufacturer. Continuous testing and product improvement are some of the ways we serve the total industry. Encouraging better understanding of mutual problems through information such as this is another.

Universal®
MILKING MACHINE DIVISION
NATIONAL COOPERATIVES, INC.
ALBERT LEA, MINNESOTA

One of the world's most remarkable fabrics is in KENDALL NON-GAUZE MILK FILTERS

KENDALL scientists made history when they invented this unique non-woven fabric. Its superior strength and density make it ideal for filtering milk.

KENDALL **non-gauze** Milk Filters are uniform throughout, with no thick spots to clog — no weak spots to tear. They're just as efficient as any gauze faced filters and cost up to 25% less.

They help you control milk quality, cut down on costly rejections, and receive a regular supply of cleaner milk. Tell the dairymen you know about them soon.

KENDALL

THE KENDALL COMPANY
FIBER PRODUCTS DIVISION
WALPOLE, MASSACHUSETTS

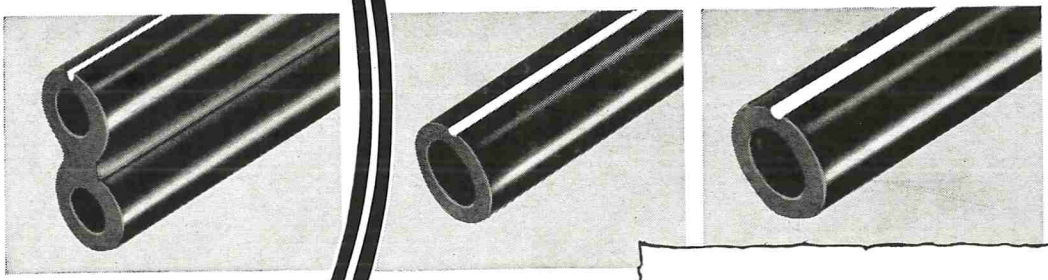
Makers of KENDALL Calf Scours Tablets, KENDALL Triple-Action Udder Cream, and SANI-GUIDE Pipeline Inserts.

NEW!

TRANSFLOW® Vacuum Hose *for Milking Machines*

. . . the long-needed companion product to Transflow M-34R Raw Milk Tubing

- ***GREATLY INCREASED SERVICE LIFE***
  Transflow Vacuum Hose won't age, oxidize, crack or flake . . . will last several times longer than conventional vacuum hose.
- ***EASIER TO HANDLE***
  The reduced bulk and lower weight of Transflow Vacuum Hose make for much easier handling. What's more, Transflow Vacuum Hose was specifically formulated to stay supple and flexible, even in the coldest weather.
- ***OUTSTANDING ATTRACTIVE APPEARANCE***
  Transflow's highly polished, shiny black appearance sets off the gleaming beauty of milking equipment, will keep its attractive appearance for months and years to come. It is absolutely non-staining to any milker part or accessory equipment, even when fully automatic CIP systems are used.
- ***EASY TO CLEAN AND KEEP CLEAN***
  Transflow's smooth, shiny finish — inside and out — eliminates soil build-up, makes it very easy to clean and keep clean.
- ***SAFE***
  Although it is not required, Transflow Vacuum Hose nonetheless is manufactured using only ingredients on the FDA's "Safe" list.



You can tell genuine Transflow Vacuum Hose at a glance: There's a white stripe running lengthwise along its shiny black surface. In addition, the words "TRANSFLOW VACUUM HOSE" are branded on every foot. Look for the white stripe and the brand!

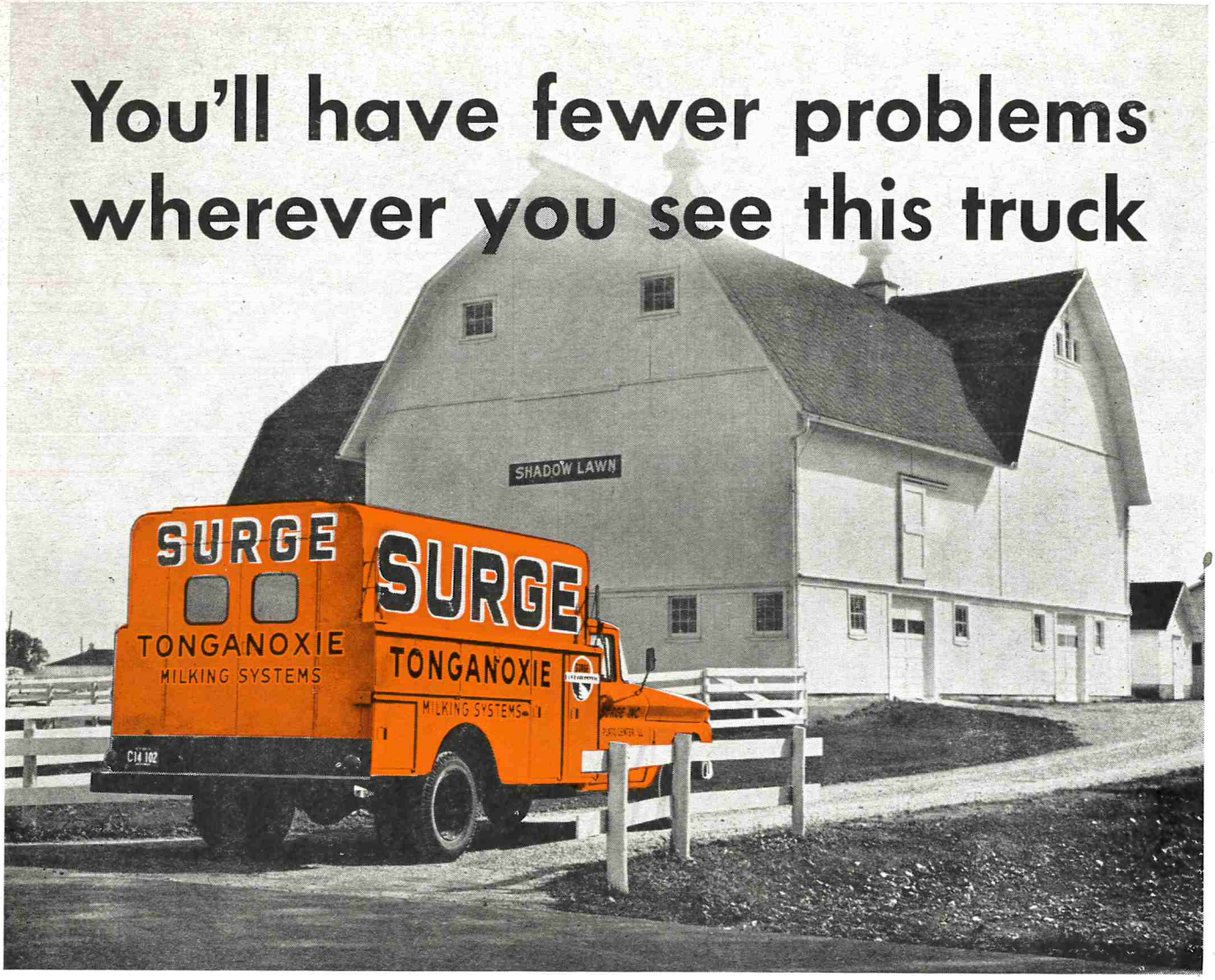
FOR MORE INFORMATION ABOUT TRANSFLOW VACUUM HOSE
write to Chamberlain Engineering Corporation, Akron, Ohio 44309.

Plastics and Synthetics Division

CHAMBERLAIN
engineering corporation
AKRON, OHIO 44309

1770-B

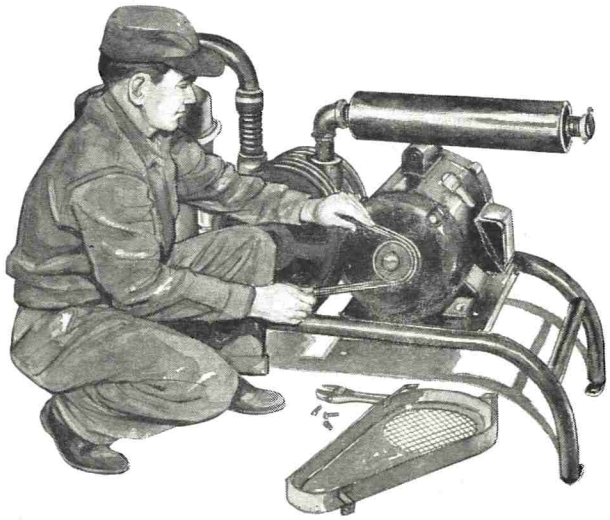
You'll have fewer problems wherever you see this truck



Whether your local Surge Service Dealer is there on a regular preventive maintenance call or an emergency repair call, it is his job to keep every installation operating as it should.

He has precision instruments to check the vacuum system's efficiency. The Surge Water Analyzer enables him to determine the exact amounts of the proper detergents to keep the equipment clean. His training and experience help him find potential trouble spots before they affect the quality of the Dairyman's milk.

In short, your Surge Service Dealer will be glad to assist you in any way he can.



SURGE is a Babson Bros. Co., trademark © Babson Bros. Co., 1965

BABSON BROS. CO.

Builders of the

SURGE

2100 S. YORK RD. • OAK BROOK, ILL. 60523