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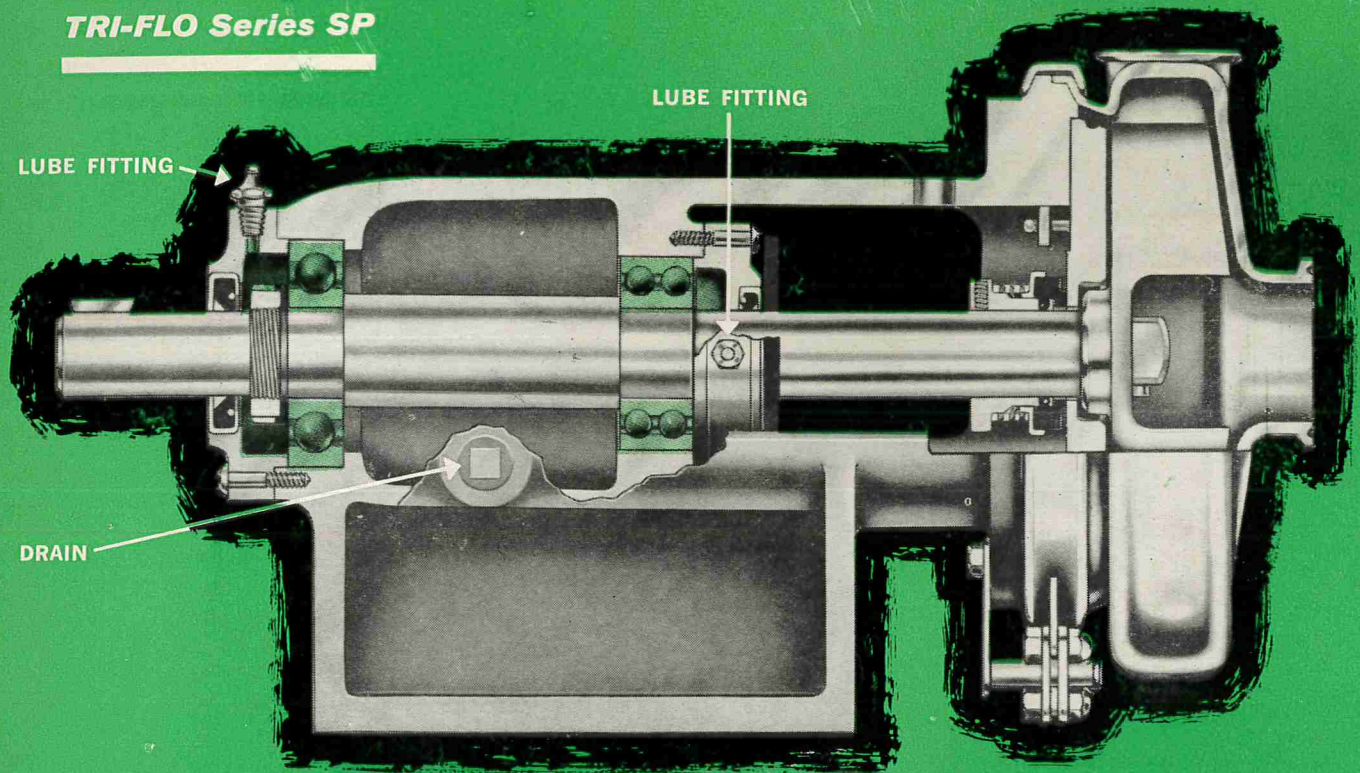
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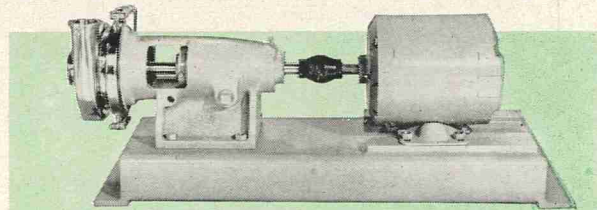


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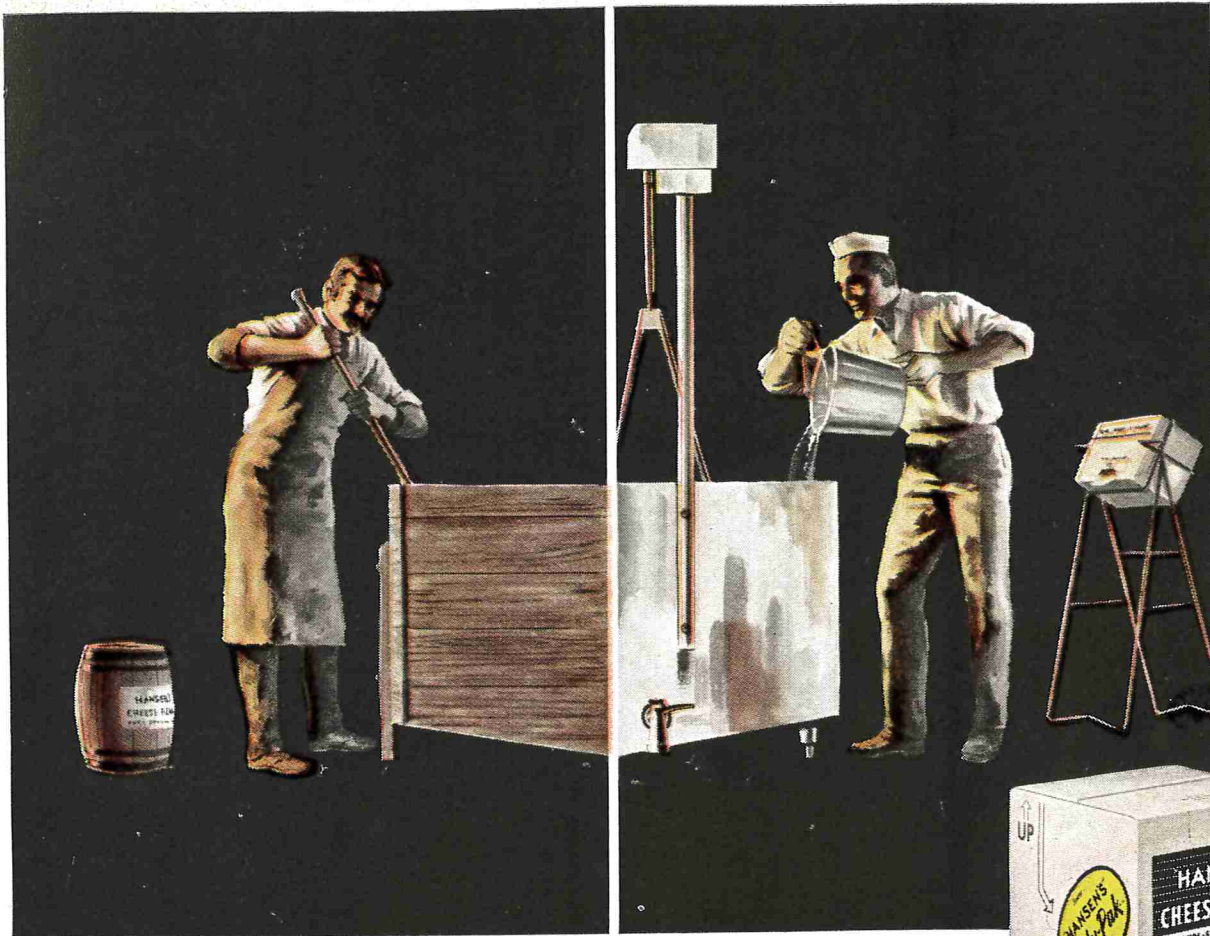
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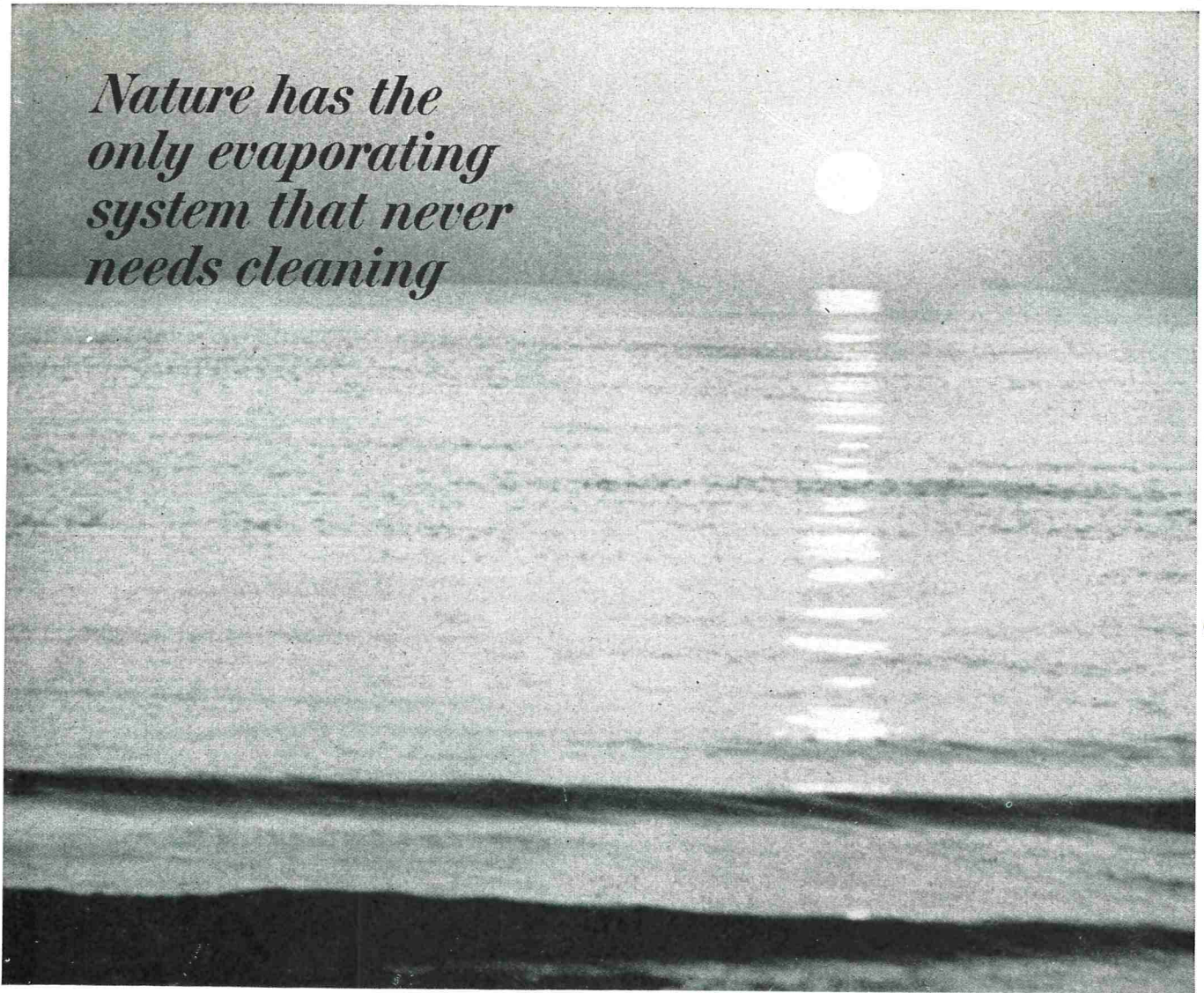
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Journal of

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INCLUDING MILK AND FOOD SANITATION

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

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Volume 28

October, 1965

Number 10

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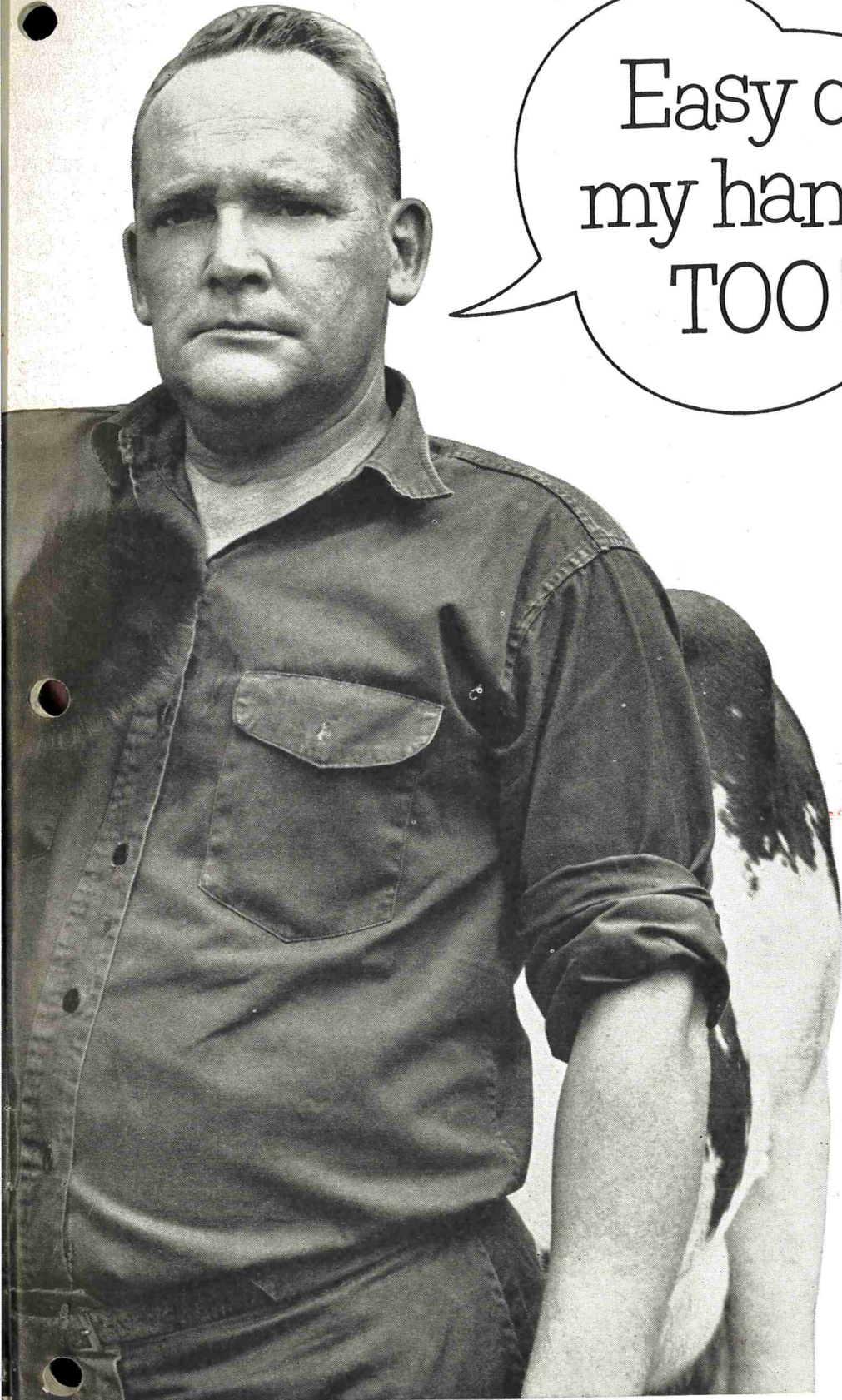
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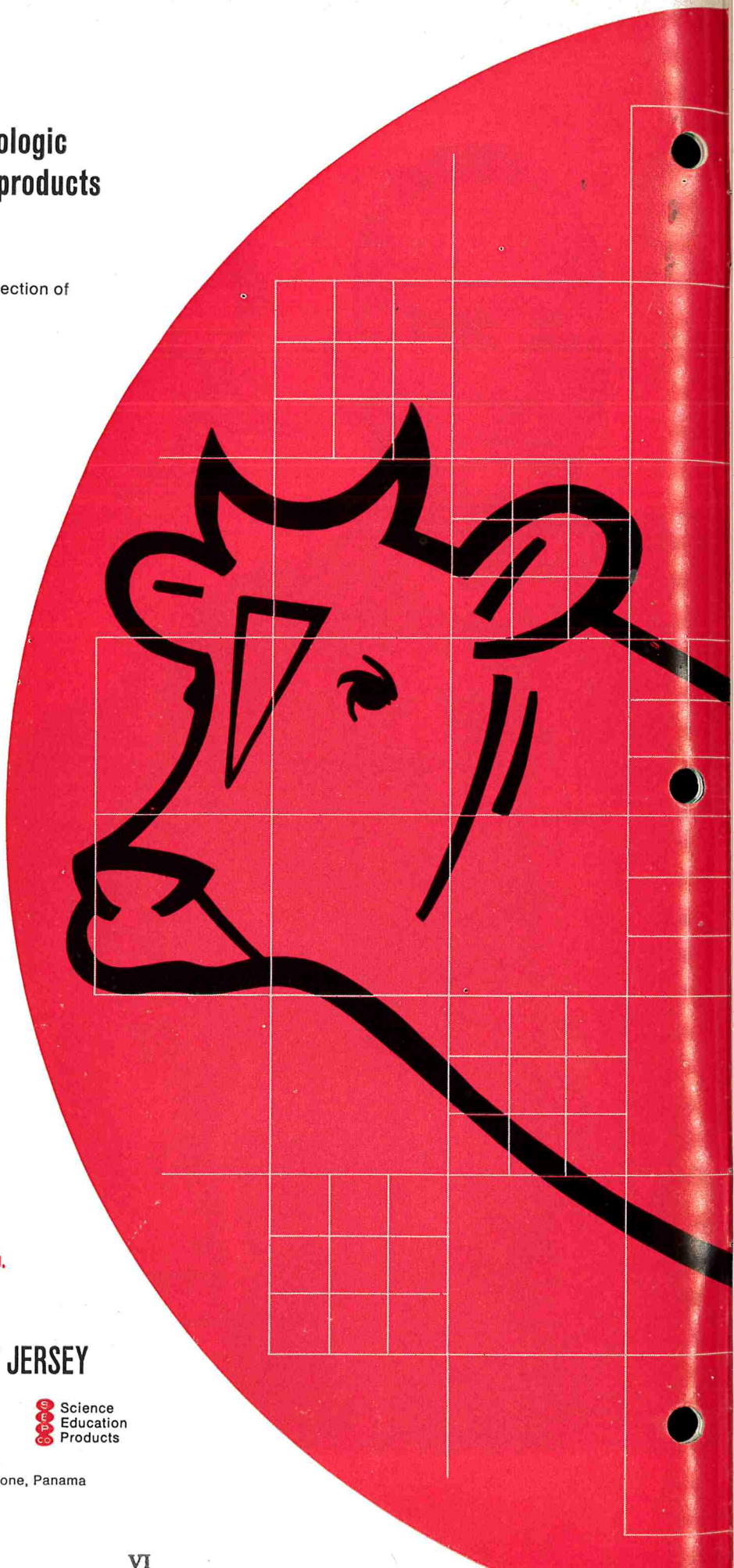
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as a step toward our mutual goal of cleaner milk, Johnson & Johnson is presenting to the dairy farmer a series of educational articles under the general heading The Scientific Approach to Milk Filtering. These articles are intended to provide simple, practical answers to everyday questions concerned with the production of better milk, and to help educate the dairy farmer to the need for and value of proper milk filtration. If you are interested in obtaining the first two articles, already in print in leading dairy farmer journals, simply fill out and mail the attached coupon.

Chapter I: The Scientific Approach to Milk Filtering

Why Should I Filter My Milk?

by E. E. Kihlstrum

"It's not so much the cost of the filter pads—some cost little more than a penny—it's the bother and time it takes—"

Therefore, the more dairymen who produce cleaner milk, the better the chances for the dairy industry to get more of the consumer's food dollar. This is Reason #2 for proper filtering: help increase the sale of dairy products.

Mastitis is the hidden profit stealer. So much has been written on this subject that it is hard to know where to start, but it is agreed that mastitic cows produce much less milk than healthy cows. Cost of feed and costs of medicine and treatment, plus loss of production, can soon turn a profitable cow into one that is a real loss factor in your herd. Early detection of mastitis is important provided it is followed up by prompt correction. A reliable milk filter permits quick, low cost early detection. This milk filter is available now, let's state Reason #3 for proper filtering: help increase the sale of dairy products.

Mr. Kihlstrum is Director of Trade Relations, Johnson & Johnson Dairy Department. He is also a member of the Board of Directors, National Mastitis Council; member of Farm Practices Committee, International Association of Milk, Food and Environmental Sanitarians; member American Dairy Science Association.



Chapter II: The Scientific Approach to Milk Filtering

How Can Filtration Help Overcome Mastitis?

by Dr. H. E. Kennedy

"I don't see how a milk filter has anything to do with mastitis—after all, mastitis is an udder problem, not a matter of careless milking like dirt and sediment."

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This column will be the discussions about milk filter pad has to do—what kinds of equipment related to filtering—any you money. The quest—times—in all parts of it first. It is important

If cows could use soap, wouldn't be a great success for the hands of a boy used soap, water a successful dairyman for the cows, before tests—milking equipment—into the milk. The and efficiently . . . and the h

Standards for years ago. The enforced in all closer attention not up to station. From t interest in p filtering: less Everyone h

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Have being effect plan cour

Dr. H. E. Kennedy—currently Director of Dairy Products Research for Johnson & Johnson. Received his A.B. from Atlantic Christian College and Ph.D. from North Carolina State. Former Staff Member, Department of Dairy Technology, Ohio State University. Member of American Dairy Science Association, International Association of Milk, Food and Environmental Sanitarians, National Mastitis Council.



Chapter I discussed w No. 3 was the early income. At first glance and mastitis may not above comes up in and mastitis.

Mastitis is a broad conditions of the mammary milk, inflammation always, a diseased organism. Mastitis production regards or long duration—cal or non-clinical.

Mastitis is costly, is the most seri counter. Studies mates of its doll \$25 per cow pe milk production discarded milk mastitis or loss feed and cost cows, but brin

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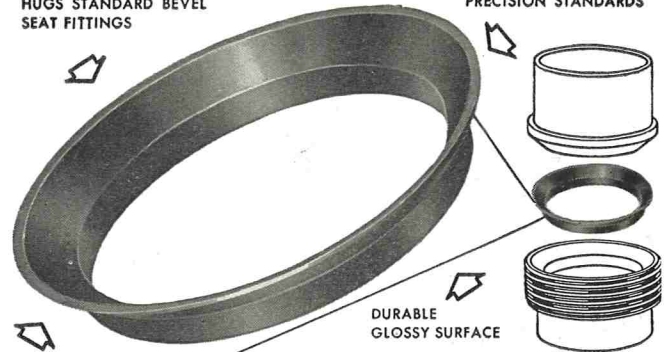
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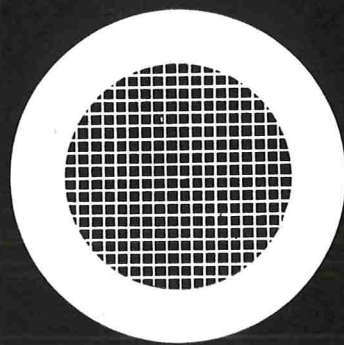
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On the Incubation Period for Bacterial Counts of Dried Milk

In all probability the 12th edition of *Standard Methods for the Examination of Dairy Products* will become available in 1966. This is a most significant publication to all milk regulatory personnel as well as to those of industry concerned with milk quality control. It is important that methods and techniques described in "Standard Methods" be sound in principle. A change currently under consideration relative to the bacteriological analysis of dried milk is the subject of the following comments.

In the 11th edition of "Standard Methods", published in 1960, the incubation period for dry milk plates was increased from 48 to 72 hr. This change followed submission to Dr. L. A. Black, then chairman of the Standard Methods Committee, of results obtained by the Canada Department of Agriculture which are summarized in Table I.

TABLE I. COMPARISON OF COUNTS ON 153 DRY MILK SAMPLES AFTER 48 AND 72 HOURS INCUBATION

Incubation period	Plate count per g					
	5,000 and under	5,001-10,000	10,001-25,000	25,001-50,000	50,000-100,000	Over 100,000
(hr)						
48	38	32	38	22	22	1
72	12	23	25	24	28	41

It will be noted that only one sample (0.65%) exceeded the count limit of 100,000/g after 48 hr as against 41 (26.8%) after 72 hr. It was our opinion that the 48-hr count allowed too many substandard products to escape detection; furthermore, many colonies at 48 hr were so small that it was difficult to distinguish them from specks of undissolved powder, etc.

In Canada, dry milks moving out of the province in which they have been manufactured are required to be graded by the Canada Department of Agriculture. Grade standards for First Grade powder include a standard plate count limit of 10,000/ml on a reconstituted basis (100,000/g of powder). The change to 72-hr incubation, officially made in November 1960, has been accepted by the industry without demur. The officials concerned with inspection of drying plants and grading of product are convinced that this change forced increasing attention to plant practices and sanitation, with a resultant better product. In the United States also, the official agency, the USDA, has been well pleased with the results of 72-hr incubation. The industry, however, has been unwilling to accept the change. Probably as a result of their representations, it is proposed to change back to 48-hr incubation in the 12th edition of *Standard Methods*, which is expected to be published in 1966.

The chief reasons advanced for taking this step are: (a) that the extra 24-hr incubation necessitates 50% greater storage capacity for product, (b) only a small percentage of samples is degraded through the extra 24-hr incubation³, and (c) that 32 C for 48-hr should be standard for viable counts for all products in addition to fluid milk and cream. While it is true that increased storage capacity may be required, the industry in Canada, where practically all powder is officially graded, has adjusted without any difficulty. As to the percentage of powder degraded by the longer incubation, careful inspection of the published data³ reveal that 10 out of 57 samples of low heat powder (17.5%) were lowered in grade. This class of powder is used for beverage purposes, cottage cheese, etc., and has greater public health significance than powders from higher heat treatments. The results in Table I above reveal an even higher percentage of samples affected by the longer incubation. The third point, that there should be one incubation period for plates from all products, ignores the fact that in dry milk many bacteria are too dormant to develop recognizable colonies in 48-hr.

In a recent paper, Thomas, Reinbold and Nelson⁴ state, "A plating method for the enumeration of organisms in milk should nevertheless have the objective of determining the greatest possible proportion of the bacteria present." They go on to say, "A second objective of a plating procedure should be the production of easily discernible and countable colonies." Both of these objectives the 48-hr count fails to reach.

An additional reason for requiring 72-hr incubation is the recent finding that the organisms responsible for marked increases beyond 48-hr are Gram-negative rods². Even pasteurization should destroy such organisms. Hence their presence in powder in large numbers strongly suggests recontamination and growth before drying. In view of the food poisoning outbreaks traced to dry milk, such contamination has public health significance.

"Standard Methods" were developed primarily to enable official agencies to exercise better control over farm and plant sanitation. The USDA is so convinced of the superiority of 72-hr incubation for this purpose that they intend to continue with it even if *Standard Methods* reverts to 48 hr¹; the Canada Department of Agriculture is seriously considering doing the same. It is difficult to see the justification for ignoring the views of the official agencies in both countries in contemplating what must be regarded as a retrograde step from the standpoint of sanitation.

¹Fenton, F. E. Personal communication, August 13, 1965.

²Pedraja, R. Personal communication, January 5, 1965.

³Pedraja, R. and Mengelis, A. Effect of Time and Temperature of Incubation on the Plate Counts of Dry Milks. *J. Milk Food Technol.* 27:241. 1964.

⁴Thomas, W. R., Reinbold, G. W., and Nelson, F. E. The Effect of Temperature and Time of Plate Incubation on the Enumeration of Pasteurization-resistant Bacteria in Milk. *J. Milk Food Technol.* 26:357. 1963.

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SANITARY DESIGN OF FOOD PROCESSING EQUIPMENT¹

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To design and construct food processing equipment that can be cleaned with a minimum of effort, and which, during its operation, will not contribute microbial, chemical, or extraneous contamination to the products, is a goal worthy of the best efforts. Such a goal is easy to define, but much more difficult to attain, particularly with today's production pressures.

CONCERN OF MANAGEMENT

Sanitation is of vital concern to company and plant managers in food processing. It is a necessary and integral part of food processing and can add materially to a firm's success or failure.

It has far more significance today than ever before, because the public is becoming increasingly sensitive about food. Consumer confidence in, and acceptance of, processed packaged foods is of utmost concern. The sanitary design of food-handling equipment is an important factor in preventing consumer dissatisfaction.

To design and construct equipment for the best advantage of the food processor becomes doubly important when it is realized that present day production and profit trends leave little room for mistakes. Today, there is even less room for the old fashioned trial and error methods. The pressure is on management and technical personnel at all levels. High maintenance costs, including cleanup for all useful years, because of poor equipment design assumes greater relative importance. The economic factors involved place a great responsibility on those who would recommend the best design and construction for a unit of equipment.

INDUSTRY TECHNOLOGY NEEDED

Technical knowledge and experience in the specific food processes and attendant sciences and the availability of research assistance are prerequisite to any attempt to specify for industry what shall constitute sanitary design and construction.

The canning industry alone packs approximately 1200 separate food items and combinations in 49 of the 50 states. The preparation and packing procedures for even the same products may vary from

one plant to the next, and from one area to another. Because of the fiercely competitive nature of the industry, newer and more efficient methods are developed rapidly. Every industry needs room for innovations, for creativity, for the exercise of its ingenuity. Who can deny that competition and innovation are not to the advantage of the consumer? Let us be cautious that in the interest of simplicity of inspection and regulation we do not "standardize" initiative out of existence.

THE CANNING INDUSTRY EQUIPMENT COMMITTEE

The canning industry's approach to sanitary design and construction of equipment has been through the National Cannery Association by the formation of a Special NCA Committee on Sanitation of Canning Equipment, which is composed of staff members, representatives of canning companies, and liaison members representing the Canning Machinery and Supplies Association.

One of the purposes of the Committee is to prepare and publish "recommendations" concerning sanitary design and construction of canning equipment with special consideration given to the efficiency and effectiveness of cleaning the equipment. The Committee does not attempt to establish iron-clad requirements which would be detrimental to the future progress of the industry. Also, because of the diversity of procedures and equipment and the desire to avoid unwarranted standardization, basic recommendations or suggestions are written in broad terms.

With such information accumulated and evaluated by the canners' own technologists and engineers, management has the means of exercising direct control over equipment constructed in the plant, and can also exert profound influence on the design of equipment available for purchase by specification of sanitary features.

The following list includes items generally applicable to most canning equipment. This was taken, with slight editing, from canning equipment construction and design recommendations approved by the National Cannery Association Special Committee on Sanitation of Canning Equipment. The list will be expanded and modified as new recommendations are approved.

1. Canning equipment should be designed for easy cleaning, safety, and easy repair of mechanical failures.
2. All surfaces and areas should be readily accessible.

¹Presented at the 51st Annual Meeting of the International Association of Milk, Food and Environmental Sanitarians, Inc., Portland, Oregon, August 18-21, 1964.

This means accessible with no tools, or at most, with very simple tools, and so that all surfaces and areas can be seen or felt and easily cleaned.

3. In general, no wooden parts should be used.

4. Other absorbent materials, such as fabric, belting with exposed fabric core, and absorbent sponge type rubber should not be used.

5. All metal surfaces in direct contact with the food product should be of stainless steel with a finish of at least 2-B, or metal of equal resistance and finish.

6. All structural parts not in direct contact with the food product should be of smooth, non-corroding metal, or of metal that can be covered with a non-toxic coating to render it resistant to corrosion and easily cleanable.

7. Where possible, all external parts should be of round or tubular material to avoid accumulation of debris and to permit easy cleaning. They should be sealed to prevent corrosion.

8. All non-functional pockets should be filled to facilitate self-cleaning and self-drainage.

9. There should be no interior ledges, recesses, pits, unfinished welds, etc.

10. All joints should be continuously welded and ground smooth, or of equal sanitary construction.

11. Legs should be readily adjustable for height and rounded at the floor level. Exposed threads should be kept to a minimum.

12. Horizontal side rails, braces, etc., should be at least six inches above the floor to facilitate cleaning.

13. No motor or other drive mechanism should be mounted over the product unless adequately equipped with well-drained pan under all bearings. Any lubricated moving mechanism should be located or protected, so that contamination of the product cannot occur.

14. Sanitary type self-draining greaseless inboard bearings should be used. If other type bearings are used, they should be sealed with corrosion-resistant, non-absorbent materials and be drained to the outside. Outboard bearings should be sealed from the interior with corrosion-resistant non-absorbent material. All seals should be accessible, and provided with conventional means of adjustment to prevent leakage.

15. All belts should be of sanitary grade, moisture-resistant, non-absorbent material.

16. Conveyor guides, splash guards, etc., should be easily removable, or of open construction to permit cleaning.

17. All pulleys should be of sealed drum metal construction (without recesses or open joints). Some device should be provided to prevent product being ground between return belt and pulley.

18. Provision should be made at all transfer points to prevent accumulation of leaves, stems and other debris.

19. Steam and water valves should be designed and installed to prevent any leakage.

20. Product and ingredient line valves should have no pockets or recesses.

21. All product washing sections should be self-cleaning to prevent the accumulation of silt, dirt, leaves, etc.

22. Drains and water inlets should be of adequate size to permit rapid draining and refilling. Drains should be at the lowest point with no inside collar or projection. Water inlets should discharge above the water line. Overflow and make-up rates should meet maximum production requirements.

23. Drain pans, where necessary, should be sloped for adequate drainage, with outlets properly conducted to the sewer.

They should be wide enough to prevent spillage, and open or detachable for easy cleaning.

The preceding list is not unique, and the items, in most cases, are generally applicable to food processing other than canning. Equipment recommendations for much canning equipment encompassing these items only, would be inadequate. In this connection it is appropriate to review some of the design and operating recommendations made by the NCA Committee for Post-Processing Can Handling. In the canning industry "processing" refers to retorting or cooking the sealed can of food.

POST-PROCESSING CAN HANDLING

Food preservation by canning depends upon the fulfillment of two conditions: (a) the destruction by heat of bacteria capable of spoiling the food product (known as the "process"), and (b) the prevention of bacterial recontamination of the product by means of the sealed container. Although heat processes have been developed that will insure the destruction of organisms normally present in the canned product, there remains the hazard of re-entry of bacteria during post-processing can handling operations.

Spoilage Factors

The three main factors in spoilage resulting from post-processing can handling operations are: (a) the condition of the can double seams, (b) the presence of bacterial contamination in cooling waters or on can runways, and (c) excessive abuse due to poor construction, operation, or adjustment of the filled can handling equipment. Rough can handling and resulting leaker spoilage potential relates to:

- a. The type of can runways.
- b. The wetness - dryness of can runways.
- c. Microbiological buildup on runways.
- d. Crate dumping and can unscrambling.
- e. Speed of handling cans.
- f. Rolling vs. conveying cans.
- g. Prevalence and type of can bumpers.
- h. Type of can elevators and lowerators.
- i. Degree and prevalence of small dents near seams from cans slamming into each other.
- j. Type of labelers.
- k. Type of casers.

Briefly this adds up to (a) the amount of moisture and microbiological contamination picked up under the double seams, and (b) the amount of shock and strain exerted on the cans and can seams (rough handling, denting, etc.) causing aspiration into the can of minute amounts of bacteria laden moisture.

If cooled cans can be dried or left in the retort baskets until dry, the spoilage hazard is materially

reduced, but not necessarily eliminated. Modern methods of straight line rapid handling through cooling, labeling, and casing make the attainment of such favorable conditions more difficult.

The Continental Can Company published in May, 1963, an excellent bulletin titled "Spoilage of Canned Foods Due to Leakage" by V. S. Troy, J. M. Boyd, and F. J. Folinazzo (1). They also concluded that "rough handling of cans in the filled can handling system is the major cause of 'leaker-type' spoilage in cans showing no structural defects Contamination of filled can handling equipment contribute(s) to this type of spoilage."

NATIONAL CANNERS ASSOCIATION EQUIPMENT COMMITTEE RECOMMENDATIONS

With results of research available, and the knowledge and experience of technical representatives from canning companies, the Committee for Sanitation of Canning Equipment was able to publish "Recommendations for Post-Processing Can Handling," which made recommendations concerning operating precautions and sanitary design.

OPERATING PRECAUTIONS

1. Inspect can seams frequently to insure that they are properly formed, and that seamer adjustments have not exceeded tolerances.
2. Periodically inspect the can handling system from the closing machine to the caser. Where rough handling of the cans is apparent, smooth out the operation to minimize can seam and body damage. Automatic casers must be adjusted carefully to prevent violent can to can contact, or can seam to can body contact.
3. Do not allow cans to drop freely into crates from closing machine discharge tables.
4. Do not overfill the retort crates. This will eliminate protruding cans which could be crushed by the crate bales, or by crates placed on top of them in the retort.
5. Prevent sharp impacts between filled crates or against protruding points.
6. Operate crate dumps smoothly to prevent impact denting.
7. Chlorinate all cooling waters to a point where there is at least one part per million chlorine residual at the discharge end of the can cooler.
8. Thoroughly scrub and sanitize all tracks and belts which come into contact with the can seams at intervals frequent enough to prevent bacterial build-up.
9. Replace all worn and frayed belting, can retarders, cushions, etc., with new non-porous material.
10. Run cans through a can dryer immediately on leaving the cooling system or tip the full retort baskets to drain water trapped on can ends and allow the cans to dry in the retort crates before discharge into the can handling unit, to lessen the recontamination hazard. High velocity air blasts over the body and ends of cans will remove excess water and aid in keeping the can tracks dry. Bacteria may develop on can handling equipment in a film of water, lubricants or other material. Bacterial contamination at the juncture of the body

and double seam can be significant as a cause of spoilage. Can-drying methods which remove the visible water after contamination of the double seam may not be adequate for spoilage prevention. Chlorinated cooling water deposited by the cans on the runways will tend to depress bacterial growth, however, the effect rapidly dissipates as the distance of travel from the cooler increases.

11. Wet conditions can be deliberately created by continuously running or spraying water containing 3 to 5 ppm of free residual chlorine on the can tracks. Adequate control of continuous drippage must be provided and the cans must be dried before entering the labeler.

12. Can-transporting belts and elevators, unless completely dry, should be continuously sprayed at the beginning of the return with water containing 3 to 5 ppm of free residual chlorine.

SANITARY DESIGN

Under present day production pressures, post-retort and/or post-cooling equipment must be designed to minimize pick-up of bacterial contamination around the double seams. The design must also prevent shock, strain, or even small denting of the cans, particularly on or near the seams. The engineering and design objectives of post-retort can lines should include the above considerations: (a) minimize contamination and (b) prevent shock, strain, and denting (rough handling). The following are recommendations to help accomplish these objectives:

1. Keep handling to a minimum. All switchbacks, quarter turns, lowerators and other changes of can direction or orientation should be engineered to minimize can damage with consideration given to can speed, size, and weight. In general, sharp reversals of direction should be avoided. Quarter turns should have a long radius to handle the cans gently.

2. The need for "bumpers" should be avoided, but where necessary they should be of non-absorbent, easily cleaned material. Fabrics, wood, or absorbent core belting are not satisfactory, since these materials harbor bacterial populations that cannot be eliminated. The combination of contamination at the site of the bump and the resultant can shock and seam strain is a known cause of leaker spoilage, and the harder the bump, the greater the hazard. Such bumping also increases the spoilage hazard from contamination picked up from subsequent equipment.

3. If possible, eliminate the rolling of cans, where can-to-can contact may occur. Each can should be positively controlled as far as practical, such as by flat belts or cables. The drive mechanism of belts and cables should be automatically controlled, so cans cannot slam into each other or have seams strained or damaged by belts and cables continuing to run under jammed (stopped) cans. Line-flow controls, if properly installed, will permit an even flow of cans without jamming, and will shut off power driven belts or cables when conveyors are full.

4. When cans are rolled, the slopes, can spacing and can speeds should be engineered to prevent cans bumping into each other. This is a common cause of seam strain and damage. Can track adjustments and can and guide clearance tolerances should be such as to assure that any unavoidable can-to-can contact will be seam-to-seam contact and not seam-to-body contact.

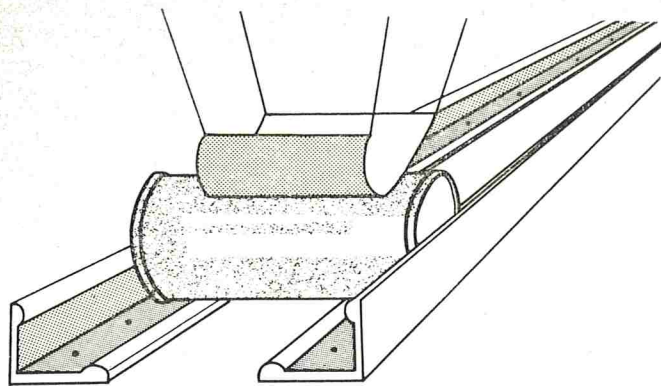


Figure 1. Modified angle iron runway.

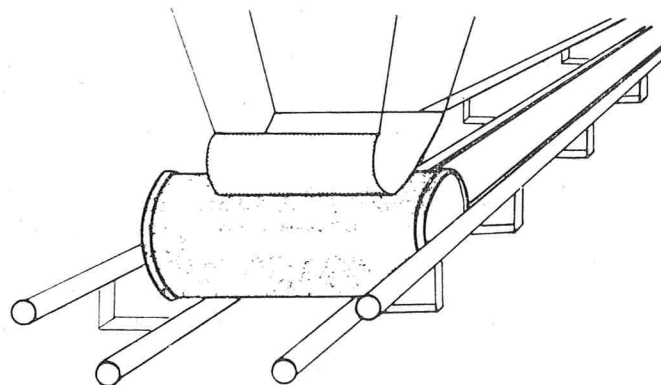


Figure 2. Round bar type open runway.

5. When cans are rolled the double seams should not contact the runway surface except in coolers. In angle iron runways, (Figure 1) installation of metal half-rounds, as illustrated, is one possible way to keep the can double seams from contacting wet or damp angle iron guides. In the type of construction illustrated, drill weep holes to prevent water accumulating in the tracks behind the half rounds. Weep holes must be large enough not to clog.

6. Round-bar open runways (Figure 2) accomplish the same purpose. With larger size heavy cans a larger can

body support area may be necessary to prevent damaging the can body. In all cases, use drip pans or install so as to prevent water from one can track dripping onto another track or cans below. Also consider safety, housekeeping, appearance, and comfort hazards caused by dripping water.

7. Where cans pass between belts or other retarders, and on some elevators, cut away the contacting material so that the can double seams ride free of contact (see illustration). Also do not slow the can to the extent that the following cans will bump into it.

8. At palletizers and other take-off and transfer points, provide for a continuous and gentle deceleration of the cans. Can-to-can impact can be prevented by use of take-off belts to move each can out of the way of the following can. Do not run cans at high speed into a dead-end where they are stopped suddenly by bumping into the can ahead.

9. Dirt and organic debris, as well as bacterial contamination, will accumulate on can handling equipment. The equipment must be designed and installed so that it can be cleaned. This means it must be accessible for cleaning. Since water, detergents and sanitizers will be used, drainage must be provided. In some installations, drip pans or other shields will be necessary. Dry steam cleaning in problem areas may be adequate.

This discussion has included only one of the equipment recommendations. The purpose was to emphasize the individualistic nature of canning equipment design. Sanitary equipment specifications can be helpful, but must be practical and functional as well. The food processing industries are fortunate in having many experienced and qualified technologists and engineers who are aware of the necessary performance characteristics of food handling equipment, and, at the same time, are cognizant of the value of equipment sanitation from the viewpoints of economy, public health protection, and esthetics.

REFERENCES

1. Troy, V. S., Boyd, J. M. and Folinazzo, J. F. Spoilage of Canned Foods Due to Leakage. Continental Can Company, Chicago, 1963.

APPLICATION OF THE WISCONSIN MASTITIS TEST UNDER FIELD CONDITIONS¹

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SUMMARY

The Wisconsin Mastitis Test was subjected to a trial in five Wisconsin Department of Agriculture Brucellosis Ring Test Laboratories. The test was conducted by 15 laboratory technicians and was evaluated on two bases, namely (a) reproducibility and (b) correlation of the test results of the technicians with a standard. The reproducibility for the results of each technician and each laboratory was expressed as a coefficient of variability (average pooled C.V. 8.46%) and the correlation was expressed as correlation coefficients (average 0.96). The results of the field trial indicate that the Wisconsin mastitis test can perform as well under field conditions as in a research laboratory.

The principle of estimating products of inflammation in milk from the gel produced by a detergent reagent in the presence of nucleated cells (California Mastitis Test - CMT) (3) has been widely accepted. Jaartsveld (1) presented a method for measuring and recording the degree of gelation present in a CMT-like reaction. The Wisconsin mastitis test (WMT) (5) was introduced as an extension of this principle, to fill a need for an objective screening test with an increased sensitivity for indirectly estimating the cell content of bulk milk samples with a range of cell numbers between 200,000 and 1,500,000/ml.

In the WMT, a 2-ml portion of well mixed milk sample is combined with 2 ml of CMT reagent that has been diluted 1:1 with distilled water. The milk and reagent are combined in a test tube that is fitted with a cap having a center orifice of 1.15 mm diam. Following mixing of reagent and milk, the test tube is held in an inverted position for 15 seconds to permit out-flow through the cap orifice. The test is scored by measuring in millimeters the height of the fluid column remaining in the tube after the tube has been returned to an upright position following out-flow. The agreement between the WMT method and a direct microscope method of estimating cell content of milk samples has been reported (5). Be-

cause demands of a large scale screening program would present significantly different laboratory conditions from those found in a research laboratory, it was necessary to know if the WMT would give valuable information under field conditions. It was also necessary to know if the WMT could perform well when conducted by laboratory technicians with limited technical experience or training.

Permission was granted to conduct a trial in the five Brucellosis Ring Test (BRT) laboratories operated by the Division of Animal Health of the Wisconsin Department of Agriculture. These laboratories are located in Mineral Point, Watertown, Green Bay, Black River Falls and Barron, Wisconsin. Three technicians in each laboratory were available for the conduct of the trial.

The trial followed the same pattern in each laboratory and was divided into three sessions: orientation and training, testing for reproducibility and a correlation test. The time spent in each laboratory (parts of 3 days) precluded the use of the same milk samples for all parts of the trial.

MATERIALS AND METHODS

All equipment necessary for the conduct of the WMT, as well as the milk samples necessary for training and reproducibility exercises, was furnished by the authors.

Continuing experience since the introduction of the WMT has led to the conclusion that duplicate WMT examinations of milk samples are desirable. An average of two readings for each milk sample should represent a more accurate result than a single reading. Duplicate tests also permit a check on the technique of the operator (measuring milk and reagent, mixing, timing of outflow and accuracy of reading the scoring gauge). A discrepancy of more than 4 mm between the duplicate readings suggests that the milk sample should be retested. Such a discrepancy can result from obstructions in the cap orifice as well as errors in measuring. All milk samples involved in this trial were submitted to duplicate applications of the WMT and the averaged results were recorded. Those samples with duplicate readings having a discrepancy of more than 4 mm were re-submitted to the testing procedure.

Technicians

The formal education of the 15 BRT laboratory technicians represented a broad range. One received a college undergraduate degree, five completed either a 1st year of college or the University of Wisconsin Farm Short Course, five com-

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TABLE 1. COMPARISON OF THE WMT RESULTS OF 15 LABORATORY TECHNICIANS WITH THE WMT RESULTS OF THE SENIOR AUTHOR

Laboratory	Individual	Correlation coefficient	Y intercept on X axis	Slope of regression curve (b)	Standard error of estimate	No. of samples
I	1	0.96	0.89	0.99	2.02	100
	2	0.96	1.35** ^a	0.96	1.95	100
	3	0.91	5.75**	0.83**	2.99	100
II	4	0.91	2.28**	0.83**	2.40	117
	5	0.94	0.85	0.88**	1.97	117
	6	0.93	-0.43	0.88**	2.04	117
III	7	0.98	-0.62	1.03	1.08	118
	8	0.97	0.55	0.99	1.61	118
	9	0.96	0.53	1.01	1.22	118
IV	10	0.96	0.49	1.03	1.85	100
	11	0.94	0.96	1.02	2.20	100
	12	0.95	-0.68	1.00	1.40	100
V	13	0.97	-0.28	1.01	1.46	112
	14	0.98	-0.06	0.95**	1.27	112
	15	0.97	0.14	1.02	1.44	112

^a°, ** Indicate significance at 5% and 1% level respectively, using t tests for Y intercept=0 and b=1.

TABLE 2. DATA FROM THE REPRODUCIBILITY PORTION OF THE FIELD TRIAL SHOWING AVERAGE WISCONSIN MASTITIS TEST READINGS AND COEFFICIENTS OF VARIABILITY

Laboratory	Average WMT reading of individuals			Average WMT readings within laboratories	Coefficients of variability			
	1	2	3		1	Individuals 2	3	Pooled
I	16.83	18.49	17.73	17.68	8.3%	6.6%	5.9%	6.9%
II	12.84	11.71	12.56	12.37	14.2	8.6	9.7	11.3
III	15.57	15.14	16.07	15.59	5.5	5.3	4.9	5.2
IV	9.16	9.70	10.54	9.80	13.7	8.2	7.3	9.8
V	12.36	12.81	11.41	12.19	10.3	8.0	8.8	9.1

pleted high school, two completed 11th grade, one completed 10th grade and one completed 8th grade. All technicians were male with an average age of 41½ years (range: 25-64 years). Experience in the BRT laboratories represented a range of from 13 years to less than 1 year. Seven men had 13 years experience, one had 10 years, one had 3 years, and six men had 1 year or less experience.

Training

The orientation and training of the three technicians in each laboratory was completed in approximately 1 hour. An explanation of the purpose and theory of the WMT was offered, followed by a demonstration of calibration and testing procedures. Each technician was then invited to conduct as many calibration and testing procedures as he felt necessary to become familiar with the appropriate technique.

Reproducibility test

Reproducibility tests permit an expression of the ability to repeat the same results when the procedure is repeatedly applied to the same samples. The reproducibility is expressed as coefficients of variability (4) and the lower the coefficient of variability, the more reproducible the test. A low coefficient of variability engenders confidence in the mechanism of the test. To compare the reproducibility of the WMT when conducted under field conditions with the reproducibility

reported from studies in a research laboratory (2) ten composite milk samples with California mastitis test (CMT) reactions varying from trace (T) through 2 plus (+ +) were chosen. From these 10 composite samples, three racks of 20 samples each were prepared. Each rack contained duplicate aliquots of each of the 10 composite milk samples. In each rack, samples numbered 11 through 20 were duplicates of samples numbered 1 through 10. The order of the 20 samples in each rack was randomized following a random-digits table. Each technician was assigned one rack of samples and was requested to apply the WMT to each sample. After this assignment was completed, the order of the samples was arranged in a different random order and the same technician was requested to reapply the WMT to his 20 samples. This entire procedure was repeated three more times permitting a total of 100 WMT observations for each technician with a grand total of 1500 observations for the entire trial.

Correlations

The major purpose of the WMT is to estimate the cell content of milk. To determine if this function could be performed as well under field laboratory conditions as in a research laboratory, 547 bulk milk samples were examined. Technicians from each BRT laboratory were requested to

collect bulk milk samples representing a minimum of 100 farms in their respective areas. The number of samples examined in the five BRT laboratories were: 100, 117, 118, 100 and 112 respectively, making a total of 547. These milk samples were subjected to the WMT simultaneously by the three BRT laboratory technicians and the senior author.

For the correlation phase of the trial, the WMT results of the senior author were used as a standard with which to compare the WMT results of the 15 technicians. Comparisons were expressed as correlation coefficients (4).

RESULTS

Reproducibility

The average WMT results from 100 milk samples recorded by each technician, along with the average WMT readings within each laboratory, the coefficients of variability of each technician and the pooled coefficients of variability (4) for each laboratory are presented in Table 2. The coefficients of variability were computed for each individual in each laboratory using the variation within the 10 replicate tests within samples for that individual.

Any significant difference among the mean squares of individual technicians in each laboratory; among mean squares of "individuals x samples"; and among the variances of the three individuals in each laboratory (Table 3) was determined from an analysis of variance (4) of the data collected from the reproducibility portion of the trial. No comparison of the WMT results between laboratories was possible since different milk samples were supplied to each laboratory.

Although the differences among the average WMT readings of the three individuals in each laboratory were small, there was a significant difference within each laboratory as determined by the F value for the mean squares of individuals. Because large numbers of observations were collected, these small differences could be demonstrated.

Differences among samples for these several individuals tended to remain quite constant throughout the trial. This was especially evident in laboratories II through V as shown by the mean squares of "individuals x samples" (Table 3).

The chi-square test for homogeneity of variances was used to compare the variances of individuals within a laboratory (Table 3). The residuals for all technicians were examined and were found to have essentially normal distributions. Only two technicians (Individuals I in laboratories II and IV) were significantly more variable than the other technicians in their respective laboratory (Table 2).

Correlation

Correlation coefficients provide a standardized statistical tool for measuring how two variables vary together, or expressed in another way, a measure of

TABLE 3. STATISTICS FOR DETERMINING SIGNIFICANCE OF DEVIATIONS FROM THE MEAN AND HOMOGENEITY OF VARIANCES

Laboratory	Mean squares of:		Error	Chi square
	Individuals	Individuals x samples		
I	69.05***	3.73**	1.52	5.36
II	34.63**	2.70	1.95	33.98**
III	21.67**	1.04	0.67	0.03
IV	48.11**	1.05	0.93	13.06**
V	51.09**	1.79*	1.22	5.67

**, ** Indicates significance at 5% and 1% respectively. Significance of mean squares of individuals determined from F value = $\frac{\text{Individuals}}{\text{Individuals} \times \text{Samples}}$.

Similarly, the significance of individuals x samples is determined from F value = $\frac{\text{Individuals} \times \text{Samples}}{\text{Error}}$. Test of the

homogeneity of variances among the three individuals in each laboratory is expressed by Chi square values. The degrees of freedom for individuals, individuals x samples, and error were 2, 18 and 270 respectively for data from laboratories II through V. For data from laboratory I, the degrees of freedom were 2, 38 and 240.

the intensity of association of two variables. A perfect functional linear relationship between two variables may be expressed as a correlation coefficient of 1. The agreement between the WMT results of the various BRT laboratory technicians and the standard used, expressed as correlation coefficients, ranged from 0.91 to 0.98 (Table 1) with an average of 0.96². To further illustrate the agreement, the Y axis intercept point, the slope of the regression curve and the standard error of estimate were determined from the results of each technician. Significance at the 5% and 1% levels of any differences between the Y intercept points = zero and the slope of the various regression curves (b) = 1 was determined by application of t tests. These data are summarized in Table 1.

As an illustration of the value of these descriptive quantities, a scatter diagram is presented (Figure 1) showing: The correlation between the WMT results of technician nine³ (X axis) and the standard (Y axis), the regression equation, the standard error of estimate, the regression curve, and the point of intercept of the regression curve on the Y axis. If the results represented on the X axis (technician's WMT results) were identical with those represented on the Y axis (standard), the slope of the regression curve would be 1, the Y intercept would be zero and all points would fall on the regression line⁴.

²Average r was computed from z transformation (4).

³Random selection.

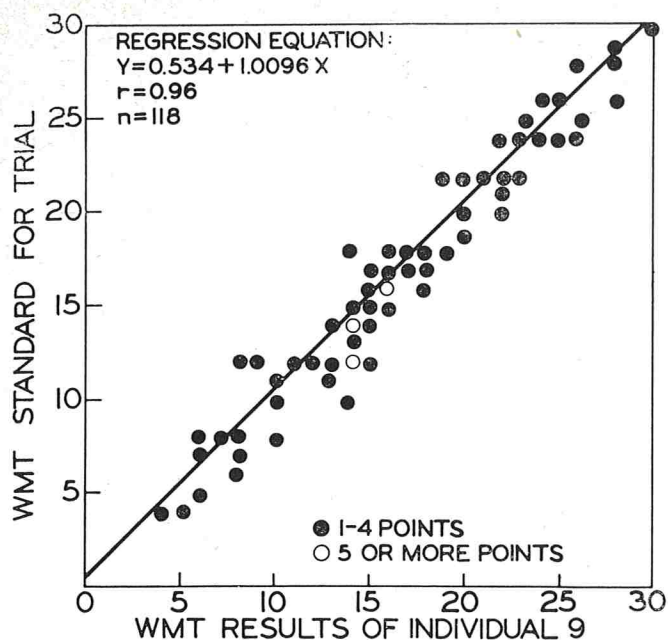


Figure 1. Scatter Diagram Illustrating correlation between WMT results of individual 9 (X) and WMT standard for this trial (Y).

The average correlation coefficient of 0.96 indicates a very high agreement between the WMT score of the technicians and the standard used. Twelve technicians produced results in which there was no significant difference between the respective Y intercepts and zero. As an example of a significant difference, individual number 3 in laboratory I (Table 1) had a Y intercept of approximately 6 mm. Similarly, the slope of the regression curve for the same individual was significantly different from 1 ($b = 0.83$) indicating that he read one unit for each 0.83 units of the standard. This large Y intercept indicates that this individual was reporting results consistently lower than the standard. The slope of the regression line being less than 1 indicates that the difference was more pronounced at the lower end of the scale than at the upper end.

The two greatest standard error of estimates were found for the same individuals whose Y intercepts were farthest from zero. Ten technicians produced results in which there was no significant difference

*The Y intercept points and the slopes (b) of the various regression curves are offered here only to clarify the agreement between the results of technicians and the standard used. No estimation of points along the Y axis from points along the X axis is appropriate with these data.

between the slope of the respective regression curves (b) and 1.

CONCLUSIONS

These data permit some general statements. Individuals produced WMT results with a high degree of consistency. Similarly the variation between individuals was greater than the variation within individuals. The technicians conducting the WMT produced results showing excellent agreement with the standard used. Further, the WMT in the hands of these technicians proved to be highly reproducible. The design of the trial permitted a highly critical examination of the WMT under field conditions. Consequently, even minor differences between individuals conducting the test were demonstrated. When translated into cell numbers, however, the importances of these differences is questionable. As an illustration, the greatest difference between individual average WMT readings within any laboratory (Table 2) was 1.6 mm, which represents approximately 70,000 cells per milliliter of milk when this measurement is made in the central range of the WMT scale.

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REFERENCES

1. Jaartsveld, F. H. J. Bijdrage Tot de Diagnostiek van Mastitis bij Runderen in het Kader van een Georganiseerde Bestrijding. (Contribution to diagnostics of mastitis in cattle in connection with the mastitis control.) Ph.D. thesis, State University of Utrecht, Utrecht, The Netherlands, 1961. (Abstracted in Netherlands Milk and Dairy J. 16:260-264. 1962.)
2. Postle, D. S. The Wisconsin Mastitis Test. Proceedings, United States Livestock Sanitary Association. 1964 (In press).
3. Schalm, O. W. and Noorlander, D. O. Experiments and Observations Leading to the Development of the California Mastitis Test. J. Amer. Vet. Med. Assoc. 130:199-204. 1959.
4. Steel, R. G. D. and Torrie, J. H. Principles and Procedures of Statistics. 3rd ed. McGraw-Hill Book Co., Inc., New York, N. Y. 1960.
5. Thompson, D. I. and Postle, D. S. The Wisconsin Mastitis Test—An Indirect Estimation of the Leukocyte Count in Milk. J. Milk and Food Technol. 27:271-275. 1964.

EFFECT OF PIPETTE TYPE AND SAMPLE SIZE ON PLATE COUNT RESULTS

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SUMMARY

Raw and pasteurized milk samples were plated by seven analysts using 0.1- and 1.0-ml quantities (of appropriate dilutions) dispensed by 0.1-ml glass, 1.1-ml plastic and 1.1- and 2.2-ml glass pipettes. Incubation was at 32 C for 48 hr. Data were subjected to an analysis of variance and the standard deviation as a ratio was calculated. The procedures were compared from two points of view, first to determine if biases existed between the different methods and second if the techniques differed in their random error. No appreciable differences were found between types of pipettes when pasteurized milk was plated. The quantity used, however, was important. Use of a 0.1-ml sample size was associated with more variable results which averaged 10% higher than when a 1.0-ml quantity was plated. Statistical analysis of test results obtained with pasteurized milk suggests: (a) when 0.1-ml samples were used least variation was encountered with the 0.1-ml glass pipette and most variation with the 1.1-ml glass pipette, and (b) when 1.0-ml samples were used very little difference appeared between pipettes although the 1.1-ml plastic pipette tended toward less variation. When raw milk contained large numbers of bacteria, the plastic pipette tended to give higher results than glass pipettes when the 1.0-ml quantity was used; however, these differences with raw milk were not found to be statistically significant. Standard deviations as a ratio revealed: (a) greatest variation with the 2.2-ml glass pipette and least with a 0.1-ml glass or 1.1-ml plastic pipette when a 0.1-ml quantity was used, and (b) greatest variation with a 1.1-ml plastic pipette and least with a 2.2-ml glass pipette when a 1.0-ml sample size was used.

The eleventh edition of *Standard Methods for the Examination of Dairy Products (1)* recommends the use of glass 1.1-ml and 2.2-ml size pipettes when measuring liquids to be tested by plate count procedures. Recently two new types of pipettes have been suggested for use in place of the conventional pipettes. One of these, a glass pipette calibrated to measure 0.1 ml liquid, has been suggested for use in plating milks when a 0.1-ml sample size (of diluted or undiluted milk) is the proper inoculum. Another, a 1.1-ml presterilized plastic pipette, has been suggested for use in place of the conventional 1.1-ml glass pipette. These new pipettes have not yet received extensive testing under laboratory conditions. Hence the experiments described below were conducted in an attempt to evaluate the suitability of these pipettes for use by different workers under conditions typical of a bacteriological laboratory.

METHODS

Pipettes tested

Conventional 1.1- and 2.2-ml glass pipettes, 0.1-ml glass (NJDL Supplies, Inc., New Brunswick, N. J.) and 1.1-ml plastic (Baltimore Biological Laboratory, 7502) pipettes were used in this study. The three types of pipettes able to measure two quantities were tested to compare both the 0.1- and 1.0-ml sample sizes.

Milk samples

Four samples each of pasteurized and raw milk were used in these tests. The milks were plated prior to use for this experiment to determine dilutions needed so plates with 30-300 colonies would result. Just prior to using a sample appropriate dilutions were prepared so that both the 0.1-ml and 1.0-ml quantities could be plated. The diluted samples were iced immediately after preparation and held in an ice-bath until all analysts had used them.

Plating of samples

Samples were plated by either six or seven analysts. Each analyst used milk (or diluted milk) from the same container. Four plates were inoculated by each analyst using a given quantity (0.1 and 1.0-ml) of sample dispensed by each type of pipette and the technique of *Standard Methods for the Examination of Dairy Products (1)*. This means that for each milk sample a maximum of 84 plates were inoculated with the 1.0-ml quantity (four plates per person per pipette) and a maximum of 112 plates were inoculated with the 0.1-ml quantity. Plates were poured with Plate Count agar (Difco) and incubated at 32 C for 48 hr. All plates for a given milk sample were inoculated and poured in approximately one hour.

Counting of plates

Plates were counted in the usual manner with the aid of a Quebec colony counter and hand tally. Counting was done by two analysts to minimize differences possible if each person counted the plates he or she inoculated; however, no plates were counted twice.

Statistical analyses of data

Analyses of variance were applied to transformed data (logs of numbers of bacteria). Complete sets of data on raw milks obtained by three analysts and on pasteurized milks obtained by four analysts were available and subjected to analysis. Data obtained by other analysts were incomplete and hence omitted from statistical analysis. Variances obtained were used to calculate the standard deviation as a ratio (2) of the various methods (e. g. pipettes, quantity, kind of milk).

TABLE 1. NUMBERS OF BACTERIA PER ML OF ONE RAW MILK SAMPLE AS DETERMINED, IN QUADRUPLICATE, BY FOUR ANALYSTS USING DIFFERENT SAMPLE SIZES AND PIPETTES

	0.1-ml Quantity				1.0-ml Quantity		
	0.1-ml Glass	1.1-ml Plastic	1.1-ml Glass	2.2-ml Glass	1.1-ml Plastic	1.1-ml Glass	2.2-ml Glass
Analyst A	43,000	27,000	37,000	33,000	37,000	26,000	34,000
	33,000	36,000	41,000	29,000	31,000	43,000	43,000
	44,000	46,000	32,000	38,000	35,000	37,000	36,000
	50,000	41,000	43,000	52,000	28,000	43,000	27,000
Analyst B	25,000	21,000	35,000	65,000	37,000	24,000	28,000
	35,000	38,000	24,000	26,000	30,000	28,000	37,000
	44,000	35,000	49,000	34,000	38,000	32,000	34,000
	37,000	38,000	27,000	48,000	46,000	35,000	35,000
Analyst C	34,000	30,000	45,000	53,000	38,000	35,000	43,000
	47,000	45,000	33,000	56,000	37,000	30,000	32,000
	35,000	46,000	43,000	57,000	35,000	35,000	34,000
	41,000	43,000	52,000	35,000	35,000	35,000	36,000
Analyst D	32,000	31,000	32,000	29,000	30,000	26,000	46,000
	40,000	34,000	32,000	29,000	22,000	33,000	41,000
	35,000	29,000	24,000	37,000	28,000	36,000	29,000
	30,000	30,000	36,000	28,000	37,000	32,000	48,000

TABLE 2. NUMBERS OF BACTERIA PER ML OF ONE PASTEURIZED MILK SAMPLE AS DETERMINED, IN QUADRUPLICATE, BY THREE ANALYSTS USING DIFFERENT SAMPLE SIZES AND PIPETTES

	0.1-ml Quantity				1.0-ml Quantity		
	0.1-ml Glass	1.1-ml Plastic	1.1-ml Glass	2.2-ml Glass	1.1-ml Plastic	1.1-ml Glass	2.2-ml Glass
Analyst A	540	500	720	520	420	470	520
	620	500	550	660	400	500	580
	600	430	670	540	460	540	440
	510	470	670	580	420	470	520
Analyst B	560	470	680	780	620	500	370
	490	530	500	500	500	480	760
	720	460	830	590	440	600	620
	380	520	820	560	750	480	510
Analyst C	700	660	460	700	510	370	670
	610	560	530	680	460	410	700
	740	640	590	600	480	490	670
	510	470	740	850	460	450	740

RESULTS AND DISCUSSION

Data presented in Table 1 are typical of those obtained in various trials with raw milk. The table lists results of four analysts using the different pipettes and a single raw milk sample diluted appropriately. Table 2 reports similar data obtained by three analysts when they tested one pasteurized milk sample. Both of these tables permit the reader to examine some of the results obtained in these experiments and also to comprehend the volume of data subjected to statistical analyses.

A preliminary examination of results obtained with

the plate count procedure revealed that the standard deviation between numbers of bacteria obtained within milk types tended to be proportional to the means. Consequently all plate count values were transformed to logarithms in order to minimize heterogeneity among the variances. The test of significance of F ratios summarized in Tables 3, 5 and 6 refer to differences between logarithmic transformations of numbers of bacteria. The variances of the logarithmic transformations were then utilized to derive the standard deviations as a ratio (2), Table 7, by using the appropriate antilogarithms. Since

TABLE 3. ANALYSIS OF VARIANCE OF DATA OBTAINED WITH 1.1-ML PLASTIC AND GLASS PIPETTES, 2.2-ML GLASS PIPETTES, AND RAW MILK

Source of Variation	Degrees of freedom	Sum of squares	Mean square	F Value
Trials	3	70.5189	23.5063	
Analysts	2	0.0101	0.0051	<1.0
Methods	5	0.0730	0.0146	<1.0
Interactions				
Trials X analysts	6	0.0513	0.0086	<1.0
Trials X methods	15	0.8367	0.0558	2.89 ^a
Analysts X methods	10	0.1703	0.0170	<1.0
Trials X analysts X methods	30	0.5785	0.0193	

^aHighly significant

logarithmic transformations were employed, geometric means were utilized when averaging for discussion purposes.

Bias

Tests using raw milk. The analysis of variance presented in Table 3 is a straight forward test containing a mixed model where one factor (Methods) is fixed and the other two are random. The denominator of the F ratio was determined according to the procedure of Brownlee (2) as were the other calculated ratios in Tables 5 and 6. The F ratio for the methods by trials interaction (Table 3) is significant at the 0.01 level.

Regarding trials as a random effect, this implies that the point estimate of the component of variance corresponding to the interaction is 0.0122, somewhat

smaller but of the same order of magnitude as that of the three-way interaction, 0.0193. Inspection of the data suggests that this interaction may be associated with the testing of milk containing high numbers of bacteria. This is suggested as an explanation since in the trial employing milk with the highest number of bacteria, in Table 4, the results obtained when the 1.0-ml quantity was plated were consistently higher than those obtained with the 0.1-ml sample size. Furthermore, the plastic pipette seemed to give the highest discrepancy in this direction when milk with high numbers of bacteria was being tested. This might indicate that plastic pipettes of the type evaluated in this study give higher estimates of numbers of bacteria, at least in some instances, and suggests a point for future investigation. It should also be mentioned that dilutions of the milk were prepared prior to the start of the experiment. Although great care was used in their preparation, it is possible that a slight discrepancy in measurement may have contributed to the differences observed in one trial (Table 4) using raw milk with relatively high numbers of bacteria.

Tests using pasteurized milk. The analysis of variance of results obtained from tests with pasteurized milk is presented in Table 5 and was conducted in an identical manner with that for trials using raw milk. The F ratios were calculated in a similar manner. This analysis revealed the F ratio for methods was significant at the 0.001 level thus presenting convincing evidence that differences do exist between methods. Inspection of means of numbers of bacteria disclosed that there was a consistent bias between results obtained with the 0.1- and 1.0-ml quantities, disregarding pipette types (plastic vs glass and 1.1-ml vs 2.2-ml). This bias, as estimated from these data, indicates that results obtained using the 0.1-ml

TABLE 4. NUMBERS OF BACTERIA PER ML IN A MORE HEAVILY CONTAMINATED RAW MILK AS DETERMINED, IN QUADRUPLICATE, BY THREE ANALYSTS USING DIFFERENT SAMPLE SIZES AND PIPETTES

	1.1-ml plastic pipette		1.1-ml glass pipette		2.2-ml glass pipette	
	0.1-ml quantity	1.0-ml quantity	0.1-ml quantity	1.0-ml quantity	0.1-ml quantity	1.0-ml quantity
Analyst A	160,000	2,100,000	320,000	690,000	450,000	540,000
	160,000	1,500,000	490,000	780,000	320,000	620,000
	120,000	2,000,000	340,000	540,000	400,000	540,000
	98,000	1,200,000	200,000	400,000	210,000	650,000
Analyst B	160,000	880,000	540,000	420,000	430,000	590,000
	160,000	770,000	450,000	500,000	480,000	560,000
	140,000	590,000	480,000	350,000	270,000	380,000
	130,000	640,000	530,000	360,000	310,000	350,000
Analyst C	260,000	470,000	140,000	1,200,000	300,000	360,000
	280,000	530,000	150,000	1,200,000	200,000	400,000
	360,000	480,000	130,000	1,200,000	490,000	320,000
	390,000	480,000	220,000	1,400,000	310,000	450,000

TABLE 5. ANALYSIS OF VARIANCE OF DATA OBTAINED WITH 1.1-ML PLASTIC AND GLASS PIPETTES, 2.2-ML GLASS PIPETTES, AND PASTEURIZED MILK

Source of Variation	Degree of freedom	Sum of squares	Mean square	F Value
Trials	3	6.3426	2.1142	
Analysts	3	0.0113	0.0037	<1.0
Methods	5	0.0730	0.0146	7.3 ^b
Interactions				
Trials X analysts	9	0.0421	0.0047	2.3 ^a
Trials X methods	15	0.0224	0.0015	<1.0
Analysts X methods	15	0.0314	0.0021	1.0
Trials X methods X analysts	45	0.0900	0.0020	

^aSignificant^bVery highly significant

quantity are 9.7 per cent higher than those obtained with a 1.0-ml sample size. A suggested explanation might be that if an analyst overdraws the meniscus past the scribed line on the stem of a pipette marking the 0.1-ml quantity, this error represents a greater percentage of the total volume than would the same mistake made with a 1.0-ml sample.

The F value of 2.3 for the trials by analysts interaction must be disregarded since these are random effects over which one has no control.

Random error

Analysis of variance of variances. The data for each procedure was subjected to an analysis of vari-

TABLE 6. ANALYSIS OF VARIANCE OF VARIANCES CALCULATED FROM DATA OBTAINED WITH 1.1-ML PLASTIC AND GLASS PIPETTES, 2.2-ML GLASS PIPETTES, AND RAW AND PASTEURIZED MILKS

Source of Variation	Degree of freedom	Sum of squares	Mean square	F Value
Pipette type	2	0.0372	0.0186	1.005
Quantity	1	0.1167	0.1167	6.308 ^a
Milk type	1	0.5035	0.5035	27.216 ^b
Interactions				
Pipette type X quantity	2	0.0351	0.0176	<1.0
Pipette type X milk type	2	0.0108	0.0054	<1.0
Quantity X milk type	1	0.0013	0.0013	<1.0
Pipette type X quantity X milk type	2	0.0821	0.0411	

^aSignificant.^bHighly significant.

ance in order to estimate the random error associated with that procedure. As an example, Table 7 shows the data obtained with raw milk, 0.1-ml quantity and using a 2.2-ml glass pipette. Table 8 is the analysis of variance of the logarithms of the values appearing in Table 7. The random error for this procedure is thus the sum of the components of variance presented in the last column of Table 8 excluding trials as a source (within rounding errors).

Similar analyses were made for each procedure and results are listed in Table 8. In order to determine whether the random error differed significantly according to the procedure, the procedure variances were analyzed (in making an analysis of variance of variances, it is appropriate to use the logarithms of the variances). This analysis, presented in Table 6, shows that the random error for raw and pasteur-

TABLE 7. NUMBERS OF BACTERIA PER ML IN FOUR RAW MILKS PLATED IN QUADRUPPLICATE BY FOUR ANALYSTS USING A 0.1-ML SAMPLE SIZE AND A 2.2-ML GLASS PIPETTE

Analyst	Trial 1	Trial 2	Trial 3	Trial 4
A	33,000	7,000	75,000	450,000
	29,000	1,000	91,000	320,000
	38,000	3,000	82,000	400,000
	52,000	7,000	81,000	210,000
B	53,000	8,000	74,000	430,000
	56,000	14,000	73,000	480,000
	57,000	12,000	100,000	270,000
	35,000	12,000	63,000	310,000
C	31,000	12,000	79,000	300,000
	37,000	10,000	76,000	200,000
	23,000	6,000	110,000	490,000
	50,000	9,000	75,000	310,000
D	65,000	11,000	49,000	330,000
	26,000	25,000	70,000	430,000
	34,000	7,000	68,000	420,000
	48,000	9,000	110,000	390,000

ized milk (milk type) differed very significantly and also that the random error differed significantly for the two quantities (0.1-ml and 1.0-ml). The analysis of variance in Table 6 also shows that the pipette type had no significant effect on the random error.

An examination of the estimated variance values (Table 8) recorded for pasteurized milk indicates that greatest variance was associated with the use of a 0.1-ml sample as compared to a 1.0-ml quantity. This was also true when raw milk was tested using 1.1- and 2.2-ml glass pipettes but not when 1.1-ml plastic pipettes were used. Donnelly, et al. (3) reported that the variance in the Standard Plate Count procedure should not greatly exceed 0.012. Their results appear to be based on the use of 1.0-ml samp-

TABLE 8. ANALYSIS OF VARIANCE OF THE LOGARITHMS OF THE NUMBERS OF BACTERIA IN RAW MILK WHEN A 0.1-ML SAMPLE AND A 2.2-ML GLASS PIPETTE WERE USED

Source of Variation	Degree of freedom	Sum of squares	Mean square	Estimated component of variance
Trials	3	22.1359	7.3786	0.4572
Analysts	3	0.2427	0.0809	0.0011
Interaction				
(Trials X analysts)	9	0.5611	0.0623	0.0090
Between replicates	48	1.2560	0.0261	0.0261
Estimated variance of the logs for the method = 0.0363 ^a				

^aEstimated variance of the logs of all methods:

Method	Raw milk	Pasteurized milk
0.1-ml glass pipette, 0.1-ml sample	0.0193	0.0066
1.1-ml plastic pipette, 0.1-ml sample	0.0183	0.0096
1.1-ml sample	0.0226	0.0050
1.1-ml glass pipette, 0.1-ml sample	0.0275	0.0120
1.0-ml sample	0.0181	0.0092
2.2-ml glass pipette, 0.1-ml sample	0.0363	0.0081
1.0-ml sample	0.0099	0.0060

les. In these tests the use of 0.1-ml samples of raw milk delivered by the 0.1-ml glass and 1.1-ml glass pipettes yielded values which approached that of Donnelly, et al. (3) while those obtained from tests on 0.1-ml quantities delivered by 1.1- and 2.2-ml glass pipettes were substantially higher. Use of a 1.0-ml sample was, as might be expected, associated with values which more nearly approximated (in one instance, lower and for two methods, higher) the estimate of variance reported by Donnelly, et al. (3). Test results on pasteurized milk, regardless of method used, were all equal to or lower in variance than the suggested value of 0.012.

TABLE 9. STANDARD DEVIATIONS AS A RATIO—ALL PIPETTES, QUANTITIES AND TYPES OF MILK TESTED

Quantity	Type of pipette	Raw milk	Pasteurized milk
0.1-ml	0.1-ml Glass	1.38	1.21
	1.1-ml Plastic	1.37	1.25
	1.1-ml Glass	1.46	1.29
	2.2-ml Glass	1.55	1.23
1.0-ml	1.1-ml Plastic	1.41	1.18
	1.1-ml Glass	1.36	1.25
	2.2-ml Glass	1.26	1.20

Standard deviations as a ratio. The numbers in Table 9 are ratios corresponding to the antilogarithms of the standard deviations derived from the analysis of variances of the logarithms of numbers of bacteria. Hence, for the 2.2-ml glass pipette, 0.1-ml quantity, raw milk, the standard deviation of an individual result may be represented by a deviation from the mean determined by dividing or multiplying that mean by 1.55. For example, if the mean were 100 then the mean plus the standard deviation would be 155 (100 x 1.55) and the mean minus the standard deviation would be 64.5 (100 ÷ 1.55). Thus, for practical purposes, the standard deviation may be considered as approximately 55%.

The individual random errors, expressed as standard deviations as a ratio, are given in Table 9, but the significant effects are summarized in Table 10. This table shows, first, the extent by which the random error associated with raw milk exceeds that with pasteurized milk and, second, the extent by which the random error, associated with the use of a 0.1-ml quantity, exceeds that with the 1.0-ml sample size.

Inspection of values in Table 9 reveals when a 0.1-ml quantity of raw milk was plated, the smallest variation was associated with the use of the 0.1-ml glass and 1.1-ml plastic pipette while the greatest

TABLE 10. STANDARD DEVIATIONS AS A RATIO PRESENTED IN A TWO-WAY CLASSIFICATION

	0.1-ml quantity	1.0-ml quantity
Raw milk	1.46	1.35
Pasteurized milk	1.26	1.21

variation was noted when 2.2-ml glass pipettes were used. Least variation was also noted when a 0.1-ml glass pipette was used to plate pasteurized milk while the greatest difference in variation was associated with the plating of 0.1-ml quantities delivered by 1.1-ml glass pipettes.

When a 1.0-ml sample of raw milk was plated, the smallest variation was associated with use of the 2.2-ml glass pipette while the greatest appeared to accompany use of the 1.1-ml plastic pipette. This is in keeping with comments made earlier in the section on Analysis of Variance of Variances. However, these differences for raw milk were not statistically significant. Plating a 1.0-ml sample of pasteurized milk was associated with least variation when a 1.1-ml plastic pipette was used and greatest variation with a 1.1-ml glass pipette. It should be emphasized that although these differences were relatively small when pasteurized milk was plated, nevertheless the

variability was found to be statistically significant.

As with any new tool, the analyst must get used to handling plastic pipettes. Since these pipettes are lighter and somewhat different in structure than glass pipettes, it is only reasonable to expect a difference in the "feel" of these pipettes in the hands of technicians who for varying periods of time have used only glass pipettes in conducting plate count tests. Some technicians participating in the present study felt that the length of plastic pipettes between the mouth end and the 1.1-ml graduation should be extended somewhat to facilitate their use.

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REFERENCES

1. American Public Health Association. Standard Methods for the Examination of Dairy Products, 11th ed. New York, New York. 1960.
2. Brownlee, K. A. Statistical Theory and Methodology in Science and Engineering. John Wiley and Sons, Inc., New York, New York. 1960.
3. Donnelly, C. B., Harris, E. K., Black, L. A., and Lewis, K. H. Statistical Analysis of Standard Plate Counts of Milk Samples Split with State Laboratories. J. Milk and Food Technol. 23:315-319. 1960.

FIFTY-SECOND ANNUAL MEETING OF IAMFES

SEPTEMBER 13-16, 1965

SUCCESSFUL PROGRAM SPONSORED BY CONNECTICUT ASSOCIATION

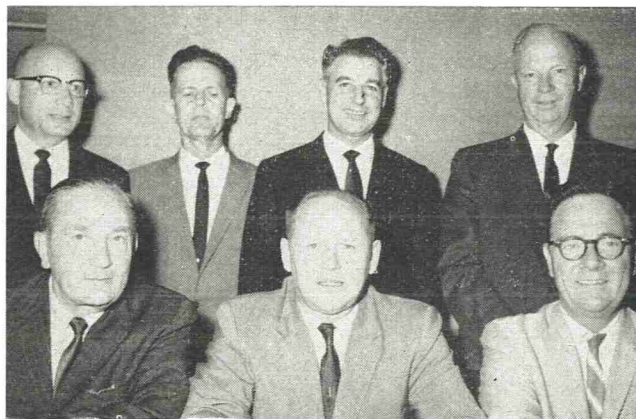
Approximately 400 members and guests of the International Association of Milk, Food and Environmental Sanitarians enjoyed an interesting and informative program at the Fifty-second Annual Meeting at Hartford, Connecticut on September 13th to 16th.

The meeting was sponsored by the Connecticut Association of Dairy and Food Sanitarians and its Local Arrangements Committee under the leadership of Dr. R. M. Parry did an excellent job in providing facilities for the program and in setting up the many other local arrangements and functions contributing to the success of the meeting. Dick Parry was ably assisted by an outstanding group of committee chairmen and members.

The three day program was opened by a welcoming address by the Honorable Fred J. Doocy, President Pro-tem of the Connecticut State Senate and, as Chairman of the Senate Agriculture Committee, a man vitally interested in milk and food production. Senator Doocy complimented the Association for its selection of Connecticut for the site of its 1965 meeting.

In his Presidential Address, Dr. W. C. Lawton reviewed the accomplishments of the Association during the past year and high-lighted the work of the Standing Committees. A revision of the booklet "Procedures for the Investigation of Food Borne Disease Outbreaks" is nearing completion under the sponsorship of the Committee on Communicable Diseases Affecting Man. The Sanitary Procedures Committee has worked diligently in the promulgation of further important standards for dairy equipment by the 3-A Standards Committee.

Other IAMFES committees were complimented for their continued activities and programs for the intended benefit of the membership and in the interest of sanitation and public health. Dr. Lawton commented on other developments during the year and discussed specifically the expansion of the Journal of Milk and Food Technology according to a program initiated by the Executive Board at the 1964 meeting in Portland. This was predicated upon the employment of an additional part time editor for the specific purpose of expanding the scope of the Journal to include more material of a general and practical nature. The expansion was undertaken to meet the



Executive Board seated left to right, Pres.-Elect Fred E. Uetz; President W. E. Lawton; Junior Past President John H. Fritz; standing left to right, Senior Past President Ray Belknap; Secretary-Treasurer Karl K. Jones, Second-Vice President Al Myhr; First-Vice President Paul Elliker.

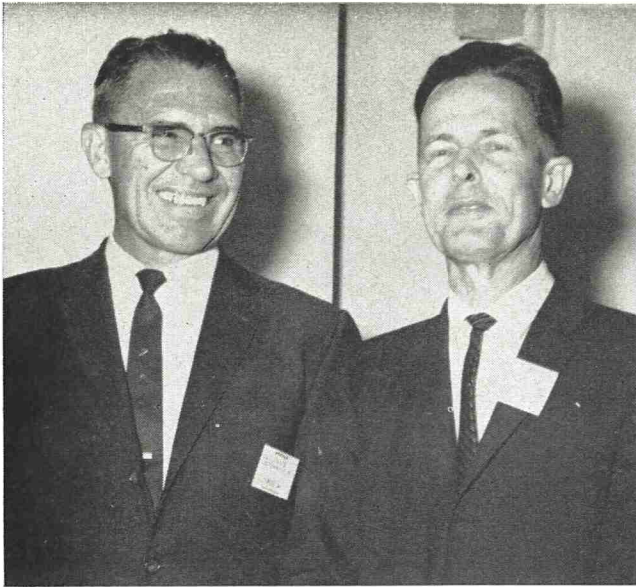
demands of many members for articles and material of this type.

President Lawton pointed out that recent issues of the Journal reflect the efforts of the staff in this direction. While preserving the high prestige of the publication in the fields of research and technical developments, professional information is now being made available to members who are in need of practical, "know-how" type of material.

Other aspects of the profession of sanitarian were reviewed in the Presidential Address and future plans for the organization were outlined. Dr. Lawton emphasized particularly the need for an increase in membership dues to carry on the current work of the Association and to initiate and expand useful programs of the future. It is planned that the proposal for increase in dues will be presented at affiliate meetings during the coming year so that constructive action can be taken at the next annual meeting in Minneapolis.

Finally, Dr. Lawton stressed the necessity for greater membership participation. Much of the progress of our organization, both on the affiliate and on the international level, can be credited to a relatively small minority of interested and active members. The 1965 election of officers was cited as an example of membership interest. After a change in the Constitution to provide for election by mailed ballot, the voting for the 1965-1966 officers approximated 11% of the membership. Furthermore, less than 10% attend the annual meetings, seemingly regardless of the geographical location. A greater

¹President Lawton's address will appear in the November 1965 issue.



Samuel O. Noles new Second-Vice President and Karl K. Jones re-elected Secretary-Treasurer.

interest and participation in Association activities must unquestionably strengthen the organization.

In the three day program many informative papers on current problems and on new developments were presented. Most of these papers will appear in the Journal along with reports of the standing committees.

At the Annual Business Meeting on Wednesday afternoon the results of the election of officers by mailed ballot were announced. Mr. Samuel M. Noles, Milk Consultant for the Florida State Board of Health, was elected Second Vice-President and



Fred H. Fischer, Speaker.

Mr. Karl K. Jones was re-elected Secretary-Treasurer. Other officers moving up automatically to serve the Association for the 1965-1966 term are Mr. Fred E. Uetz, The Borden Company, New York, President; Dr. Paul R. Elliker, Oregon State University, Corvallis, President-Elect; and Dr. Allan M. Myhr, Ontario Agricultural College, Guelph, First Vice-President. Other matters of interest at the Business Meeting and at the various sessions of the Executive Board will be covered in the Secretary-Treasurer's report.

The Annual Awards Banquet was again an outstanding feature of the program. Mr. Harold R. Irvin of the Omaha-Douglas County Health Department received the Sanitarian's award and the accompanying check for \$1,000. The Citation Award was



Dr. Robert F. Holland, Speaker.

presented to a most deserving candidate, our eminent Executive Secretary, Mr. H. L. "Red" Thomasson. Details of these awards appear elsewhere in this issue.

Two "old-timers," Ivan Parkin and Fred Baselt, received Honorary Life Memberships in recognition of their long and faithful service to the Association and in the broad interest of sanitation and public health. Ivan Parkin, who retired from Pennsylvania State University about two years ago, is well-known to members of the Association, having served in many capacities including President in 1955. Ivan now enjoys life in a comfortable home on the Connecticut shore.



Richard M. Parry, Chairman, Local Arrangements Committee presented with glass of milk by Dairy Princess.

Fred Baselt, who likewise has retired after having been connected for many years with the American Can Company, now resides in Scottsdale, Arizona. Fred is a fine example of a sanitarian in the industry field whose interests were directed to the betterment of dairy and food production and processing. Fred has contributed a great deal to the progress and welfare of the Association and along with Ivan truly merits Honorary Life Membership.

At the close of the banquet as incoming President Uetz took over, he was presented a suitably engraved gavel. William V. Hickey presented the gavel on



Fred E. Uetz, President (left) receives gavel from William V. Hickey representing Health Officers Digest. Presentation of gavel to incoming President by Health Officers Digest to become an annual custom.

behalf of the Paper Cup and Container Institute and announced that this was the beginning of an annual custom.

As usual the Council of Affiliates held its annual meeting concurrently with the Association's program. Minutes of the Council Meeting under the chairmanship of Mr. Orlowe Osten, Secretary of the Minnesota affiliates, will appear later in the Journal.

As a program "break" to get a little exercise, members and guests spent an afternoon viewing the completely uptodate ice cream plant of H. P. Hood & Sons at Suffield, Connecticut. All on the tour agreed



Dr. V. W. Greene, Speaker.



Eaton E. Smith, Speaker.



Dr. Ruth Kundsins, Speaker.

that the trip was most enlightening in the demonstration of modern ice cream processing.

The ladies enjoyed a particularly entertaining program highlighted by a trip to Sturbridge, Massachusetts and a tour through the famous reconstructed village of colonial days. All buildings are authentic



Past Presidents with Dairy Princess; seated left to right, C. K. Johns, Harold S. Adams, standing left to right, H. L. Thomasson, Ivan E. Parkin, William V. Hickey, Charles E. Walton, Franklin Barber, C. A. Abele, Milton Fisher.

and original, having been brought together from various locations throughout New England to form a most interesting and educational exhibit of early America. The ladies also toured the famed Con-

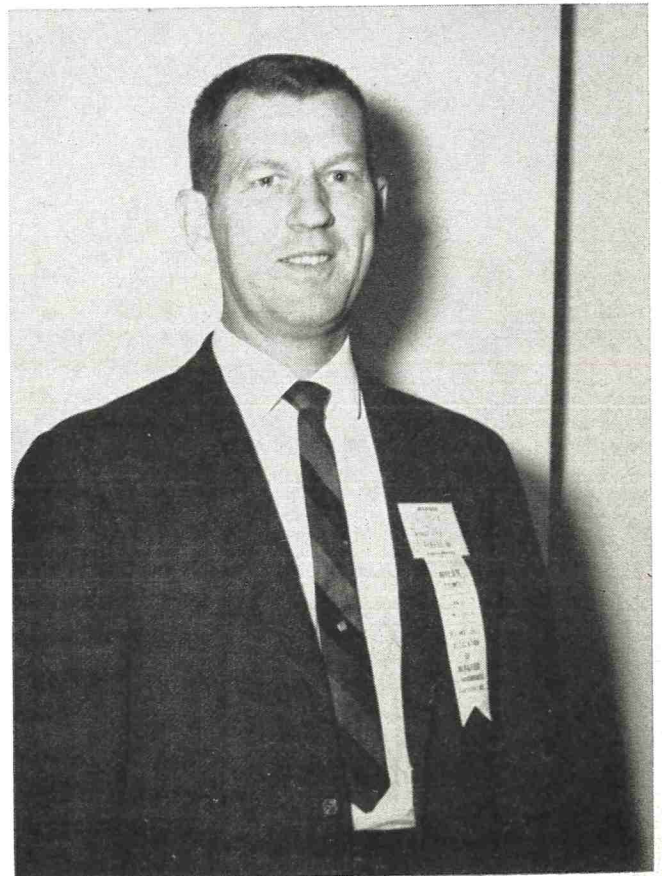
stitution Plaza, an entirely rebuilt and modernized downtown section of Hartford featured in a recent article in Look magazine.

The convention closed with a pleasant and enjoyable chicken barbeque Thursday evening on the



Fred E. Uetz, Pres.-Elect, Chairman of Program Committee; Reverend Russell Camp, Banquet Speaker; Clifford H. Goslee, Master of Ceremonies.

grounds of the new plant of the Connecticut Milk Producers Association at Newington. An interesting trip through this modern plant, designed to handle surplus milk and specialty products, completed the evening festivities.



Orlowe Osten, Chairman, Affiliate Council.



Chicken Barbecue held at Connecticut Milk Producers Association plant, Newington, Conn. last evening of meeting well attended.



Ladies enjoy luncheon during program of ladies activities.

CONGRATULATIONS TO THE LOCAL ARRANGEMENTS COMMITTEE

Much of the success of any meeting depends on the setting, the meeting room facilities, the organization of special activities, a congenial atmosphere and the many niceties it takes to make a person comfortable. The Local Arrangements Committee for the Fifty-second Annual Meeting at Hartford, Connecticut, certainly deserves an expression of appreciation for a long, hard job carried to a successful conclusion.

Names of all who served in various capacities are not available but the following, all of whom are residents of Hartford and its environs, served as Chairmen in direct charge of various activities: Dr. R. M. Parry, General Chairman; C. W. Chaffee, Registration; Charles Whiting, Finance; H. Ewell, Arrangements; Ted Blakely, Publicity; E. A. Smith, Door

Prizes; and Roy Anderson, Entertainment and Ladies Activities.

According to Dr. Parry, the Committee was so successful in securing contributions to finance the cost of the convention that it was not necessary to use a \$1000 fund set aside in the state budget for the purpose. After receiving authorization, this fund was utilized to defray the expenses of representatives of interested state departments, throughout the state to promote attendance at the conference.

RESOLUTIONS ENDORSED AT IAMFES ANNUAL MEETING

RESOLUTION NO. 1

WHEREAS: The 52nd Annual Meeting of the International Association of Milk, Food, and Environmental Sanitarians, Inc., has been held on September 13-16, 1965, at the Hotel America, Hartford, Connecticut; and

WHEREAS: The facilities, the professional and social program, and the hospitality have been excellent; Therefore, be it resolved that the International Association of Milk, Food, and Environmental Sanitarians, Inc., express its deepest appreciation and thanks to the following:

The Connecticut Association of Dairy and Food Sanitarians for being outstanding hosts and sponsors for the meeting, including the ladies program:

The Local Arrangements Committee—Chaired by Dr. R. M. Parry; and

The Hotel America for the facilities and services provided during the meeting.

RESOLUTION NO. 2

WHEREAS: The plate counts on dried milk samples after 48 hours incubation at 32° are frequently much lower than after 72 hours; and

WHEREAS: The organisms responsible for such increases are generally Gram-negative rods, which represent recontamination and growth in the plant, and thus have public health significance; and

WHEREAS: It is proposed to revert to 48 hour incubation in the forthcoming 12th edition of Standard Methods for the Examination of Dairy Products, despite the strong objections of official agencies engaged in controlling dry milk in Canada and the United States;

Therefore, be it resolved that this Association goes on record as opposing the proposed changes as a retrograde step, not in the interest of dairy sanitation, and that copies of this resolution be forwarded to the Chairman, Standard Methods Committee, the Chairman of the sub-committee concerned, The American Public Health Association, the U. S. Department of Agriculture, the U. S. Public Health Service, and the Canada Department of Agriculture.

RESOLUTION NO. 3

WHEREAS: The *Grade "A" Pasteurized Milk Ordinance—1965 Recommendations of the United States Public Health Service* has been developed by the Service with the assistance of milk sanitation and regulatory agencies at all levels of government, national health related organizations, educational and research institutions and all segments of the dairy industry; and

WHEREAS: The *Grade "A" Pasteurized Milk Ordinance* is designed to meet the complex technical and administrative problems associated with the sanitary control of milk and milk products which have come into being because of new products, new processes, new materials, and new marketing practices; and

WHEREAS: The new recommended Ordinance is a pasteurized milk standard which can be uniformly, and equitably translated into safe milk and milk products of high sanitary quality; therefore, be it

RESOLVED: That the International Association of Milk, Food, and Environmental Sanitarians endorses the *Grade "A" Pasteurized Milk Ordinance—1965 Recommendations of the United States Public Health Service*, and urges its legal adoption by all States and communities as a law or regulation for the sanitary control of milk and milk products; and be it further

RESOLVED: That the *Grade "A" Pasteurized Milk Ordinance* be used as the sanitary standard for the procurement of milk and milk products for all public schools, State hospitals and institutions throughout the country; and be it further

RESOLVED: That such procurement be only from suppliers who have been awarded a "pasteurized milk rating" of 90 percent or higher and an "enforcement rating" of 90 percent or higher by a certified State milk sanitation rating officer on the basis of the United States Public Health Service rating method.

RESOLUTION NO. 4

WHEREAS: The Dairy Industry Committee, representing all segments of the dairy industry has for more than 20 years

collaborated with the United States Public Health Service and the International Association of Milk, Food, and Environmental Sanitarians in the development of 3-A Sanitation Standards for dairy equipment; and

WHEREAS: The Dairy and Food Industries Supply Association, as one component of the Dairy Industry Committee has through its Technical Committee made a significant contribution to this effort by undertaking the administrative responsibility for and expense of preparing the initial drafts, numerous revisions and amendments and supplements needed in the development and publication of over twenty-six 3-A Standards; and

WHEREAS: The Dairy and Food Industries Supply Association has strived diligently to include with its Technical Committee representation of all manufacturers on record of dairy processing equipment; and

WHEREAS: The Dairy and Food Industries Supply Association has clearly demonstrated its dedication to the development of sanitary standards for dairy equipment which has gone beyond the limits of ordinary services expected by the members of such trade associations, and may, therefore, be considered as being in the public interest; therefore, be it

RESOLVED: That the International Association of Milk, Food, and Environmental Sanitarians takes cognizance of the contributions made by the Dairy Industry Committee, and goes on record commending DIC for its generous and dedicated contribution to advancing the cause of public health through the development of 3-A Sanitary Standards for dairy processing equipment.

HAROLD R. IRVIN RECIPIENT OF HIGHEST NATIONAL AWARD BESTOWED UPON PROFESSIONAL LOCAL SANITARIAN



Harold R. Irvin (left) Sanitarians Award Winner receives plaque from Ray Belknap.

Harold R. Irvin, Chief of the Milk Sanitation Section of the Omaha-Douglas County Health Department, Omaha, Nebraska, has received the Sanitarian's Award as the outstanding local sanitarian, having made meritorious contributions to the health and welfare of his community in the past five years. The

award carries with it a check for \$1,000.

The presentation was made at the 52nd Annual Banquet of the International Association of Milk, Food, and Environmental Sanitarians, September 16, at Hartford, Connecticut. Administered by the IAMFES and presented annually only to municipal or county sanitarians, the Sanitarian's Award is the highest national recognition bestowed upon professional local sanitarians.

The Citation which accompanied Mr. Irvin's Award reads:

"This Award is conferred for distinguished service to his community in the fields of public health; for his contributions to the advancement of the Sanitarian; for his meritorious achievements in the field of milk, food, and environmental sanitation; and for his ability to personalize the ideals of the Sanitarian."

Nearly a dozen outstanding specific achievements of Mr. Irvin in the past five years were considered by the Awards Committee in deciding that he qualified for the title of 1965 Sanitarian of the Year. The Committee reviewed secret nominations for several



Sponsors of Sanitarians Award with Winner Harold R. Irvin. Seated left, James Sharp, Diversey Corporation; standing left to right: R. F. Rintleman, Klenszade Products, Inc., James Fike, Pennsalt Chemicals Corp., Olin Mathieson Chemicals representative not present.

sanitarians from various parts of the country and Canada before deciding that Mr. Irvin's total record of accomplishments merited him the title. Among his achievements listed were:

His initiation of a cooperative mastitis enforcement program between the Nebraska-Iowa Cooperative Milk Association and the Omaha-Douglas County Health Department which resulted, after four years of research and education, in widespread acceptance of this program by the producers, industry, veterinarians, the Nebraska State Health Department, the Nebraska Department of Agriculture, as well as the local health departments.

His two year research study and project on silo type milk storage tanks, installed in a powder, cheese, milk and butter plant, terminated with the publication of a paper of this study in the February 1965 issue of the *Manufactured Milk Products Journal*.

His cooperation in an eighteen-month joint research project with the University of Nebraska, Department of Dairy Science, in the kinds of microorganisms found in equipment cleaned by automated circulation.

The results of this study improved the health and welfare of the community in that it was possible to secure better program cleaning and sanitizing operations in all dairy plants, both from the standpoint of effectiveness and of economy.

His leadership in developing an educational program on mastitis control for all Grade A milk producers during which, as representative of regulatory agencies, he presented numerous talks and distributed material to aid the projected educational program.

His assumption of a newly formed housing section of the health department and the formulation of a housing program in cooperation with the Omaha Urban Renewal Administrator which resulted in joint neighborhood efforts toward improvements in housing and public health.

His cooperation with industry and the State Health Department in the promotion of a State Grade A Milk Law and compulsory pasteurization of milk to insure a safe milk supply for the consuming public of his community as well as of the State.

His completion of a three-year study on welded pipelines installed in a milk pasteurization plant which has aided the industry in the formation of an acceptable method of welding sanitary milk lines.

His survey of all veterinarians in Nebraska on mastitis which helped to identify the mastitis problem and was the first step toward a Statewide mastitis program.

His development of standards which serve as a guide for the installation, construction, and cleaning of cleaned-in-place sanitary pipelines and bucket milkers on farms resulting from an eighteen-month study of 650 farm installations. Operations have standardized farm milking installations and have helped to improve dairy herdsmanship and reduce the incidence of mastitis.

His formulation of swimming pool standards for public and residential pools which were adopted and passed by the Omaha City Council.

His continued devotion toward cooperation between industry and regulatory agencies for mutual benefits and the public's interest.

In addition, to these achievements, Mr. Irvin has prepared and written various articles and papers dealing with rancidity of milk, silo tanks, automated cleaning, industry-health department teamwork, mastitis, welded pipelines, installation and cleaning guides for CIP pipelines, dwelling and swimming pool standards.

Mr. Irvin has been associated with the field of milk, food, and environmental sanitation since 1951 when he became a Food Sanitarian for the Omaha-Douglas Health Department. In 1952 he became a Milk Sanitarian and in 1957 he was appointed as Acting Chief of the Milk Sanitation Section. In 1958

Mr. Irvin became Chief of County Sanitation and in 1960 was appointed Chief of Milk Sanitation. In 1962 Mr. Irvin assumed the duties as Chief of Housing Sanitation for a short period of time but returned in 1963 to his present position as Chief of Milk Sanitation.

Mr. Irvin, a native of Des Moines, Iowa, is married and has three sons. He received his BA degree from the University of Omaha in 1950 and his MPH degree from the University of Minnesota in 1957. He is a member of the International Association of Milk, Food, and Environmental Sanitarians and has been a member of the 3-A Sanitary Standards Committee since 1961. He was Chairman of the Douglas-County Sanitary Improvement District for four years; President of the Sanitation Section of the Nebraska Public Health Association (1963); Vice President of the Nebraska Association of Sanitarians (1962); and is currently Chairman of the Milk Sanitation Committee of the National Association of Sanitarians.

The Sanitarian's Award is made possible by four companies: Diversey Corporation; Klenszade Products, Division of Economics Laboratory, Inc.; Olin Mathison Chemical Corporation; and Pennsylvania Salt Chemicals Corporation. Selection of the recipient is an exclusive function of IAMFES, however, and the firms have no voice in selection or consideration of recipients.

Past award winners and their positions at the time

are: Paul Corash, Chief of Milk Division, Bureau of Foods and Drugs, New York City, N. Y., (1952); Dr. E. F. Meyers, Chief of Milk, Meat, and Food Division, City Health Department, Grand Rapids, Michigan (1953); Kelley G. Vester, Senior Sanitarian, City Health Department, Rocky Mount, N. C. (1954); B. G. Lennet, Chief Sanitarian, Escambia County Health Department, Pensacola, Florida, (1955); John H. Fritz, Chief of Milk and Food Section, City Health Department, Kansas City, Missouri (1956); Harold J. Barnum, Chief of Milk Sanitation, City Health Department, Denver, Colorado, (1957); Carl A. Mohr, Sanitarian and Deputy Health Officer, City Health Department, Green Bay, Wisconsin (1958); William Kempa, Dairy and Milk Inspector, City of Regina, Saskatchewan, Canada (1959); James C. Barringer, Director of Sanitation, City Health Department, Evansville, Indiana, (1960); Martin C. Donovan, Airport Sanitarian, Dade County Health Department, Miami, Florida (1961); Larry Gordon, Director, City-County Health Department, Albuquerque, New Mexico (1962); R. L. Cooper, Administrative Assistant, Callaway County Health Department, Murray, Kentucky (1963). In 1964, there was no award.

To this growing group of outstanding Sanitarians who so well serve their Association, their community, and entire sanitarian profession, it is indeed a privilege to add the name of Harold R. Irvin.

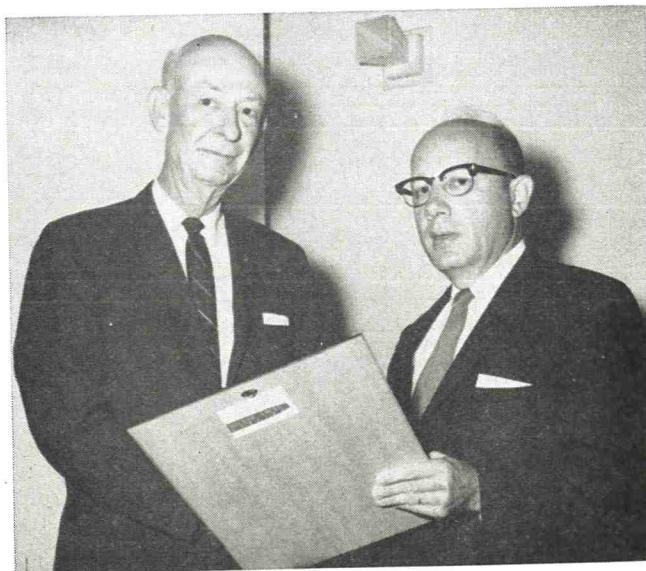
H. L. THOMASSON RECEIVES CITATION AWARD

The Citation Award, for distinguished service to the International Association of Milk, Food, and Environmental Sanitarians, was presented to H. L. "Red" Thomasson at the 52nd Annual Meeting, Thursday, September 16, 1965, at Hartford, Connecticut. The Citation was presented to Mr. Thomasson on behalf of the Association by R. A. Belknap, Chairman of the Committee on Recognition and Awards.

Mr. Thomasson is a graduate of Franklin College, Franklin, Indiana. Upon graduation, he spent a year in the State of Texas as a sales representative of a supply company. He served as manager of a creamery company in Shelbyville, Indiana, and later became affiliated with the Indiana State Board of Health as Milk Sanitarian. While in this position, he promoted the adoption of the Grade A milk program in the local communities, raising the number of Indiana cities operating under the Grade A milk program from one to seventy. He also assisted the Board of Health in the promotion of its Restaurant Sanitation Programs. Mr. Thomasson is an active worker in the Indiana Milk and Food Sanitarian's Association and for several years was a guest lecturer

at the Indiana Medical School.

Mr. Thomasson, known to the members of the In-



H. L. "Red" Thomasson (left) receives Citation Award from Ray Belknap.

ternational as "Red," has long served the IAMFES as a member of various committees and in national affairs relating to milk sanitation. He is a past president and member of the Executive Board. In 1951, "Red" became our first full-time Executive Secretary and Business Manager and since that time has represented our organization in many areas of endeavor.

The Certificate of Citation as presented to Mr. Thomasson is as follows: "Able worker, overseer, and observer in many phases of public health activities who has graciously given of his knowledge, experiences, and abilities to fellow sanitarians; wise counsellor of a long line of officers of the organization; outstanding leader as chairman of various committees; and as an officer, a successful coordinator on behalf of the Association in the development of sanitary standards for dairy equipment which has benefited everyone. Through his affable disposition and exemplary behavior, all become friends. This Citation is presented for Distinguished Service to the International Association of Milk, Food, and Environmental Sanitarians."



John H. Fritz, (left) Junior Past President receives President's Award from Ray Belknap.

DOOR PRIZES PRESENTED BY AFFILIATES AT ANNUAL MEETING

Seventeen door prizes donated by state affiliate associations were presented at the various sessions at the IAMFES Annual Meeting. The donors, the type of gifts and the lucky recipients are as follows:

Central Ontario, Ceramic book ends, Gordon Sanders, Milwaukee, Wis.

Connecticut, Black and Decker electric drill, Charles Eddy, Florham Park, N. J.

Idaho, Western slip necktie, Carrol Sellers, Birmingham, Ala.

Illinois, Box of assorted cheese, Nelson Hall, Saginaw, Mich.

Illinois, Box of assorted cheese, Dr. W. C. Lawton, Minneapolis, Minn.

Iowa, Box of assorted cheese, Paul Daniels, New York.

Iowa, Box of assorted cheese, Kenneth Sibley, East Hartford, Conn.

Kentucky, 12½ pound cheese, Richard Montgomery, Birmingham, Ala.

Kentucky, 12½ pound cheese, James Fike, Philadelphia, Pa.

Maryland, Brief case, Archie Freeman, Boston, Mass.

Minnesota, 5 pound cheese, Dr. Arnold Smith, Storrs, Conn.

New York, Gallon maple syrup, H. E. Eagan, Atlanta, Ga.

Pennsylvania, Gallon maple syrup, E. L. Ruppert, Arlington, Va.

Rocky Mountain, Set of knives and holder, Stanley Motyka, Commack, N. Y.

South Carolina, Ronson can opener and accessories, Dr. R. F. Holland, Ithaca, N. Y.

Virginia, Virginia ham, Whitney Morse, Guilford, Conn.

Washington, Box of Washington apples, Dr. Frank Barber, Glenview, Ill.

Mr. Eaton A. Smith of the Connecticut Department of Consumer Protection, one of the hard working chairman of the Local Arrangements Committee, handled the receiving and distribution of the prizes.

NEWS AND EVENTS

OSTEN GIVEN MINNESOTA AFFILIATE'S OUTSTANDING ACHIEVEMENT AWARD



Orlowe M. Osten

The highlight of the Minnesota Sanitarians Association Banquet following their annual meeting September 16, 1965, was the presentation of the Association's Outstanding Achievement Award to Orlowe M. Osten, Assistant Director, Food Inspection Division, Minnesota Department of Agriculture, St. Paul.

Mr. Osten received the B.S. degree, major in Dairy Technology, from the University of Minnesota, in 1947, after his return from military service with the Corps of Engineers in the European theater. On graduation he was employed by Twin City Milk Producers' Association and in 1949 joined the Inspection Service of the Minnesota Department of Agriculture. In 1952 Mr. Osten was appointed Interstate Milk Survey Officer for the Minnesota State Health Department. In 1957 he returned to the Department of Agriculture to head Minnesota's Grade A milk program and in 1964 was appointed to his present position.

Mr. Osten has played a key role in the activities of the Minnesota Sanitarians Association having served as its President in 1959, a member of the Board of Directors since 1957 and Secretary-Treasurer since 1960. He has represented the Association at annual meetings of the International and served as Chairman of the Council of Affiliates during 1964-65.

The development of Minnesota's Grade A milk supply, much of which is distributed interstate, is due in large measure to Mr. Osten's leadership. His excellent work in connection with the program of the National Conference on Interstate Milk Shipments

also has brought recognition to Minnesota as well as to himself. He presently is a member of the Board of Directors of the Conference.

Recently, the Minnesota Mastitis Council was organized as a statewide organization dedicated to the control of mastitis and other factors in an effort to eliminate abnormal milk from the supply. Mr. Osten assisted in the organization of the Council and presently serves as its Secretary.

In presenting the Outstanding Achievement Award to Mr. Osten, the Minnesota Association gave recognition to one of its outstanding sanitarians.

INDIANA DAIRY FIELDMEN'S AND DAIRY PLANT SANITATION CONFERENCES

The Indiana Dairy Fieldmen's Conference will be held on November 16 and the Indiana Dairy Plant Sanitation Conference on November 17, 1965 at Purdue University. The conferences are sponsored annually in cooperation with the Indiana Dairy Products Association.

The Dairy Fieldmen's Conference will include papers on Controlling Mastitis, Modern Manure Handling Systems for Dairymen, What is Needed for Dairying Today and a panel discussion on Current Questions in Dairying. The Dairy Plant Sanitation Conference will feature discussions on Sources of Psychrophiles and Their Growth Rates, Prevention of Post Pasteurization Contamination, Changes in the Interstate Milk Shipper's Agreements and the New Ordinance and Code, and U.S.D.A. Inspection Requirements.

Further information may be obtained from the program committee chairman, H. F. Ford, Smith Hall, Purdue University, Lafayette, Indiana.

SOUTHEAST DAIRY CONFERENCE SCHEDULED

Problems affecting the economic health of the dairy industry in the Southeast will be studied at a 2-day conference involving Dairy Industry people in the states of Virginia, North Carolina, Alabama, Georgia, South Carolina and Florida. The meeting is scheduled to be held November 30 and December 1, 1965 at Charlotte, North Carolina.

This conference, initiated and sponsored jointly by the Land-Grant universities of the above 6 states, is intended to bring dairy people in tune with today's highly competitive and dynamic industry which is experiencing many growth pains in relation to production and marketing of milk and milk products.

The conference will provide an atmosphere for a free exchange of ideas and discussions centered around three basic questions: (1) What is the cost of milk production in the Southeast and at what price can the milk supply be maintained; (2) What are the basic causes for changes in milk processing and distribution; (3) What variations are there in milk regulations in the Southeast and what uniformities are desirable.

Among those appearing on the program will be Linley Juers, National Commission on Food Marketing; Paul Tracy, Dairy Industry Consultant, W. D. Knox, Hoard's Dairyman and S. Kent Christensen, National Association of Food Chains.

RESUME' OF FDA ANNUAL REPORT FOR 1964

A 7-page bulletin, "Resumé of Federal Food & Drug Annual Report for 1964", is now available upon request from the Hugé Company of St. Louis. Highlighting information and statistics most important in food protection, this bulletin provides a comprehensive review of the recently-published F&D Annual Report for 1964.

Touching on cause as well as effect, this Resumé begins by explaining FDA's expanding role in consumer protection due to a "growing population, an expanding economy, new technology and scientific breakthroughs" — plus, a tremendously increased operating budget. Statistics given include a highly readable, useful chart describing actions on foods during the fiscal year of 1964. Projects are broken down into the various types of industries, enabling the reader to see immediately the preponderance of F&D action in any one industry, in relation to all the other industries.

Also discussed are chemicals in food (additives, pesticides, etc.) and other harmful contaminants — including the recent salmonella and other bacterial outbreaks of food poisoning. Keeping food clean both in the plant and warehouse, pocketbook protection for the consumer involving short weight and faulty labeling, new court interpretations, regulations governing the use of pesticides, and results of scientific investigations are reviewed, and related to Food & Drug compliance in the plant and warehouse.

Revealing the extent and character of F&D activity, this Resumé extracts information vital from the Annual 1964 report and condenses it into a comprehensive form. For copies of this bulletin, contact the Hugé Company, P. O. Box 9502, St. Louis, Missouri 63161.

USPHS BOOKLET ON TESTS FOR ABNORMAL MILK

A new publication on the use of five screening tests to detect abnormal milk has been published by the Milk and Food Branch, Public Health Service, U. S. Department of Health, Education, and Welfare, Washington, D. C. The 30-page illustrated booklet shows how the tests, all based on determining the number of white blood cells or leucocytes in milk, may be made. Each test is described as a presumptive screening test and is not intended for diagnosing mastitis in cows.

The tests—the California Mastitis, the Catalase, the Direct Microscopic Leucocyte Count, the Modified Whiteside, and the Wisconsin Mastitis—all indicate whether the milk tested is within normal leucocyte limits. The publication is the first known compilation of commonly used screening tests in one volume.

The foreword of the booklet points out that high leucocyte counts in milk may indicate the presence of infectious mastitis in the cow, udder injury, colostrum or "new" milk, stripper milk, or a disease condition at another location in the cow's body. Veterinary consultation, it is pointed out, should be sought for mastitis diagnostic purposes.

Copies of the booklet, Public Health Service Publication No. 1306, are available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., 20402, at 20 cents each. A 25% discount is given for quantities of over 100. Single copies are available on request from the PHS Public Inquiries Branch, Washington, D. C., 20201, or from Regional Offices of the Department of Health, Education, and Welfare.

NEW NORRIS CATALOG ON MILK DISPENSERS

A new four-page catalog illustrating and describing the Manhattan line of milk dispensers has been issued by Norris Dispensers, Inc. With headquarters in Minneapolis, Norris manufactures a complete line of commercial and home milk dispensers, milk venders, milk and beverage coolers, walk-in coolers and freezers, and automatic ice makers.

Covered in the new catalog are the one-, two- and three-container Manhattan dispensers as well as the Manhattan rear-loaders, models with creamers, and automatic portion control dispensers. Nineteen Manhattan models are available, including those with door-mounted malted milk mixers. Meeting all nationally recognized standards, the Norris Manhattan line provides the ultimate in quality, styling and engineering advancements.

A copy of the new catalog is available by writing to Norris Dispensers, Inc., 2720 Lyndale Avenue South, Minneapolis, Minnesota 55408.

BILL HICKEY DIAMOND "EXPERT"

On the "To Tell The Truth" TV program on Thursday afternoon, September 30, 1965, one of the three contestants trying to fool the panel was none other than our own past president William B. Hickey. Each of the three contestants posed as an expert and collector of synthetic stones copying the most famous diamonds in the world.

Bill didn't actually fool the panel but after all he's only an expert on the public health aspects of paper cups and containers. Bill, of course, is Public Health Counsel for the Paper Cup and Container Institute in New York City.

STATEMENT OF OWNERSHIP,
MANAGEMENT AND CIRCULATION

(act of October 23, 1962; Section 4369, Title 39, United States Code)

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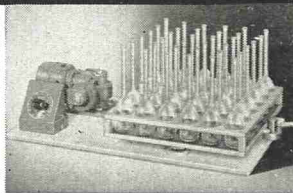
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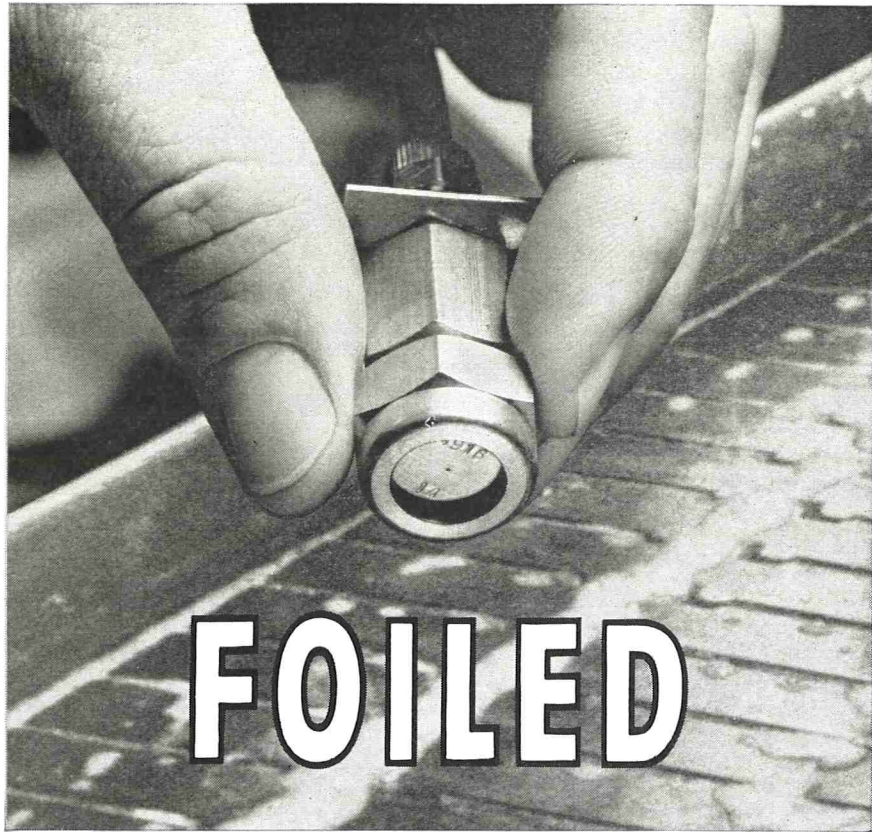
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NEW GOVERNMENT RESEARCH REPORTS IN FOOD PROCESSING RELEASED

The following research and development reports in food processing have just been released to science and industry through the clearinghouse for Federal Scientific and Technical Information, U. S. Department of Commerce, Springfield, Va. 22151.

Compression and Dehydration of Food . . . The development of compressed dehydrated food rations with high acceptability and good storage stability is a distinct possibility. Besides savings in transportation and storage space such rations would increase efficiency in the military use of food in the field. In research undertaken for the Army's Natick Labs, powdery homogeneous materials including eggs and potatoes as well as larger particled items—beef, spinach, cabbage, carrots, apples, and strawberries—were used for making compressed compositions. To make the distribution of the components uniform the maximum size of the food particles was kept at $\frac{1}{2}$ inch. Compression did not cause any difference in equilibrium relative humidity moisture content. Storage stability and organoleptic acceptability were not significantly affected by changes in chemical composition. The optimum storage relative humidity was 7 percent or less . . . FMC Corporation, Santa Clara, Calif., for Army's Natick Labs., Apr. 1965, 165 pages . . . Order AD 619 448N *Studies of the Effect of Compression Rate of Attainment and Final Equilibrium Relative Humidity Relationships of Dehydrated Foods* from Clearinghouse, U. S. Department of Commerce, Springfield, Va. 22151, price \$5.00.

Botulism . . . Thermal resistance of spores of 11 strains of Type E. *C. botulinum* have been studied in phosphate buffer at pH 7.0 in the




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temperature range of 60-90 C. According to AEC-sponsored biologists, all strains had a similar resistance to heat. Very little inactivation occurred at 60 C and 65 C, but at 70 C-90 C there is a rapid initial kill of the majority of the spores in the population within 10 minutes of heating with a small fraction surviving longer heating times giving a tailing effect. With two strains slight activation of dormant spores was apparent at 70 C. Toxin production was detected by the spores surviving heating at higher temperatures and for longer periods of time. However, in some cases non-toxic isolates were obtained. Spores produced by the heat-surviving spores had a resistance similar to the stock spore suspensions. Resistance of the spores of six strains of Type E to gamma radiation in phosphate buffer was found to be similar, but less than Type A spores. Irradiation of the spores in haddock homogenates and oyster juice resulted in an increase in survivors which was 100-1000 fold greater than that resulting from irradiation in phosphate buffer. This study was prompted by the September 1963 outbreak of Type E botulism in Michigan . . . University of Michigan, for the AEC, Dec. 1964, 100 pages. . . Order COO 1095-3N *A Study of the Effect of Ionizing Radiation on Resistance, Germination, and Toxin Synthesis of Clostridium Botulinum Spores, Types A, B, and E* for Clearinghouse, U. S. Department of Commerce, Springfield, Va. 22151, price \$4.00.


Irradiation to Prevent Potato Sprouting . . . Widespread use of irradiation as a potato sprout inhibitor is not likely because of higher cost and lesser flexibility in method of application as compared to chemical inhibitors, according to the Western Nuclear Corporation. Irradiation is most promising when potatoes are again sorted at some time during the storage season. But irradiation

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does have its faults, producing deleterious side effects such as after-cooking darkening and increased susceptibility to black spot. Like the major chemical inhibitor, irradiation also inhibits periderm formation, thus preventing healing of harvest induced bruises. There is a long-term buildup in reducing sugar after about 8 months of storage regardless of storage condi-

tions, but this buildup appears more pronounced in irradiated potatoes. . . Western Nuclear Corp., Idaho Falls, Idaho, for the AEC, Feb. 1965, 16 pages. . . Order IDO-11300N *Add. Current Status and Potential of Irradiation to Prevent Potato Sprouting* from Clearinghouse, U. S. Department of Commerce, Springfield, Va. 22151, price \$1.00.

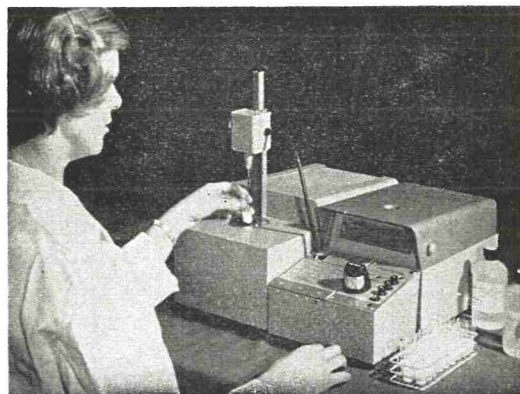
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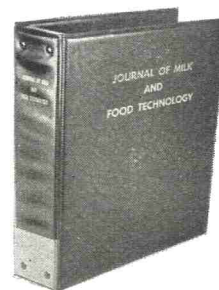
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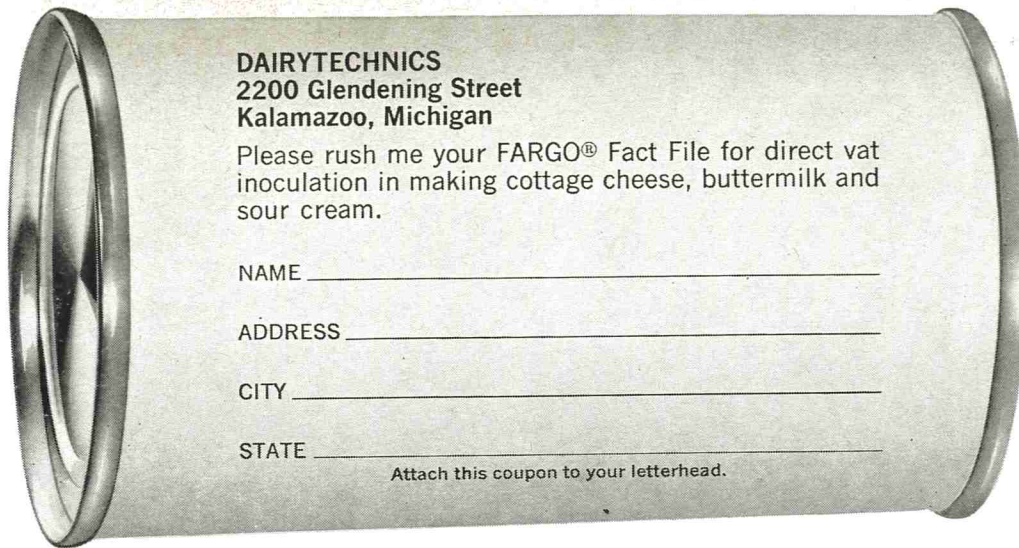
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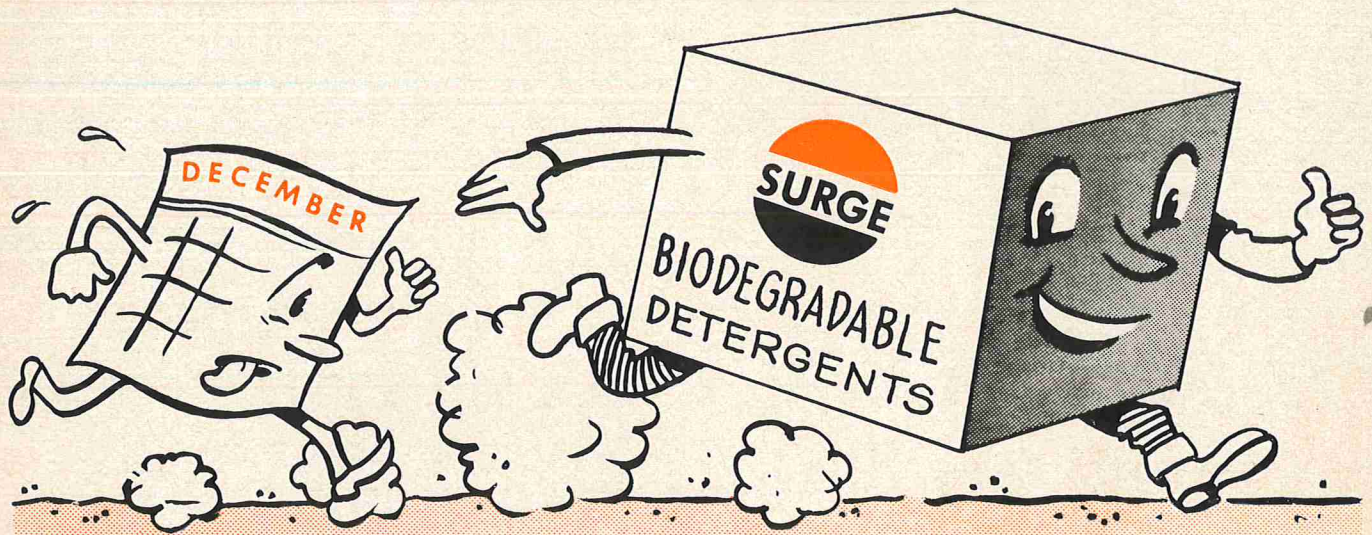
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