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Official Publication

International Association of Milk and Food Sanitarians, Inc.

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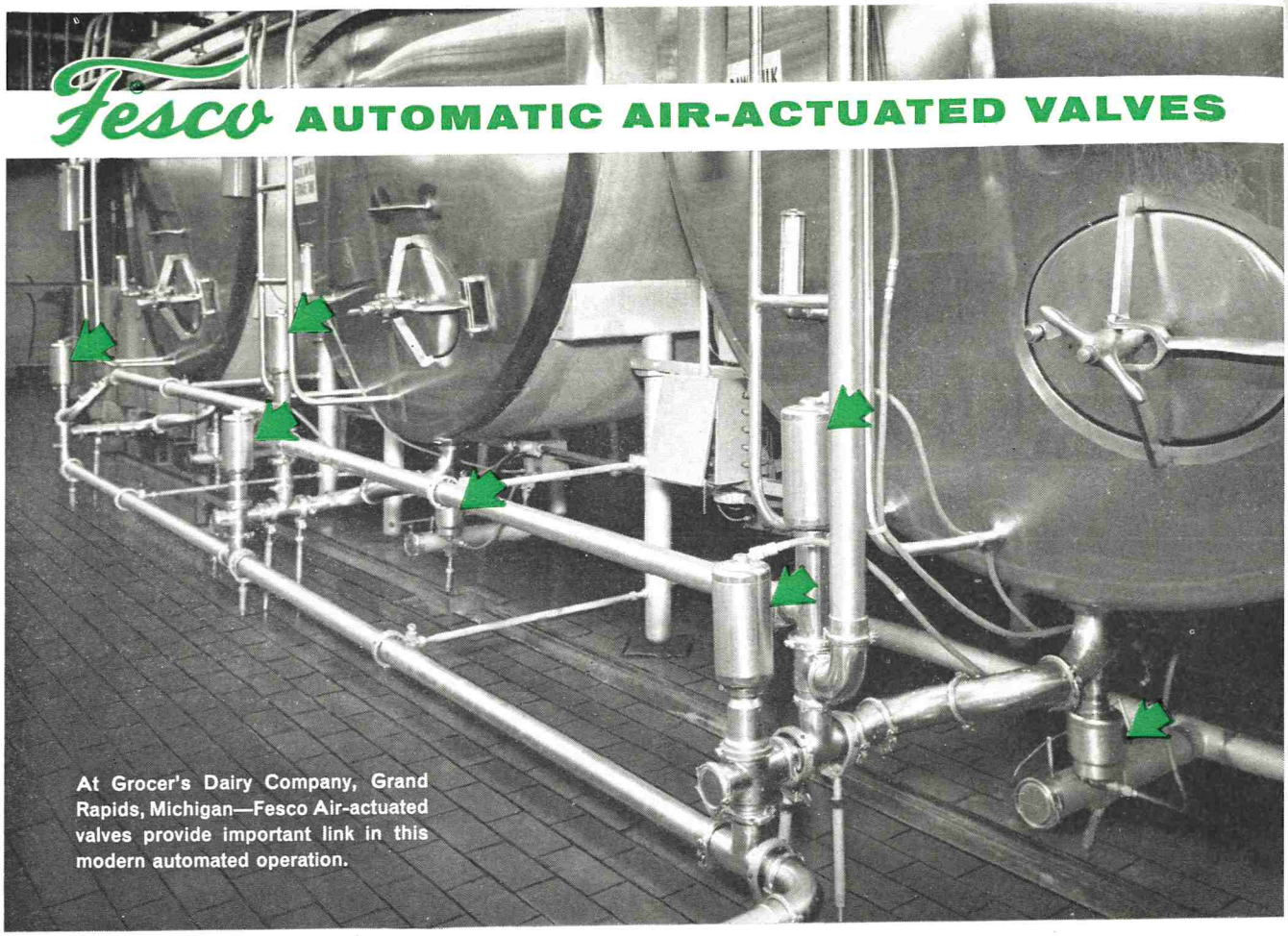

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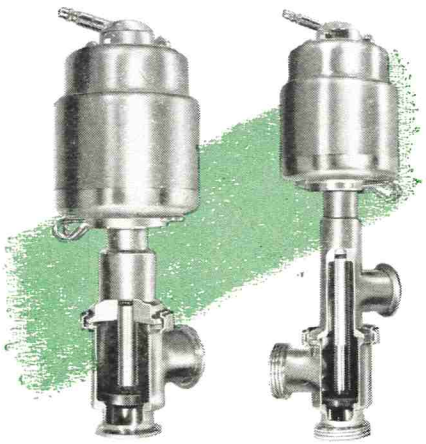

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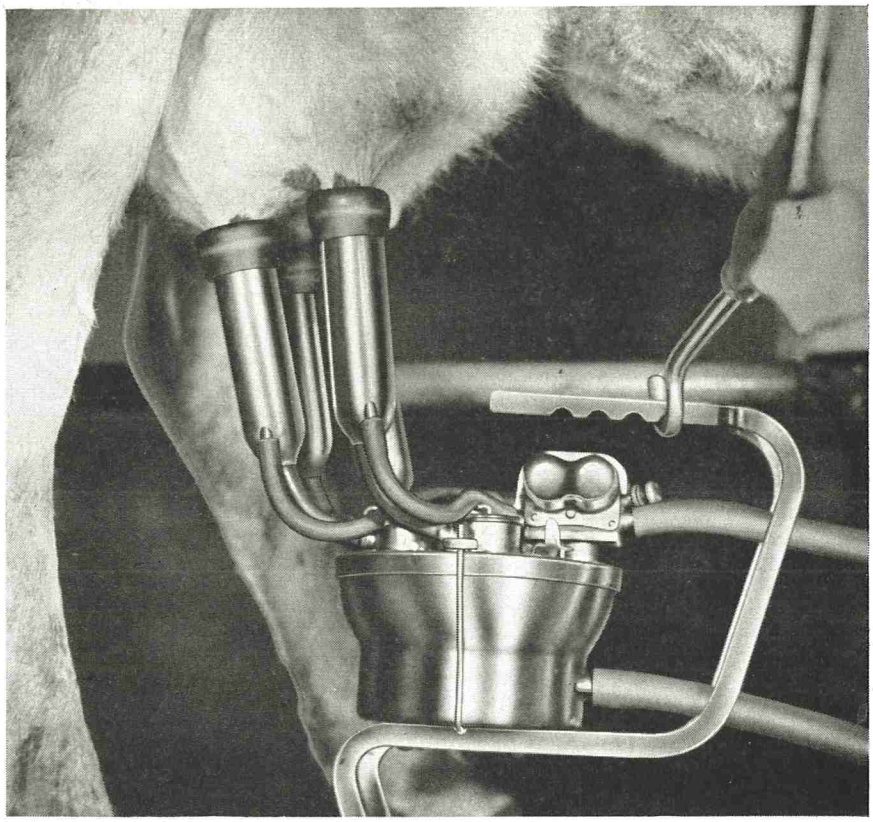

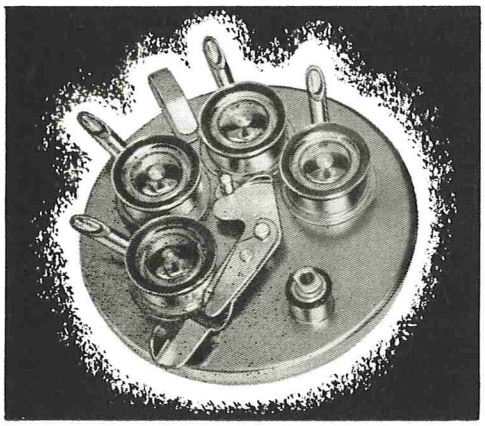

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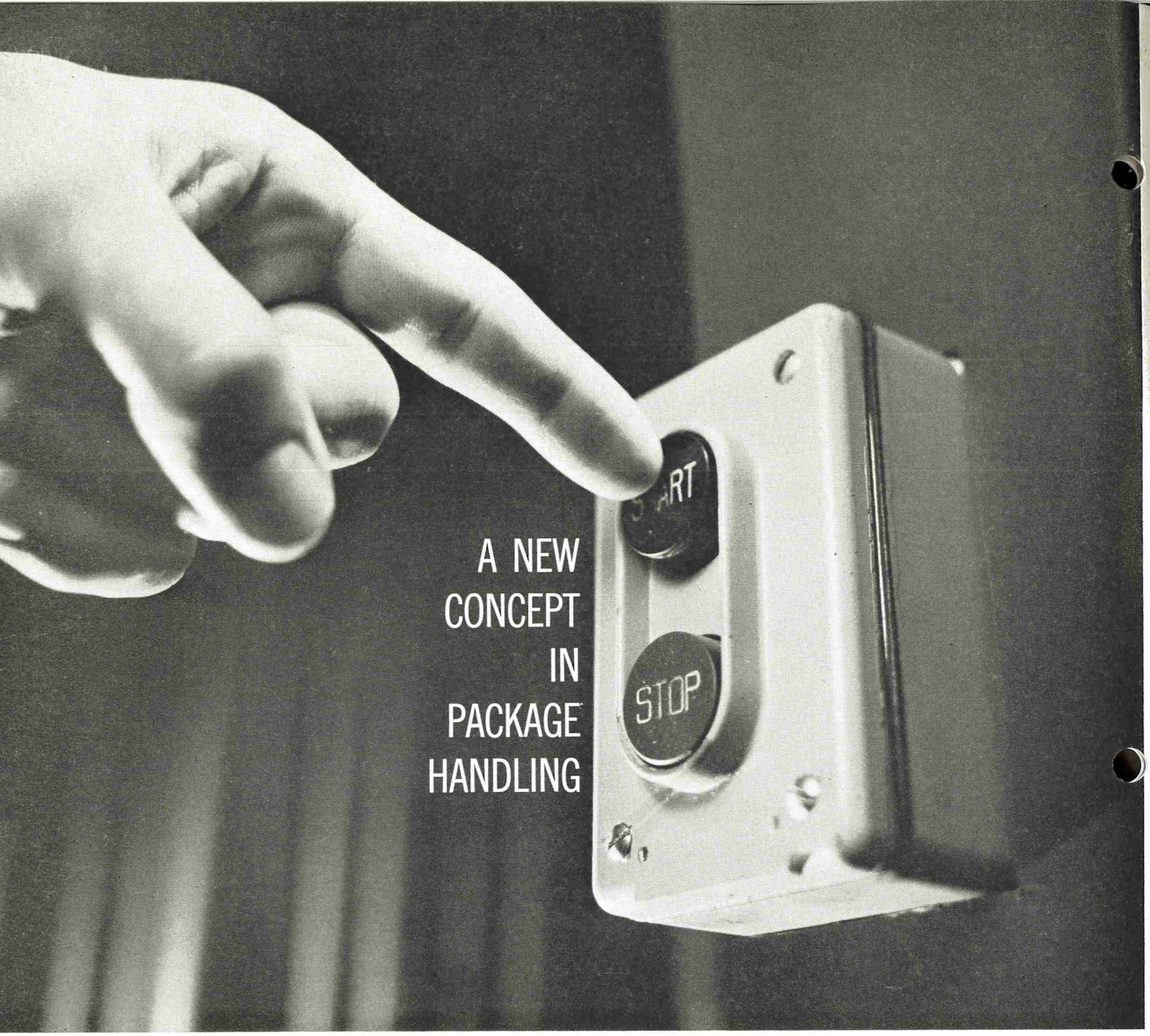

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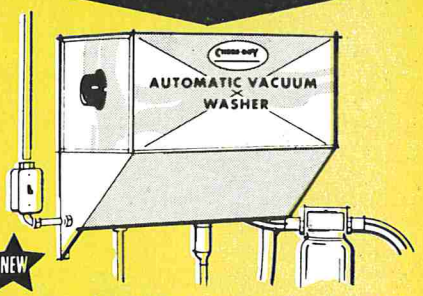

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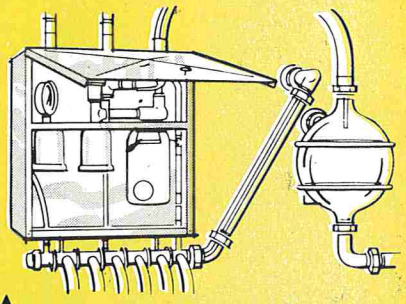

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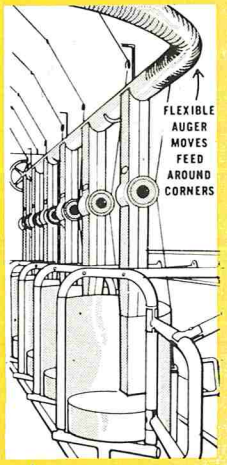

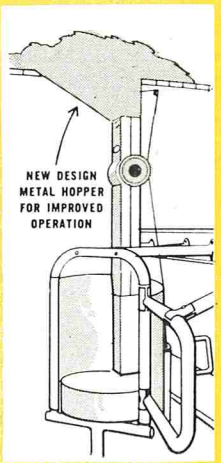

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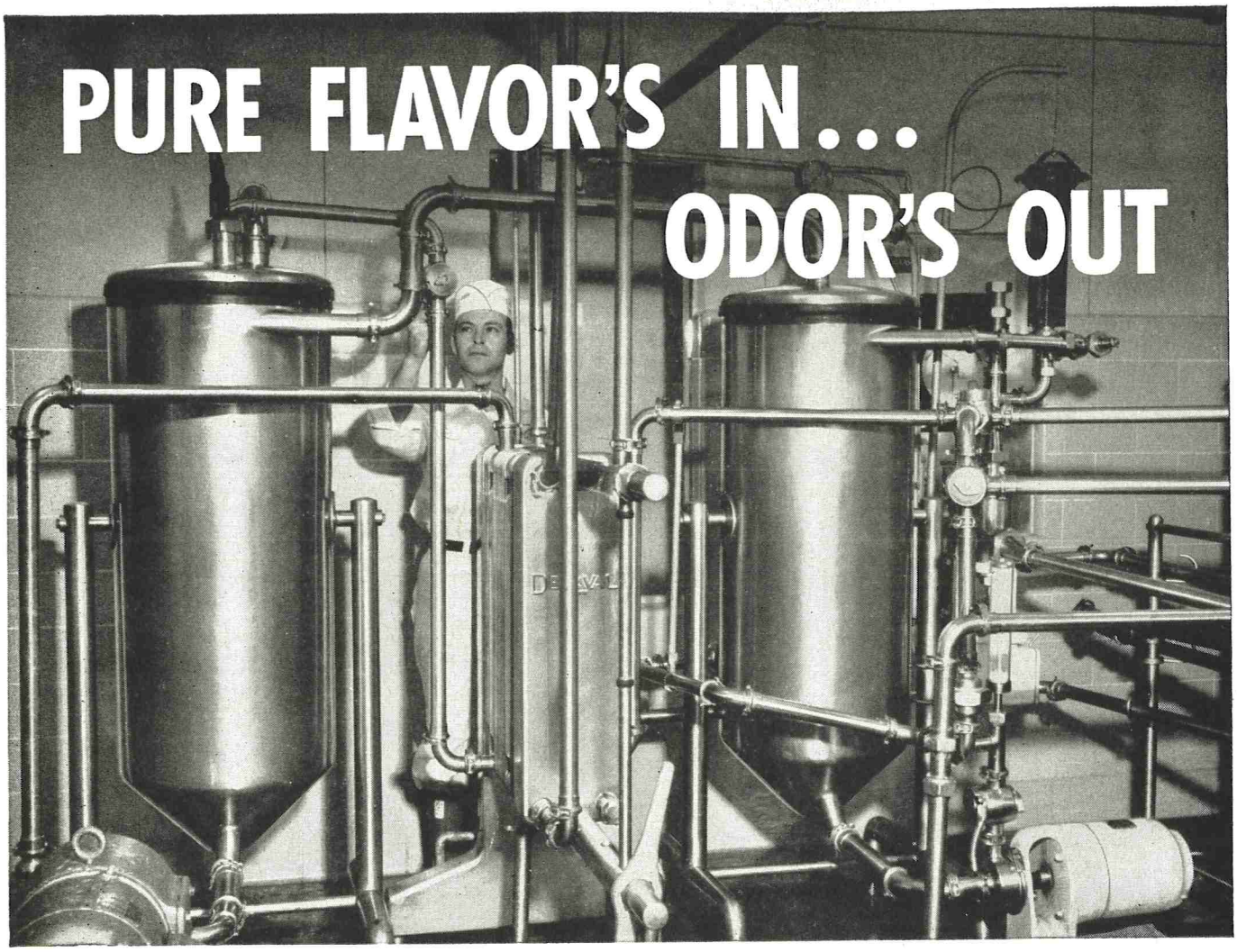

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AN APPRAISAL OF THE GERBER TEST FOR MILK FAT IN MILK AND MARKET MILK PRODUCTS[1]

DAVID LEVOWITZ

New Jersey Dairy Laboratories,

New Brunswick, New Jersey

Most of the milk provided to consumers is "homogenized;" a major portion of the balance, supplied in paper containers marked "pasteurized" is a variable blend of "homogenized" and "creamline."

While the laws of many states including your state (*13*) require that milks be tested for fat by only the Babcock Method, this procedure is not appropriate for either homogenized milks or its blends. In order to determine their compliance with standards, or to get figures so that you can account for fat (the costliest commodity), you as well as others, are either (*a*) testing these homogenized and blended milks, with slight success, by one or another of the (illegal) Babcock modifications, or (*b*) resorting to the expensive (and also illegal) Roese Gottlieb solvent-gravimetric (or its Mojonnier modification).

You would like a fat test as simple, or preferably simpler, than the Babcock, that you could use on any milk-creamline or homogenized or blend, or sweetened, flavored, or soured or cultured, that would give you data of the same order of accuracy as the solvent-gravimetric procedure. If you found such a method, it should be easy enough to ask your legislature to modify your current law to permit it—the purpose of a law is to promote citizens' best interests.

From experience with Babcock modifications, one might feel that such a test is not possible—but it is not only possible, it has been in existence almost as long as the Babcock. We will review this test and appraise it to see how well it satisfies the needs.

THE GERBER TEST

Origin and Hypothesis

Researchers in Europe were, like many in America, in 1880-90, seeking a simple replacement for the costly, time-consuming solvent-gravimetric method for determining fat in milk. In continental Europe, milk was regularly boiled before consumption. Dr. Nicholas Gerber, a Swiss chemist, found, shortly after the Babcock Method was published, that it did not bring all of the fat of these "heat-homogenized" milks into the bottles' graduated areas. Gerber learned that a specific iso-amyl alcohol, added to the sulfuric acid-milk mixture, decreased the interfacial tension of the fat, to permit it to rise completely.

Years before Bailey (*2*) and Herreid, Jenness and Whitman (*9*) reported that the use of strong acid increased the moisture of the material which rose into the column of the Babcock bottle, Gerber recognized that to achieve constancy of composition of the fat which was to be measured, the concentration and volume of reagents had to be kept constant. To insure that they would not be altered, he limited the capacity of his test bottle. Years before Lucas and Trout (*12*) pointed out that charring is avoided by adding acid in increments, Gerber learned it, and adopted a bottle design which provided it automatically. Gerber's bottle consists of a large upper bulb connected to a smaller bottom one by a calibrated column; the entire charge of acid is added at one time, but its specific gravity entraps a fourth of it in the small bulb and stem; it is released only when the bottle is inverted.

Working with heat-homogenized milk, Gerber could not make an empiric correction for the small fat gobules which did not rise from raw milk, as did Babcock. That the correction Babcock utilized (the depth of a meniscus) was inaccurate, was obvious: the meniscus depth is contsant, all other conditions being equal; a raw milk-distilled water mixture containing 2% fat, prepared from a 4% raw milk, will possess half the number of small gobules per unit volume as the original; yet both samples will be given the same meniscus depth as a "correction," in the Babcock test. Gerber sought to eliminate menisci as a source of confusion years before Bailey (*2*) Sanmann (*11*) and Dahlberg (*3*) pointed out that not only did different observers read the same test differently, but an individual might not replicate his own readings, because it was difficult to tell where the top of the upper meniscus ended, and capillary creep began; and because the depth of the meniscus increased, as bottles cooled from water bath temperature toward room temperature. Gerber used a flat glass stem — wherein the fat-reaction mixture interface is a straight line, and the fat-vapor interface is a

[1]Presented at the "Annual Minnesota Dairy Products Institute," Department of Dairy Industries, University of Minnesota, September 15-17, 1959.

shallow, clearly defined constant meniscus, which can be read promptly, by anyone.

Years before Hileman, Rush and Moss (*11*) showed that Babcock "tolerances" prevented accurate accounting for the fat of non-homogenized milk, and Gould (*7*) commented that calibrating Babcock milk bottles to ± 0.05% instead of the AOAC specification (*1*) of ± 0.1% was desirable, Gerber required the maximum error of his milk bottles' stems not to exceed ± 0.05%.

Gerber's reaction to the slow introduction of reagents in Babcock's test, through the stem whose maximum i. d. (at the minimum length of 63.5 mm.) is 5.7 mm., was to put a wide neck on the large bulb of his bottle. Reagents may be introduced rapidly—with automatic dispensers, if desired.

The open Babcock bottle must be swirled; it can not be shaken—its corrosive contents might be expelled—ruining tests and dispositions; Gerber stoppered the bottle, so that it could be safely shaken as rapidly as any hand or mechanism might permit.

Gerber, like Babcock, employed centrifugal force to accelerate fat separation; using a narrower bottle (25 mm. o. d. max. as contrasted to Babcock's 37 mm.) Gerber employed higher speeds with safety. Since the bottle is filled right at the beginning, only one centrifuging is required. To avoid the need for external heat, Gerber used a revolving turntable centrifuge, within which the bottles remain adequately hot. To avoid guessing operational speed at any time, he made a simple liquid-filled speed indicator an integral part of the turntable.

To insure uniform conditions at the time of measuring the fat, Gerber, like Babcock, tempered the bottles after centrifuging. The lower extremity of the Gerber fat column remains a straight line at all times; the shallow upper meniscus elongates very slightly on cooling, instead of greatly, as do both Babcock menisci. Gerber used pressure on the stopper, to elevate the straight line at the bottom of the fat column, to bring it promptly into registration with a unit graduation. The reading at the bottom of the shallow upper meniscus was then made, the unitage at the bottom meniscus substracted, and the fat test recorded.

Thus by means of the Gerber Test, all of the fat of any milk sample is brought, at constant composition, into a precisely graduated stem, where it is rapidly measured to yield data which agrees with that obtained by Roese-Gottlieb solvent-gravimetric method to within 0.05%. The Gerber test sounds quite modern; it appears to cope satisfactorily with all of the problems that American dairy technology literature has established as existing in the Babcock. Yet it is far from new—it first appeared in 1892. (*6*).

Gerber Equipment

Specifications for Gerber equipment will not be included here – they are reviewed in detail, in the releases of the British, German, Dutch, Belgian, Swiss, Irish, South African, French and many other governments' Bureau of Standards, and will appear in the forthcoming 11th Edition of Standard Methods for the Examination of Dairy Products, of the American Public Health Association.

The Gerber Test for Fresh Milk

By way of review, the Gerber procedure for testing milk, step by step, is as follows:

(a) Into a Gerber 8% milk bottle, add 10 ml. 70°F. sulfuric acid (1.820-1.825 sp. gr.), using preferably, an automatic syringe which delivers the volume accurately, rapidly, and without time loss for drainage.

(b) Fill the "11 ml." Gerber pipette with the prepared milk sample. Discharge slowly at first (to prevent "local action") then allow to drain. After free flow stops, wait 3 seconds, then blow out last drop.

(c) Add 1 ml. Gerber "pretested, certified" iso amyl alcohol (128-131°C. Boiling Point). Preferably use automatic syringe.

(d) Distend self-sealing lock-stopper with key. Insert into bottle; release pressure to seat stopper firmly.

(e) Shake bottle, without allowing terminal bulb to empty. After curd which first forms is completely dissolved, invert four times to permit acid entrapped in terminal bulb and stem to mix thoroughly with the balance. (Bottles held in Quick-Lock racks may be shaken in almost any mechanical unit, and the rack inverted to mix in the concentrated acid of all of the bottles at one time).

Note: any bottle whose liquid contents do not fill stem almost completely when terminal bulb is uppermost, is evidence that a reagent or sample was not measured accurately.

(f) Balance bottles in centrifuge, terminal bulbs towards center. Spin for four minutes at 1100 r.p.m.

(g) Immerse to bulb in a water bath at 140°F. for 5 minutes.

(h) Remove bottles singly; by applying gentle pressure to the lock stopper, bring bottom line of fat column to coincide with a unit graduation. Read bottom of upper meniscus on scale to nearest 0.05%; substract bottom unitage and record.

(i) Return bottle to water bath. When all tests are read, invert bottle; remove stopper and rinse in water. The lead sulfate precipitated from sulfuric acid is impacted at the base of the stopper: it, and fat are both removed from the bottle as the reagent mixture drains out; the stem is clean – has been

cleaned by fat-free reagent mixture; the bottle is completely cleaned, finally, by rinsing with water.

The Gerber Test for Preserved Milk

Milks which must be warmed before sampling, or milks to be sampled at one time or place, and tests completed at another, should be introduced before the acid. Do not add acid until ready to complete tests. Arrange the bottles in racks so that the flat faces of their stems are parallel to the rack's long axis. Support one end of the rack to bring its base 30° off the horizontal. Chill the acid to 45°-50°F.; introduce 10 ml. into each bottle. The acid will rapidly flow down the lower side of the flat glass stem to displace the milk from it and the terminal bulb without "local action." Add iso-amyl alcohol and complete tests as before.

Gerber Tests for Other Fluid Milk Products

Cream is tested by identical procedure excepting that a 5.00 g. portion is weighed into a 50% (graduated in 0.5%) or a 25% (graduated in 0.2%) bottle, then followed with 5 ml. of water.

Chocolate-flavored (sugar sweetened) milks and drinks, if not viscous, are measured out by milk pipette; if viscous, 11.125 g. are to be weighed out; special weights are available. Because of the high sugar contents, the acid must be modified — 94 parts by volume of standard acid to 6 parts of water. (Note — to prepare acid safely, weigh out ice; add acid to ice, slowly, in rubber or plastic container).

Skim milk is tested in 1% bottles (graduated in 0.01%); since phospholipid is extracted by Roese-Gottlieb solvent, but is not a true fat (*8-11*), Gerber skim milk tests will be lower than solvent-gravimetric results; since all skim milks' fat globules rise in the Gerber, its results will be higher than Babcock.

Cultured or soured milks must first be brought to homogeneity. Since these are viscous and may entrap air, they must also be weighed, rather than measured, into the bottle. Excepting only for weighing in 11.125 g., proceed as in the test for milk.

APPRAISAL OF THE GERBER TEST

At this point perhaps many questions come to mind. Is the simple Gerber Method actually able to test homogenized milks so readily? The answer, as supplied by Trout and Lucas, in their "Comparison of Babcock, Gerber, Minnesota, Pennsylvania and Mojonnier methods for Determining the Percentage of Fat in Homogenized Milk" (*15*): "In making the Gerber tests of homogenized milk the following factors were striking: (*a*) the clarity of the fat column and supporting liquid, (*b*) the identical reading of the duplicate tests, (*c*) the consistent check with tests on the non-homogenized milk and (*d*) the complete freedom of any char formation . . . Homogenization does not affect the Gerber test . . . the Gerber test was by all odds the most satisfactory test studied for making fat tests of homogenized milk."

If the Gerber Test, obviously simpler than the Babcock, is so much more fool-proof, hasn't it been appraised by others before this? Yes — but it was not compared from the aspect of practicality, even when only unhomogenized milks were considered. For example, Fisher and Walts, in 1925 (*5*) said: "The Babcock and Gerber methods for milk and cream seem to rank about the same from the standpoint of accuracy . . . as the Babcock method for milk and cream is recognized as an official method and generally used in the United States, there can be no advantage to the industry in introducing another method which is not more accurate or practical."

Dahlberg, Holm and Troy in 1926 (*4*) were equivalently unenthusiastic: "This investigation has shown that from the standpoint of accuracy the Babcock and Gerber tests are comparable. Whether the Gerber test should be introduced into this country or the Babcock test into Europe, is a question which the dairy industries of the countries concerned must settle for themselves through personal preference in respect to the technic of making the tests. One good practical test for fat in milk and cream is better than two of equal merit because of the confusion which would be created in the industry by the use of two tests." Gould in 1955 (*7*) also reviewed the advantages of the Gerber Test but concluded his appraisal with paraphrasing the above — "it would be better to have one generally accepted test in the United States." In spite of this, Gould recommends the Lucas-Trout modification of the Babcock for use on milks which might contain homogenized fat, even though its own authors point out that it is erratic in performance (*12*).

What is the actual limit of error of the Gerber test on milks? Competition yields bottles whose errors are well below the maximum permitted tolerance of ± 0.05%. Replicate tests are either identical, or come within 0.05% of each other. Their average will match within 0.05%, the mean of replicate Roese-Gottlieb (or Mojonnier) tests, which themselves range ± 0.03 (*4, 10*).

Has the Gerber Test been legally recognized by any states? Yes; by New York and New Jersey 30 years ago; by California a few years ago, and (in February 1959) by Pennsylvania.

Has it caused confusion? Quite the reverse! It has not only decreased confusion, it has made technicians much more efficient and fat testing much more accurate!

Is the Gerber Test easy to learn and to perform? If there were a simpler test of equivalent accuracy, this paper would not have been presented today. Try the Gerber yourself, on any kind of milk. Whether homogenized or creamline or a blend — you will get uniformly perfect, easily read, accurate columns rapidly; without acid spillage, repetitive bottle swirling, water additions, nursing a centrifuge, finger sticking, the need for a revelation to disclose the top of the top meniscus, and in spite of all care, globs in the fat columns.

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AN OFFICIAL LOOKS AT SANITATION[1]

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Editorial Note: In the December 1959 issue of the Journal there appeared an article entitled, "What is Wrong with Official Regulation of Food Sanitation," by J. Lloyd Barron, Director of Sanitation, National Biscuit Co., and Past President of the National Association of Bakery Sanitarians. There are two sides to every question. In the article below Mr. A. E. Abrahamson, Chief, Wholesale Division, New York City Health Department, discusses the subject of food sanitation regulation from another point of view.

This topic ordinarily calls for an evaluation of current practices. I am taking the liberty of a broader inquiry. I believe that the official who looks at sanitation should do so not with the view of law enforcement alone. Experience has long ago established that policing a food industry solely on the basis of "do it because you must" yielded unenduring results in too many instances. Recognizing this the laws regulating the sanitation of food processing establishments and other phases of food control permitted administrators of these laws the use of an educational approach. This is revealed for instance, in Section 306 of the Federal Food, Drug and Cosmetic Act which reads, "nothing in this Act shall be construed as requiring the Secretary to report for prosecution, or for the institution of libel or injunction proceedings, minor violations of this Act whenever he believes that the public interest will be adequately served by a suitable written notice or warning." The new Health Code of the City of New York takes a similar view. It provides under Section 3.13 "in lieu of enforcement of this Code by way of prosecution, recovery of civil penalties, revocation of permits, seizures and embargoes and condemnations, and other compulsory means, the Department may seek to obtain the voluntary compliance with this Code by way of notice, warning or other educational means, - - - ."

I am reminded of a telephone call received by an administrator of a food control agency who was asked, "for Pete's sake when is the inspector going to revisit my establishment." This seemed an odd request. Further inquiry disclosed that the restaurant

[1]Presented at the annual meeting of the Institute of Sanitation Management, New York City, September 24, 1959.

owned by the caller was inspected three weeks earlier and the work ordered by the inspector was completed. The caller said that the restaurant was in an ultra clean condition and was ready for the inspector. The restaurant owner was advised that a re-check would be made eventually, in the very near future. Where-upon the caller asked indignantly, "how long do you expect me to keep this place in this shape?"

Sense of Responsibility

Here is represented an attitude born of misunderstanding. It also shows a lack of a sense of responsibility which reduces the effect of prosecution and fining to a cost of doing business, a tax in a sense.

Unless this attitude is altered, long term results can hardly be expected.

That the official has the responsibility of law enforcement there is no doubt. But he has also to try to achieve lasting results. Frequently to do this he must play the role of educator and counselor.

The official who looks at sanitation of food establishments realizes that his system of infrequent visits cannot in and of itself attain his public protection objectives which are, among others, clean processing plants, clean practices and wholesome ingredients. Many officials feel that there are ways to develop the philosophy, the methods and the means of sanitation. These officials feel that supervision of sanitation is a function of management independent of production and that sanitation must be recognized as an important step in every phase of the technology of food. To get the food industry to realize this as one of its responsibilities is an educational process which officials have undertaken.

Sanitation or the lack of it is not revealed by inspection alone. Process observations, chemical, microscopic and bacteriological examinations are the other tools of the trade. The conditions which characterize poor sanitation are those physical and maintenance defects in plant and equipment which may contribute to the contamination of food in manufacture, storage or service, the defects in the processing and handling of food and its ingredients and its keeping between processes and before service and use.

The official in appraising sanitation must consider, (*a*) the aesthetic aspects, (*b*) danger of accidental contamination by chemicals, and (*c*) presence of bacterial agents from various sources and contacts.

Aesthetic considerations generally relate to the environmental factors surrounding food processing. This was regarded as a public health problem more than 75 years ago. Since then there has been a great movement in this country which was aimed at the control of disease through the improvement of the environment. Programs were pushed for water sanitation, proper sewage and waste disposal, fly and mosquito control, good drainage, ventilation and lighting in food factories and good factory building construction. These programs still are important.

If we may assume that these programs were properly carried out, they have set the stage for the great new era of factory made foods.

Early in this period of the emancipation of the home maker, about twenty years ago the Federal Food, Drug and Cosmetic Act of 1938 was enacted. The importance of environmental conditions in food plants took on a "new look." Under this law, food is adulterated if it is produced under unsanitary conditions whereby it may become contaminated. To be sure that a crime is not charged on flimsy evidence most agencies determine if filth in food is present which may be attributed to the condition of the physical plant. The laboratory measures which now are used frequently reveal yesterday's housekeeping neglect.

Construction and Replacement

Not only may the conditions of the physical plant be transferred to the food item, but the neglect in sanitation maintenance of food equipment may bear even more directly on contamination. Realizing this, a broad new program of food equipment design, construction and replacement has become the order of the day. The danger that foreign material may be found in the food product and the high cost of equipment cleaning have accelerated an interest in the design and construction to facilitate cleaning of food equipment and machinery of all kinds. Frequently modern machines not only improve the product through better technology, but result in cleaner operations with lower costs of both production and cleaning.

The official looks at this as a constructive program and assists in every way possible in the development of equipment standards codes which now are being undertaken by the country's bakers, canners, vending machine owners, restaurateurs and others.

A Program of Self Inspection

In 1942 the Sanitary Code of the City of New York was amended to require that food plant processors carry out a program of self-inspection. This was introduced at the time as an educational device. The idea took hold as evidenced by the fact that many plants employ full time personnel to make sanitation evaluations of the plant and its practices. Others contract outside services for the same purpose. The official looks at these efforts as an adjunct to his own program which he recognizes as one which does not

afford sufficient coverage to assure continuous satisfactory operation. Secretary Flemming of the U. S. Department of Health, Education and Welfare, in support of his current budget request in which he sought funds to increase the frequency of Federal inspection of food plants from once every 4½ years to once in 4 years, illustrates the difficulty of assuring adequate coverage by an official program. The official sanitarian, in order to be assured that the assistance of the professional and employed sanitarians continue at a high level, must periodically check the reports which the latter issue as a result of their efforts.

A recent study was made of the sanitary conditions in over one hundred plants under plant employed and professional inspection programs. The frequency of official inspection of these plants was reduced to a minimum consistent with good administrative practice so that there would be little influence exerted by the regulatory agency on the sanitation of the plant. It was found that where a conscientious effort was made to carry out a self-inspection program by company employes a relatively high level of sanitation was maintained.

It was also disclosed that better reporting is done by professional sanitarians although application of such reports is less evident, possibly indicating that self-inspection is effective if management wants it to be.

In the revision of the Health Code of the City of New York which became effective October 1, 1959, the requirement for self-inspection was extended to non-processors but otherwise was retained without substantive change. A new concept also was added as follows:

"Every food establishment shall post or maintain in a readily accessible place, on a form acceptable to the Department, a schedule for maintaining the sanitation of its premises, including control and elimination of rodents and insects and other pests and the cleansing of its equipment. The schedule shall show the job title of persons assigned to the cleaning operations, and the times when such operations are to be performed, as well as the name of the person who supervises the sanitation of the establishment pursuant to the requirements of Section 81.37." (Cleaning-Method provision).

FOOD ADDITIVES MUST BE CONSIDERED

Thus the tools for better sanitation programs are rapidly becoming available. These and classes of formal instruction which are given to food plant personnel are some of the educational efforts of the official concerned with sanitation. There is increasing evidence of a vastly improved condition in the sanitary quality of foods as a result of the attack on the aesthetic aspect of food sanitation by law enforcement and by the various educational programs which have been outlined.

The broad official interpretation of sanitation includes safety. Therefore, not unrelated to sanitation is the problem of the presence of chemical materials in food plants. Some of these chemicals are needed to control rodent and insect life. Others may be added to perform a specific function in the process of food preparation. Where there is danger that a hazardous chemical may be incorporated into food by accident or by bad plant practice the official must take swift and positive action. He must see to it that hazardous substances are stored safely, and are labeled properly and legibly. The official looks at chemicals which are proposed for use as food additives, or at a chemically treated surface in contact with food, or at a resin or plastic material used as a coating of a food machine or tank in a new light. The Food Additive Amendment to the Federal Food, Drug and Cosmetic Act regulates the use of such chemical materials which are added to food or which by contact may migrate into food. Such chemicals must be proven both safe and necessary to be permitted, and must not exceed the amount tolerated. Food containing an additive which is not permitted or is in an amount exceeding the established tolerance is violative of the Act.

Thus, sanitary inspections now must include an examination of the chemical materials used for sanitation, recognition of the dangers atttendant upon their storage in the food plant and an understanding of the safety of and need for chemicals used as food additives.

Sanitation has yet another and very important aspect: Slocum, of the U. S. Food and Drug Administration believes, "a sanitary food strictly speaking, is one free from injurious substances, particularly infectious micro-oranisms. But, modern concepts of food control have expanded this definition to include freedom from materials that are repulsive or obnoxious regardless of their importance as an agent of disease."

EATING HABITS CHANGED

The eating habits of the population of the U. S. have changed radically during the period since World War II. With the family eating out once a week, with the increase of female workers (now estimated to exceed 20 million, many of whom eat at least one meal a day in restaurants), and with the vast amount of travelling for business, and vacation, food preparation has become a major business. The busy homemaker who is frequently also one of the

millions of workers, patronizes the manufacturer of convenience foods. There are thousands of these manufacturers ranging from the local delicatessen or restaurant to nationally famous producers, who cater to this business with numerous varieties of "heat and eat" foods. These include meat, poultry, fish and egg salads; meat, poultry and fish pot pies and frozen dinners; breaded and fried meat, poultry and fish and Chinese style foods. While there are no reliable estimates of the amount of these foods produced, a cursory survey of the display cases of many restaurants and self-service stores, gives some indication of the scope of the development of this business. The general acceptance of these products is based most likely on convenience to the homemaker. Good quality and safety are assumed. Studies have been made to ascertain both the sanitary quality and the safety of ready to eat food.

Some of these so-called convenience foods by these recent studies involving laboratory examination, have shown such bacterial populations as to warrant the concern of some official sanitarians. The official in this field of activity has a sanitation problem not unlike that which he had to control in the days of milk-borne and shellfish-borne disease outbreaks.

Industry is ready to use morbidity and and mortality statistics to prove by the relatively few reported cases of illness that these food items are sanitary and safe. The reporting of cases of food illness in the U. S. is known to be incomplete and is not a valid basis for judging the sanitary quality of these foods.

It was reported to the Annual Conference of the Association of Food and Drug Officials of the United States in 1957:

"The human handling which frequently occurs in the manufacture of many frozen foods, such as deviled crab, lobster-a-la Newburg, chicken-a-la-king, stuffed poultry, poultry and meat pies, frozen dinners and others, places these foods in an especially critical category. If the idea is sound that the possibility of contamination varies inversely with the distance from the contaminating source, then foods which are of necessity handled, such as the many frozen pre-cooked foods, must receive our immediate attention and must be controlled at least to the degree that other foods are controlled, such as milk, ice cream, oysters and clams, fresh crab meat and others for which microbiological standards obtain."

Sanitation of Heat-and-Serve Items Needs Attention

Many workers in the field of food sanitation and food technology have recognized the need of a high order of sanitation in the preparation of ready-to-eat foods. The Department of Health of the City of New York, following studies of the bacterial populations of the foods which have been mentioned, has undertaken the laboratory work needed, not only to ascertain their sanitary quality but also to aid producers with these problems, by the assignment of sanitarians trained in this field of process analysis and consultation.

Pre-cooked chilled and frozen foods do not require thorough heating in preparing them for service. As a consequence of this, these products must be safe at the outset. This safety must be achieved as a joint effort of management at the planning and supervisory level, and plant employes at the practical level. No new techniques are needed to produce foods on a commercial scale which are low in bacterial counts. The general principles which obtain relate to strict compliance with good practices in personal hygiene, plant and equipment sanitation, terminal heat treatment and time-temperature control. Defects in personal hygiene are frequently revealed by bacterial counts and can often be traced to the responsible individual by phage typing techniques. Manual contact with food must be held to a minimum. Where hand processing is necessary, regulated and supervised hand sanitation procedures are most important. This is difficult to control, but when properly carried out, it results in most gratifying bacteriological counts.

The investigation of some recent food borne cases has established that objects in the food establishment carried the suspected bacterial agent. Swabbings of these objects have yielded results as high as 6 million total count in a meat grinder, 230 million in a food chopper and 2,300 and 425,000 coliform bacteria, respectively, in these devices. The equipment following dismantling and cleaning with a suitable detergent, a hot water rinse and chlorine solution sanitizer resulted in essentially negative counts.

The official looks at his work in promoting the sanitation of food processing plants, which includes all of these measures and more, as a service to the public, both consumer and processor. The other services not mentioned are, for example, the matter of assuring a safe environment for the worker, the elimination of causes of nuisances, such as excessive noise, smoke, dust and noxious fumes, the prevention of the contamination of water supplies and the control of waste disposal. The official must be sure that the food plant operator is a good neighbor who tries to conduct his business without creating health problems in the community.

The official sanitarian recognizes his responsibilities and carries out his job without fuss or fanfare. His problems arise when someone else fails to carry out theirs.

LACTIC STARTER CULTURE ACTIVITY IN MILK FROM COWS ON PASTURE AND IN MILK FROM COWS ON DRY FEED[1]

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Lactic starter culture activity in milk from cows on rye pasture and in milk from cows on dry feed was compared, using two cultures widely distributed by commercial laboratories. The milk was pasteurized at 62.5°C. for 30 min. In 16 and 24 hr. at 21°C. one culture developed slightly higher acidities in milk from the pasture cows than in milk from the dry-feed cows, as shown by the means of 8 trials. The differences were statistically significant. On the other hand, the second culture, which showed lower activity in the test milks, developed a higher acidity in the milk from cows on dry feed. The differences at the 16-hr. period were statistically significant.

The total solids content of milk averaged 13.70% from the cows on pasture and 13.20% from those on dry feed. The proteose-peptone content varied but the mean value was about the same for milk from the pasture cows as for that from the dry-feed cows: 2.4 and 2.3 mg./10 ml. milk, respectively. Non-protein nitrogen averaged 4.5 mg./10 ml. milk from cows on pasture and 2.8 mg./10 ml. milk from cows on dry feed.

Although the differences in milk composition might have influenced lactic culture activity, it is considered that the effect of milk from cows on pasture depended on the characteristic of the lactic culture. Such effect appears to be of doubtful practical significance.

Cheese manufactured during spring and summer seasons sometimes has been considered superior to that made during winter. Van Slyke and Price (*11*) surmise that summer milk, as opposed to "fodder" milk, may contain factors that stimulate the growth and activity of microorganisms in cheese starter and during cheesemaking and ripening processes. Ritter (*9*) concluded that slow acid development in cheesemaking was not due to inherent differences in milk and that no significant effect was produced by feeding cows winter-type or summer-type feed.

Riel and Sommer (*8*) noted that milk from pasture-fed cows showed an increase in total nitrogen content and the proteose-peptone fraction. Anderson *et al.* (*1*) reported that milk with relatively high peptide content was usually more stimulatory to lactic culture development than milk low in these constituents. However, responses of different cultures varied. Milk from two cows on a low carotene diet supported poor growth, although the protein content of the milk was normal.

Variations in cheese starter activity associated with season or weather have been noted (*2, 5, 6*) but were attributed to causes other than the type of feed. At the Kansas Station, duing a period when some cows were on spring pasture and others still remained on winter feed, exploratory tests suggested greater activity of lactic cultures in milk from cows on pasture than from cows on dry feed. Since further information on the effect of pasture feeding of cattle on the milk as a growth medium for lactic culture organisms seemed desirable, additional study was undertaken.

Methods

The activity of lactic starter cultures usually varies somewhat over a period of time, even when the cultures are propagated under uniform conditions. Pasture conditions also change with time. Therefore, comparisons were made simultaneously with different groups of cows rather than successively with the same group. Such procedure permitted inoculation of milk samples from the same culture transfers in each comparison. However, it limited the number of cultures that could be tested at one time.

In early spring, while the College dairy herd was still on dry feed, 20 cows were selected for the experiment. Those picked were free from mastitis and had received no recent antibiotic treatment. Cows at extreme ends of their lactation periods were excluded. Eight Holsteins and four each of Ayrshires, Jerseys, and Guernseys were included.

Balancing of cow groups

In an effort to divide the cows into balanced groups so that milk from each group might be equally suitable for culture development, culture activity tests were made on the milk from each cow before starting the main experiment. It was considered that such activity tests would provide the best information for equalizing the cow groups.

Two trials were conducted with a 2-day interval between. From the results on individual samples, cows were placed in four groups so that the developed acidity in the milk averaged the same for each group. The cow groups, designated I, II, III, and IV were also arranged to include two Holsteins

[1]Contribution No. 269, Department of Dairy Husbandry, and No. 44 Statistical Laboratory, Kansas Agricultural Experiment Station, Manhattan.

and one each of the Ayrshire, Jersey, and Guernsey breeds.

Following the group balancing procedure and using a table of random numbers, cow groups I and II were placed on rye pasture with a grain supplement. During the first 3 days, they were on pasture only 3 hr. daily and received some alfalfa hay each day. After 3 days, groups I and II were on pasture day and night except for about 1 hour before and during milking and received no hay. During much of the experiment the weather was wet and cool, the pasture muddy, and cows grazed relatively short periods. Groups III and IV remained on dry feed consisting of Atlas sorgo silage, grain, and alfalfa hay. Comparisons of lactic culture activity were started after groups I and II had been on pasture 4 days. The investigation was continued for 4 weeks to allow adequate time for possible cumulative effects of pasture feeding. A longer period was not used because of increased maturity and decreased productivity of the pasture.

Sampling and testing procedures

In trials comparing milk from cows on pasture with milk from cows on dry feed, representative milk samples were obtained from each cow during morning and evening milkings. Night portions were held refrigerated and morning portions were added to the same containers. The samples were taken to the laboratory promptly after the morning milking and composite samples were prepared for each cow group (I, II, III and IV) in accordance with the production of the different cows.

To check culture activity and permit some comparison between trials, control milk samples were used as a standard. Control milk was made from reconstituted nonfat milk solids, previously tested to insure absence of inhibitory substances. The same lot of powder was used throughout the study. Reconstituted control milk was prepared to contain 9.0% solids. Each cow group sample and the control milk was dispensed in 100-ml. lots into four 6-ozs. prescription bottles. Portions were also taken for initial titratable acidity, pH, total solids, proteose peptone and non-protein nitrogen determinations. Total solids determinations were made gravimetrically and proteose peptone and non-protein nitrogen fractions were measured by methods of Shahani and Sommer (*10*).

The 100-ml. milk samples were pasteurized promptly in a water bath at 62.5°C. ± 0.5° for 30 minutes. After cooling in water they were held in the refrigerator 3 to 4 hr. until inoculated. At that time samples were tempered to 21°C., inoculated with 1% lactic culture, and incubated at 21°C. The pasteurizing treatments, amounts of inoculum, and incubation conditions were selected as approximating methods followed in the overnight set for cottage cheese. Also, the relatively low incubation temperature and inoculation rate would be more likely to show differences in acid production than would higher temperatures, heavier inoculations and shorter incubation periods.

Although it would have been advantageous to use a number of different lactic cultures, the desirability of making all comparisons in each trial at the same time limited the number of cultures that could be used satisfactorily. Since the procedure described required 10 samples for acid development with each culture, the number of cultures tested was limited to two. These (A and B) were widely-used, mixed strain commercial cultures. One culture (A) was the same as previously used in the preliminary balancing trials. The cultures were propagated in reconstituted, pretested, nonfat milk, made to 9% solids. Transfers were made three times weekly with incubation at 21°C. for 18 hr. followed by refrigeration. Inoculations of milk samples for activity tests were made from cultures transferred the previous day. Titratable acidity and pH determinations were made on the samples at 16 and 24 hr. After adjusting for initial titratable acidity and pH, results were reported as developed acidity and pH changes. All samples were tested in duplicate with each culture. Trials were conducted twice weekly during the 4-wk. period, making eight trials in all. The data were studied by analyses of variance and t-tests. Unless otherwise stated, the 5% level of significance is used throughout this manuscript.

RESULTS

With culture A and a 16-hr. incubation period, the mean developed acidity for eight trials was somewhat higher in milk from cow groups on pasture than in milk from cow groups on dry feed (Table 1). Differences varied with trials but were statistically significant for the 4-wk. period. Differences between reconstituted control milk and milk from pasture groups were not statistically significant.

Results with culture B at 16 hr. differed from those obtained with culture A and, in general, the developed acidity was lower. Milk from the pasture groups developed significantly less acid than milk from the dry-feed groups, as shown by the means for the eight trials. Milk from each cow group was significantly lower in acid production than was the control. Milk from group II rather consistently supported poor growth of culture B.

At 24 hr. with culture A, milk from the pasture groups remained significantly higher in developed

TABLE 1—ACID DEVELOPED BY TWO LACTIC CULTURES IN 16 HOURS AT 21°C. IN RECONSTITUTED, PASTURE, AND DRY-FEED MILKS

Trial	Sample	Culture A					Culture B				
		Reconstituted milk	Pasture milk Cow groups I	II	Dry-feed milk Cow groups III	IV	Reconstituted milk	Pasture milk Cow groups I	II	Dry-feed milk Cow groups III	IV
					Per cent acid developed[a]						
1	1	.45	.45	.46	.39	.41	.50	.37	.39	.42	.41
	2	.47	.46	.49	.39	.42	.50	.36	.38	.42	.51
2	1	.47	.47	.49	.44	.41	.48	.35	.31	.27	.35
	2	.50	.49	.47	.42	.41	.45	.37	.27	.28	.35
3	1	.50	.49	.52	.49	.51	.50	.35	.30	.38	.39
	2	.55	.50	.54	.48	.52	.50	.36	.32	.39	.40
4	1	.50	.46	.45	.39	.43	.44	.31	.22	.30	.30
	2	.53	.47	.44	.41	.41	.43	.30	.22	.29	.31
5	1	.38	.39	.38	.40	.40	.41	.32	.25	.40	.37
	2	.38	.39	.39	.40	.40	.43	.33	.25	.39	.37
6	1	.57	.51	.50	.48	.55	.54	.40	.37	.41	.44
	2	.57	.52	.52	.49	.54	.56	.41	.37	.44	.46
7	1	.51	.54	.57	.46	.48	.46	.33	.22	.28	.32
	2	.54	.56	.54	.47	.49	.46	.34	.22	.29	.33
8	1	.42	.35	.36	.37	.37	.37	.25	.12	.23	.25
	2	.40	.34	.38	.38	.38	.35	.27	.12	.23	.25
	Means		.484 < ns > .465 < * > .437					.461 < * > .304 < * > .348			
			< * >					< * >			

[a]Final titratable acidity minus initial; ns = Statistically nonsignificant; * = Statistically significant at or beyond the .05 level.

acidity than milk from dry-feed groups (Table 2). Also, with all groups the developed acidity was significantly higher than for the reconstituted control milk. With culture B, at 24 hr., differences between pasture and dry-feed groups were not statistically significant, but developed acidities were significantly higher in milk from all cow groups than in the control milk. Unlike the situation after 16 hr. of incubation, the level of developed acidity was the same for cultures A and B after 24 hr. of incubation.

Changes in pH values generally corresponded to changes in titratable acidity, but there were variations in this relationship. Data on pH changes from the eight trials are summarized in Table 3. With culture A at 16 hr. the mean pH changes for milk from pasture groups and from dry feed groups were similar, but each was significantly less than the reconstituted control. At 24 hr. the mean pH change was greater statistically in milk from the dry-feed groups than in milk from the pasture groups, with the latter being similar to the control. With the B culture, mean pH changes were statistically in accordance with changes in titratable acidity except after 24 hr. incubation, at which time there was not an important difference between any two groups.

Data on total solids content of the samples are presented in Table 4. Milk from the groups on pasture averaged 0.5 of a percentage point higher in solids than milk from the groups on dry feed, and the difference was statistically significant. The reconstituted control milk, which was prepared to contain 9.0% total solids, deviated somewhat from this figure in the different trials. However, there appeared to be no close relation between the total solids in control samples and the corresponding developed acidities. Also, all linear correlations between developed acidity and total solids computed within each of the five sources of milk were insignificant, well above the 10% level.

In non-protein nitrogen content, the milks from Groups I and II (on pasture) were similar and quite uniform throughout the experiment (Table 5). The same was true with Groups III and IV (on dry feed). However, the level was 61% higher for the pasture groups than for the dry-feed groups. This difference was significant even at the 0.1% level. The proteose-peptone nitrogen fraction in the milk varied with groups and trials. Group III, on dry feed, averaged the lowest in this fraction, while Group IV, also on dry feed, averaged the highest. However,

TABLE 2—ACID DEVELOPED BY TWO LACTIC CULTURES IN 24 HOURS AT 21°C. IN RECONSTITUTED, PASTURE, AND DRY-FEED MILKS

Trial	Sample	Culture A					Culture B				
		Reconstituted milk	Pasture milk		Dry-feed milk		Reconstituted milk	Pasture milk		Dry-feed milk	
			Cow groups I	II	III	IV		Cow groups I	II	III	IV
		Per cent acid developed[a]									
1	1	.56	.65	.66	.66	.65	.65	.64	.65	.66	.64
	2	.55	.65	.66	.58	.65	.65	.65	.65	.66	.63
2	1	.61	.67	.66	.67	.66	.61	.65	.64	.64	.63
	2	.63	.67	.66	.67	.63	.63	.65	.65	.66	.63
3	1	.60	.61	.64	.65	.56	.68	.68	.69	.69	.64
	2	.63	.64	.62	.62	.59	.66	.67	.70	.67	.63
4	1	.57	.66	.67	.63	.64	.67	.67	.64	.67	.63
	2	.56	.64	.66	.64	.65	.66	.66	.66	.65	.65
5	1	.61	.67	.68	.63	.64	.64	.68	.67	.67	.63
	2	.61	.67	.69	.61	.64	.62	.67	.68	.65	.65
6	1	.65	.65	.67	.65	.66	.62	.68	.66	.69	.66
	2	.66	.66	.68	.66	.66	.65	.68	.68	.67	.68
7	1	.60	.63	.62	.62	.59	.50	.65	.67	.63	.62
	2	.61	.64	.63	.61	.60	.51	.66	.66	.63	.63
8	1	.60	.68	.70	.66	.65	.69	.65	.59	.65	.60
	2	.60	.68	.69	.67	.65	.60	.66	.60	.64	.62
	Means	.603	.658		.639		.621	.645		.659	
			*		*			*		ns	
			*								

[a]Final titratable acidity minus initial; ns = Statistically nonsignificant; * = Statistically significant at or beyond the 0.5 level.

TABLE 3—SUMMARY OF DECREASES IN pH VALUES PRODUCED BY TWO LACTIC CULTURES AT 21°C. IN RECONSTITUTED, PASTURE, AND DRY-FEED MILKS[a]

Incubation Period	Culture A					Culture B				
	Reconstituted milk		Pasture[b] milk		Dry-feed[b] milk	Reconstituted milk		Pasture[b] milk		Dry-feed[b] milk
	pH changes[c]									
16 hrs.	-1.83	*	-1.74	ns	-1.73	-1.66	*	-1.22	*	-1.46
24 hrs.	-1.95	ns	-1.97	*	-2.05	-2.06	ns	-2.01	ns	-2.05

[a]Mean values from 8 trials in duplicate with each culture; [b]Includes 2 cow group; [c]Final pH minus initial pH = ms Statistically nonsignificant; * = Statistically significant at or beyond the .05 level.

the difference between the mean for the pasture groups and the mean for the dry feed groups was not significant.

DISCUSSION

Whole milk was used in the investigation, partly as a matter of convenience and partly because some differences in milk from cows on pasture and from cows on dry feed are known to be associated with the butterfat. Although it has been reported (3, 7) that differences in acid production in whole milk and skim milk are negligible, the milk used in the studies was heated to a relatively high temperature and one which would reduce subsequent creaming. Since creaming of milk is considered by Wright and Tramer (13) to affect culture development, it may account for some of the variations occurring in this experiment with milk heated to only 62.5°C. for 30 min.

The generally lower activity in the pasture and dry-feed milks than in the reconstituted control milk at 16 hr. may arise from the relatively low heat treatment. Although the control milk was similarly pasteurized, its previous heat treatment during pow-

TABLE 4—TOTAL SOLIDS IN RECONSTITUTED, PASTURE, AND DRY-FEED MILKS[a]

Trial	Reconstituted milk	Pasture milk Cow groups I	Pasture milk Cow groups II	Dry-feed milk Cow groups III	Dry-feed milk Cow groups IV
	Per cent total solids				
1	9.02	13.60	13.63	12.60	12.74
2	8.90	13.57	14.26	13.43	13.50
3	9.09	13.82	13.66	13.57	13.08
4	9.11	13.52	13.66	12.85	13.24
5	9.06	13.93	13.89	13.26	13.24
6	9.22	14.10	13.66	13.35	13.36
7	8.91	13.55	14.00	13.58	13.26
8	8.78	13.16	13.13	12.89	13.20
Means	9.01	* 13.70		* 13.20	

[a]Av. of duplicate samples; * = Statistically significant at or beyond the .05 level.

TABLE 5—NON-PROTEIN NITROGEN AND PROTEOSE-PEPTONE NITROGEN IN PASTURE, AND DRY-FEED MILKS

Trial	NPN Pasture milk Cow groups I	NPN Pasture milk Cow groups II	NPN Dry-feed milk Cow groups III	NPN Dry-feed milk Cow groups IV	PPN Pasture milk Cow groups I	PPN Pasture milk Cow groups II	PPN Dry-feed milk Cow groups III	PPN Dry-feed milk Cow groups IV
	Mg./10 ml. milk							
1[a]	—	—	—	—	—	—	—	—
2	4.7	4.7	2.7	2.7	2.0	2.8	1.9	2.3
3	4.4	4.6	2.7	2.9	2.2	2.5	1.9	2.6
4	4.4	4.6	2.7	3.0	2.0	2.1	1.4	2.7
5	4.3	4.4	2.7	2.9	2.1	2.5	2.3	2.3
6	4.4	4.7	2.7	2.9	2.3	2.5	2.1	2.7
7	4.9	4.6	3.1	3.1	2.6	2.4	1.9	2.8
8	4.5	4.4	2.8	2.8	3.0	2.6	2.2	3.1
Means	4.5		*** 2.8		2.4		ns 2.3	

[a]Data not obtained in trial 1; ns = Statistically not significant; *** = Statistically significant at or beyond the .001 level.

der manufacture, undoubtedly contributed to a greater total heat effect. While higher heat treatment of the pasture and dry feed milks probably would have resulted in higher developed acidity, it was preferred to keep the treatments in accordance with cheesemaking processes.

The fact that cultures A and B reacted differently to milk from different cow groups is not unusual in view of recognized variations in culture characteristics. Since both cultures developed about equally well in reconstituted milk, the differences presumably arose from response of the cultures to certain characteristics of the pasture and dry feed milks. The generally lower activity of culture B in pasture and dry feed milks at 16 hr. indicates that it was more fastidious than culture A.

Although the mean developed acidity with culture A at 16 hr. in milk from cow groups on pasture was significantly greater statistically than that developed in milk from cow groups on dry feed, the difference is of doubtful practical significance. The slightly higher mean total solids content of the milk from pasture groups may have contributed to the somewhat higher acidity, although analyses of the data showed no significant linear correlation with total solids variations within groups. Also, it has been previously reported (*4*) that the correlation between acid development and total solids is not a close one.

The uniformly greater non-protein nitrogen content of milk from pasture cows might partially account for the slightly greater activity of culture A in this milk. However, Walker reported (*12*) that these fractions were not generally utilized by lactic acid bacteria, although proteose-peptone was stimulatory. In this investigation the average values for proteose-peptone nitrogen fractions were generally the same in milk from cows on pasture as in milk from cows on dry feed. Differences were not correlated with differences in culture activity.

At 24 hr. differences in developed acidity in milk from pasture groups and dry feed groups with either culture A or B would be of little practical significance.

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SANITATION PROBLEMS IN THE NEW PRESSURIZED FOODS[1]

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The amazing acceptance by the consumer of both the pressurized whipped cream container and non-food aerosols is finally leading to the development of many other pressurized foods.

Special public health precautions must be taken, including sanitary design of equipment, temperature controls, aseptic gassing, mechanical valve insertion, and sanitizing of valve and can.

The consumer is convenience-package-minded, but the industry must not neglect to continuously follow basic public health requirements for these new products.

At a recent meeting of manufacturers and suppliers for the pressurized packaging field, a manufacturer of pressurized foods issued the following warning:

" . . . The custom filler *must* provide complete services along with active sales campaigns to demonstrate to merchandising food people the facts and potential of this field. He must have the facilities and personnel to perform and a willingness to cooperate with suppliers and food companies alike, for the problems can easily be too vast for one to handle. He must be prepared to meet high production demands on short notice with positive and unwavering quality control. Costs must likewise be carefully controlled to avoid pricing above the volume market (2)."

It was further pointed out that bacteriological control was important and descriptive tests for the final product were given, but no mention was made of the need for the application of sanitation procedures and the importance of using equipment designed for sanitation.

The sanitarian is familiar with pressurized whipped cream and its phenominal growth to over 80 million cans in 1958. It has been the forerunner in the convenience packages that are steadily becoming an important part of the food industry. The list of products capable of being marketed in the pressurized package continues to grow. Available today are milk and milk products, cream, dairy dressings, horseradish whip, barbecue sauce, catsup, coffee, chocolate and other syrups, tea, toppings, batter, cheeses, sweeteners, butter, and mustard.

This is only a partial list and food technologists are rapidly developing new products. Many of them have one common feature. They are capable of supporting microbiological organisms. This is why the sanitarian must play a vital role in the metamorphosis of pressurized foods. No attempt will be made in this discussion to delve into the technological problems that beset the industry, other than in their relation to public health.

Pressurized foods properly prepared can be a boon to the restaurant sanitation program. Their very nature makes them single service and some day may eliminate the insanitary cream pitcher, the open sugar bowl, the unsightly mustard and catsup container, the open and unrefrigerated bowls of salad dressings, the finger print on a butter patty, and the mold-coated syrup containers.

A short review of the processing problems and techniques will serve to introduce the role the sanitarian must play in this field.

There are a number of reasons, each in itself contributing a small but significant part, why pressurized foods have taken so long to reach the consumer. Some of these are:

1. The slow speeds of the present whipped cream fillers.

2. The reluctance on the part of governmental officials to approve certain of the newer gases for food products.

3. The need for more basic research into formulae and types of food to be pressurized.

[1]Presented at the 46th Annual Meeting of the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, INC., at Glenwood Springs, Colorado, August 26-29, 1959.

4. The absence of proper valves for dispensing foods other than the foamed type.

5. A dearth of sanitary plants for the packaging of pressurized products.

6. The lack of equipment engineered for sanitation.

Although present whipped cream fillers range in speed from 40 to 60 per minute, there are available machines that will fill 200 per minute, and it has been estimated that within the next few years, these speeds will be increased to 300 per minute. The speeds, of course, are a direct function of the type of gas and the method of gassing used.

Where nitrous oxide and carbon dioxide are used, as in the case of whipped cream, it is necessary to agitate the final container after it has been sealed and gassed, in order to fully incorporate the gas into the product. This, of necessity, retards production. Although machines could be manufactured that would fill at high speeds and feed a series of shakers, it is economically unsound, not only from a cost standpoint, but from space limitations to build such equipment. The answer, of course, is to find a gas or gases that could be incorporated into the food product in the same manner and at the same speed that gases are incorporated into non-food products, thus eliminating shaking. It will also be necessary to vary valve design in order to feed the containers in an automatic manner and thus eliminate the languid and insanitary hand-operated procedures now in vogue.

The fillers, the valves, the gases, and the entire assemblies have been developed to increase capacity. What then is the next step in bringing this product to the consumer? Are there gases other than nitrous oxide and carbon dioxide that could be used in the food industry?

It is surprising how many gases are available for this purpose — nitrogen, argon, hydrogen, and certain fluorinated hydrocarbons. The first three gases mentioned are all non-liquefiable at the temperature and pressure ranges commonly used in pressure containers, and vary in solubility. The propellant force is provided mainly by expansion of gas in the head space of the can and, to a limited extent, by expansion of dissolved gas in the product (*1*). With compressed gas propellants, dispensing pressures decrease as the product is used and the head space volume becomes greater. By contrast, the liquefied gas propellants (halocarbons and hydrocarbons) used for most non-food pressurized containers, provide a uniform dispensing pressure for the entire contents of the container. The liquefied gas partially mixes with the product and the gas vapor fills the can head space above the product-propellant mixture. When the container valve is actuated, pressure on the head space forces the mixture up a siphon tube and through the valve opening. As soon as the mixture contacts the atmosphere, the propellant expands and vaporizes, scattering the product into small particles.

The most significant step would be the introduction of a liquefied gas propellant into the food field. Experimentally, food packs with a fluorinated hydrocarbon propellant have been made by a number of larger companies.

Regular fluorinated hydrocarbon propellants are not suitable for use with foods because of their taste. In addition, there is a possibility that a breakdown could occur during storage that would result in the formation of free fluoride ions. A new type of liquefied gas, octafluorocyclobutane (Freon C-318) has been developed for this purpose (*4, 9*).

At the request of the Food and Drug Administration, a long term toxicological study was conducted. The study has been completed and is presently undergoing evaluation by the Food and Drug Administration. Those in charge of the study have reported, "Our experience to date indicates that C-318 should present no problems from a toxicological standpoint."

This gas is practically odorless and tasteless, — a very important factor for that segment of the food industry which is interested in producing bland foods. Furthermore, the experimental products made, using the gas, indicate that it will not likely promote can corrosion or spoil product flavor. With soluble oil base foods, the use of C-318 may be economically feasible. Even where acid and alkaline foods have been used, laboratory tests have shown no deterioration under rigorous storage conditions.

C-318 has still another valuable contribution to make. It can be cold filled. In other words, the product to be pressurized is placed in a container and the fluorinated hydrocarbon then added in the liquid state at approximately -30°F. The container is then capped and sealed. When the contents of the container reach room temperature, the liquefied fluorinated hydrocarbon has become a gas, ready to dispense the product.

Of the presently acceptable compressed gases, nitrous oxide and carbon dioxide have had the widest use, both as foams and as sprays. Both gases are readily soluble in water, fats, and oils. When a product, such as cream, is discharged from the can, the dissolved gas expands into tiny bubbles, releasing in a whipped foam.

Nitrous oxide has a slight sweet taste, which is not detectable in most foods. Carbon dioxide imparts a more acidic taste, which is objectionable in bland foods. This is why certain of the whipped creams

and toppings have used a mixture of these two gases.

One of the most promising versatile compressed gas propellants is nitrogen (8). It is inexpensive, chemically inert, has no taste or odor, and has very little effect on food colors. Since it is relatively insoluble, nitrogen does not change the physical appearance of most foods. It dispenses both thin liquids and thick pastes in their original state when used in combination with special actuator valves. Nitrogen is best for products which are to be delivered in a non-aerated continuous stream with a minimum amount of foaming or bubbles. It will not burn or explode.

When nitrogen was originally discovered in 1772 by Rutherford, it was thought that it did not support life. Present day research, however, has indicated that in the presence of oxygen, nitrogen will not inhibit mold growth (6). The practical elimination of oxygen from pressurized containers is, commercially unfeasible, so that other methods have to be developed for insuring ultimate sanitation rather than by gassing alone.

However, before methods of processing or handling can be described, it is of primary importance that limitations and needs for formulae be understood (5). Experience to date has indicated that it is almost impossible to take an existing formula for a food product and subject it to pressurizing without significant changes. Many of the food products now on the market are of such high viscosity that they could not normally be dispensed through existing valves. With products that have large particles, or are pulpy, it will be necessary to reduce the particle size to a point wherein proper flow through the valve orifices can be achieved.

Another important factor is pH. This can affect not only the final shelf life, but can also be of considerable importance in its effect upon the container liner. Color and flavor must also be given consideration in the formulation of a food product for pressurizing, in order to obtain the desired dispensing characteristics.

On the basis of valves now in existence, a particle size of less than 1 mm. is required to prevent clogging. One manufacturer states that the largest particle size permissible should be no more than 60% of the diameter of the smallest orifice. The presence of large particles will not only cause a change in the pattern of dispensing, but may also result in complete clogging.

The control of viscosity must be given careful consideration. It is viscosity that will limit many existing formulations from being pressurized. However, reformulation can easily correct this deficiency by homogenization or by the use of additives.

High acid, low soluble solids, with a pH under 4.1, are acceptable. Low acid, low soluble solid foods, such as dairy products, with a pH ranging from 4.5 to 7.0, also have been successfully packaged. However, the pH will have to be tailored for the particular product.

Foods can be propelled in four ways — as a foam, a spray, a steady stream, or a drop. In all cases, the valve guides the product and actuates the propellant. The type of valve and actuator used are extremely important. The design of the valve mechanism, the can, and the dip tube, if necessary, will have an important bearing upon the final product.

There are two basic types of valves. Foam valves are best known in the food industry, since they have been used for a number of years for whipped cream. Recent research has indicated that this valve, under certain circumstances, can also be used in a stream delivery. In using this valve, the can must be inverted and the valve dispensed in that position. This, to a certain extent, limits its functions.

The other type has a dip tube extended from that portion of the valve that is inside the container, to the bottom of the can. In this case, products can be dispensed in the upright position and can be used for solid streams, sprays, foams, or drops. It differs further from the foam valve in that its small orifice limits particle size, as well as viscosity.

With the use of certain foods in either type of valve, there may be a tendency for the food to deposit upon the dispensing spout after use. This can build up into a plug which will in turn restrict or completely stop the flow and increase bacterial growth. This again points up the need for proper product formulation together with sufficient shelf life testing and the inclusion of a program of sanitation.

The type of can in use has changed considerably over the last few years. It is available in sizes from fractions of an ounce up to 16 ounces, and is normally coated with a protective material to prevent corrosion. This corrosion is not only due to the food itself, but to the head space and the incorporation of oxygen. There are certain foods, particularly those high in acid, which would deteriorate in a can of this type. For this purpose, an aluminum container has been developed and is now undergoing market tests in several areas. The cost factor is the greatest hindrance in the production of the aluminum can. However, it is possible that increased consumption will tend to reduce the price differential.

Although processing is similar to that used in the canning industry, there are certain inherent differences that must be given attention in order to prevent spoilage and increase shelf life.

Where the final product is to be refrigerated, pre-

cautions similar to those taken in the manufacture of whipped cream, should be observed. The products can be pasteurized at relatively high temperatures through properly sanitized equipment into clean containers. Extreme care must be taken to avoid contamination during the valving or gassing procedure. Furthermore, the equipment used for filling, gassing, and capping, must meet equipment sanitation requirements, similar to those developed for the 3A Standards.

Where pressurized foods are to be stored for long periods of time without refrigeration, precautions must be taken throughout the processing and filling cycles to preclude the entrance of both food spoilage and food poisoning organisms. Normally, canned foods are not processed to obtain absolute sterility, but to destroy those organisms which could prove harmful upon ingestion, and those organisms which could cause spoilage when cans are held unopened under normal storage conditions.

All processing procedures, handling methods, and many of the packaging requirements and product composition specifications have, as their basis, the need for preventing or inhibiting microbiological spoilage.

Since the gases used in pressurized foods have little or no inhibitory effect upon the growth of food spoilage and pathogenic organisms, the same sanitation techniques now practiced in the dairy and food industries for conventional packing of foods, would have to be followed.

Products that are high in acid, or that are high in sugar, should be filled and gassed hot (170°F. to 190°F.) in order to prevent spoilage. It is possible to gas a product with nitrogen at 190°F., producing maximum can pressures of not over 120 pounds without any danger involved.

Low acid foods must either be refrigerated or processed at relatively high temperatures to prevent spoilage. Where dairy products are used, as an example, filling should be done into sterile containers after the product has been properly pasteurized. It is highly important that all necessary precautions be taken to prevent contamination from the point where the products leave the pasteurizer until the final container is gassed and sealed.

One manufacturer has successfully produced a sterile whipped cream product, using an aseptic canning system.

Unrefrigerated low acid foods must also be processed at relatively high temperatures. In the food industry today, ultra high temperature equipment is available that can handle food products at temperatures up to 290°F. Here, the importance of aseptic handling is quite evident, and undoubtedly aseptic filling and canning techniques will be required before such food can be packed commercially.

Where the temperatures of processing are not critical, it is possible to first process the foods into clean containers, gas, and crimp, and then subject the gassed products to retorting at temperatures of about 190°F. The advantage of this method of processing is that "commercial sterility" can be obtained in the final package, although some contamination may occur during the processing cycle.

At one time, it was considered dangerous to process containers that had already been gassed. Twelve-ounce aerosol cans have been charged with nitrogen and processed for 30 minutes at 240°F. without any abnormal conditions arising, either relating to the product itself, or to the container.

Where the filled container is processed either before or after gassing, precautions must be taken that the valve and the dip tube, if used, be made of plastic materials that are capable of withstanding these high temperatures without any change in dimension or strength (3). The only material at present that has been successful for this purpose is nylon, although it is possible that other plastics, such as polypropylene and polystyrene, can be altered to be sufficiently heat-resistant.

Regardless of the method of processing, filling, or gassing that is used, the need for following basic public health requirements must be continuously emphasized:

1. The processing equipment must be of sanitary design.
2. Proper controls must be included to insure that the temperatures required are consistently obtained.
3. The filling equipment cannot be of the type normally used for non-food pressurized packages. All the essentials of a sanitary filler must be included in this equipment.
4. Gassing must be done under aseptic conditions. This includes the storage of the container and the handling of the gas, whether it be in the liquid or vapor state. Contrary to some conceptions, nitrogen will not prevent the growth of microbiological organisms.
5. Valves should be inserted mechanically and should either be received in a sterile condition or sterilized before use.
6. The plant in which the foods are pressure packaged must be of sanitary construction and operated in such a manner as to minimize contamination from any source.

Today, there is a movement on hand for the establishment of so-called "contract packagers" to do this job. These, in general, are manufacturers who have been packaging non-food materials, such as insecti-

cides, hair sprays, paints, and waxes. Their plants are not physically suited to handle food products. Their lack of knowledge of santiary procedures and the importance of quality control could lead to serious food-borne outbreaks. The results might not only be harmful to the consumer, but could also result in a deluge of governmental prohibitions and regulations that would seriously retard the sale of pressurized foods.

The food industry should proceed cautiously in the pressurized food field. There is available inexpensive laboratory equipment which includes all of the necessary components for gassing, crimping, and sealing the containers. This can help many plants to test their own products, determine what changes have to be made in their formulation, and permit them to conduct small market tests before installing complete filling lines. At the same time, the sanitation problems can be investigated and many public health pitfalls eliminated.

It is up to the sanitarian to insure that the food products sold in pressurized containers are safe and that all of the sanitation procedures now required in the food and dairy industry are incorporated into the manufacturing and storage processes. It is shameful to report that sanitarians today are neglecting to apply the principles that have been developed for other foods. The equipment and the know how are available, but as long as enforcement is lacking, the products will continue to be handled, processed, and stored under insanitary methods.

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A STUDY OF WELDED LINES FOR PROCESSING MILK[1]

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A study was made of the sanitary aspects of using welded lines in the processing of milk. The criteria used included visual examination, swab tests, rinse tests and standard plate and coliform counts on the milk at various stages of the processing.

The results indicate that the use of welded lines of the type used in this plant in conjunction with an automatic CIP system is satisfactory for processing Grade A milk.

The cleaning of milk lines in-place (CIP) has rapidly gained popularity due to savings in labor and materials and to the sanitary efficiency of this system. Much research has been conducted on CIP methods. The fact that the Milk Ordinance and Code recommended by the U. S. Public Health Service accepts this method is evidence of its efficiency. Since CIP lines are not disassembled daily, the use of welded connections for permanently installed lines offers possibilities for savings, provided such construction would not impair the sanitary quality of the milk and milk products.

Havinghorst (*1*) presented the results of using welded lines in a milk plant in California. Bacterial counts were reported for the various fluid milk products processed during the last 16 weeks of operation of an old plant with conventional lines and manual CIP system, and for the first 15 weeks of operation after moving into a new plant with permanently welded lines and "push-button" CIP system. The average bacterial counts were lower on all six products processed with the welded lines and automatic CIP system compared to the counts obtained when the manual CIP system and conventional lines were used.

The work herein reported involved a study of the sanitary aspects of using welded lines in a milk plant processing Grade A milk products. A new milk plant was constructed in Oklahoma City and permanently welded milk lines were installed with the permission of the Local and State Health Departments. These agencies together with representatives of the U. S. Public Health Service assisted the plant personnel and the Oklahoma Agricultural Experiment Station in planning the study undertaken[3].

The U. S. Public Service Milk Ordinance and Code, 1953 edition, permits the use of welded sanitary milk lines where crosses or tees are placed at each change of direction to permit inspection. The plant studied in this work varied from that permitted under the Milk Ordinance and Code in that welded elbows were used instead of the crosses or tees. Permission by the regulatory agencies for the use of the welded elbows was granted on the basis of an experimental installation for the purpose of obtaining data on such construction.

General Procedure

The connections in the milk lines were welded by a method of fusion of the metal by heat in the presence of argon gas to prevent oxidation. These welds with slightly raised beads, were free from pits and crevices but, since they were not polished, they were slightly rougher than the adjoining polished interiors of the pipes. To facilitate sampling, four special inspection ports were installed in the lines: one each on the holding tube of the HTST pasteurizer, the skimmilk line to the cheese making room, the cream line, and the pasteurized milk line. These latter two were near the entrance to the holding tanks for the pasteurized products. In addition, a four foot removable section of pipe, the sanitary connection to the cream pump, and tees located at the fronts of two of the raw milk holding tanks provided a total of eight inspection and sampling ports for the study.

The plant employed an automatic CIP system controlled by a Taylor "Flex-O-Timer." The procedure involved a 1-minute rinse with cool water, 20-minute circulation of alkali and a 1-minute final rinse with water. The alkali solution was made up of 6 pounds of a commercially available chlorinated detergent per 100 gallons of water. The alkali solution was cir-

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[2]Present address: Safeway Stores, Inc., Milk Department, Oklahoma City.

[3]The study planning group included: W. N. Dashiel and O. D. Moore, Regional Milk and Food Consultants, U. S. Public Health Service, Dallas, Texas; D. C. Cleveland, Oklahoma City-County Board of Health; Lloyd Pummill, Oklahoma State Department of Health, Oklahoma City; J. O. Hall, Safeway Stores, Inc., Oklahoma City; and Carl Marshall, Statistical Laboratory, Oklahoma State University.

culated at a return temperature of 145°F. and at a velocity of approximately 8.75 feet per second. All lines were sanitized just prior to use by rinsing with a solution containing 200 ppm available chlorine.

At each examination several criteria were used to determine the sanitary condition of the milk lines and the equipment associated with the processing of the milk. At each of the eight inspection ports, visual examinations were made with the use of a flash light. Swab tests then were made, the ports closed and rinse tests were run with chlorine treated water and the Millipore technique (*2*).

For this test approximately 30 gallons of tap water were placed in the surge tank between the pasteurizer and homogenizer and chlorine solution was added to give 20 ppm. This was allowed to react 10 to 20 minutes and then sufficient sterile sodium thiosulfate was added to neutralize the chlorine and a sample was taken for analysis. The water then was pumped through the homogenizer and approximately 50 feet of line to the top of the surface cooler. A 200-ml. sample was taken at this location after most of the rinse water had passed through the lines. The samples taken before and after passage through the milk handling equipment then was filtered through type HA Millipore filter, using 10- and 100-ml. quantities. The media used for developing the colonies were BBL No. 330 M-Endo broth and BBL No. 01-417 M-dextrose tryptone broth for coliforms and total counts, respectively.

Standard plate counts were run on the raw milk and on these same samples after laboratory pasteurization. High-temperature, short-time pasteurization was used in this plant. An exposure of 143°F. for 30 minutes was used for the laboratory pasteurization because of inherent difficulties in control of time and temperature in HTST laboratory pasteurization.

At the beginning of the day's operation, samples were taken at various stages of processing to determine the degree of contamination from the various sources. Standard plate counts and coliform counts were run on these samples. All sampling and plating was done in accordance with the procedures in *Standard Methods for the Examination of Dairy Products* (*3*). Standard plate counts were run on Plate Count Agar (Difco) and the plates were incubated at 92°F. Coliform counts were run on desoxycholate agar (Difco) No. B-273 and the plates were incubated at 95°F. The plating was done by Experiment Station personnel in the well equipped plant laboratory, except for a few trials at the beginning of the study when the samples were iced and transported to the laboratory at Oklahoma State University for plating. Both the University laboratory and the laboratory of the milk plant were checked by a representative of the Oklahoma State Health Department for uniformity of compliance with *Standard Methods for the Examination of Dairy Products*. For certain samples with very low counts which yielded less than 30 colonies per plate a special technique was used. The count was determined on a one ml. sample by placing approximately half the milk in each of two plates and counting the total colonies developing on the plates.

Comparisons of the bacteriological quality of the products from the plant used in the study and those from similar plants in the same locality were made by obtaining the counts run by the Oklahoma City Health Department and the Oklahoma State Health Department. These latter plants employed conventional milk lines and manually operated CIP procedures.

Examinations were made on each day of operation during the first 2 weeks (8 trials), at weekly intervals during the next 3 months (14 trials) and at monthly intervals during the remainder of the study (7 trials) for a total of 29 examinations. The general procedure was to arrive at the plant just before the beginning of the day's operation at 1 to 3 A. M. without prior knowledge of anyone in the plant. Visual examinations, swab tests and rinse tests were run just before the pasteurizer was put in operation. Samples of the raw milk and first pasteurized milk through the lines were taken at different stages of the operation. Additional samples of raw milk as it entered the pasteurizer and of the finished pasteurized milk were taken at hourly intervals. All samples were iced immediately and plated as soon as possible. Normally the entire inspection and sampling required 8 to 10 hours.

Results and Discussion

Visual Examinations

The visual examination of the pipe lines at 8 selected locations revealed no accumulation of milk stone at any time during the 11 months the plant was under observation. After approximately 5 months and again after 8 months of operation, sections of line, including welds, were cut out for close inspection. The welds were free from pits and crevices and there was no accumulation of milk stone. The welds appeared to be slightly raised above the adjoining interior surface of the line and had slightly wavy appearances. The dark color of the metal that was apparent just after welding had been entirely removed by the CIP cleaning.

Swab Tests

Swab tests were run in 28 of the 29 trials. Because of the limited surface area accessible, an area

TABLE 1—SWAB TESTS ON MILK LINES AT EIGHT SELECTED LOCATIONS (28 TRIALS)

Location	No. >100	Counts per 8 sq. in. Maximum	Counts per 8 sq. in. Log. av.
Skim milk line to cheese room	2	19,000	12
Raw milk line, tank No. 4	4	460	18
Raw milk line, tank No. 1	7	200,000	49
Pasteurizer holding tube	4	1,200	8
Connection to cream pump	3	560	7
Pasteurized cream line	2	320	8
Pasteurized milk line	3	100,000	9
Pipe section in cheese room	6	9,300	14

of approximately 8 sq. in. was swabbed at each of the 8 locations selected to give representative sampling points in both the raw and pasteurized milk line systems.

The standard plate counts of the swab tests are shown in Table 1. Coliform counts were also run on desxoychocolate agar but only two samples were positive, each with one colony per plate. The standard plate counts are shown as the number per 8 sq. in. with counts of 100 or less being satisfactory according to "Standard Methods" (3). The results revealed generally low swab counts, with most of them well below the standard of 100 per 8 sq. in. However, it appeared that the lines were not properly sanitized in a few instances. A notable example was the one count of 100,000 (est.) on the swab sample from the pasteurized milk line. Since only two other counts (260 and 270) at this particular location were above 100, it appeared that the extremely high count must have been due to the lack of the usual sanitizing by rinsing with chlorine. The results indicate, in general, that when the prescribed cleaning and sanitizing procedures were used, the welded lines were in satisfactory sanitary condition.

Rinse Tests

The results of the rinse tests, run at the time of the last 8 monthly inspections, are shown in Table 2. It appears that the rinse water used was not sterile in any of the trials as the counts ranged from 11 to 840 per 100 ml. In 4 of the trials there appeared to be an increase in total count incident to passage through the milk line; however, in the remaining 4 trials there appeared to be a decrease which may have been due to residual chlorine in the line from the sanitizing treatment. In two trials there appeared to be significant increases in coliforms, while in the remaining 6 trials no coliforms were found in 100-ml. quantities of the rinse water. The results indicate, in general, that the lines were receiving satisfactory sanitizing treatment prior to use. It should be emphasized that if the counts recorded were reduced to a per ml. basis, the counts on the rinse waters would all be less than 5 per ml.

Line Counts

Samples of milk were taken at various stages of processing to detect the extent of contamination from the equipment with which the milk came in contact. A total of 29 trials (see Table 3) were made but these are reported in two sections of 14 and 15, respectively, because of a change in sampling procedure for the last 15 trials.

The first 14 trials were run from March 29 to May 22, 1958, inclusively. The plant operated four days a week and the first 8 trials were on every day's operation for the first two weeks and the remaining 6 trials were at weekly intervals. The samples were taken at the following locations:

TABLE 2—RINSE COUNTS OF WELDED LINES PRIOR TO USE (MILLIPORE TECHNIQUE)

Date	Number of colonies per 100 ml. of rinse water before and after passage through milk lines					
	Total counts			Coliform counts		
	Before	After	Change	Before	After	Change
July 26, 1958	840	360	−480	0	50	+50
August 27, 1958	11	13	+2	0	0	0
September 29, 1958	20	80	+60	0	0	0
October 27, 1958	120	0	−120	0	0	0
November 29, 1958	31	0	−31	0	0	0
December 22, 1958	660	6	−554	0	0	0
January 12, 1959	70	200	+130	0	0	0
February 26, 1959	420	460	+40	10	92	+82

1. Raw milk from surge tank immediately before pasteurization.
2. Pasteurized milk either from the surge tank between the pasteurizer and the flow metering pump, or from the sanitizing solution drain valve.
3. At the inlet to the surface cooler after passing through the homogenizer and approximately 50 feet of 2-inch milk line.
4. From trough after passing over the surface cooler.
5. From pasteurized milk storage tank taken from a tee at the front of the tank on the milk line to the carton filler.
6. At inlet to filler bowl after passage through approximately 75 feet of 2-inch line.
7. From filler bowl.
8. Fifth carton filled by the ½ gallon Pure-Pak Machine.
9. Half gallon carton taken at random after filling several cases.

After the first 14 trials the sample from the pasteurizer (No. 2) was eliminated because of difficulty in getting a satisfactory sample. Also, the sample from the bottom of the surface cooler (No. 4) was eliminated because the counts were practically the same as those taken as the milk entered the top of the cooler. In place of these samples, collections were made from the outlet of the pasteurized milk storage tank and at the inlet to the filler bowl.

The data show that there appeared to be a slight build-up of contamination during the handling of the pasteurized milk from the pasteurizer to the finished carton and that the contamination was excessive in only a few instances. The average standard plate counts in the first 14 trials show a marked decrease from the pasteurizer to the inlet to the surface cooler. From close examination of the individual counts, it appears that the sampling procedure for the samples taken from the pasteurizer was unsatisfactory as coliforms were detected in 5 of the 14 trials, whereas no coliforms were found in laboratory pasteurized samples of this same milk. It appeared that the drain valve and pipe from which the samples were taken were not exposed to the sanitizing solution long enough during the drainage of this solution from the system. Another factor partially responsible for the lower counts on the milk samples taken at the entrance to the surface cooler was the dilution with residual sanitizing solution in the line. This was verified by running total solids on several of these samples. They were invariably low — about 5 to 6 percent.

Table 3—Raw Milk Counts and Line Counts on Pasteurized Milk

Milk Sample	Standard plate counts			Coliform counts	
	Log. av.	Maximum	No. >2,000	No. positive	No. >10
	First 14 Trials — March 29 - May 22, 1958				
Raw	485,700	18,000,000	14	—	—
From pasteurizer	1,680	5,900	5	5	4
Inlet to surface cooler	440	3,300	2	0	0
Outlet from surface cooler	510	3,200	1	0	0
Carton filler bowl	1,280	4,900	3	1	1
Fifth carton	1,560	8,400	3	8	1
Random carton	1,980	13,000	5	3	0
	Last 15 Trials — May 29, 1958 - February 26, 1959				
Raw	110,000	500,000	15	—	—
Inlet to surface cooler	1,040	7,700	3	2	3
Outlet from storage tank	1,590	32,000	5	4	3
Inlet to carton filler	1,340	12,000	5	0	0
Carton filler bowl	1,880	12,000	5	1	0
Fifth carton	1,440	8,900	6	2	0
Random carton	1,340	7,500	6	2	1

The results in the first 14 trials indicate some contamination from the carton filler machine as shown by the increase in total counts and incidence of positive coliform tests after passage through the filling machine. It may also be noted that the average total count on the random carton was 1,980 compared to 1,560 for the fifth carton. However, there was only three samples with positive coliforms on the random cartons compared to eight for the fifth carton.

The results obtained in the last 15 trials were, in general, better than those in the first 14 trials. The counts on the raw milk supply were much improved and the average count on the pasteurized milk was significantly lower. Although there were fewer pasteurized milk counts below 2,000, there were fewer instances of samples with coliforms. The somewhat erratic results obtained during the first few months of operation were probably the result of inexperience on the part of the personnel. This was a new plant with all new personnel, many of whom were untrained or had limited experience in modern dairy plant operations. The very satisfactory results obtained during the latter part of the study are a credit to personnel in adjusting themselves to the operations in this plant.

In the last 15 trials, the average count on the milk leaving the storage tank was 1,590 and after passage through approximately 75 feet of milk line to the filler bowl it was 1,340. This would indicate that there was no contamination from the milk line. The higher plate counts of the milk at the storage tank may have been due to some contamination in the valve and from the tee from which the sample was taken.

The overall picture in the 29 trials indicates generally satisfactory results as the average count on the random cartons was only 1,620 and there were only 5 of these samples positive to coliforms with only one having more than 10. The majority of the counts at each of the stages in the handling of the milk were less than 2,000. Using the number of counts over 2,000 as a criterion, it appeared that the carton filler was the greatest source of contamination.

Counts on Plant vs. Laboratory Pasteurization

In 25 of the 29 trials, samples of the raw milk were pasteurized in the laboratory at 143°F. for 30 minutes. The HTST method of pasteurization was used in the plant but was not used in the laboratory because of difficulties in controlling time and temperature for this method. Standard plate counts and coliform counts were run on the laboratory pasteurized samples. While an accurate comparison of these counts with those obtained on the finished milk in the random cartons cannot be made because of the differences in pasteurization exposures used, nevertheless, they agreed fairly well. In the 25 trials run, the logarithmic average count on the laboratory pasteurized samples was 1,460 and in the same 25 trials the average count on the milk in the random cartons was 1,720. Assuming that approximately the same percentage of kill was obtained with the two methods, the results indicate a slight build-up of contamination between the pasteurizer and the finished carton. The fact that no coliforms were detected in any of the samples which were laboratory pasteurized, while they were found in 5 of the 25 samples from the random cartons, indicates that there was some contamination.

Standard Methods (3) states (p. 50): "When Standard Plate Counts of samples of milk collected in sterile containers at bottle filler before bottling begins exceed that of samples removed directly from pasteurizing vats by 100 percent plus 2,000, sanitization of equipment is usually considered unsatisfactory." Using this as a criterion, there were 3 trials out of the 25 in which the equipment was unsatisfactory. An examination of the detailed data indicated that in two of these instances the contamination was primarily from the carton filling machine and in the other trial it was primarily from the pasteurized milk storage tank.

Counts on Random Cartons

Random half-gallon cartons were taken for the line tests and additional samples were taken at hourly intervals while the research workers were in the plant. Standard plate counts and coliform counts were run on 89 samples. A summary of the counts is presented in Table 4. The results show that the majority of the Standard Plate Counts (65) were 3,000 or less and there were only 2 counts over 9,000. The maximum count was 13,000, and the logarithmic average was 1,730. Coliform counts were run on 84 of the 89

TABLE 4—FREQUENCY DISTRIBUTION OF COUNTS ON RANDOM CARTONS OF PASTEURIZED MILK

Standard plate counts		Coliform counts	
Range	No.	Range	No.
<1000	27	<1	70
1000 to 3000	38	1-10	12
3000 to 5000	8	>10	2
5000 to 7000	5	Maximum count	16
7000 to 9000	9		
>9000	2		
Log. av.	1,730		
Maximum Count	13,000		

samples. A majority of these (70) were negative in 1 ml., 12 had from 1 to 10, only 2 had more than 10, and the maximum count was 16. These results indicated generally good sanitary conditions in the plant.

Hourly Samples Examined by Plant Laboratory

Laboratory personnel of the plant under study ran standard plate counts and coliform counts on random cartons of milk taken at hourly intervals during each day's operation. A total of 1,879 samples were taken during approximately 13 months of operation. The results are summarized in Table 5. Since the counts were predominately low and since the milk plant calculated the daily arithmetical average, the averages given are arithmetical rather than logarithmic. The general results indicate good sanitary conditions in the plant as the majority of the counts were very low. The average standard plate count for the 1,879 samples was 1,560, slightly below the average of 1,730 obtained on 89 samples taken by the research workers from the University. The maximum daily average count was 7,340. It may be observed that highest maximum counts and highest daily averages occurred during the months of May through October and that the lowest counts occurred during the months of January and February 1959 with averages of 390 and 320, respectively, on 160 samples each month.

The coliform counts were generally satisfactory as only 109 of the 1,879 samples were positive and only 7 of these had more than 10 per ml., with most of these occurring during the warm months. During February and March, 1959, a total of 316 samples were run and all were negative to coliforms.

Comparison with Milk from Similar Plants

As a further check on the sanitary quality of the milk from the plant with welded lines, counts on milk from other plants operating in the vicinity of Oklahoma City were obtained from the Oklahoma City Health Department and the Oklahoma State Health Department. Personnel from these two agencies selected the plants as being approximately equal in size and method of operation. These plants all distribute milk to several cities in the central part of Oklahoma. Samples of retail packages were taken in 12 cities and the counts were run in the Oklahoma State Health Department Central Laboratory or one of the State

Table 5—Summary of Hourly Counts of Random Cartons of Pasteurized Milk

Month 1958	No.	Standard plate counts			Coliform counts		
		Arith. av.	Max. count	Max. daily av.	No. positive	No. >10	Max. count
March	16	1,170	4,100	1,870	7	2	60
April	99	800	4,100	1,670	6	0	4
May	90	2,980	7,800	5,350	1	0	1
June	132	2,590	20,000	5,240	8	0	10
July	141	1,190	6,700	4,780	25	0	10
August	150	2,640	8,400	7,340	18	2	12
September	174	4,070	17,000	6,220	17	2	30
October	174	1,900	9,600	5,340	8	1	12
November	159	1,380	6,100	4,560	9	0	5
December	170	730	2,400	1,530	6	0	2
1959							
January	160	390	2,400	1,060	2	0	1
February	160	320	2,300	780	0	0	<1
March	156	510	2,270	1,290	0	0	<1
April	98	890	2,500	1,370	2	0	4
Total	1,879		20,000	7,340	109	7	60
Average		1,560					

TABLE 6—LOGARITHMIC AVERAGES OF COUNTS OF MILK DELIVERED IN VARIOUS CITIES

City	Plant: A		B		C		D		Plant under study	
	No. Samples	Av. Count	No. Samples	Av. Count	No. Samples	Av. Count	No. Samples	Av. Count	No. Samples	Av. Count
Ada	9	2,600	11	1,900	—	—	9	1,500	11	1,900
Anadarko	6	4,200	9	3,600	4	36,000	—	—	8	3,700
Chickasha	12	4,000	12	3,600	12	4,000	9	5,100	11	3,200
Clinton	11	2,000	—	—	11	2,400	10	2,500	12	1,700
Duncan	—	—	4	4,300	10	3,600	8	3,500	10	6,100
El Reno	12	2,500	12	1,800	11	2,600	12	1,700	12	3,100
Guthrie	—	—	12	2,700	—	—	12	2,100	12	2,100
Norman	15	2,000	20	2,300	12	2,500	11	1,700	9	1,600
Oklahoma City	12	2,100	11	2,900	11	2,800	11	2,100	13	1,800
Pauls Valley	18	2,900	16	1,500	10	8,100	2	2,000	11	1,500
Purcell	6	2,400	6	3,200	4	2,900	3	1,300	—	—
Shawnee	—	—	9	1,700	9	3,300	10	2,200	8	1,600
Weatherford	10	5,900	—	—	8	2,400	—	—	—	—
Total	111		122		102		97		117	
Av. all counts		2,800		2,400		3,600		2,200		2,300
No. counts 3000 or less	71		85		56		76		84	
% counts 3000 or less		64%		70%		55%		78%		72%

Health Department Branch Laboratories. The reports on the counts were compiled by the Oklahoma State Health Department for the cities other than Oklahoma City. The samples taken in the latter city were analyzed and the results compiled by the Oklahoma City Director of Sanitation.

A total of from 97 to 122 counts were obtained on each of the four plants and the results compared with those from 117 counts on milk from the plant under study. These results are summarized in Table 6. The results show that the counts on the milk from the plant compared very favorably with the counts on milk from similar plants located in or near Oklahoma City. The logarithmic averages of all the samples analyzed ranged from 2,200 for Plant D to 3,600 for Plant C, with the plant under study having the next to lowest average of 2,300.

Since the majority of the counts for each plant was 3,000 or lower and since some of the laboratories reported very low counts as less than 3,000, the numbers and percentages of the counts of 3,000 or less were calculated. The counts of 3,000 or less ranged from 55% for Plant C to 78% for Plant D with the plant under study having the next to highest with 72%. The ranking on the basis of percentage of counts of 3,000 or less agreed with the ranking on the basis of average counts. The general results indicate that the welded construction used in the plant under study did not impair the sanitary quality of the milk.

Summary and Conclusions

A study was made of the sanitary aspects of the use of welded milk lines in a milk plant processing Grade A milk and milk products. This plant used an automatic CIP system for cleaning. The research was conducted over a period of approximately one year and included 29 inspections and examinations of the plant. The sanitary condition of the lines was evaluated by visual inspection, swab tests, rinse tests and line tests on the pasteurized milk during passage through the equipment.

The sanitary quality of the finished product was evaluated by standard plate counts and coliform counts of random samples at each inspection and on hourly samples run by the plant personnel during each day's operation. Further evaluation was

obtained by comparing the counts on the milk from the plant under observation with those from similar plants operating in the same area.

The results indicate that there was no excessive contamination or build-up of milk stone in the welded lines used in conjunction with an automatic CIP system. The bacterial counts of the milk in the plant and of samples delivered to several cities indicated that the milk was of satisfactory sanitary quality. The counts of the milk from the plant under observation compared very favorably with those of milk from similar plants operating in the same area. When welds are made in accordance with the procedure used in this milk plant, it may be concluded that welded milk lines used in conjunction with an automatic CIP system are satisfactory for the processing of Grade A Milk.

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NEWS AND EVENTS

QUESTIONS AND ANSWERS

Note: Questions of technical nature may be submitted to the Editorial Office of the Journal. A question in your mind may be in the minds of many others. Send in your questions and we will attempt to answer them.

QUESTION:

When doing a routine plate count for coliforms in milk, I find colonies in Violet Red Bile Agar which are pin point in size and are too numerous to count. They are purplish red in color, but lack the surrounded reddish zone of precipitated bile salts characteristics of the coliform group. Can you help me classify this type of bacterium?

ANSWER:

Quite likely the small purplish red colonies appearing in large numbers on Violet Red Bile Agar are true coliform organisms which have failed to reach the normal size because of over-crowding. When such colonies are encountered it is well to fish one or two into Brilliant Green Bile Broth to make sure they are lactose fermentors. It is also possible that the pin point colonies are actually precipitated dye particles. This may occur if the medium is not mixed properly before the plates are poured. However, if the colonies in question are really true colonies they could be lactobacilli or yeasts.

"Standard Methods," page 147, states "Presence of dark red colonies at least 0.5 mm in diameter constitutes a positive presumptive test." To determine whether you have overcrowding make higher dilutions. Also, transfer some colonies to Lactose Broth. If gas is produced, confirm the coliforms by use of suitable media.

QUESTION:

Why should a dairyman use a strip cup or preferably a strip plate?

ANSWER:

There are three main reasons: (*a*) to make sure the teat and udder is examined for cleanliness, cuts, bruises, warts, cowpox and fungus growths prior to the attachment of the milking machine; (*b*) to eliminate the fore streams of milk which are normally heavily contaminated with bacteria; and (*c*) to examine the first few streams of the milk for any abnormal physical appearance. The strip plate should be used under good lighting conditions otherwise abnormalities of milk may be missed.

QUESTION:

Do washing powders and sanitizing compounds constitute a potential hazard in milk?

ANSWER:

Yes, they do. In practical use washing materials are not always thoroughly and properly rinsed off dairy utensils prior to use. Hence they may adulterate milk. If sanitizing agents are not used according to manufacturers directions, this easily may occur.

QUESTION:

What volume of water is used to in-place-clean farm bulk milk cooling tanks?

ANSWER:

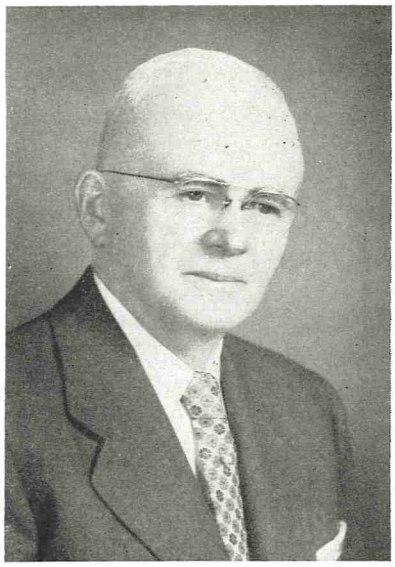
This question is difficult to answer properly because little research work on this specific question has been published. In general, the amount of water used for tank size ranges from 200 to 600 gallons will be from 7 to 20 gallons per cycle. Thus, 20 and 60 gallons may be needed for a 3 cycling operation. In addition some water is necessary for fogging or spraying the tank with a sanitizing agent.

ANNUAL MEETING PLANS PROGRESS

"The 1960 meeting of the International Association of Milk and Food Sanitarians is scheduled to be held at the world-famous Morrison Hotel, Chicago, Illinois, on October 26-28, 1960. The Morrison Hotel is situated in the center of the Loop, in the center of things, in the center of life, in the center of the United States—the one and only Chicago, Illinois. The meeting this year will be held immediately preceding the

International Dairy Exposition. The management of the Morrison Hotel has guaranteed the assignment of requested rooms at the rate requested on the advance hotel reservation card which you will receive in a forthcoming copy of the Journal. The Ladies' Activity Committee is arranging for a style show at Marshall Fields and Company as well as attendance at Don McNeill's famous Breakfast Club radio show. Plan your vacation to include the last week end in October at the Morrison Hotel in Chicago."

ARCHIE H. ROBERTSON RETIRES FROM NEW YORK STATE POST



Dr. Archie H. Robertson, formerly Director of the Food Laboratory, New York State Department of Agriculture and Markets.

Dr. Archie H. Robertson retired recently from his position as Director of the State Food Laboratory, New York State Department of Agriculture and Markets. Dr. Robertson took both his undergraduate and graduate work at Cornell University where he was awarded his doctorate in 1927.

He gained world wide recognition for his achievements as an agricultural scientist and for a number of years served as chairman of the Standard Methods Committee of the American Public Health Association. He edited the ninth and tenth editions of, *Standard Methods for the Examination of Dairy Products.*

During his career he served successively as city bacteriologist for Geneva, N. Y., five years as bacteriologist with the Agricultural Experiment Station at Geneva and nearly three years with the Vermont Agricultural Experiment Station at Burlington. In 1928 he was appointed as bacteriologist with the N. Y. State Department of Agriculture and Markets. In 1930 he was appointed Director of the State Food Laboratory.

Early in his career as Food Laboratory Director, Dr. Robertson inaugurated the licensing of persons who were conducting bacterial counts along with the inspection of laboratories in which this work was done. In addition, he devoted his many years of public service to the development and use of chemical tests for the determination of adulteration of food.

In 1958-1959 he served as president of the Association of Official Agricultural Chemists. In 1956 when the processing and care of frozen foods came to the attention of the Association of Food and Drug Officials of the U. S., with the intent of establishing a national code for sanitary practices, Dr. Robertson became a vigorous and active member of the Association's Committee and contributed much toward code development.

One most interesting sidelight of his career, was his early contact with the movement which started in the late 1890's for the production of what later became, *Certified Milk.* For about ten years following 1913, the first premium priced low bacterial count milk was shipped from his farm, along with ten others in the near vicinity, to the Oranges, in New Jersey. The milk was under contract to Stephen Francisco, a dairyman who was a pioneer in the production of sanitary milk. On several occasions, William B. (Bill) Palmer, who was for many years Secretary-Treasurer of IAMFS and business manager of the Journal, called at Dr. Robertson's farm to make inspections. Dr. Robertson says that Bill's visits were always constructive and helpful.

Dr. Robertson has been a member of IAMFS for a number of years and is well known to many of our members. After a most productive and busy career, this Association wishes him many happy and profitable years in his retirement.

ANNOUNCE NINTH SOUTHERN MUNICIPAL AND INDUSTRIAL WASTE CONFERENCE

The Ninth Southern Municipal and Industrial Waste Conference, will be held on April 7th and 8th, at North Carolina State College, Raleigh, North Carolina.

These conferences have been organized jointly by Duke University, the University of North Carolina and North Carolina State College for the purpose of bringing together engineers, public health officials, representatives of industries, municipalities and other governmental agencies who collectively and separately strive for "Clean Waters in the Southern Economy."

The program for this conference will feature papers directed at encouraging large and small industries and municipalities to work independently and collectively toward the solution of their waste problems.

Dr. Clair N. Sawyer, Director of Research for Metcalf and Eddy, will keynote the conference with the topic "Stop, Look and Listen." Dr. Mark Hollis, Assistant Surgeon General, will deliver the banquet address.

The several sessions will explore individual and joint efforts to solve textile, paper, food processing, metals, and municipal wastes by techniques ranging from the simplest to the most complex. Methods of reducing waste and conserving water on an in-plant basis will be discussed.

A registration fee of $15 will include two luncheons, the banquet and a copy of the proceedings.

Further information and a copy of the final program may be obtained by addressing Charles Smallwood, Chairman, North Carolina State College of Agriculture and Engineering, Raleigh, N. C.

SCHOOL LUNCH MARKET IS LOCAL BIG BUSINESS

Schools have become "big business" for the food industry, and most of it is local, according to a new marketing research report by the U. S. Department of Agriculture. Public schools alone provide a total annual outlet for about $600 million in food for daily lunches, most of which is purchased from local processors, distributors and wholesalers.

Agricultural Marketing Service researchers made a detailed, nationwide study of foods used during the 1957-58 school year. They found the value of food from all sources, both purchased and donated, delivered to 60,000 public schools having a feeding service amounted to $597 million, or $28 per pupil for the 21 million enrollment. Only 15 percent — about $95 million — was the value of food donated directly by the Federal Government from purchases made specially for school lunches or from commodities acquired under price support and surplus removal programs.

In addition to volume and value of foods delivered to schools, the marketing researchers examined sources of supply, food buying practices, and other pertinent facts. At least 95 percent of total purchases of the major food classes were made at the wholesale level.

Already an important segment of the away-from-home eating market, school food services are continuing to expand with the construction of new schools and increased enrollments, the report notes.

CRUZ VOTED OUTSTANDING SANITARIAN

Edward C. Cruz of Trinidad, Colorado

Edward O. Cruz, Sanitarian with the Huerfano-Las Animas District Health Department, Trinidad, Colorado was voted the outstanding sanitarian of the year 1959 by the Rocky Mountain Association of Milk and Food Sanitarians. Cruz, a former language teacher in high schools has been with the District Department of Health since 1952. He is a graduate of the Colorado State Teachers College. The Rocky Mountain Association chose Cruz because of his well executed program in environmental sanitation and the progress he has made in effecting improvements since he became a district sanitarian. The recipient of the honor is fond of tennis and swimming. In addition to his honor, he was also elected auditor and editor of the Association's Newsletter. Congratulations to Ed Cruz.

COURSE IN RADIONUCLIDES TO BE HELD

Designed for professional personnel having responsibilities for surveillance of radioactive materials in milk and food, a course "Radionuclides in Foods" will be presented April 18-29 at Robert A. Taft Sanitary Engineering Center, PHS, Cincinnati.

A cooperative achievement of the Radiological Health and Milk and Food Training units of the SEC Training Program, the new course first was presented last September, eliciting so much interest that the 200-copy first edition of the course manual was exhausted before November 1.

Purposes of the course are to provide technical training in methods for sampling and assay of radioactive contaminants, to discuss procedures for the interpretation of data obtained, and to provide an opportunity for discussion of the problems in this environmental area.

Sessions on radiation fundamentals and instrumentation provide foundation for subsequent discussion of sources of radionuclides in foods, aquatic and terrestrial food chains, milk and dairy product surveillance, sampling procedures, radiochemical procedures, maximum permissible concentrations, and public health significance of radionuclides in foods.

Approximately 40% of the course will be devoted to laboratory work. Because of the specialized equipment and facilities required, the number of trainees who can be accommodated will be limited.

Applications should be addressed to the Chief, Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio, or to a PHS Regional Office Director.

GEORGIA SANITARIANS PLAN MERGER

The Georgia Society of Sanitarians, at their Executive Board meeting held in Atlanta early in February received a report from the President of the Georgia Chapter, National Association of Sanitarians indicating that it was in the best interests of all Sanitarians in Georgia to have one effective organization of sanitarians. Mr. Richard Clapp, President of the Georgia Chapter, NAS stated that the officers of his group believed that it was best to merge with the Georgia Society of Sanitarians and that action should be taken to effect such a merger. Mr. Clapp agreed to poll the members of his Chapter and inform the Georgia Society of the final decision.

Frank Golden, President of the Georgia Society of Sanitarians, speaking for that Society's Executive Board, stated that he believed this to be a progressive merger and that the joining together of the memberships of both Associations would result in a single, effective sanitarian association in the State.

At the same meeting a suggestion was made that the Georgia Society of Sanitarians be renamed to become The Georgia Society of Professional Sanitarians, but this was tabled for the present and until further study could be made.

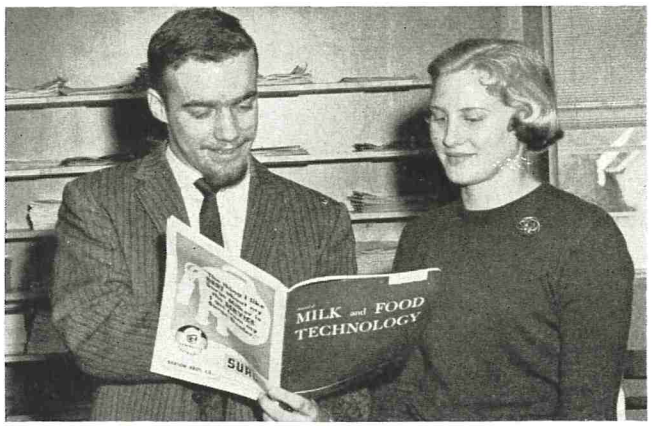
Following the above meeting W. V. Hickey, President of International Association of Milk and Food Sanitarians together with John J. Sheuring, President-Elect and H. L. Thomasson, Executive Secretary con-

ducted a discussion session with representatives of surrounding state affiliates. The discussion dealt with affiliate relations with each other and with International Association. Ways and means to improve coverage of the Journal to include material on general sanitation to meet the growing demand of an increasing number of members in this specific work was thoroughly covered.

Representing South Carolina was James H. Fowler and Eugene Kibler, both from Columbia. Representing Tennessee was E. H. Abernathy, Secretary-Treasurer, Tennessee Association of Sanitarians, Harry K. Elmore of Bristol and John P. Montgomery of Athens.

ILLINOIS TO HOLD DAIRY TECHNOLOGY CONFERENCE

A two day conference will be held at Urbana April 12 and 13. The conference will open at 1:00 P. M., April 12 and close with a luncheon the next day. Sponsored by the Department of Food Technology and Division of University Extension, emphasis will be placed on food additive laws and regulations including antibiotics and insecticides. On Tuesday evening there will be sessions on product judging. Other sessions will consider problems in the areas of procurement, processing and management. Further information may be obtained by writing Reid T. Milner, Head, Department of Food Technology.



Alexander Hart, Bethlehem, Conn., and Joyce Kinney, Hebron, Conn., students at the University of Connecticut are the recipients of scholarships granted by the Connecticut Association of Dairy and Food Sanitarians.

LETTERS TO EDITOR

Dear Mr. Thomasson:

During the recent Methods and practices for State Milk Laboratory Survey Officers Course at the Robert A. Taft Sanitary Engineering Center in Cincinnati the detection of antibiotics in milk was discussed. We commented on the work being conducted in the Food and Drug Laboratory, Ohio Department of Agriculture. Dr. Olson was present at this meeting, and he encouraged us to submit our modifications to you as a "Letter to the Editor." They are as follows:

The "Disc Assay Method" for detecting Penicillin and other inhibitory substances in milk is conducted as follows:

Difco Whey Agar[1], or its equivalent, is reconstituted or synthesized and dispensed in 100-ml lots in rubber-lined screw cap, heat resistant bottles, autoclaved, and stored at 40°F until required.

When an assay is to be made, the medium is melted and tempered to 50°C at which time a suspension of *Bacillus subtilis* spores, ATCC 6633, prepared in ampules by Difco, is introduced into the media. One ampule is used per 100 ml of agar. (The equivalent of this spore suspension may be prepared by growing the organism under rigid conditions, harvesting the growth, heat shocking, and dispensing for storage. The commercial preparation, however, has always proven satisfactory in our laboratory).

The spores are now uniformly distributed by inverting the agar bottle ten times. Care should be taken to avoid the introduction of air bubbles. The media-spore suspension is then poured uniformly into a 9 x 15 inch rectangular Pyrex baking dish. The media is now allowed to become firm; care being taken to insure that the baking dish is level.

Bacto-Concentration Pencillin standard discs are now placed along the top of the dish with forceps. Equivalent standards could be used, but it is strongly advised to use commercial prepared standard discs. We use all seven commercial Penicillin standard discs on each dish; however, for routine control work, the two lower Penicillin standard discs, 0.05 unit and 0.1 unit, should be sufficient. All discs should be placed at least one inch from the outer margin of the agar layer. Penicillin standard discs are placed one and one half inches apart.

The milks[2] are tested by dipping one fourth (¼) inch disc in the well mixed milk and blotting the excess onto a clean towel. The blotted milk discs are then placed on the agar approximately one half inch apart. Dishes have been prepared with the milk discs only one fourth inch apart. The milk discs are tapped gently onto the agar to insure uniform contact. After each sample, the forceps should be dipped into alcohol and flamed. Approximately 300 discs can be placed upon one Pyrex baking dish.

For *raw* milk samples, it is necessary to heat the samples to a temperature of 180°F and hold that temperature for 5 minutes. Raw milk samples are obtained from the field in 16 x 125 mm screw capped tubes, filled two-thirds full with milk. These are held in racks, 72 tubes each. The heat treatment is accomplished by autoclaving while both outlet and inlet steam valves are open, and adjusting the autoclave temperature to 180°F. Several racks of raw milk can be heated at one time. The heated milk samples are then cooled rapidly in a water bath, to room temperature.

This heat treatment tends to eliminate, by heat destruction or by killing, multiple confused results which may be due in part to possible residual chloramines from the chlorine sanitizing of bulk tanks; pyocyanase and pyocyanogen from *Pseudomonas*, a common and abundant organism in bulk tanks; native milk lysozozyme or lysozyme type substances; or in situ (in disc) acid production by lactose fermentors. However, this mild heat treatment does not affect the penicillin potency seriously enough to invalidate the test.

The Pyrex dish is now covered with aluminum foil or a glass plate and incubated at 35°C for five hours. Occasionally, when time is pressing, (nearly all the time) the Pyrex dishes are incubated overnight at room temperature. The plate is read at the end of the period by comparing, visually, the clear zones of no-growth of the samples with the inhibition zones of no-growth around the standard Penicillin disc.

Any positive samples are reported as having "inhibitory substances equivalent to "X" units of Penicillin per milliliter of sample." Those which are found to contain inhibitory substances are saved and frozen, then retested the following week for Penicillin by placing a Bacto-Penase disc, approximately 1/16 of an inch from the sample disc containing the inhibitory milk. If Penicillin is present, a flattening of the zone around the milk sample is obtained, resembling a "flat tire." If the inhibitory substance is not Penicillin, a normal inhibition zone will appear around the milk sample disc.

During the past year we have found 0.6 per cent of the raw milk samples and 1.7 per cent of the pasteurized milk samples to contain inhibitory substances. Approximately 90 per cent of these were found to be Penicillin. (5200 raw milk samples and 1200 pasteurized milk samples were analyzed for inhibitory substances).

Very sincerely yours,
Raymond H. Blackmore, Ph.D.
Food and Drug Laboratory
Division of Food and Dairies
Ohio Department of Agriculture
Reynoldsburg, Ohio

Dear Dr. Olson:

Thank you for publishing the article "What is wrong with official regulation of food Sanitation" which appeared in the December 1959 issue. It should serve as a stimulus to heads of official agencies to employ and retain qualified sanitarians at adequate salaries.

We should thank the author for the very few compliments he bestowed on the public sanitarian. However we should remind Mr. J. Lloyd Barron that his job is to benefit his company alone, but our efforts are directed to benefitting the public.

Sincerely yours,
Edward Burton,
Public Health Sanitarian
Rome, New York

REVISED 3-A STANDARD FOR FARM TANKS GETS COMMITTEES' APPROVAL

The revised 3-A Sanitary Standards for Farm Milk Cooling and/or Holding Tanks was officially approved by representatives of all participants in the 3-A Sanitary Standards Committees, at their regular semi-annual meeting March 1 in Athens, Ga.

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[1]Personnel at the Robert A. Taft Center recommended that Penassay Seed Agar, dehydrated, (Antibiotic medium No. 1, Bacto 0263) be used in preference to Difco Whey Agar.

[2]Milk samples (pasteurized) are received during the first three days of the week. While the milks are being plated out for bacteriological examination, a 10 ml aliquot of the thoroughly mixed sample is transferred to milk sample tubes (16 x 125 mm), capped and held at refrigerated temperature until the disc assay is made on Thursday.

The revision will become effective on September 1, 1960. After this time, manufacturers of tanks may apply to the 3-A Symbol Council for authorization to use the 3-A Symbol on tanks complying with the new standard. The revised standard will be published in the June 1960 issue of the Journal of Milk and Food Technology.

3-A Sanitary Standards are developed in tri-partite conferences among sanitarians and public health officials, dairy equipment and supply manufacturers, and dairy processors. The program is entirely voluntary, but once a 3-A Sanitary Standard has been developed, its provisions are generally accepted in health and sanitary jurisdictions, without further modifications, in nearly every part of the United States and Canada.

Further information on 3-A Sanitary Standards may be had from the headquarters of any national dairy processor organization, or from the International Association of Milk and Food Sanitarians, or from Dairy Industries Supply Association.

METER DEVELOPED FOR READING SEDIMENT TESTS

A meter for reading sediment tests taken from farm tanks has been developed by Dairy Technology Inc. in cooperation with Oregon State College and the Oregon Milk Sanitarians.

The meter is a valuable aid in detecting poor milking practices and loafing conditions. The meter reads extraneous matter in solution consistantly and accurately. It was found that authorities could only agree with each other no better than 63 per cent of the time, which is not satisfactory for enforcement work.

A definite standard is retained by the college which establishes unacceptable limits for extraneous matter in solution.

The developing company loans sampling equipment with instructions and upon receiving pads reads them and returns a reference reading.

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SINGLE MANHOLE TRANSPORT TANKS MAY BE SEVEN FEET LONGER DUE TO AMENDED 3-A SANITARY STANDARD

Effective on July 5, 1960, automotive milk transportation tanks with single manholes may be seven feet longer than at present, and still comply with 3-A Sanitary Standards.

That's the effect of an amendment to the 3-A Sanitary Standards for Stainless Steel Automotive Milk Transportation Tanks for Bulk Delivery and/or Farm Pick-up Service, approved March 2 at the regular semi-annual meeting of the 3-A Committees, held in Athens, Ga.

Under present 3-A Standards, either end of a transportation tank shall not be more than 15 feet from a manhole opening; under the amended version, the ends shall not be more than 18′6″ from the manhole. The amendment, considered by the 3-A groups to be thoroughly justified because of improved cleaning methods in the industry and by state highway legislation which provides for longer trailers, will permit larger over-the-road tank capacities for single manhole tanks.

The amended 3-A Standard will be published in the April 1960 issue of The Journal of Milk and Food Technology, and manufacturers may apply to the 3-A Symbol Council in July for authorization to place the 3-A Symbol on tanks complying with the amended length.

3-A Sanitary Standards are recommended by committees representing sanitarians and public health officers, equipment makers, and dairy processors. In general, equipment bearing the 3-A Symbol is acceptable in nearly all health jurisdictions in the United States and Canada.

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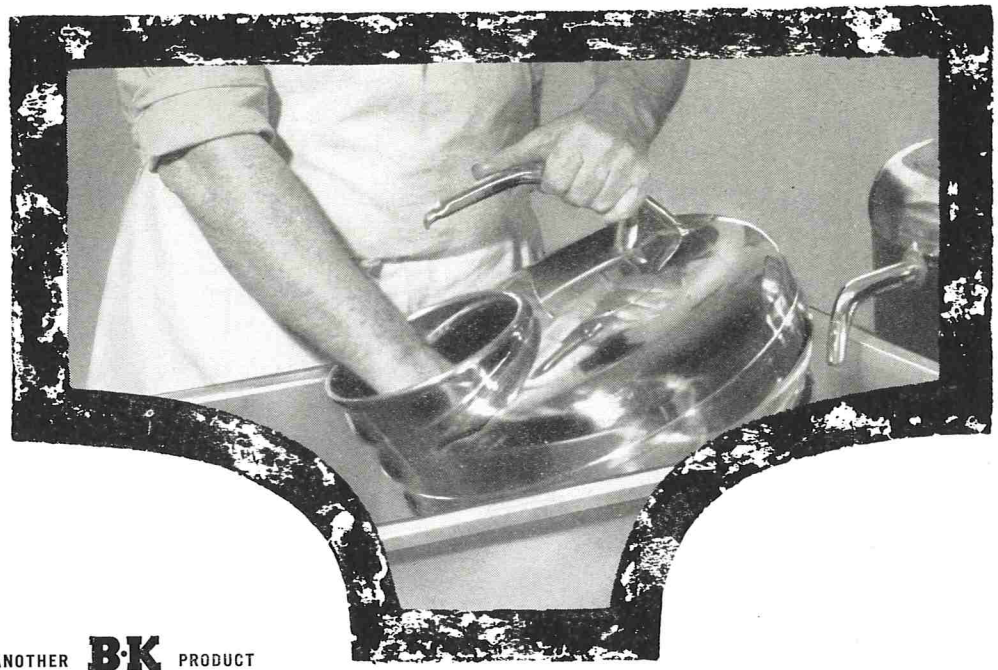

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4	Very slight	No
5	Yes	No
6	Yes	No
7	Yes	No
8	Yes	No
9	Yes	No

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