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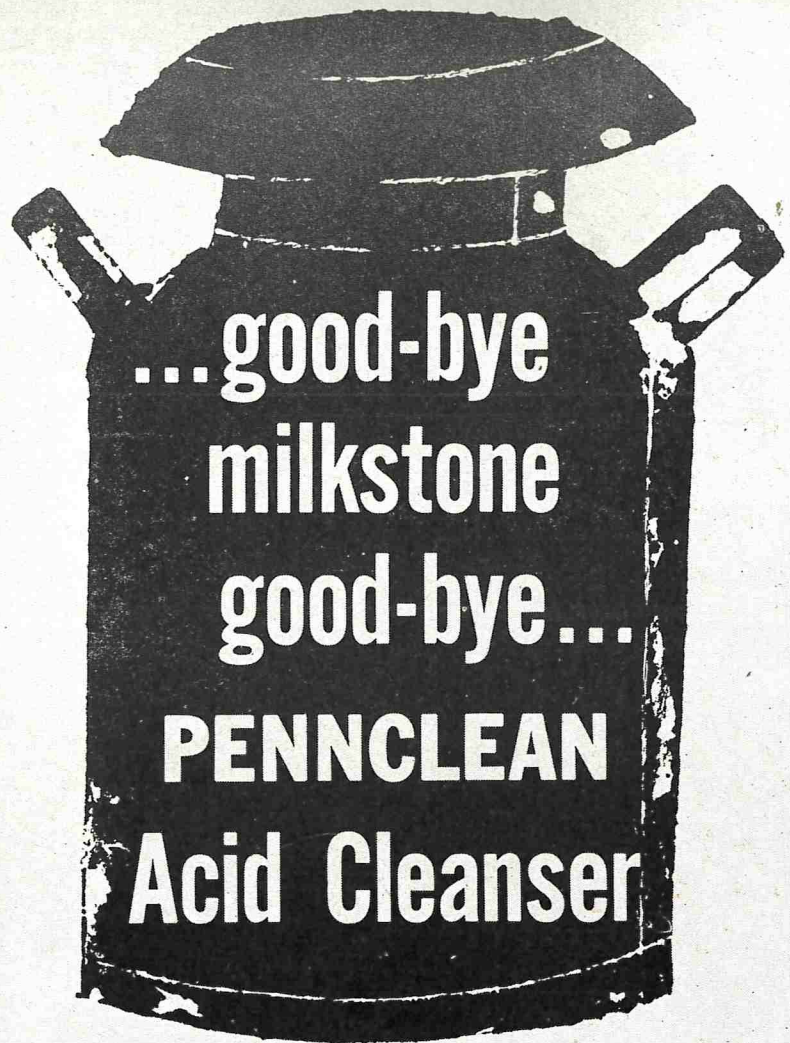
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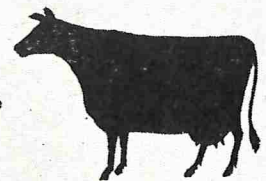
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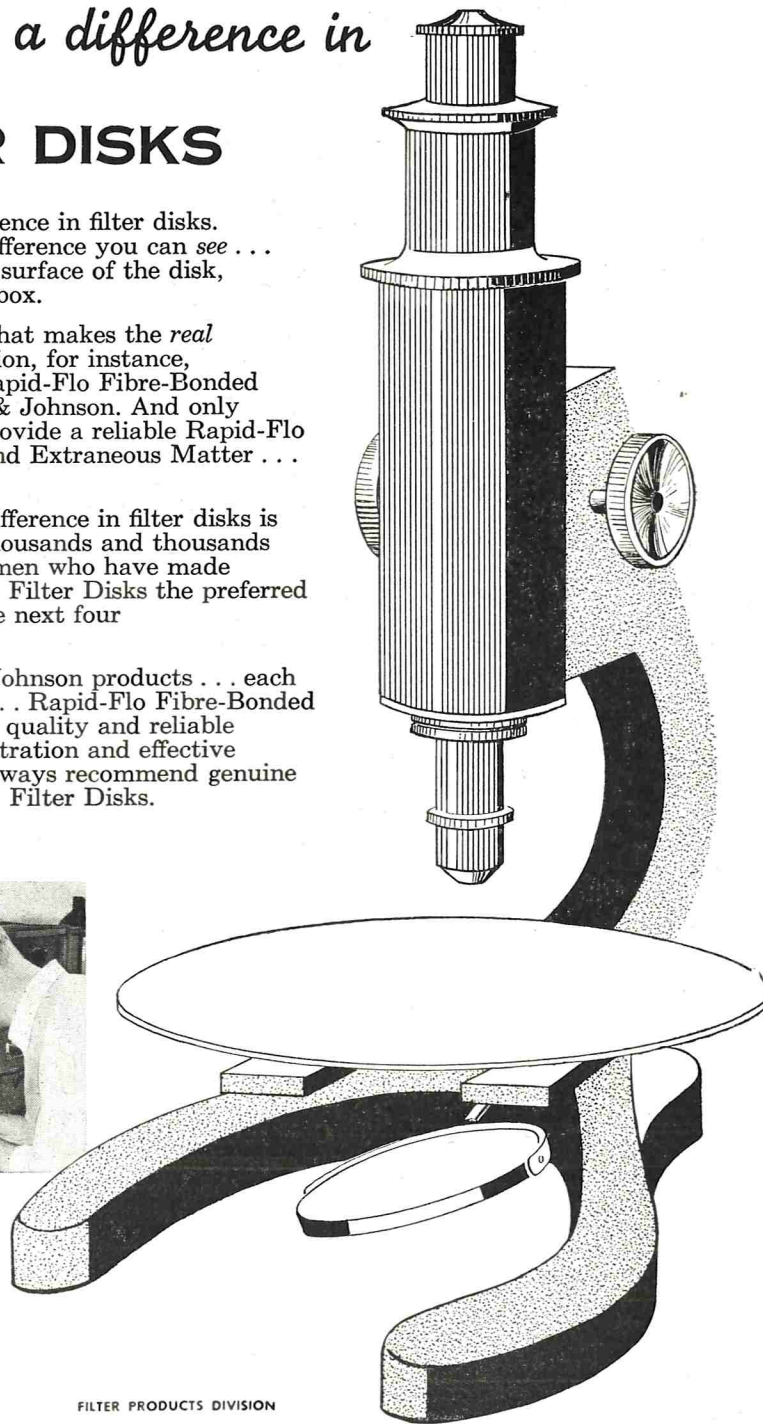
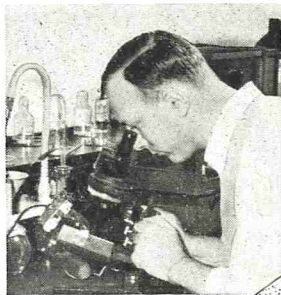
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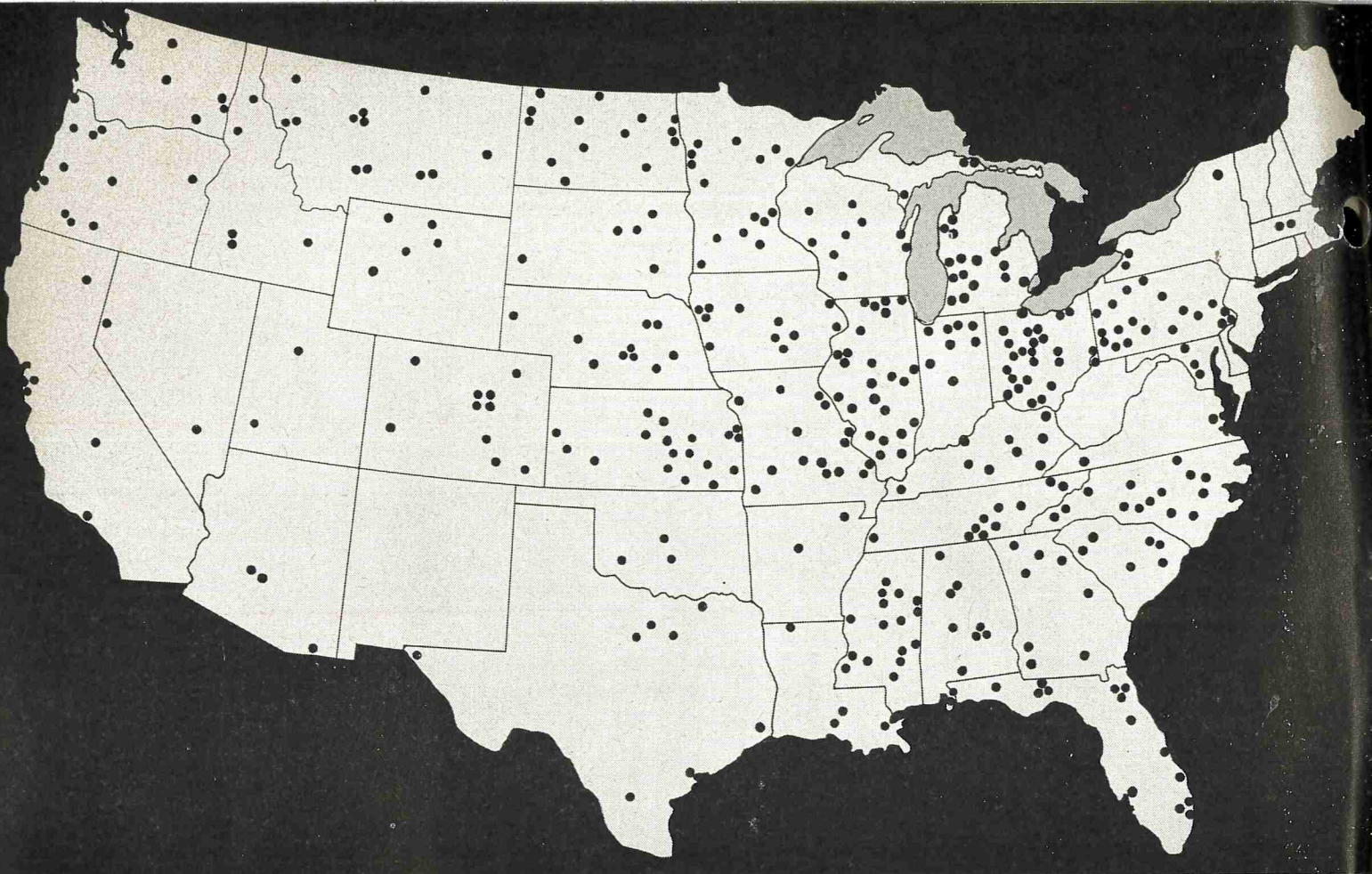
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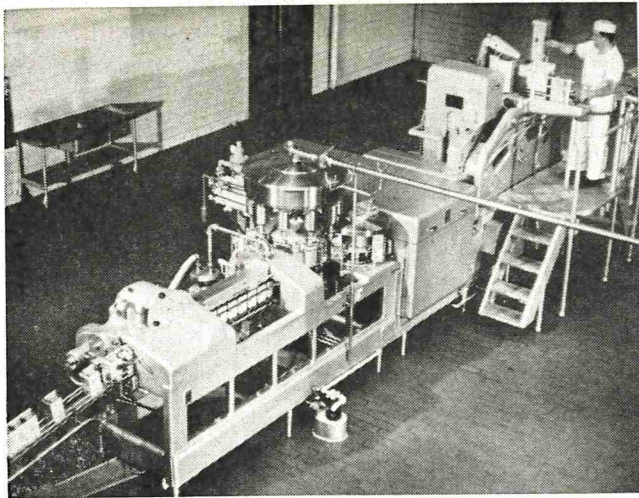
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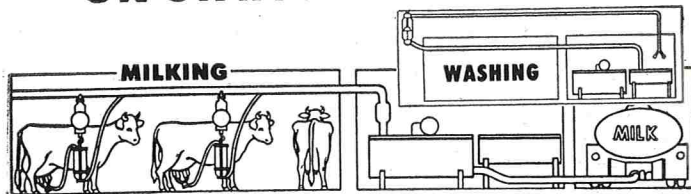
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April

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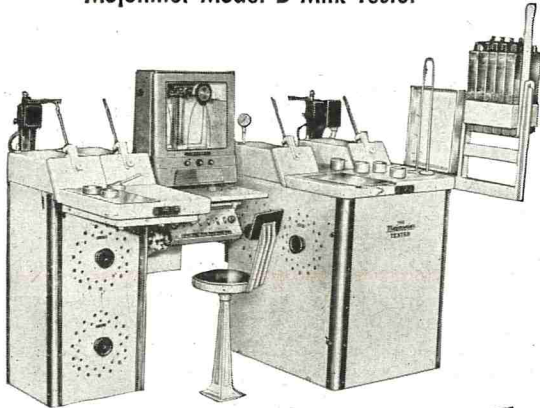
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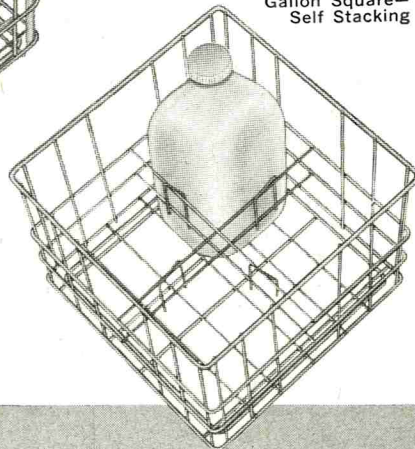
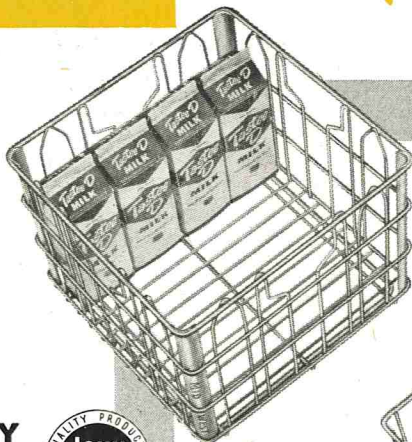
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BACTERIOLOGY OF MILK HELD AT FARM BULK COOLING TANK TEMPERATURES

III. PSYCHROPHILES FOUND AND THEIR GROWTH^{1 2}

E. H. MARTH AND W. C. FRAZIER

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University of Wisconsin,

Madison

(Received for publication September 8, 1956)

Predominant bacteria in raw milks held at farm bulk cooling tank temperatures were gram negative rods of the following genera: *Achromobacter*, *Aerobacter*, *Alcaligenes*, *Flavobacterium* and *Pseudomonas*. When inoculated into raw milk and held at 38° F., most of the *Pseudomonas* cultures grew rapidly and steadily for the first two days and more slowly during the last two days. The *Achromobacter* and *Alcaligenes* cultures grew rapidly for the first three days and more slowly during the fourth, while the *Aerobacter* culture growth. *Flavobacterium* cultures failed to grow appreciably.

The importance of adequate cooling in the production of high quality milk has long been recognized. Gelpi, McClesky and Seath (8) have reported improper cooling or lack of cooling as the greatest causes of high bacterial counts in milk as it is received at the dairy plant. Although cooling will not compensate for faulty milk production methods, it is an important phase in the production of high quality milk according to Anderson and Nicholas (3).

Ayers, Cook and Clemmer (4) observed that bacteria frequently grew in milk when both low and high quality raw milks were held at refrigerator temperatures. It has been reported by Sherman, Cameron and White (18), Thomas and Chandra-Sekhar (19) and Rogick and Burgwald (17) that psychrophilic bacteria able to grow in raw milk held at refrigerator temperatures were primarily gram negative, non-spore-forming rods. Bacteria able to grow in refrigerated milk have been found to belong to one or more of the following genera: *Achromobacter*, *Alcaligenes*, *Flavobacterium*, *Pseudomonas*, *Aerobacter*, *Escherichia*, *Lactobacillus* and *Streptococcus* by Morrison and Hammer (15); Sherman, Cameron and White (18); Thomas and Chandra-Sekhar (19); Thomas,

Blodwen and Ellison (20); Erdman and Thornton (7); and Abdel-Malek and Gibson (2). Psychrophilic bacteria in raw milk, according to Jezeski and Macy (9), produced ropiness, discoloration, proteolysis and bitter flavors. They further reported that psychrophiles (a) were sometimes responsible for failure of market milk to meet standards, (b) produced unsatisfactory methylene blue tests, and (c) could interfere with the phosphatase test since they showed phosphatase activity. Lawton and Nelson (10) found that when a culture similar to *Pseudomonas fluorescens* was grown in pasteurized or sterilized milk and when a culture similar to *Pseudomonas geniculata* was grown in sterilized milk, most rapid growth occurred during the second and third day of storage at 41°F. (5°C.). Olson *et al.* (16) found that psychrophiles could grow in recombined concentrated milk when stored at 38.8°F. (1°C.) and 39.2°F. (4°C.).

One of the advantages claimed for the handling of milk in bulk on the farm is better cooling and hence reduction of problems caused by the growth of bacteria in milk while it is stored on the farm. Marth, Hunter and Frazier (14) reported that when high quality milk was held in a farm bulk cooling tank for two days at 38°F., increases in psychrophilic bacteria were noted in only a few samples. Such increases ranged from two to nine times the original number of psychrophilic bacteria present in the raw milk. In further work, Marth and Frazier (13) showed that occasionally large increases of psychrophilic bacteria would occur when raw milk samples with either high or low initial numbers of bacteria were stored at farm bulk cooling tank temperatures.

The research reported in this paper was designed, (a) to determine the kinds of bacteria present in raw milk and able to grow when it was stored at farm bulk cooling tank temperatures and (b) the ability of pure cultures of these bacteria to grow when inoculated into raw milk that then was held at a farm bulk cooling tank temperature.

¹Published with the approval of the Director of the Wisconsin Agricultural Experiment Station. This work was supported, in part, by funds from the United States Steel Corporation.

²The research reported herein was conducted as a part of the North Central Regional Research Project NC-3, One Story Dairy Barns and Related Structures.

METHODS

Isolation of bacteria

Bacteria were isolated from petri dish cultures prepared for either the standard or psychrophilic plate counts of milks held at the temperatures of farm bulk cooling tanks for three or four days as previously described by Marth and Frazier (12). Colonies of the predominant types were picked and streaked on tryptone-glucose-beef extract-milk (TGEM) agar (Difco) slants, which were incubated at 35°C. for 48 hours and then stored at 10°C.

Purification of isolates

The isolates were inoculated into a broth of the following composition:

Difco tryptone	1.0 per cent
Difco beef extract	0.3 per cent
Glucose	0.5 per cent
K ₂ HPO ₄	0.2 per cent
Distilled water	

Twenty-four hour broth cultures were streaked on TGEM agar in petri dishes. After the plates had been incubated for 48 hours at 35°C., well isolated colonies were picked into the broth described above. The broth cultures were incubated at 35°C. for 48 hours and stored at 10°C.

Grouping of isolates

The following tests were used to group organisms isolated and purified as previously described:

Gram stain. Twenty-four hour broth cultures of all isolates were checked by means of the gram stain procedure for morphology and reaction. Gram negative rods were predominant in milk samples stored at farm bulk cooling tank temperatures and hence this group of organisms was selected for further study.

Litmus milk. Twenty-four hour broth cultures of all isolates found to be gram negative rods were inoculated into litmus milk and incubated at 35°C. for seven days. Litmus milk cultures were examined after two, five and seven days of incubation for curd formation, acid production, alkali production, reduction, proteolysis and wheying off.

Gelatin. Twenty-four hour broth cultures of all isolates found to be gram negative rods were inoculated into a nutrient gelatin medium of the following composition:

Difco beef extract	0.3 per cent
Difco tryptone	0.5 per cent
Difco gelatin	12.0 per cent
Distilled water	

The gelatin cultures were incubated at 35°C. for 14 days and checked for liquefaction after seven and 14 days.

Nitrate reduction. The nitrate reduction test described by Conn and Breed (6) was employed in these studies. Twenty-four hour broth cultures of the isolates found to be gram negative rods were inoculated into the nitrate medium as described in the Manual of Methods (11). After 24 hours of incubation at 35°C. the nitrate broth cultures were tested for the presence of nitrites.

Classification of isolates according to genera

The isolates were divided into 18 groups by means of the tests described above. A representative was chosen from each group and identified as to genus according to characteristics outlined in *Bergey's Manual of Determinative Bacteriology* (5).

A twelve-hour broth culture was used to study motility and flagellation as described in Manual of Methods (11). Flagellar stains were made according to the Fisher and Conn modification of the Bailey method (11).

Growth of isolates in milk at 38°F.

A water bath cooled with a one-fourth horsepower capacity compressor was used for this series of experiments. The compressor and a 750 watt water heater were controlled by two thermoregulators so that the water bath temperature was held at 38°F. and varied less than plus or minus 0.1°F.

One representative from each of the 18 groups of organisms isolated from raw milk incubated at low temperatures as previously described by Marth and Frazier (12) was inoculated into 50 ml. of the tryptone-beef extract broth described above and incubated at 35°C. for 24 hours. Five ml. of the 24 hour broth culture were inoculated into duplicate samples of approximately 250 ml. of fresh raw milk with a very low bacterial content to give an inoculum of two to 120 million bacteria per ml. The inoculated milk samples were incubated at 38°F. in the previously described water bath and numbers of bacteria were estimated daily by means of the standard and psychrophilic plate counts as described in *Standard Methods for the Examination of Dairy Products* (1).

Isolates able to grow in raw milk at 38°F. when a large inoculum was employed were checked for ability to grow when present in milk in numbers approximating possible farm contamination (160,000 bacteria per ml. or less). To obtain this level of inoculum, numbers of bacteria per ml. in 24 hour broth cultures were determined by the direct microscopic method as described in *Standard Methods for the Examination of Dairy Products* (1); then the proper amount of broth culture was added to duplicate 250-ml. samples of raw milk with a very low initial bacterial content so that there was a maximum of

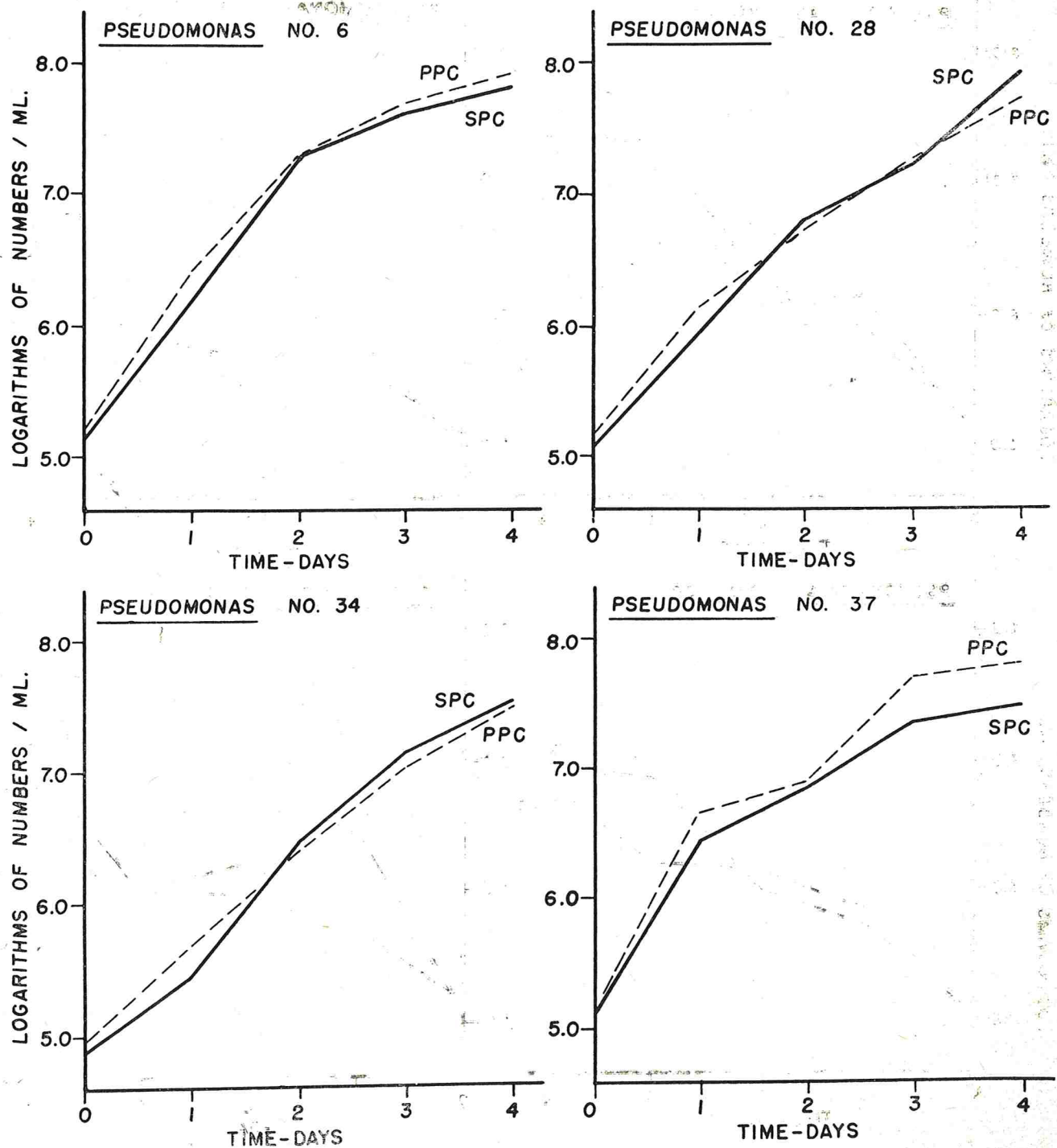


FIGURE 1. Daily changes in numbers of *Pseudomonas* in raw milk at 38° F.

150,000 bacteria present per ml. of milk. The inoculated milk samples were incubated at 38°F. in the previously described water bath and numbers of bacteria were estimated daily by means of the standard (SPC) and psychrophilic plate counts (PPC). Raw milk of excellent bacteriological quality was used for these experiments since it more nearly

duplicates the product that may be found in farm bulk cooling tanks. Furthermore, experimental evidence indicated that some of the cultures grew as well as or better in raw milk than they did in pasteurized (143°F. for 30 minutes) or sterilized (15 pounds pressure for 25 minutes) milk.

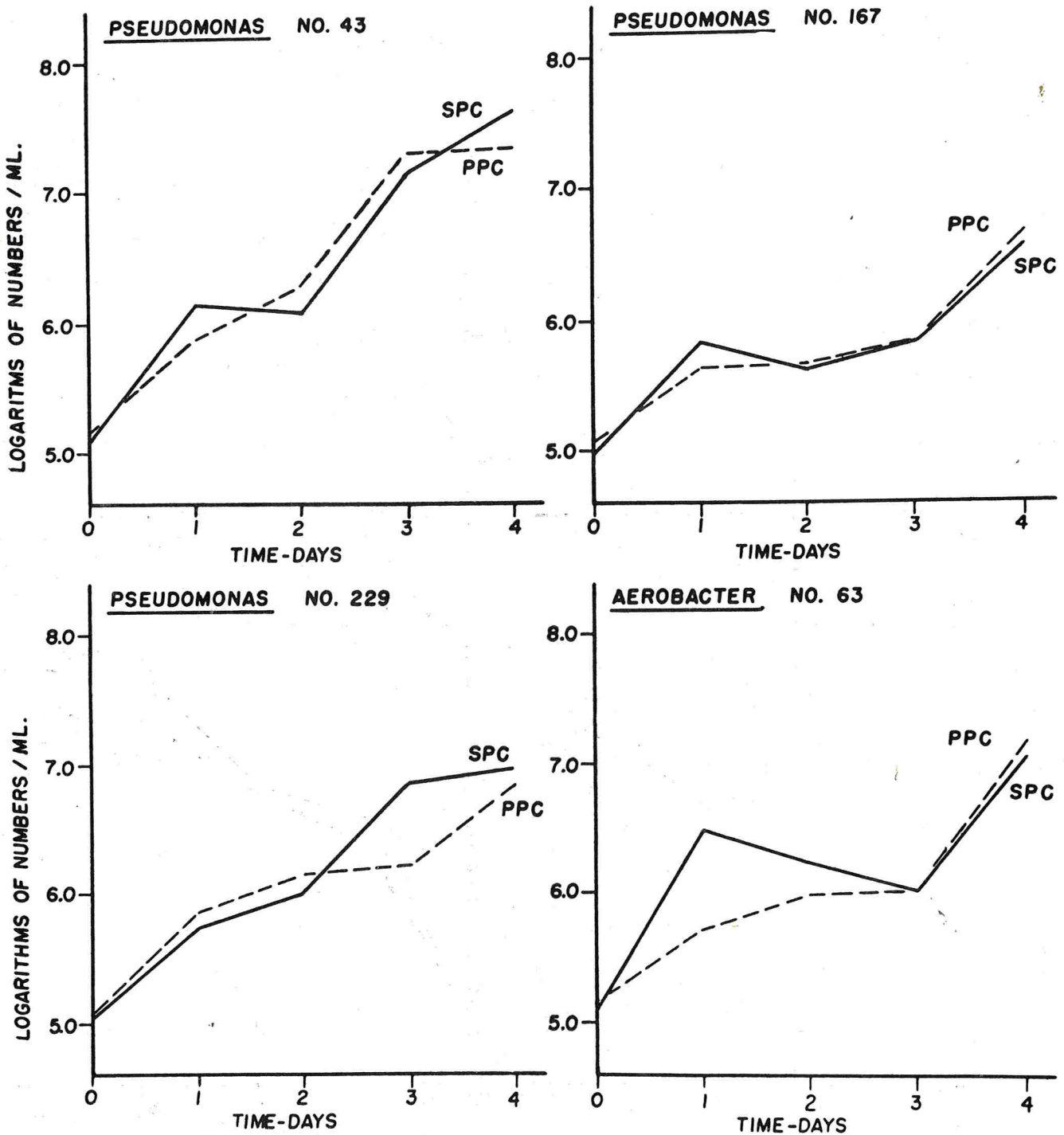


FIGURE 2. Daily changes in numbers of *Pseudomonas* and *Aerobacter* in raw milk at 38° F.

RESULTS

Identification of isolates

One hundred and thirty-nine cultures of gram negative rods were isolated from raw milk samples after incubation at low temperatures. These were divided into 18 groups on the basis of their reactions in litmus

milk, gelatin and nitrate broth. Representatives were chosen from each group and identified as to genus. Of the 18 cultures studied, three were found to be different species of *Achromobacter*, three included two species of *Aerobacter*, two were different species of *Alcaligenes*, three were different species of *Flavobacterium* and seven comprised six species of *Pseudomonas*.

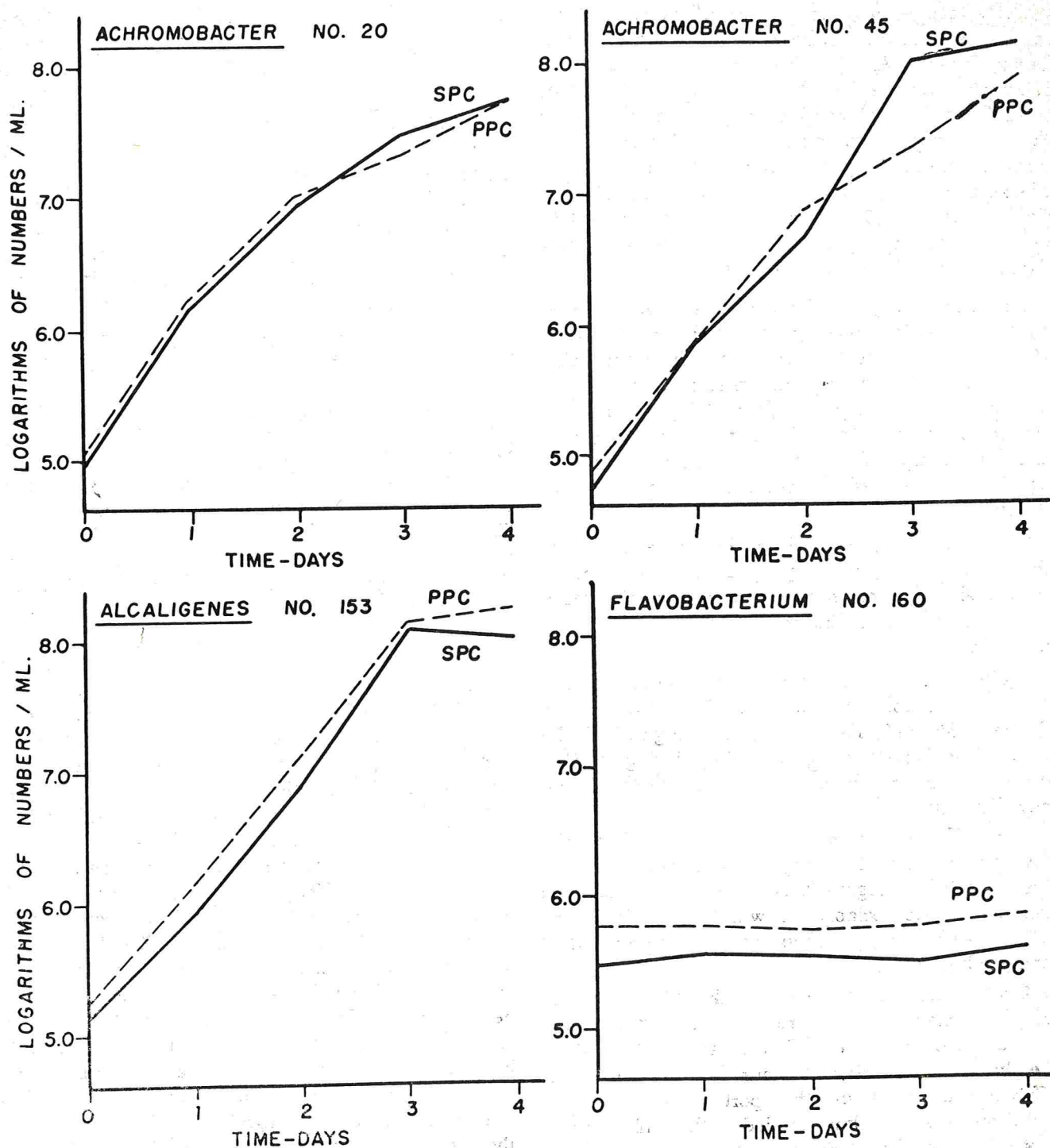


FIGURE 3. Daily changes in numbers of *Achromobacter*, *Alcaligenes* and *Flavobacterium* in raw milk at 38° F.

Growth of isolates in raw milk

When raw milks of excellent initial bacteriological quality (SPC 2,000 - 7,300 per ml.) and free of antibiotics were heavily inoculated with a broth culture of each of the 18 isolates indicated above, it was found that two of the *Achromobacter* sp., one *Aerobacter*

sp., one *Alcaligenes* sp. and six *Pseudomonas* sp. were able to grow at 38° F.

Additional samples of raw milk (SPC 2,000 per ml.) were then inoculated with each of the isolates, previously found able to grow, at levels which might occur in a normal farm operation. Results from this work are shown in Figures 1, 2, and 3.

Daily changes in numbers in *Pseudomonas* cultures in inoculated raw milks held at 38° F. are shown in Figures 1 and 2. All seven *Pseudomonas* cultures grew rapidly during the first day of storage and most of them (except No. 43 and No. 167) continued to grow rapidly during the second day. All of the seven cultures continued to grow throughout the four days of holding although three (Nos. 43, 167 and 229) grew slower than did the other four. The SPC and PPC, in general, were equally good for counting these "psychrophilic" species of *Pseudomonas*.

The daily changes in the single *Aerobacter* species able to grow in raw milk at 38° F. are shown in Figure 2. This culture grew rapidly during the first day, stopped for two days and then resumed growth during the fourth day of storage. The SPC showed higher counts than the PPC at the end of the first and second days of storage, but counts were nearly equal at the end of the third and fourth days of storage.

The two species of *Achromobacter* tested, as is shown in Figure 3, grew rapidly during the first three days at 38° F. and much more slowly during the fourth day of storage, according to both the SPC and PPC methods.

Daily changes in numbers of the one *Alcaligenes* culture found able to grow in raw milk at 38° F. are shown in Figure 3. The culture, according to both the SPC and PPC methods, grew rapidly during the first three days and much more slowly during the fourth day of storage.

Three *Flavobacterium* cultures were tested and the results with one, which are typical of all three cultures, are indicated in Figure 3. None of the cultures was able to grow appreciably in raw milk at 38° F. during a four day holding period as shown by both the SPC and PPC methods.

Control samples of the raw milk which served as a culture medium also were stored at 38° F. There was a reduction in the SPC while the PPC remained nearly constant during the four day storage period. This indicates that growth reported above occurred as a result of the cultures added to the milk and was not the result of bacteria initially present in the milk.

DISCUSSION

Five genera of bacteria were identified as predominant in milk after storage at farm bulk cooling tank temperatures. This probably is not a complete picture of the bacteria able to proliferate in milk at low temperatures. Only gram negative rods were studied in this research since they predominated in milk samples stored at low temperatures; however, other bacteria,

mainly gram positive cocci and rods, also were isolated. They were not the predominant kinds, but their importance cannot be ruled out.

In this research, the isolates within a genus differed sufficiently in the characteristics employed to identify them to indicate that several species of the different genera were involved although no attempt was made to identify the isolates as to species. It is further evident, since some of the isolates failed to grow in raw milk at 38° F., that only certain species of the genera will grow in milk stored in farm bulk cooling tanks. Furthermore, it is possible that certain strains within a species will be able to grow better than others at these low temperatures. An attempt was made to select representative cultures from each of the five genera for these experiments but it is possible that other cultures of the same genus might have grown better than those chosen.

On the basis of calculated generation times for these different cultures, there would need to be about 50,000 to 115,000 of the *Pseudomonas* organisms present initially per ml. of raw milk if a count of more than 200,000 per ml. were to be reached within a 24 hour storage period. The required initial "load" would be reduced to about 30,000 to 70,000 per ml. if the milk were held for 48 hours without additions. If, in raw milk, there were about 40,000 per ml. of the *Aerobacter* organisms, the count would probably exceed the 200,000 mark after 24 hours of storage. If there were less, the count might not reach that level until the fourth day. Initially there would need to be about 50,000 *Achromobacter* organisms per ml. of raw milk for the count to exceed 200,000 per ml. by the end of 24 hours of storage. This would be reduced to about 30,000 to 40,000 per ml. if the milk were held without additions for 48 hours. There would need to be an initial count of about 80,000 *Alcaligenes* organisms per ml. of raw milk if the count were to exceed 200,000 by the end of the 24 hour storage period. This would be reduced to about 30,000 if the storage period were 48 hours long. It must be remembered that these calculations are based on results obtained by the growth of pure cultures in raw milks of excellent quality. Although it is possible, in practice, that heavy bacterial contamination of milk with one species of a given genus may occur, it is more likely that the contamination will be made up of a number of species and genera. In this instance, not only would the interaction of bacteria and milk be of importance, but also the interaction of different kinds of bacteria.

The germicidal substances naturally present in milk may also determine, in part, the kinds of bacteria that will grow. The effect of these germicidal substances is prolonged by the low temperatures but they act more slowly at these temperatures than at room or

higher temperatures. It is also doubtful that these germicidal substances have much effect on the psychrophiles discussed here since of those tried all grew in fresh raw milk as well as or better than in the same milk which had been pasteurized or had been sterilized in an autoclave.

The results indicate that some genera of bacteria studied grow rapidly during the early part of the storage period, while others grow rapidly during the later part of the storage period. This then points to the importance of kinds of bacteria in determining the occurrence and rapidity of bacterial growth in raw milks held at low temperatures. Since psychrophiles, able to grow in the milks at low temperatures, enter the milk as contaminants during production, the prevention of such contamination is of utmost importance in the bulk handling of milk on the farm.

SUMMARY

Selected cultures of gram negative rods isolated from raw milks stored at farm bulk cooling tank temperatures were identified as belonging to the following genera: *Achromobacter*, *Aerobacter*, *Alcaligenes*, *Flavobacterium* and *Pseudomonas*.

When the ability of these cultures to grow in raw milk held at 38° F. was studied, it was found that some cultures of each of the genera except *Flavobacterium* were able to grow during the four day storage period. Most of the *Pseudomonas* cultures grew rapidly and steadily for the first two days and continued to grow at a slower rate for the last two storage days. Two of the cultures grew at similar rates during the entire four days. Three of the cultures grew more slowly than did the other four.

The two *Achromobacter* cultures and the *Alcaligenes* culture grew rapidly at 38° F. for the first three days and more slowly during the fourth, while the *Aerobacter* culture grew during the first day, stopped for two days and then resumed growth.

Most rapid growth of all organisms studied was shown by several *Pseudomonas* cultures. They were followed by cultures of *Achromobacter*, *Alcaligenes*, other *Pseudomonas*, and *Aerobacter*. *Flavobacterium* cultures failed to grow appreciably.

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PENETRATION OF PROTECTIVE COVERINGS BY INSECTS¹

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Stored cereal products are subject to infestation by several species of insects. Insect infestation of whole and milled grains can be so rapid that within a very short period great inroads can be made in the quantity, as well as the quality of the cereal products by the presence of thousands of insects, skins, webbing and excreta. Such contamination results in tremendous losses, and, in the United States alone the yearly damage is reported to be up to 300,000,000 dollars (3, 7). The study of insect infestation is of particular interest to the Department of Defense because of the necessity for purchasing great quantities of grains and cereal products for distribution to the Armed Forces in all parts of the world.

Unfortunately the many kinds of beetles, weevils and moths which are prone to infest storage houses, mills, bakeries, cereal product factories, boxcars, etc., are very hardy and very prolific. Adult beetles survive two years or more in cold, unheated buildings. Within a period of two years the female of certain species will produce about 1,000 eggs which hatch in from five to twelve days into larvae (6). In properly heated storage areas several generations might develop annually. As a result, the difficult problem of decontaminating storage areas, processing and handling grains and cereal products and providing uncontaminated means of transportation is of considerable economic importance.

Grain and cereal products are so attractive to insects that they have to be packaged in containers that afford them the greatest protection from infestation during later storage.

Most insects that infest cereal products have comparatively weak mouth parts and cannot cut through substantial wrappers. Many can thrust their ovipositors through the meshes of fabric bags and lay their eggs directly in the cereal products within the bags. The immature stages of many insects also can crawl through the meshes and through needle holes along

the seams and at the top or bottom where the bags are sewn. The more closely woven fabrics offer the greatest resistance to penetration. Bags made of paper, paper laminated to cloth or back-filled fabrics, and cartons of fiberboard offer more resistance to insect penetration than ordinary cotton or jute bags. Unless such containers are adequately sealed, however, small flat beetles, such as the saw-toothed grain beetle and the larvae of other beetles and moths, may easily penetrate through minute openings where the seals are imperfect. Most commercial methods of sealing bags and cartons are inadequate. If the bags are closed by sewing, the sewed ends must be protected by the use of a gummed strip that will cover all needle holes. For fiberboard cartons the application of a wet-wrap cover offers the best protection. Experimental work with insect repellents for incorporation in the adhesives used to seal fiberboard cartons and paper bags may help solve the problem.

Impregnation of fabric and paper bags with pyrethrins or pyrethrin synergists has been found to afford considerable protection against penetration by insects. In fabric bags this protection is more efficient when the weave is close enough to offer some mechanical resistance against penetration. More powerful insecticides such as DDT, benzene hexachloride, and chlordane also are effective in resisting penetration when used to impregnate bags, but because of the danger of contaminating the food are not practical for use in insect-proofing bags intended for packaging food. Insect-repellent chemicals may offer the best means of providing an insect-proof container. Packages impregnated with them are particularly useful in resisting the invasion of certain insects that have wood-boring habits.

The cadelle, probably the most troublesome of the boring insects, feeds on a wide variety of stored commodities and is widely distributed. It is primarily a pest of grain and flour and is commonly found in railway boxcars, ships, warehouses, farm granaries, and other places in which foodstuffs are stored or transported. The larva bores into woodwork to form a sheltered place in which to hibernate or to transform to the pupal or adult form. It has jaws powerful enough to cut through many types of packages. It

¹This is the first of a series of papers which were presented at the Second Conference on Problems of Extraneous matter in foods, arranged by Dr. J. D. Wildman, Department of Plant Science, Syracuse University, Syracuse, New York, and held at that institution April 16, 1956. Other papers in this series will appear in this or subsequent issues of the Journal.

will cut through a multiwall paper bag, or metal-foil-wrapped carton overnight.

Termites also burrow through cartons and other packages that are stored in warm, damp locations, or in warehouses with wooden floors that are infested. The larvae of many insects, when fully grown, have the urge to migrate in the search of pupation quarters (9).

It is well established that insects attack packages which do not contain food. That insects are not always searching for food in boring through protective materials has been demonstrated by experiments conducted by the Department of Plant Quarantine, United States Department of Agriculture, Savannah, Georgia. The insects will attack packages left in the room even though unpackaged and unprotected food is available to them. Insects try to find their way into dark areas. This could be one cause of penetration. In addition they try to find seclusion and a protected area in which to lay their eggs. Some insects bore holes merely as a pastime because they enjoy boring holes. This is apparent from some types of damage that have been observed. The adults of some insect species will penetrate most packaging, including aluminum foil 0.002 inch thick. The penetration of cellophane presents a problem due to its smoothness. However, adult weevils can penetrate cellophane if they can get leverages for their hind feet. For this reason, and due to another cause to be brought up in this discussion, cellophane wrapping is no guarantee against insect infestation.

Insects apparently do not derive any nourishment from metals or even ingest them. Nevertheless, they are injurious to several different metals (10).

Since lead is the softest common metal, it is not surprising that a fairly long list of insects are known to damage it. In some cases the damage is due to perforation by beetles or bees attempting to emerge from wood which has been covered with lead. In other cases lead is used as a place of pupation by beetles which would ordinarily bore into branches or other wood. Probably most termites damage lead only when they encounter it in the course of making their galleries. In parts of Australia buried electrical cables are seriously damaged by termites during the dry season, apparently because of condensation of moisture near the cables. Lead is soft enough so that a considerable thickness may be penetrated, probably a quarter of an inch without great difficulty. Three moths are on record as perforating very thin aluminum sheets or foil. Probably many other insects could do so if they would come in contact with the metal. The two beetles known to damage copper are both

noteworthy for their ability to bore into hard substances, and apparently even copper foil is no proof against attack of the vast majority of insects. Tin is sufficiently soft so that at least tinfoil of unstated actual composition has been perforated by several insects, including moths, beetles, and wood wasps. The larder beetle can penetrate lead and tin but not zinc, aluminum or brass.

A species of powder post beetle has been given the name of lead cable borer because of its troublesome habit of eating holes through the lead sheathing of aerial telephone cables. These holes admit moisture and cause short circuits; often the insulation becomes water-soaked and ruined for an appreciable length, necessitating splicing and resheathing. In southern California this type of insect injury is reported as causing about one-fifth of all aerial cable troubles. As many as 125 holes to a span of 100 ft. have been found. A single hole may put from 50 to 60 telephones out of use for from 1 to 10 days. Termites have similarly bored through the lead pipe and the cotton insulation inclosing underground cables, thus ruining them within a year after they were laid down. Beetles of at least a dozen different families, besides the caterpillars of several moths and adult wasps of several kinds, have been recorded as boring through metal (6).

Insects are the only really small animals able to live in dry conditions. This is partly due to their success in reducing their loss of water and in their ability to relieve desiccation by extra production of metabolic water. Water-saving insects live in dry environments, eat dry food, have a low body-water content, and are resistant to starvation. Xerophilous insects such as the meal worm, clothes moth, and flour beetle avoid moist environments as long as food is available. They excrete dry urine. Meal worms survived more than 210 days over strong sulfuric acid. Due to their high surface volume ratio and active metabolism, water conservation in insects is an especially urgent problem. They are, therefore, especially well equipped physiologically to cope with this problem. Their ability to survive under adverse conditions of relative humidity contributes to their hardiness and potential menace to mankind. Insects have humidity receptors which help them seek moist or dry areas as their needs require. A number of insects and ticks can absorb water from vapor in the air. A relative humidity of 50 per cent or more is needed. Absorption is most rapid at high relative humidities. The water content of the blood of insects is 90 to 94 per cent, thus allowing some leeway for loss of water under adverse conditions. Insects living

on dry food eat excess food which is used for the production of metabolic water. They also reabsorb it from the excreta before defecation. The contents of the hindgut are semifluid at the anterior end, quite dry in the rectum, and a dry powder in the excrement. In most insects food material in the hindgut is partly dehydrated before elimination. The urine is often semi-solid. Insects utilize the same metabolic device as snakes and birds in that the end product of nitrogen metabolism is the slightly soluble uric acid rather than urea. Thus, when water is actively resorbed by the rectal epithelium, a much smaller osmotic gradient has to be overcome to precipitate uric acid than would be necessary to cause urea to crystallize (11).

A new line of attack has been launched on cellophane wrapped military rations by the class *Insecta* in their ceaseless struggle with mankind for a greater share of the earth's victuals. The insects were discovered invading the emergency ration cereal bars which form part of the breakfast menu of soldiers in combat. This first came to light when Quartermaster inspectors noted the presence of these insects in stored cereal bars. Investigation by the Quartermaster Subsistence Testing Laboratory showed that the eggs, larvae, and adult insects infesting the rations were those of beetles of the species *Tribolium confusum* (du Val) also of beetles of the species *Trogoderma versicolor* (Creutz,) and of the Indian meal moth of the species *Plodia interpunctella* (Huebner).

The history of these insects shows a long record of destruction. Specimens of the confused flour beetle, *Tribolium confusum* or the rust-red flour beetle, *Tribolium castaneum*, were found in a jar of grain inside the tomb of one of the Pharaohs of the 6th Dynasty about 2,500 B. C. One of these two species of beetles was named *confusum* by Jaquelin du Val in 1868 to distinguish it from the other with which it had been confused frequently (3). Both beetles are found in all parts of the world, but the confused flour beetle, first reported in the United States in 1893, occurs in greater numbers in the northern part of the United States than elsewhere (6). The confused flour beetle prefers milled and processed cereal products to other types of food. It feeds especially on parts of milled grains which include the germ and outer layer not used in making flour. This insect is unable to feed on whole, raw grains but is found in all types of flour, ground or rolled grains, breakfast foods, shelled nuts, spices, drugs and other food items of vegetable origin. It can easily be recognized by the reddish-brown color of its oval, flattened body which is about one seventh of an inch long, and by its slow

movement. It is commonly called "bran bug" by millers and grain dealers. The larvae or "flour worms" as they are commonly called, are about one quarter of an inch long when fully grown and vary in color from white at molting to yellow. The eggs are oval and are about one-seventy-fifth of an inch in average diameter. These are sticky and the material in which they are laid adheres to the surface making it easier to find them. They hatch in one week, mature in about twenty days, pupate over a period of ten days, and then emerge as adults. Under favorable conditions a life cycle may be completed in three or four months (5, 6, 8).

Trogoderma versicolor Creutz, known to be injurious to stored wheat and rice, is a cosmopolitan species of beetle found in the island of Cyprus, in India, and in Europe and is apparently synonymous with *Trogoderma inclusum* (Leconte). Several specimens of *Trogoderma versicolor* (Creutz) have been misidentified as *Trogoderma ornata* (Say) or as *Trogoderma tarsalis* (Melsheimer). Although closely related to *Trogoderma versicolor* (Creutz), *Trogoderma frosti* (Casey) is classified as a separate species.

The Indian meal moth, *Plodia interpunctella* (Huebner), originally a pest in the Old World is found everywhere, particularly in California where it is abundant in stored dried fruits. This insect was first described in 1827 by J. Huebner, and its destructive work on the dried fruits of California was recorded as early as 1895 by Chittenden (4). The Indian meal moth is the most troublesome of the moths and was first found in corn meal from which it derives its name. Being one of the most destructive pests of food products, it will eat any food material, altered or whole, that is stored anywhere. The ravages of this insect are easily detected because after the larvae eat all they need they come out to spin cocoons and cover the remaining material with extensive webbing and excreta. The caterpillars feed on cereals, candies, shelled nuts and dried fruits. The adult has a wing spread of about three-fourths of an inch and can be easily distinguished by the coppery brown color of its forewings which have a pale gray band at the base. The female moth may lay as many as 350 eggs or more, singly or in clusters on the desired food. The minute white eggs hatch in from two days to two weeks into whitish, or lightly tinted pink, yellow or green larvae. They attack the food and spin a cocoon to pupate. Under favorable environmental conditions the moth may emerge in four days. In warm climates in the presence of adequate nourishment, complete generations will develop within a month and in rapid succession. For this reason the

dried fruit industry in California suffers great losses each year (2, 4, 5, 6, 8).

INSECT PENETRATION OF CEREAL RATION BARS

Cereal ration bars which had been in storage were found to have been infested with these three species of insects. The composition of these ration bars is as follows:

Cereal Ingredient	60%
Sucrose	14%
Nonfat dry milk solids	14%
Shortening	10%
Glycerol	2%

Samples of these infested ration bars were furnished the Quartermaster Subsistence Testing Laboratory for analysis. The problem presented to the Quartermaster Subsistence Testing Laboratory consisted of resolving whether or not adult insects penetrated the cellophane wrapper by boring through the wrapper, or gained access into the bars through some other avenue. The cellophane wrappers were found to be punctured with numerous holes, and insects and larvae were observed crawling on the inside of each infested case. Initial examination of the infested cereal bars showed extraneous matter inside the bars, which consisted of living larvae and fragments of *Triboleum confusum*, *Trogoderma versicolor*, and *Plodia interpunctella*.

Further study on the bars was conducted by breaking pieces from the surface of the entire bar. These separated gently by hand into smaller pieces in a dish, then covered with gauze and placed in an incubator. The period of incubation was six weeks at 29 degrees centigrade and 70 per cent relative humidity. The results revealed that the larvae had metamorphosed into the two beetle forms: *Triboleum confusum* and *Trogoderma versicolor*, and into the moth species *Plodia interpunctella*.

As a control experiment, cereal ration bars of wheat flakes, sucrose, nonfat milk solids, shortening and glycerol were prepared for experimental study according to the general formula for cereal bars previously given. These bars were wrapped in cellophane in the same manner as the bars that were procured, and later became infested.

At the same time that the infested bars were being incubated, these control bars were placed in a dish in which adult beetles, *Tribolium confusum*, were added and then incubated under the same conditions of temperature, relative humidity and length of time as the infested bars.

It was observed that the adult beetles crept under the folded cellophane corners of the wrapping of the

control bars. The beetles then laid their eggs inside the wrapper on the surface of the bar. Here the eggs developed into the larval stage. Later, the larvae were observed leaving the bars by puncturing holes in the wrapper. Outside of the bar, the larvae completed their development forming the adult insect, thereby completing the cycle. A reexamination of the holes in the original insect infested ration bars revealed that the holes seen were exit holes.

Thus it was observed that the adult insects that invaded these cereal bars could flatten themselves sufficiently to slip under the folded ends of the cellophane wrapper, partake of the contents, lay their eggs and then depart. The eggs would hatch and develop on the nutrients into strong and powerful larvae, for it was the larvae, and not the beetles that had the capacity to get through the wrapper by boring from within. After metamorphosis into the adult form, the insects would repeat the cycle. In time, the wrappers contained numerous holes. This allowed the entrance of moisture and microorganisms, thereby making the bars subject to complete spoilage. The results of the study indicate that cleanliness and frequent inspection are vitally necessary. A better seal of the folded ends is recommended so as to help prevent possible insect infestation while in storage. But the prime consideration is prevention through vigilance, sanitation and cleanliness.

CONCLUSIONS

1. Adult insects of the species *Tribolium confusum* are not able to penetrate a cellophane wrapping by boring through the wrapper under conditions where it is not possible for the insects to obtain firm leverage for their hind feet.

2. *Tribolium confusum* adult beetles are able to flatten themselves very effectively so that they can enter between the folded ends of the cellophane wrapper covering the cereal ration bars.

3. *Tribolium confusum* adult beetles are thereby able to lay their eggs inside of the cellophane wrapped ration bars.

4. Larvae of *Tribolium confusum* are able to exit from the inside of a cellophane wrapped cereal bar by boring holes through the cellophane wrapper.

5. A more effective seal of the folded ends of cellophane wrapped cereal bars than heretofore available is necessary if there is danger of extrinsic insect infestation.

6. Constant vigilance must be practiced to assure freedom from insect infestation of military rations through eradication, cleanliness and other preventive measures.

ACKNOWLEDGMENTS

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AMENDMENT

To

3-A SANITARY STANDARDS FOR STAINLESS STEEL AUTOMOTIVE MILK TRANSPORTATION TANKS FOR BULK DELIVERY AND/OR FARM PICK-UP SERVICE

Formulated by
International Association of Milk and Food Sanitarians, Inc.
United States Public Health Service
The Dairy Industry Committee
 April 30, 1957

In accordance with action taken by the 3-A Sanitary Standards Committees on December 13, 1956, Para. D(7) "Manhole Dust Cover" of the "3-A Sanitary Standards For Stainless Steel Automotive Milk Transportation Tanks For Bulk Delivery And/Or Farm Pick-Up Service, Amended April 28, 1954", is further amended to read as follows:

7. Manhole Dust Cover: The interior finish of the manhole dust cover shall be smooth, readily cleanable and free from bolts and screws. Round or oval head rivets shall be deemed acceptable. Welded interior attachments shall have a minimum radii of 1/16 inch. A suitable vent shall be provided to relieve vacuum and pressure when dust cover is closed. The dust cover when closed shall provide an effective seal to prevent entrance of dust. If a rubber, rubber-like or plastic gasket is used as a seal, it shall be smooth, either removable or firmly bonded to manhole dust cover to provide a smooth, easily cleanable surface without crevices. Locking device on dust cover shall be designed to provide a tight seal. Deck plate, if attached to the outer jacket, shall be effectively sealed. Dust cover shall have suitable provisions for the use of a sealing device to prevent tampering.
 No. 0501 (Amendment).

THE ROLE OF MICROSCOPIC ANALYSIS IN FOOD AND DRUG CONTROL¹

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Problems of extraneous materials in foods have been of vital concern to the Food and Drug Administration, since the passage of the first pure food law in 1906. Much of the work in this field, for a considerable number of years, centered around the, then, Microanalytical Division of the U. S. Food and Drug Administration. Mr. B. J. Howard, who was Chief of that Division, and Dr. J. D. Wildman, who has organized this meeting played important roles in developing this work from its early rudiments through to the time when it had become an integral part of food and drug control. These methods provided both law-enforcement officials and industry with the tools to detect contamination and adulteration. Today, many of the markedly improved sanitary conditions of foods and food production in this country are due to the impact of the microscopic-analytical methods.

Up to about 10 years ago there was an acute need for procedures to be used in microscopic-analytical work that would permit the more or less routine handling of foods when they were examined for extraneous materials. In 1945 many of the methods had reached a degree of perfection that permitted their use in routine analytical work. Also, there was a growing need for these methods to be standardized and at the same time made generally available to industry and regulatory analysts. This was done through the Association of Official Agricultural Chemists and other groups such as the American Association of Cereal Chemists.

At the present time, while many of the methods are constantly undergoing improvement, we have passed this early period of rapid exploration and development of techniques and, now that we have reliable procedures, data obtained by these microscopic analytical methods are providing useful practical information.

The early regulatory work in this field was carried

¹This is the second of a series of papers which were presented at the Second Conference on Problems of Extraneous Matter in foods, arranged by Dr. J. D. Wildman, Department of Plant Sciences, Syracuse University, Syracuse, New York, and held at that institution April 16, 1956. Other papers in this series will appear in this or subsequent issues of the Journal.



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out against foods and drugs that consisted "in whole or in part of any filthy or decomposed animal or vegetable substance." The Federal Food, Drug, and Cosmetic Act of 1938 contains in section 402 (a) (3) the same basic requirement mentioned above, and, in addition, provides that foods or drugs are adulterated if they are "prepared, packed, or held under insanitary conditions whereby (they) may have become contaminated—." With the advent of these provisions of the Federal Food, Drug, and Cosmetic Act of 1938, there has been an increasing emphasis on those sanitation aspects of food production that combine the inspectional and analytical fields as they come together in purpose and application.

It should be borne in mind that those requirements concerning the absence of filth and production under sanitary conditions are general requirements that are to be broadly applied. There is no further spelling

out of the legal requirements under the Food, Drug, and Cosmetic Act. The law provides no tolerances for filth and no specific standards for food-industry sanitation. The burden of proof is on the Government to establish by a preponderance of evidence in civil actions and beyond a reasonable doubt in criminal cases that a violation has occurred. It is the obligation of the food and drug industries to make the best use of their facilities for the production of a legal product. The language of the Act is general and the courts have consistently held that it should be interpreted in its common or usual sense recognizing that there may be unavoidable minute amounts of contamination present that do not render the product violative. The producer is called upon to exercise sufficient care to protect the integrity of his product; it will be used by consumers who depend upon this protection. Present conditions of large urban populations totally dependent on others to produce and process their foods under large-scale commercial operations demand that something more than "good intentions" be used to guarantee the production of clean foods. In most instances this calls for the establishment of raw material and production controls that are a part of good commercial practice.

Adequate control means the use of the most reliable means to evaluate the wholesomeness of the product. These means may consist of what we in the Food and Drug Administration separate into inspection and analysis although the two are so closely interdependent that the whole subject is now considered as one with both phases assuming their proper perspectives. Even though the laboratory and inspectional techniques are widely different, the underlying goal of preventing food and drug adulteration provides a common motivation. This common aspect has so cemented the term "microanalytical methods" with the concept of "sanitation" that in some quarters they are almost synonymous. This may be fortunate, for there is an obvious advantage to the centralizing of all aspects of what has been variously termed "quality control," "sanitation," "biological control," etc., under one responsible authority.

It is not the purpose here to present a manual of food and drug sanitation or to provide a compendium by which various aspects of adulteration can be detected in the finished product. Rather, the aim is to show the scope of the work, the regulatory approach used in this microscopic analytical work, and the values and approaches of such techniques to industry in product control. This aim encompasses the needs of analysts, inspectors, administrators, attorneys and jurists.

The microscopic-analytical field is sometimes ap-

proached as a means of examining the finished product to see whether or not it conforms to certain commercial or legal requirements. Such an approach is of practical value to regulatory agencies where there is a necessity of proving a case based, at least in part, upon the analytical results of the article that is offered for sale. In some instances this is all that the regulatory official has to work with. While it is useful, or even necessary, to set forth standards of purity that serve as guides to judging the acceptability of some products, a goal of meeting legal requirements without making an effort to obtain basic sanitation improvements is simply a means of "getting by." Unfortunately this approach often results in not even getting by. This should be one of the least frequently used purposes of this work and the food producer who has at his disposal all of the information that can be obtained from a knowledge of the kinds of raw material used and from the processes by which the finished product was produced should make use of this basic information available to him.

It may be of value to the regulatory official to determine the mold count of a tomato product, but for the food manufacturer to keep his Howard mold count low by constantly checking the count of the finished product would be to ignore the fact that the Howard mold count is a measure of the use of decomposed tomatoes and this might be better and more directly controlled by not allowing rotten material to get into the product. It is possible to make insect fragment counts of flour and attempt to reduce this count by continual manipulation of the raw materials and flouring system but a much more direct approach would be to mill clean wheat in a clean mill and allow the insect fragment count to take care of itself. If the latter procedure is followed only insignificant insect fragment counts will be obtained on the finished product. True, there is a place for these microscopic analytical methods, but their usefulness is only being partially realized if the accent is placed upon final results while ignoring the practices that went into this final result. If mold comes from rot, good commercial practice requires that the plant pay attention to rot. If rodent hairs come from ground-up rodent excreta, good commercial practice requires that the plant either not use raw material contaminated with rodent excreta or that it clean up a rodent infestation within the plant so that their product will not be defiled.

However, where these methods will shed light on the quality of the raw material, and so prevent adulteration of the product, then the raw material should be subjected to such examinations. Not only will this type of analytical work permit the avoidance of contaminated raw materials, but it will also serve to keep out of the plant certain types of contamination that

will spread through stored raw materials or the processing equipment with an accompanying contamination of previously uninfested materials. It is better to know in advance that a raw material should be rejected, or that it needs fumigation before it spreads an insect infestation through the equipment, than to accept it blindly and be obliged to follow up with an expensive clean-up and fumigation after it is used. It is much better to realize that a particular material has so much rot in it that it cannot possibly be handled by the sorting and trimming available at a plant than to attempt to handle it unsuccessfully and so end up with a violative product. It is short sighted to hold up production trying to make a satisfactory product out of unsatisfactory material and so keep sound material on the receiving platform until it becomes rotten.

When the use of these procedures heads off a source of potential trouble, then these methods are being used to a better advantage than when they are used to find out too late that the product is violative. Thus, the first use of the microscopic-analytical approach is in raw materials control. In this regard, the role of microscopic analysis is to determine by the most simple and direct means just what the condition of the raw materials is. In some cases this phase may be best handled by field men who are aware of general crop conditions and the specific problems of individual producers. However, there are other instances where laboratory control is required to determine the presence of undesirable characteristics that are not visible to the unaided eye. This might be the case when partial processing of an ingredient has obscured the condition of the product. Microscopic analysis would be useful in judging the quality of a raw material in which there was an opportunity to remove certain superficial or obvious evidence of adulteration or contamination while leaving the basic contamination within the material. Microscopic analysis has been used for years to detect the presence of adulterants deliberately added so that a desirable material is debased by the addition of a less valuable component. In all of these instances the examination may not only reveal some basic information useful in accepting or rejecting a commodity but these techniques can be used in investigating how reliable a processing operation is in doing a given job. A test of the adequacy of a cleaning or reconditioning operation would probably employ such analytical methods for here the original, perhaps obvious, nature of the adulteration might be so obscured by the reprocessing that laboratory analysis might be needed to determine whether the material was, in fact, cleaned, or whether the contamination was now merely more obscure.

A similar condition prevails in determining whether an undesirable condition can be removed by passing the food or raw material through a particular processing operation, or in judging the relative efficiencies of different technological processes.

Finally microscopic-analytical procedures have a place in finished product control. Data obtained from such techniques provide management with the means of checking compliance by the production staff with operating procedures designed to insure the production of clean, sound and legal products and it is possible to obtain information on the presence or absence of certain contaminants that may have crept in unnoticed during processing. This phase of the work is receiving special attention at this time and you may be interested in some new developments along this line.

Many of the microscopic-analytical methods are procedures for the extraction of insects and insect fragments from foods and drugs. Although the identification of *insects* follows the characters set forth in the usual entomological literature, the identification of insect *fragments* is made on the basis of other characteristics that are sufficiently durable to withstand the grinding and pulping that are part of the food processing operations. Observations on a wide variety of products are now underway, and we now recognize that it is possible to differentiate between insect fragments contributed by the raw materials, insect fragments contributed by insanitary factory conditions, and insect fragments contributed by infestations after processing. Although much information on food plant sanitation is developed through plant inspections, qualitative determinations of the insect fragments present actually can be used to throw some light on factory conditions. Such information can be used by the plant management as a check upon sanitation control, and it can similarly be used by regulatory officials to provide tangible evidence that a food was prepared, packed, or held under insanitary conditions. Work along this line is now appearing in the literature and, while it is not the purpose of this paper to go into extensive details along this line, it appears appropriate to cite some examples of this type of work.

Without going into the complexities of insect morphology, and the friability and structure of the insect exoskeleton, it may be stated that when insects pass thru a food processing operation the exoskeleton, including the appendages, may be broken into many fragments. The mouth parts of many groups of insects consist, in part, of a strong, toothed, chewing structure called the mandible. The very presence or absence of mandibles will serve to differentiate certain groups, but even within the mandibulate insects the mandibles

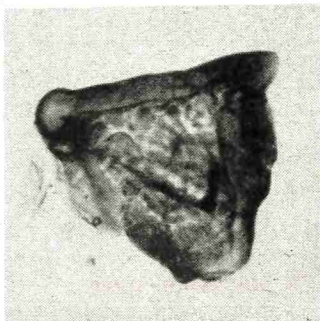


FIGURE 1. Rice weevil larva mandible.

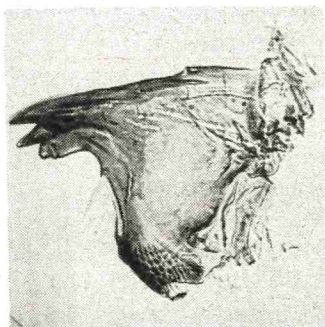


FIGURE 2. Sawtoothed grain beetle larva mandible.

can be used to differentiate between groups or actually can be used to distinguish specific insects. Moreover, the mandibles are rather durable structures that will survive a good deal of rough mechanical handling.

They have a further useful characteristic of being extracted by the microscopic-analytical methods relatively easily, and they are readily identified microscopically. Putting all of these characteristics together, some work was done on the possibility of distinguishing between insect fragments that may have arisen from internal insect infestation in grain and insect fragments arising from mill and/or bakery sanitation. Knowing that, for example, the rice and granary weevils are primarily pests of grain, and that the *Tribolium* beetles are primarily pests of milled or partially-milled materials and of the establishments where such materials are handled, it is relatively easy to see that the identification of their mandibles would provide a clue as to the source of contamination. Insect mandibles can be identified by their micromorphological characteristics as shown in Figures 1 and 2. Figure 1 is a photograph of a rice weevil larva mandible, and Figure 2 shows the mandible from the larva of the saw-toothed grain beetle. This is a simple example of a type of investigation that can be and is being carried on at this time, so that the mere quantitative counting of miscellaneous insect fragments that has served us so well for many years is finding a new assist from the qualitative appraisal of the insect parts.

Thus in microscopic-analytical methods the manufacturer has at his disposal techniques for the selection of raw materials and the establishment of a final check upon his output that may provide management with information on the entire production operation.

FORTY-FOURTH ANNUAL MEETING

BROWN HOTEL — LOUISVILLE, KY., OCTOBER 8, 9, 10, 1957

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SOME OBSERVATIONS ON TESTING MILK SAMPLES FOR ANTIBIOTICS¹

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When the Difco Bioassay Kit using whey agar and *B. subtilis* is used for the detection of growth inhibiting substances in milk for cheese manufacture, it is seldom that any antibiotic other than penicillin will be detected even though their concentrations will prevent the growth of the starter culture in the cheese milk.

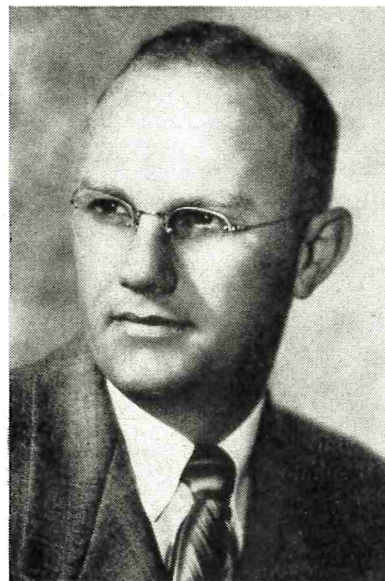
Before being analyzed for growth inhibiting substances milk samples can be frozen and stored for at least 12 weeks without reducing the accuracy of the results.

The cheese industry of Idaho has in the past few years experienced increasing amounts of starter trouble. To determine whether antibiotics in the milk supply were the cause of this trouble, milk samples were collected from a wide area. This required some method of preserving the samples for analysis at a central laboratory. The objective of this study, carried out in 1954, was to determine if frozen storage of milk samples containing antibiotics could be used to preserve such samples without interfering with the analysis for antibiotics.

PROCEDURE

The Difco Bioassay kit for penicillin was used in this study (3). One hundred ml. of sterilized whey agar at 50°C. was seeded with 1 ml. of a *Bacillus subtilis* spore suspension. Fifty ml. of the seeded agar was placed in a 9-inch pyrex pie plate. This was covered with a similar plate and allowed to cool to room temperature. Standard discs containing varying quantities of penicillin and the sterile disc containing the milk to be tested all were placed in this one culture dish and incubated at 35.5°C. for eight hours before comparing the zones of inhibition.

Various antibiotics were added to milk samples in such concentrations that their inhibiting power on *Streptococcus lactis* type dairy cultures approximated that of 0.1 to 0.2 units of penicillin, the latter being determined by bioassay as described above. Mixed milk from the University of Idaho dairy herd, previously tested and known to be free of growth inhibiting substances, was used in preparing the samples. Five hundred ml. of each sample was pre-



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pared. The various antibiotics used and their concentrations are shown in Table 1.

Two controls were used. One was a portion of the same milk used to prepare the samples containing the antibiotics and the other was nonfat dry milk reconstituted to 9 percent solids. The latter was previously tested and known to be free from growth inhibiting substances.

After the antibiotics were thoroughly mixed with the milk, 9 ml. portions were pipetted into small vials. These vials were placed in frozen storage in a cold room where the temperature ranged from 0° to 10°F.

After data had been collected for a number of weeks, a new set of samples was prepared using the same calculated amounts of antibiotics except that two smaller concentrations of terramycin with poly-

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TABLE 1 — THE INHIBITING EFFECT OF VARIOUS CONCENTRATIONS OF SEVERAL ANTIBIOTICS

Treatment	Calculated concentration	Titrateable acidity (av. of 7-12 replicates)	Diameter of zone of inhibition ^a	Coagulation (av. of replicates)
	(per ml.)	(%)	(mm.)	
1. Control				
Reconstituted milk	none	.84	0	firm, complete
2. Control, herd milk				
a 1st series	none	.74	0	weak-firm, complete
c 2nd series	none	.77	0	weak-firm, complete
3. Procain Penicillin G in aqueous solution				
a 1st series	0.1 units	.58	19	none-slight
b 1st series	0.2 units	.29	23	none
c 2nd series	0.1 units	.68	12	none-complete
d 2nd series	0.2 units	.35	19	none
4. P-35-10 ^b oil base				
a 1st series	0.2 units	.53	21	none-very slight
b 1st series	0.4 units	.26	24	none
c 2nd series	0.2 units	.76	12	slight-complete
d 2nd series	0.4 units	.65	19	none-slight
5. Terramycin with polymyxin B sulfate				
a 1st series	1.55 micrograms	.20	0	none
b 1st series	3.10 "	.18	15 ^c	none
c 2nd series	0.62 "	.25	0	none
d 2nd series	1.24 "	.22	0	none
6. Neomycin				
a 1st series	2.0 "	.51	0	slight-complete
b 1st series	4.0 "	.31	0	none
c 2nd series	2.0 "	.55	0	none-slight
d 2nd series	4.0 "	.28	0	none
7. Terramycin hydrochloride				
a 1st series	0.2 "	.49	0	none-slight
b 1st series	0.4 "	.29	0	none
c 2nd series	0.2 "	.57	0	none-slight
d 2nd series	0.4 "	.31	0	none
8. Dihydrostreptomycin				
a 1st series	0.8 "	.60	0	slight-complete (weak)
b 1st series	1.6 "	.39	0	none-very slight
c 2nd series	0.8 "	.68	0	none-slight
d 2nd series	1.6 "	.47	0	none-slight
9. Aureomycin				
a 1st series	0.1 "	.46	0	none-very slight
b 1st series	0.2 "	.28	0	none
c 2nd series	0.1 "	.50	0	none-very slight
d 2nd series	0.2 "	.28	0	none

^aDiameter of zone inhibitions given by penicillin standard assay disc were .05 units, 12 mm; .10 units, 19mm; .25 units, 23mm; .5 units, 27mm.

^bP-35-10 contains penicillin, streptomycin, neomycin, sulfanilamide, sulfamerazin, and sulfathiazole (calculation based only on penicillin content).

^cMost samples were zero, only 2 samples showing slight inhibition.

myxin B were used. These samples are shown in Table 1 as 5c and 5d and contain 0.62 and 1.24 micrograms per ml, respectively.

The Difco Bioassay method using *B. subtilis* as the test organism, and acid production when the milk samples were inoculated with 1 per cent commercial

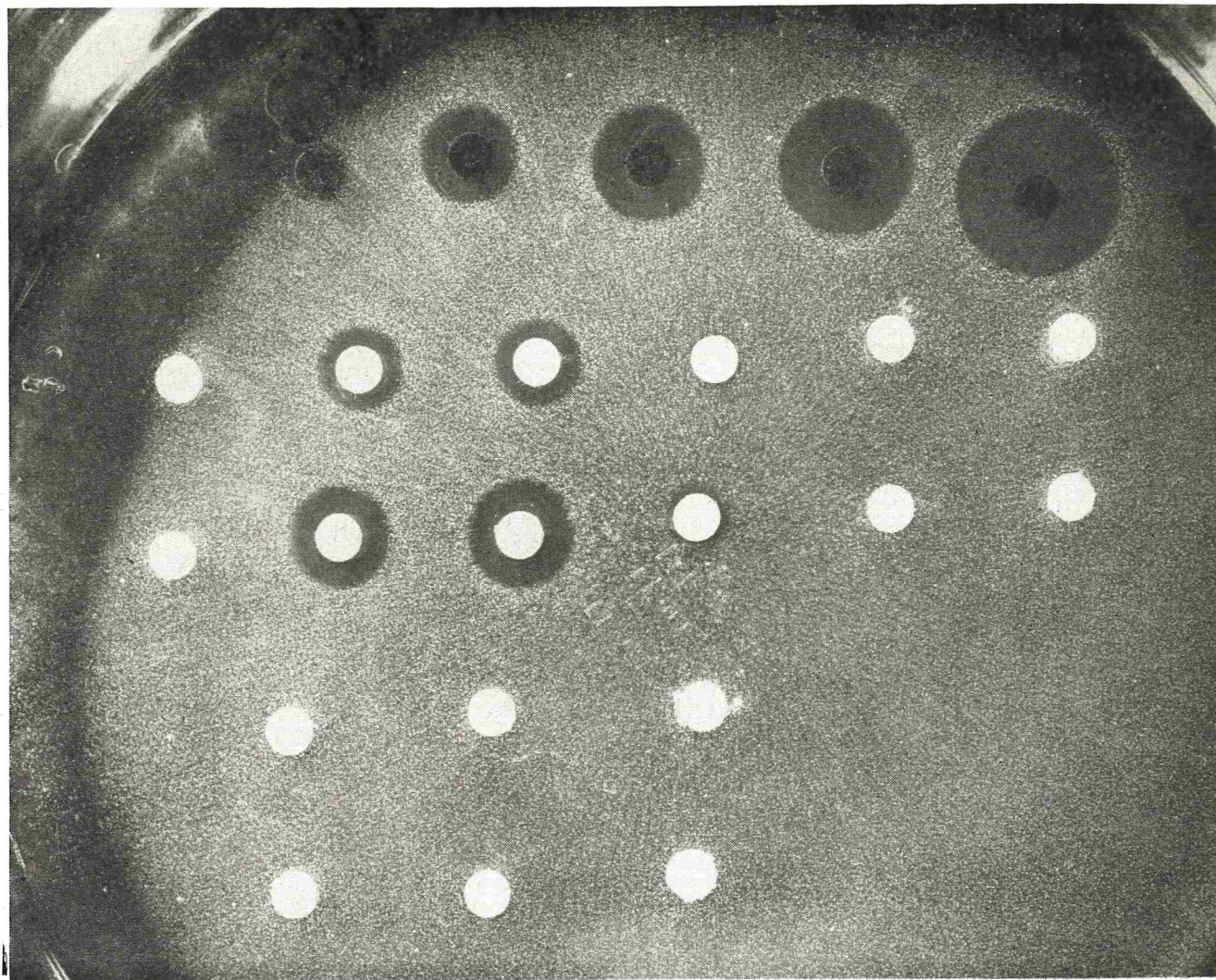


FIGURE 1. Bioassay for antibiotics, left to right:

Top row: colored disc, penicillin assay standards, 0.05 units, 0.1 units, 0.25 units, 0.5 units and 1 unit.

2nd row: control (1)*, penicillin (3a), P-35-10 (4a), terramycin with polymyxin B (5a), neomycin (6a), and terramycin H Cl (7a).

3rd row: control (2), penicillin (3b), P-35-10 (4b), terramycin with polymyxin B (5b), neomycin (6b), and terramycin H Cl (7b).

4th row: dihydrostreptomycin (8a), aureomycin (9a), unknown milk sample (10a).

Bottom row: dihydrostreptomycin (8b), aureomycin (9b), and unknown milk sample (10b).

*Numbers in parentheses refer to identification of samples as given in Table 1.

lactic starter organisms and incubated at 70°F for 16 hours, were used to detect the presence of the antibiotics. A sample was considered as showing the influence of a growth inhibitor when the titratable acidity produced was not more than 75 per cent of the titratable acidity of the control samples.

The type and degree of coagulation also were noted. Coagulation was recorded as complete when the entire contents of the vial were clotted, as slight when at least half of the vial was clotted, and as

very slight when coagulation was noticeable in the bottom portion of the vial. When a sample was completely coagulated, a notation was made as to firmness of the clot. The samples were analyzed at intervals, usually weekly, for 15 to 17 weeks.

RESULTS

A summary of the results will be found in Table 1. These are average values obtained from all sam-

ples for each treatment for the first 12 weeks of frozen storage. These data show that the controls gave reasonable acid production and that the vials of milk were completely coagulated. However, the coagulum varied in the degree of firmness.

The samples containing antibiotics varied from normal acid production to no acid production. The bioassay method consistently detected only those samples containing penicillin.

The results shown in Figure 1 are typical of the bioassays obtained for the a and b series of samples. (see Table 1) The c and d series gave similar results with the exception of terramycin with polymyxin B.

Sample 5b containing terramycin with polymyxin B produced a small zone of inhibition in some replicates of series 1 but not in others. The inhibiting power of this antibiotic on lactic cultures is far greater than indicated by the bioassay.

DISCUSSION

There was no noticeable effect of frozen storage on the ability of an antibiotic to prevent normal growth of lactic type starter organisms for periods up to 12 weeks. Due to the destabilized condition of the milk protein, the thawed samples were unsatisfactory after the 12 weeks time for the observations on curd formation or type of coagulation. This condition was attributed to the temperature fluctuation in the cold storage room.

The antibiotic level in some samples (see 3c, 4c, 6a, and 8a in Table 1) appeared to be added at threshold levels. In these samples an inoculation of one percent of lactic starter was enough in some cases to obtain coagulation while in other cases the acid production was stopped before the proper pH for clotting had been reached. Milk containing antibiotics at this level could probably be made into cheese by the use of increased amounts of starter inoculation (1).

In most samples containing antibiotics other than penicillin, concentrations sufficient to be inhibitory to lactic type cheese starter organisms were not detected by the bioassay. Dairy plants that use the bioassay to check vats of milk for freedom from antibiotics could easily miss many samples which would not support proper growth. It should be point-

ed out that the Difco Bioassay kit was developed to test for penicillin and for this we found it to be satisfactory. The use of *B. subtilis* does not appear satisfactory for detecting the presence of other antibiotics that are common for the treatment of mastitis and which may appear in milk from time to time.

The only antibiotic other than penicillin that gave positive results with the bioassay was the terramycin with polymyxin B sulfate. The zone of inhibition was occasionally present only in the highest concentration used in the first series and did not show at all when the trial was repeated. Yet, the samples containing the terramycin with polymyxin B sulfate had the lowest acid production of any of the samples used in this study.

Work recently reported by Johns and Berzins (2) indicated that improvements in the bioassay method would increase the sensitivity of the method making it more useful. These workers suggested that a different test organism may be found which will be more suitable for the different antibiotics.

On the basis of inhibition of acid production in relation to concentration of the antibiotic added, aureomycin appeared to have the strongest inhibitory effect; however, further comparisons between terramycin with polymyxin B sulfate and aureomycin using more dilute concentrations than those used in this experiment should be made.

CONCLUSIONS

Milk samples can be satisfactorily stored in a frozen condition up to 12 weeks without influencing the analysis for antibiotics.

The Difco Bioassay method of analysis for penicillin is not reliable for use in assaying for other antibiotics at levels that restrict growth of starter organisms.

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THE FUTURE OF THE SANITARY CONTROL OF MILK AND MILK PRODUCTS¹

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The opportunity to take a long look ahead on developments in the official control of the sanitation of milk and milk products is welcomed. The role of prophet is a new one to me, however, I will take an engineering approach and plot the trends in various facets of the official control of milk sanitation by going back to about the beginning of the twentieth century in order to establish a basis for the extrapolation of trends perhaps as far as or into the twenty-first century. This procedure is by no means exact but is perhaps superior to that followed by the crystal gazer or charlatan. For the sake of brevity let us consider the control of the sanitation of fluid milk with the understanding that most of the discussion also applies to fluid cream and that control of pasteurization also applies to most milk products.

DAIRY FARM INSPECTION

First, let us consider dairy farm inspection. This practice originated in the days when the family physician, serving as part-time health officer, associated milk with some of the cases of disease he was attending in his urban and rural practice. It was only natural for him to stop at the dairy farm in his rounds by horse and buggy and attempt to give the part-time dairy farmer the benefit of his capable, but then not too scientific, advice on how to produce safe milk.

Thus was established the basic principle of inspection by the health authority of the community in which the milk is consumed and which has been carried down through the years. Milk sheds expanded. The part-time health officer employed a dairy farm inspector only to be replaced in later years by a full-time health officer with his staff of farm inspectors. When it became increasingly difficult to get the budget appropriations necessary to support the numerous dairy farm inspectors required to cover metropolitan milk supplies, some turned to the alternative of requiring the milk industry to provide qualified field service men whose work was subject to approval by supervising inspectors on the city payroll. This trend is likely to continue. Certainly there is no reason to

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believe that it will be checked or reversed.

In the future the task of dairy farm inspection may be modified materially by advances in equipment. The pipe line milker, the farm milk storage tank, and the farm pick-ups of milk by tank truck have come to stay. Because of labor-saving and other economies the trend will continue in that direction. Fortunately, this carries with it the promise of improved sanitation. There also is the possibility for the development of more compact dairy farms of the Los Angeles type consisting of a pen and feeding area for a hundred or more cows and a milking parlor with all breeding of cows and growing of feed being done elsewhere. If there is emphasis on dairy farm inspection, the location of a number of such dairy farms on the outskirts of the city in which the milk is consumed does simplify the problem of official inspection by such

city because of decreased numbers and the convenient location of such farms. However, it is quite likely that economics will govern this development rather than farm inspection requirements.

Currently there exists in the United States several different patterns of official control by cities in which work on dairy farm inspection varies, according to Dahlberg's survey (1) from zero in the case of Boston to 10.6 inspections per farm per year in the case of Birmingham, Alabama. Between these extremes we have Chicago with at least 2 dairy farm inspections a year to meet the Public Health Service Ordinance in effect there, and New York City with only a small staff of inspectors to make check inspections of dairy farms. It should be borne in mind that one farm inspection a year is made by official state health department inspectors at state expense on all dairy farms located outside the state; and that within the state, industry-employed field service men are required to make at least one inspection of each dairy farm each year. Furthermore, in Massachusetts the Department of Agriculture of the Commonwealth is required to make annual inspections of dairy farms which includes those supplying Boston with milk.

In upstate New York cream for the manufacture of ice cream is not required to be from dairy farms under official inspection; and during shortage periods, cream for all purposes has been brought into Boston without advantage of any dairy farm inspection.

In metropolitan areas, like Boston for instance, efforts to adhere to the old principle of the inspection of dairy farms by the health officials of the community in which the milk is consumed leads to multiplicity of responsibility for inspection, duplication of work, and impossible situations as to travel requirements and costs.

The conclusion is correctly drawn from the data presented by Dr. Dahlberg in his report for the National Research Council (1) that increased emphasis on dairy farm inspection is reflected slightly in the quality of the milk. However, differences in number of inspections as previously stated ranged from none or perhaps one to 10.6 per farm per year. On the other hand no claims are made for increased safety of the milk and the reported improvement in quality is very slight. If the city of New York with perhaps 0.5 official farm inspections per year were to step this up to the number made by Birmingham, or even to the minimum of 2 inspections per year required by the Public Health Service Code, many additional dairy farm inspectors would be required. In the light of present knowledge and with the facts at hand, it is not at all likely that public health officials would or could persuade budgeting authorities to appropriate funds for such increases in staff.

This leads to the prediction that the next fifty years will bring less and less official dairy farm inspection with the shifting of this burden to industry. In all industries today, including those making strictly mechanical products, there is increasing emphasis on QUALITY CONTROL with considerable expenditures to maintain staffs and laboratories for the purpose. The milk industry does this to a considerable extent at present but may anticipate increasing demands from public health officials for them to assume this responsibility. It is hoped that this will not take the form of regulations prescribing exactly what must be done, especially in the line of dairy farm inspection, but more properly what must be accomplished from the standpoint of milk quality.

ALLOCATION OF MILK

Anticipated future increases in the density of population is sure to result in further overlapping of metropolitan milk sheds beginning in the Northeast. This will lead increasingly to consideration of milk as a public utility. Of course there are more devious ways of allocating limited supplies of milk than by public decree. The establishment of Federal Marketing Areas and more general adoption of regulations encouraging the interstate shipment of fluid cream, and perhaps of 3 to 1 concentrated fluid milk, may accomplish the purpose of allocating and piecing out limited supplies of milk without establishing milk as a public utility. It is quite likely that control of increases in population will precede the exhausting of the possibility of expanding the milk supply along the lines indicated to meet demands.

SAFETY OF MILK-PASTEURIZATION

One rather simple future solution of the problem of milk sanitation would be the production of synthetic milk. This would reduce official control to that required for food processing plants. Taking into consideration present substitutes for butter and cream it would be rather audacious to say that milk never will be manufactured from organic constituents but it can safely be predicted that synthetic milk will not be commercially feasible within the next century. Continued reliance must be placed upon pasteurization to make milk and milk products safe.

Since the turn of the century, stupendous strides have been made in applying the pasteurization process to milk and in developing dependable commercial equipment for everyday use in protecting the health of millions of people. Starting with the Endicott tests, the faults of vat type pasteurizers were disclosed, inefficient types discarded, and effective equipment was

developed and used. Further cooperation between research workers in the milk industry and public health resulted in the development of safe equipment for pasteurization by the high temperature — short time process. Dahlberg's survey showed that in the eight large city markets included in the study, from 77 to 99 per cent of the cream-line milk and from 87 to 99 per cent of the homogenized milk was pasteurized by the high temperature — short time process. The increased use of high temperature pasteurization will continue and the trend toward pasteurization at still higher temperatures in such equipment as the vacreator is developing and will continue to develop gradually. This, together with the increased popularity of homogenized milk, serves to give a greater margin of safety in heat effect than is possible by the pasteurization of cream-line milk by the historic low temperature process.

In my opinion there is no prospect that the treatment of milk by radiations, whether from high speed electron accelerators or from radio-isotopes and whether of beta or gamma type, will replace pasteurization. All attempts by experimentors to sterilize milk by radiations have resulted in ruining the flavor and other physical properties of the milk due, among other things, to the difficulty in destroying the enzymes. Research is being diverted to trying to accomplish the destruction of bacteria to an extent equivalent to pasteurization instead of sterilization. While this may be accomplished it is not likely, from the standpoint of practical economy, that the process will replace pasteurization within the next half century.

What, then, does the future hold in store for control of the vital process pasteurization? As recently as 25 years ago we had to deal with the health officer of the rural community of the fringe of the metropolitan district who boasted of the quality of the highly questionable raw milk supply and refused to issue permits to the "big city" dealers to bring in safe pasteurized milk. Today there is practically unanimous agreement by health officials everywhere that pasteurization of milk is essential for the protection of the health of the public. Most of them realize the importance of maintaining official supervision over pasteurization plants and progressive milk plant operators value this service when, as is usual, it is intelligently performed. There is the danger, however, that health officials will be lulled to sleep by the absence of milk borne outbreaks of communicable disease and will listen to the appeals of the budget pruners to cut this service below all reasonable limits. The result could be equivalent to that now obtaining in some communities in which health officials, yielding to the opposition of "cranks" or to public apathy or trying to affect economies, ease their efforts at immunizing the public against some

disease that has been brought under control, and as a result the public is faced with a serious outbreak of such disease. The trend is quite sure to be in the direction of side-stepping public responsibility, either as a result of budget-pruning or otherwise, and toward depending more and more upon industry to maintain control over the safety as well as the quality of the milk sold. This applies to an even greater extent to milk products.

PACKAGING AND DISTRIBUTION

Official control over the packaging, distribution, and sale of milk has changed during the past half century and no doubt will be subject to further change. The days of so-called "curb-stone" permits, when John Smith asked the part-time village health officer, "Doc" Jones, on the street if he could sell milk and Doc said "Yes", are gone forever. Not only is it necessary to satisfy the local health official and to get a written permit from him, but generally a state agricultural official or a milk control board as well, before commencing the sale of milk. One principle that has sometimes been overlooked is that, assuming that officials are effectively enforcing regulations, if milk is safe for human consumption in one community it should be safe for 41 other communities. Another basic principle is that a health officer should deny a permit for the sale of milk only for failure of the applicant to comply with requirements of the health law and sanitary code. Taking into consideration not only these principles, but the trend toward large health units, such as county or district units, the future trend is toward fewer permits covering larger distribution areas.

Development of the packaging of milk for distribution has come a long way since the day when the dairy farmer put a can of milk with a dipper on his truck and went from door to door filling pails on doorsteps. The old heavy long necked glass bottle has been replaced by bottles of much lighter weight and more convenient shape, removing the emphasis from accentuating the cream line. More recently the single service paper container and the approved bulk milk dispenser have been accepted. In single service containers there is an observable trend from paraffin to plastic coatings. The new Swedish tetrahedron paper containers may find a place for packaging small portions of milk. However, it is more likely that coffee cream will be put up in individual servings in this container by milk plants for restaurants. Another possibility in this field is the plastic envelope with built-in spout for pouring. Much could be said in favor of two quart containers from the standpoint of economy of household refrigerator space. Availability and economics are likely to govern this trend.

After some 44 years we still have with us the old regulation requiring the placing of the day of pasteurization on the caps of bottled milk. It may be said to the credit of the state and city health officials and the Public Health Service that there is no insistence upon introducing this requirement in places where it is not in effect. Although, in some instances, health departments have favored requests from industry to rescind such requirements, attempts to do so have not met with much success. After witnessing, with Dr. Dahlberg, within the past few months, a public hearing at which an unsuccessful attempt was made to rescind such a requirement in one of our large cities, I predict that some such requirements, although becoming more and more meaningless, are likely to remain in effect for the next half century.

The home delivery of milk is another field in which there have been many changes in recent years. Every other day delivery has been replaced by deliveries three times a week in many localities. If dating were of health significance, infrequent delivery would be of greater significance, yet the change has been accomplished with little furor. It would appear that if home deliveries were made any less frequently than this that the trend would be toward purchasing all milk from stores with perhaps an accompanying decrease in total per capita milk consumption.

LABORATORY CONTROL

Much progress has been made but there is room for still greater progress in the laboratory control of milk supplies. Again going back to the early nineteen-hundreds much dependence was placed upon standard plate counts made by a very unreliable technic. Health officers were concerned about the use of the "farm pump" to augment the milk supply and also of butter-fat content largely because of consumer interest. As milk quality improved, less use was made of the lactometer and butter fat test, and, as the pasteurization of milk became more general, the usefulness of the standard plate count diminished. The work of Breed and others to improve the reliability of the standard plate count through the amendment of the *Standard Methods* of the American Public Health Association helped restore confidence in its usefulness for some purposes. However, when health officials became convinced that commercial pasteurization of milk offered adequate protection to the public health, much interest was displayed in the development of a test that would tell them whether or not milk had been adequately heat treated. The phosphatase test filled this need and rapidly came into general use. No doubt it is here to stay both in field and laboratory

applications and will increase in usefulness as experience develops.

The advantages of the coliform test for the examination of pasteurized milk and milk products should not be overlooked. Properly pasteurized milk should not contain organisms of the coliform group notwithstanding the efforts of some sanitarians to explain them away. Even they should agree that coliforms should not be present to the extent of 1 per ml. which concentration is indicated when the coliform plate count is used. Some well-regulated plants operate around the calendar without a positive coliform test. This is not in criticism of the commonly used minimum standard of not more than 10 per ml. which is quite useful under present conditions. However, high quality milk should show much lower coliform counts and the future trend should be in that direction. We may anticipate a simpler test for coliform organisms in milk that may be used by small milk dealers and rural health departments with no more extensive equipment than a very small 35° C. incubator. A German invented this test two or three years ago and has applied for U. S. Patents. Material for performing the test now is on sale by a Swiss concern, namely BACTO-STRIP A. G. in Zurich. A dry sterilized paper strip containing the required media and dye is supplied in a plio-film envelope. The strip is carefully withdrawn from the envelope after cutting the end and absorbs just 1 ml. of the milk to be tested when dipped in the sample. The perforated end of the strip contaminated by the fingers is torn off and discarded as the wet strip is returned to the envelope which is resealed by heat. It is then placed in an incubator at 35° C. for just 10 hours (no more) and then the minute bright red dots are counted giving an estimate equivalent to a coliform plate count of the number of coliform organisms per ml. of milk. The very limited amount of work done in our laboratories with sample strips leads me to believe that it has good possibilities at least for the previously mentioned uses. This leads to the prediction of further development of convenient laboratory methods during the next fifty years.

Little, if any, attention has been paid to determining what constitutes a representative sample of a large daily output of pasteurized milk. This deserves study and the next half century should see the introduction of methods of sampling that will be more representative than the taking of a random quart from supplies totaling thousands of quarts daily.

INTEREST OF HEALTH OFFICER

Finally, let us consider the attitude of health officials toward the control of milk and milk products. This is still of some importance even though budget di-

rectors appear to be exerting ever greater influence on the direction of effort in health programs. At the turn of the century health officials were mostly part-time physicians. They were practically unanimous in proclaiming cow's milk and its products as excellent food for humans, even though it was then unpasteurized; and the more progressive ones knew that in many instances its consumption was causing sickness and death. Some even went so far as to characterize milk as "nature's most nearly perfect food". As the years progressed the milk industry with the cooperation of the leaders in public health, through the introduction and improvement of pasteurization and other control procedures, eliminated milk as a medium for spreading such common diseases as tuberculosis, typhoid fever, and streptococcal sore throat.

About two decades ago when this point had been reached in New York State my complacency was jarred by an eminent health official suggesting that now the emphasis on control of milk sanitation might be re-directed and adding that he was not even sure that milk was a good food for humans.

Quite recently some of the news media have taken "pot shots" at milk by reporting that some investigators feel that milk may play a role in stimulating cancer, that excessive milk fat may cause heart disease, and that the radio isotope strontium 90 in milk may accumulate in the bone marrow. Perhaps an equally searching inquisition of other foods would bring similar results. We also should bear in mind that the human body requires certain trace elements which

would be toxic, however, in much greater quantity. Of course, the milk industry is faced with the need for sponsoring research designed to separate fact and fiction.

To my thinking the raising of these doubts is not an unmixed evil as it may serve to create a renewed interest in milk and milk sanitation on the part of those health officials who now can think only in terms of devastating diseases such as cancer and heart disease.

SUMMARY

It is quite certain that under the lash of budget control there will be an increasing tendency for health officials to saddle the milk industry with as much as possible of the responsibility for maintaining the safety as well as the quality of public milk supplies. More and more the public will look to the milk dealer for a warranty as to the quality and safety not only of milk products but of market milk as well. However, some well directed official control of milk sanitation always will be necessary and no doubt will be available during the next fifty years or more notwithstanding efforts to direct official activity elsewhere.

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NEWS AND EVENTS

DR. HOWARD H. WILKOWSKE RECEIVES PROMOTION

Dr. Howard H. Wilkowske was named assistant director of the University of Florida Agricultural Experiment Stations today by the State Board of Control. His appointment was submitted by President J. Wayne Reitz and Provost William M. Fifield.

Dr. J. R. Beckenbach, who recommended his appointment, says "We are glad to have a man trained in animal science on the administrative staff of the Experiment Station to work with Dr. Roger Bledsoe and myself."

Dr. Wilkowske succeeds Dr. John W. Sites, who has been acting head of the fruit crops department as well as assistant director since July 1. Dr. Sites will now give full time to the fruit crops research, teaching and extension work.

A native of Wisconsin, he joined the staff of the University of Florida College of Agriculture and Ex-

periment Station March 1, 1950, as assistant in the dairy science department. He was promoted to associate dairy technologist July 1, 1954. In his new post he will continue as dairy technologist.

A 1940 graduate of Texas Technological College, he obtained a master's degree there in 1942 and his doctorate from Iowa State College in 1949. He worked two years each in the dairy departments at Texas Technological College and Iowa State College while getting his advanced degrees.

From 1942 to 1945 he was an officer in the United States Navy.

In the seven years he has been in Florida he has published 33 scientific and popular papers on dairy science subjects.

Dr. Wilkowske has been secretary-treasurer of the Florida Association of Milk Sanitarians since 1950 and of the International Association of Milk and Food Sanitarians since 1952.

He is a member of the American Dairy Science As-

sociation, advisory member of the Florida Dairy Association, member of Sigma Xi scientific fraternity, and deacon in the University Lutheran Church. He is married and has three children.

CONCERNS HOLDING AUTHORIZATIONS TO AFFIX THE 3-A SYMBOL TO STAINLESS STEEL STORAGE TANKS FOR MILK OR MILK PRODUCTS

- # 1 Chicago Stainless Equipment Co., 5001 Elston Ave., Chicago 30, Ill. Models: E, ERS, ERW, ERWA, ERSS, ERWS, ERWMS, S, RS, RW, RWM, RSS, RWS, RWMS, R, RRS, RRW, RRWM, RRSS, RRWS, RRWMS, V, VRS, VRW, VRWM, VRSS, VRWS, VRWMS. Authorization expires 4/30/57.
- # 2 Creamery Package Mfg. Co., 1243 Washington Blvd., Chicago 7, Ill. Tanks not designated by model numbers. Authorization expires 4/30/57.
- # 3 Stainless, Inc., 15048 Delano St., Van Nuys, Calif. Models: B (rectangular) O (Cylindrical). Authorization expires 6/18/57.
- #21 The J. A. Gosselin Co., Ltd., Box 308, Drummondville, Quebec. Models: CH, CV, and RH. Authorization expires 9/19/57.
- #28 Cherry-Burrell Corporation, 501 Albany Road, Little Falls, New York. Models: DHP, DHS, DHCW, DVP, DVCW, EHP, EHS, EHCW, EVP, EVCW, ER, EHW, R, and RW. Authorization expires 10/2/57.
- #31 Walker Stainless Equipment Co., New Lisbon, Wis. Models: HHT-1000 to 1000, HHT-1000R to 10000R, HET-750 to 3100, HET-750R to 3100R, RT-1000 to 10000, RT-1000R to 10000R, VHT-800 to 1800. Authorization expires 10/3/57.
- #39 Stainless & Steel Products Co., 1000 Berry Ave., St. Paul 14, Minn. Models: Cylindrical: ST-3E 1000 to 8000. Vertical: ST-3E 1000 to 8000. Rectangular: ST-5E 1500 to 7000. Authorization expires 10/19/57.
- #45 The Heil Company, 3000 Montana, Milwaukee 1, Wis. Tanks not designated by model numbers. Authorization expires 10/25/57.
- #53 The Pfaudler Co., 1000 West Avenue, Rochester 3 New York. Models: Cylindrical - Horizontal and Vertical. Rectangular. Refrigerated. Authorization expires 1/9/58.
- #54 Blackburn Stainless Steel Products, 9744 Firestone Blvd., Downey, Calif. Models: Horizontal and Vertical. Cylindrical. Rectangular. Authorization expires 1/22/58.

POSITION WANTED

Christian Defert, 200 6th St., S. E., Washington 3, D. C. - French, invited by U. S. Department of Agriculture, studied milk processing in France, England and U. S. (Cornell University 6 months) would be glad to communicate with any person interested in employing me in Milk Processing, possibly as trainee.

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Harvey W. Anderson, Chief, Milk Sanitation Section, Fulton County Health Department, Atlanta, Georgia with citation awarded him by the Georgia Chapter, IAMFS.

**THE GEORGIA CHAPTER
INTERNATIONAL ASSOCIATION
OF MILK AND FOOD SANITARIANS
MARCH 1957
*Annual Meeting***

The annual meeting of the Chapter and Sanitarians' Conference held on January 10-11 at the new Center for Continuing Education on the campus of the University of Georgia was very successful. Over 80 who

attended expressed themselves as being highly pleased with the whole program.

Citations Awarded

At the banquet held during the evening of January 10 the following citation was awarded to Harvey W. Anderson:

"In recognition of the attainment of an "Honor Roll" listing of the first milk shed of significant size in Georgia, continuously maintained since 1948.

The adoption of a positive policy against adulteration of milk in 1950 and 1951, which has in the face of heavy odds resulted in the elimination of watered milk on his milk shed.

First to establish and enforce a policy of requiring that bulk milk tanks comply with 3A Sanitary Standards and have vermin resistant lids. Today there are approximately 400 bulk milk tanks meeting 3A Standards and having vermin resistant lids on this milk shed.

First to establish and enforce a policy requiring "Cleaned in place" milk lines to meet 3A Sanitary Standards. This at first required replacement of many lines, some in their entirety.

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adulteration, excessive bacteria and foreign matter, evidenced by the suspension of 66 permits during the first eleven months of 1956.

High degree of success in promotion of modernization of milk plants and dairies. Seven milk plants and 62 farm dairies have been either extensively remodeled or new facilities provided during the first 11 months of 1956. Approximately 90% of this milk supply is processed at the new or remodeled plants.

Highly respected by leaders of the milk industry for sound judgment, fair dealing and progressive attitude.

The first and only milk sanitarian in Georgia to initiate a continuous program of rating his milk shed. Benefits derived are continuous training of field personnel, standardization of field duties and more diligent effort on the part of field personnel.

It is for this faithful zeal and success that the Georgia Chapter, International Association of Milk and Food Sanitation now honors for achievement in the field of milk sanitation."

HARVEY W. ANDERSON
Chief, Milk Sanitation Section
Fulton County Health Department

On the same occasion the following citation was awarded to Milton P. Moore:

"In recognition of the attainment of the first restaurant sanitation program in the nation to exceed 90% compliance with Public Health Service recommended standards, evidenced by an official Public Health Service restaurant survey, in April 1956, rated in 93.25% compliance.

Promotion of regulations governing eating and drinking establishments of the non-grading type adopted by the Spalding County Board of Health in 1952.

Organize and conduct annual food service personnel conferences (food handler schools) for management and employees thus aiding the operators in meeting local requirements and maintaining a high level of operational standards.

Cooperate with the Communicable Disease Center, USPHS, in the preparation of the food sanitation film strip series SS-S148K. This series was photographed in Spalding County.

Arrange cooperative licensing code with city officials so that city licenses and health permits would be issued or revoked simultaneously.

Inspection each thirty days and publication of appropriate numerical ratings through the press and radio, creating a competitive spirit among establishments, readily accepted by industry.

Systematic maintenance of food sanitation records.

Conduct a general environmental sanitation program in Lamar County, including adoption of regulations



Each bottle of Lo-Bax contains a measuring spoon

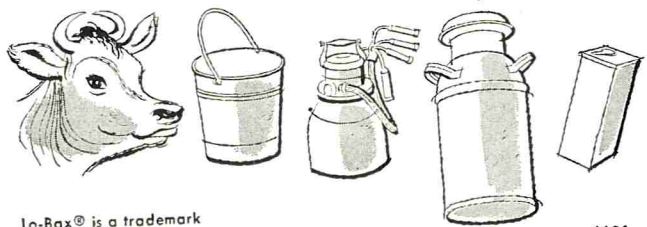
a little **Lo-Bax** goes a long way in protecting milk quality

Wherever bacteria threaten milk quality, the chlorine sanitizing action of Lo-Bax Special or LoBax-W (with wetting agent) gives quick and effective kills to minimize spoilage and rejects.

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governing eating and drinking establishments by the Board of Health in 1952, attaining official State Department of Public Health rating of 90.35% in 1955.

Local health department representative with State Department of Health and Welfare on the Joint School Lunch - Public Health Committee in 1955.

It is for this faithful zeal and success that the Georgia Chapter, International Association of Milk and Food Sanitarians, now honors, for achievement in the field of food sanitation."

MILTON P. MOORE

Sanitarian

Spalding and Lamar Counties

Both citations were signed by Louva G. Lenert, Chairman of the Awards Committee; John J. Sheuring, Secretary, and Garnett H. DeHart, President.

KLENZADE HOLDS 19TH SEMINAR

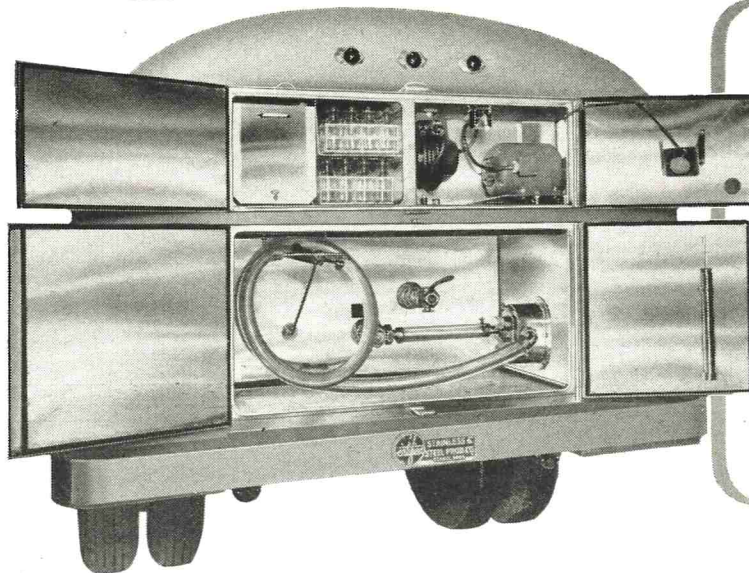
Over 700 of the nation's leading scientists, bacteriologists, sanitation specialists, health officials, dairy and food processing plant and institutional and hospital personnel attended the Klenzade 19th Educational Seminar recently held at the luxurious Shoreham Hotel in Washington, D. C. The superb accommodations of

the Shoreham were ideal for this unusually large assemblage and terminated in the most successful of all the Klenzade seminars yet held. The general meeting was called to order in the main ballroom of the hotel on Thursday, February 28, 1957. Among the principal speakers in the morning session were Mark D. Hollis, Assistant Surgeon General, Chief Engineer, Public Health Service, Department of Health, Education and Welfare, Washington, D. C.; Dr. P. R. Elliker, Chairman, Department of Bacteriology and Hygiene, Oregon State College, Corvallis, Oregon; Dr. Paul H. Tracy, Prof. Dairy Technology, Department of Food Technology, University of Illinois, Urbana, Illinois; Dr. K. G. Weckel, Prof. of Dairy and Food Industries, University of Wisconsin, Madison, Wisconsin; Prof. Harold S. Adams, Director of Sanitary Science Courses, Department of Public Health, Indiana University Medical Center, Indianapolis, Indiana and Lewis Dodson, Klenzade Products, Amarillo, Texas. The afternoon program was given over to panel sessions which continued throughout Thursday evening, Friday and Friday evening. Subjects covered included Sanitation Chemistry, Sanitation Bacteriology, Corrosion Prevention, Dairy Farm Sanitation, Dairy and Food Plant Sanitation, Cleaning Procedures in Dairy Process-



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Send for Bulletin No. PUT-1. Information also available on our complete line of milk transport and storage tanks.



Shown at the right is one of 7 Certified Bulk Milk Pick-up Tanks owned and operated by the Carnation Milk Company in Waterloo, Iowa and Oconomowoc, Wisconsin.

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ing Plants, Sanitation Control in Food Processing Plants, Recirculation, Spray and Automation Cleaning, Mechanical Dishwashing, Kitchen Sanitation for Better Food Flavors, Modern Chemistry in Institution Sanitation, and Special Problems in Food Service Sanitation. Consulting sessions were also held on Wednesday and Thursday evenings covering a broad variety of special sanitation subjects and problems. Many of the nation's outstanding leaders served as chairmen on these various consulting sessions including such well known personages as Dr. R. F. Holland, Head, Department of Dairy Industry, Cornell University, Ithaca, New York; Dr. C. K. Johns, Officer-in-Charge, Dairy Technology, Department of Agriculture, Ottawa, Ontario, Canada; E. Russell Jackson, Sanitarian, Bureau of Sanitary Engineering, Florida State Board of Health, Jacksonville, Florida; Wade D. Bash, Supervisor, Public School Lunch Division, Ohio Department of Education, Columbus, Ohio; and A. J. Steffen, Director of Sanitation, Wilson and Company, Chicago, Illinois. The guest list was by far the largest and most distinguished in the long history of Klenzade seminars. Subjects and programs were also greatly expanded and encompassed virtually all of today's most important sanitation problems facing the nation in the handling of food production of all types, as well as, environmental sanitation. Cheesebord luncheons were served each evening, and the main banquet with Dr. E. C. Thompson as Toastmaster and the internationally known Rev. Norman Rawson as speaker was held on Friday evening. Panel sessions continued through Saturday morning with a closing luncheon at noon with Dr. B. H. Jarman of George Washington University as the speaker. Copies of the major papers presented at the Seminar will be available. Interested parties are invited to write to Klenzade Products, Inc., Beloit, Wisconsin for a check list of subjects.

NATIONAL CONFERENCE ON BULK MILK HANDLING

May 13 and 14, 1957 (Monday and Tuesday)
MICHIGAN STATE UNIVERSITY,
East Lansing, Michigan

Sponsored cooperatively by the Departments of Agricultural Engineering and Dairy in cooperation with state and federal agencies and industry.

Assembly — Kellogg Center
Meeting Place — Anthony Hall, Dairy Building
Meals — Kellogg Center or Union
Co-Chairmen — Carl W. Hall and Donald L. Murray

Monday morning — May 13

8:30— 9:30 Registration

Chairman — Dr. N. P. Ralston, Head,
Department of Dairy, M.S.U.

- 9:30— 9:45 Welcome — Dean T. K. Cowden, College of Agriculture, M.S.U.
- 9:45—10:00 *Definitions and Terms* — to acquaint the audience with the meaning of words and terms related to bulk milk handling to be used during the conference.
- 10:00—10:30 *Why Bulk Milk Handling?* — Objectives, changes in design, changes in milk handling, effects, adoption, impact, future trends. Walter Ahlstrom, Technical Control Director, Fresh Milk and Ice Cream Division, Carnation Company, Los Angeles 36, Calif.
- 10:30—12:00 Panel Discussion:
FROM CANS TO BULK
Shifting from Cans to Bulk — Factors to consider, volume of milk, milkhouse, organizing bulk milk routes, (Farmer — hauler — plant). J. B. Smathers, Maryland and Virginia Milk Producer's Assoc., Inc., Washington, D. C. (20 min.)
Methods of Financing — Banks, dairies, standard deduction from milk check, federal aid, F.H.A., etc. John Clusen, Pure Milk, Chicago, Ill. (20 min.)
The Dairy Producer and Bulk Tanks — Use of bulk tank on can route, labor requirements, use of pipe line, milkhouse, milkhouse ventilation. Mr. Faye Ewbank, Michigan Milk Producer's Assoc., Imlay City, Michigan. (20 min.)
Discussion — 30 min.

Noon — Luncheon, Kellogg Center

Monday afternoon — May 13

- 1:15— 1:45 *Selecting the Tank* — Performance, operating characteristics, direct expansion, ice bank, refrigeration, control, temperature variation in tank, air cooled and water cooled condensers, vacuum tanks. Professor John Nicholas, Professor of Agricultural Engineering, Pennsylvania State University, University Park, Pennsylvania.
- 1:45— 2:40 Panel Discussion: *FREQUENCY OF BULK MILK PICK-UP*
Every-Day versus Every-Other-Day Pick-Up — Quality of Product — Bacteriological changes, enzyme changes, agitator speed, sampling, tests, rancidity. (20 min.)

Economics of Every - Day versus Every-Other-Day Pick-Up — Farmer, hauler, processor, Joseph Cowden, A.M.S., U.S. D.A. (20 min.)
Discussion — 15 min.

2:40— 3:00 Intermission

3:00— 3:30 *Installation of Bulk Milk Tank* — Getting milk into and out, calibration, metering, drain, location, setting and fastening of tank, lighting, water supply, space, wiring, remote compressor. Bob Mojonnier, Mojonnier Bros., Chicago, Ill.

3:30— 4:00 *Gaging and Testing Tanks* — Procedure, accuracy, problems experienced. M. W. Jensen, Assistant Chief, Office of Weights and Measures, National Bureau of Standards, Washington 25, D. C.

4:00— 4:30 *Pipeline Handling of Milk* — Materials, installation, sanitation, metering, quality of milk. J. M. Jensen, Michigan State University.
Discussion — 10 min.

6:00— 8:00 Banquet — Kellogg Center, Cow Confirmation for Bulk Tank Procurements. Jim Hays, Michigan State University.
TANKER AND PLANT

Tuesday morning — May 14

Chairman — Charles O. Davis, Jr., Editor Manager, Milk Plant Monthly.

9:00— 9:30 *3-A Standards for the Tank and Tanker* — Representative of 3-A Standards Committee. Mr. L. T. Gustafson, General Sales Engineer, Creamery Package, Chicago, Ill. (3-A Standards Committee).

9:30—10:00 *Factors to Consider in Tanker Selection* — Classification types, materials, plastic, baffle plates, size, cost, tandem, and single axle. Tom Burress, Heil Company, Milwaukee, Wisconsin.

10:00—10:30 *Advantages and Disadvantages of Company Owned vs Contract Hauling* — Cost, procedures, responsibilities. Panel discussion — Robert Mears, General Foods, Ewart, Michigan (co-owned); Russell Koehler, Detroit Creamery Co., Detroit, Michigan (contract hauler).

10:30—10:45 Intermission

10:45—11:15 *Sanitation and Cleaning of Tank and Tanker* — Responsibility, location, methods, including mechanized cleaning, procedures. Dale Sieberling, Dept. of Dairy Technology, Ohio State University.

11:15—11:45 *Regulation of Haulers of Milk* — Pros and cons of licensing, state regulations, requirements for licensing. Ray Watts, Ohio Department of Health, Columbus, Ohio.

12:00 Luncheon — Kellogg Center

Tuesday afternoon — May 14

Chairman — Dr. A. W. Farrall, Head, Department of Agricultural Engineering, Michigan State University.

1:15— 1:45 *Bulk Handling and Its Effect on Plant Operation* — Losses, equipment, cost, procedures, methods of evaluation. L. C. Thomsan, University of Wisconsin, Madison, Wisconsin.

1:45— 2:15 *Responsibilities of Plant Management and Fieldman* — Driver training, quality control program, milk rejection.

2:15— 2:45 *Does Bulk Milk Handling Fit Into Dairy Farm Operations?* — Myron Clark, Farmer, Former Commissioner of Agriculture, State of Minnesota, presently with A.D.A., 20 N. Wacker Drive, Chicago 6, Ill.

2:45— 3:00 Observations and summary. Dr. A. W. Farrall.

By: *National Planning Committee*

D. B. Falconer, Vice President, Detroit Creamery, Detroit, Michigan.

L. C. Peckham, Milk & Food Program, U. S. Dept. of Health, Educ. & Welfare, Chicago.

J. E. Bullis, Asst. Vice President, Carnation Co., Los Angeles 36, Calif.

C. O. Davis, Editor-Manager, Milk Plant Monthly, Kansas City 5, Mo.

F. M. Skiver, Chief, Dairy Division, Mich. Dept. of Agriculture, Lansing, Mich.

D. L. Murray, Dairy Dept., Michigan State University.
C. W. Hall, Agricultural Engineering Dept., Michigan State University.

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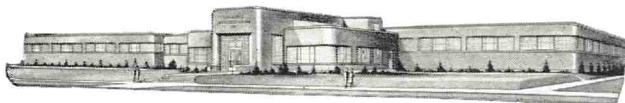
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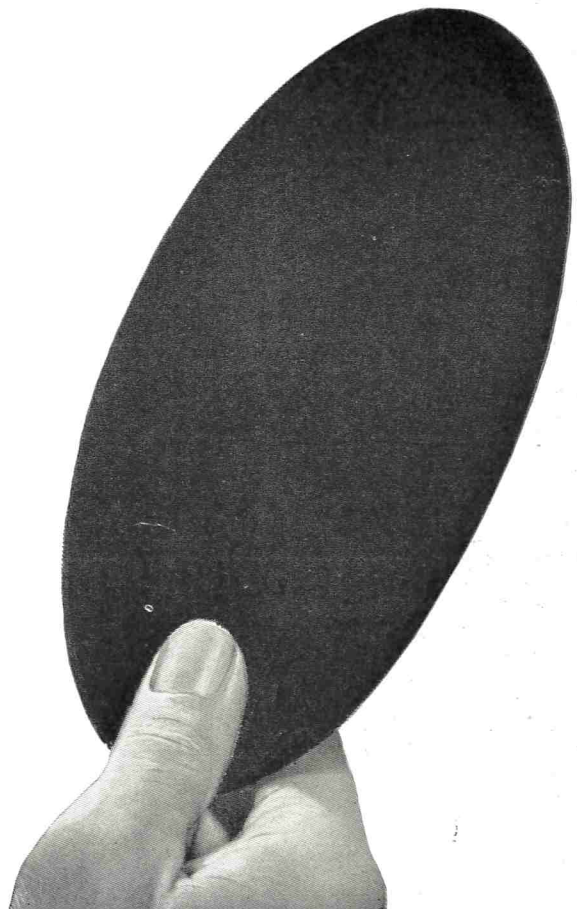
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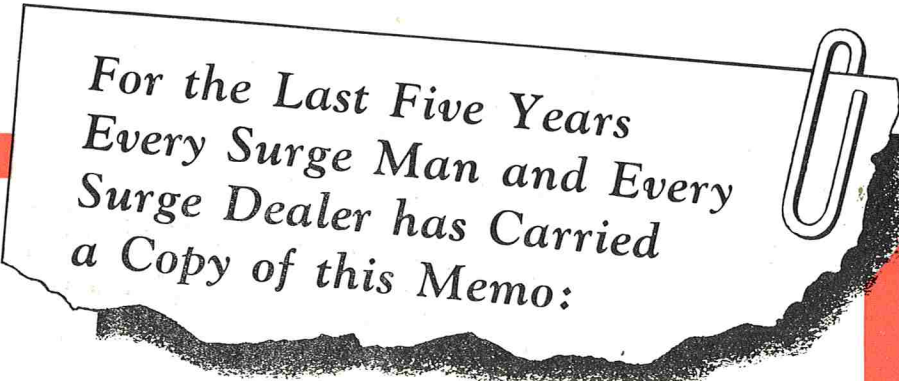
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