FEBRUARY, 1961
Vol. 24 No. 2

Journal of

MILK and FOOD TECHNOLOGY

(1911) GOLDEN ANNIVERSARY (1961)
48TH ANNUAL MEETING
AUGUST 16, 17, 18, 19, 1961
JEKYLL ISLAND, GEORGIA

Official Publication

International Association of Milk and Food Sanitarians, Inc.

GRADE A ALL THE WAY

Go Supermatic

...with NEW Pipeline Vacuum Efficiency from Cow to Cooler

Universal

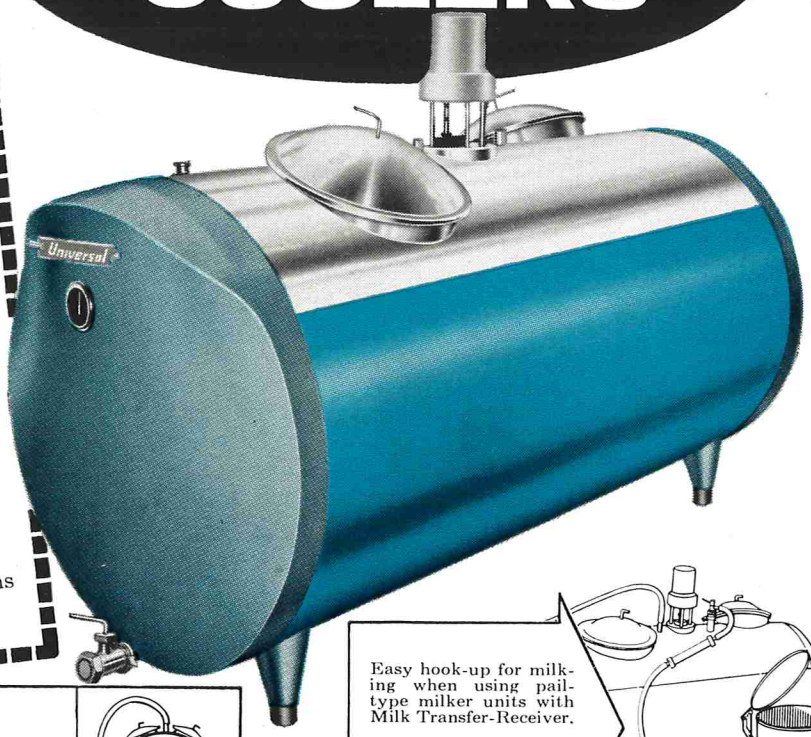
VACUUM BULK MILK COOLERS

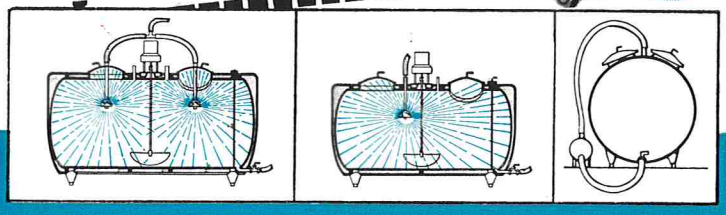
FOR SIMPLIFIED, LABOR SAVING, QUALITY MILK PRODUCTION

The ultimate in Bulk Milk Cooling and Storage! Eliminates need of a separate releaser unit or milk pumps when used with pipeline milking systems. Also convenient for use with pail type Milkers and Milk Transfer Systems. Construction features are superior to any ever offered.

- MORE CAPACITY IN LESS SPACE
- EASY-TO-CLEAN, DURABLE, FIBER-GLASS EXTERIOR SHELL
- STRONG, RIGID CONSTRUCTION
- MORE COOLING CONTACT AREA
- 100% COMPLETE INSULATION
- 10 YEAR WARRANTY

Capacities range from 200 gallons to 1000 gallons.





Easy hook-up for milking when using pail-type milker units with Milk Transfer-Receiver.

Milk Transfer-Receiver may be placed either in barn or in milk house.

MECHANICAL WASHING FEATURE

The Rotary spray ball, high-velocity washing system cleans the tank thoroughly. One rotary spray is installed on smaller units and double spray in the larger size coolers.

Get the facts on...

UNIVERSAL Supermatic

PIPELINE MILKING SYSTEMS

Send for this new catalog on Universal Supermatic systems for simplified milking and GRADE "A" PROFITS

Universal MILKING MACHINE DIVISION

NATIONAL COOPERATIVES, INC. 381 First Ave., Albert Lea, Minn., Branches in Waukesha, Wis. & Syracuse, N. Y.

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

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

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

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

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

Journal of

MILK and FOOD TECHNOLOGY

Official Publication

International Association of Milk and Food Sanitarians, Inc.

REG. U. S. PAT. OFF.

Vol. 24 February No. 2

Contents *Page*

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

Subscription Rates: One volume per year
Individual non-members, Governmental and Commercial Organization subscription,
1 yr. ---- $8.00
Public and Educational Institution Libraries, 1 yr. ---- $6.00
Single Copies ---- $1.00

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

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

ANOTHER B·K® PRODUCT

IN THE LAB
PROVED
ON THE FARM

Pennsan®

Modern Sanitizer and Cleaner Provides Extended Bactericidal Activity

Extensive lab tests and dairy experience conclusively prove that PENNSAN is an effective sanitizer. Further, it retains its bactericidal power *even after drying* on stainless steel *for as long as 24 hours!*

% REDUCTION IN BACTERIAL COUNT AFTER EXPOSURE ON STAINLESS STEEL

	1 hr.	4 hrs.	7 hrs.	24 hrs.
ESCHERICHIA COLI				
Trial 1	100	99.2	100	99.5
Trial 2	100	99.2	99.6	98.9
Trial 3	99.6	98.2	99.2	100
MICROCOCCUS CASEOLYTICUS				
Trial 1	98.9	99.5	98.0	100
Trial 2	99.5	96.5	98.5	100
Trial 3	100	94.5	99.0	99.5

PENNSAN is the superior bactericide serving modern sanitization. It removes and prevents milkstone and films, works in even hardest water, brightens and conditions stainless steel, controls bacteriophages without affecting starter cultures. PENNSAN is a unique chemical sanitizer —a new concept to serve *more* sanitizing and cleaning needs.

Write now for free booklet to B-K Dept.
PENNSALT CHEMICALS CORPORATION
East: 3 Penn Center, Phila. 2, Pa.
West: 2700 S. Eastern Ave., Los Angeles, Cal.

Pennsalt® Chemicals
ESTABLISHED 1850

EDITORAL

COMMENTS CONCERNING THE DEFINITION OF STERILIZATION

A visitor from Europe once said to me, "The trouble with you Americans is that you say one thing and mean something entirely different." With our modern concept of science and the scientific approach, and the rapidity with which writings are translated throughout the world, it is extremely important to employ clear and concise language in order to convey thoughts with the least confusion. In this respect, I submit the following example of what I choose to call a flagrant violation of the English language by men of science (who should know better).

Recently, I attended a symposium on disinfection where the term *sterilization* was used by medical men to denote a process for the exclusion of pathogenic organisms, and by food technologists to describe the removal of spoilage organisms from food. It is not difficult to understand this situation since the medical dictionaries define sterilization as "a process whereby a substrate is free from germs" and germs are defined as "any microorganism, especially any of the pathogenic bacteria." The food technologists speak of commercial sterilization as the process by which any organisms that cause spoilage are removed. Therefore, we now have the dilemma where the word *sterile* may signify (a) free from all life, (b) free from pathogenic bacteria, or (c) free from spoilage organisms (there may be many other meanings which have not, as yet, come to my attention).

It now becomes necessary to reiterate and emphasize that sterilization, sterility, and sterile are *absolute* terms. They are as absolute as the word *pregnant* — and I defy anyone to change or modify the meaning of this word! Sterilization in its proper sense means the complete destruction or removal of life in any form and should have no other meaning or connotation. The number of antimicrobial agents or processes that can be classified as achieving sterilization is limited and confined to high temperatures or certain kinds of filters. Only a few of the many chemicals and possibly one or two of the radiation treatments suitably applied are sterilizing agents. Sterilization often is loosely and erroneously used when *disinfection* is really implied. This abuse or misguided interpretation has often given rise to confusion and illustrates the need for use of correct terminology. These terms are absolute and not relative. To permit their use in a relative sense not only is incorrect, but opens the way for abuse and misunderstanding. Should the food technologists require a substitute term for commercial sterilization, then I strongly urge the adoption of the word *pasteurization.* While this term is associated with the dairy industry, I need not remind the reader that Pasteur did his original work with wine and the term pasteurized now is in common use with such products as pickles, cider, dates, etc. Likewise, should the medical men require a term to denote the absence of pathogenic bacteria, I suggest the term *disinfection* which may be defined as the process of eliminating and destroying infectious agents. This should not be confused with the present FDA definition of disinfectant. We have made some progress in the past few years with the words *sanitation* and *sanitize.* Let us keep the words *sterile, sterility* and *sterilize* as absolute terms. There should be no compromise in this regard.

Warren Litsky,
Department of Bacteriology and Public Health
University of Massachusetts
Amherst, Mass.

ANTIBIOTICS IN MILK – A REVIEW[1]

I. RECENT DEVELOPMENTS

E. H. Marth

Fundamental Research Laboratory, Research and Development Division, National Dairy Products Corporation, Glenview, Illinois

Introduction

The presence of antibiotic residues in milk and milk products continues to concern people in the dairy industry, and in regulatory agencies. Consumers have become aware of the problem through the popular press and, in a few instances, through personal experience of an allergic reaction after consuming contaminated dairy products. A previous review by Marth and Ellickson (*108*) discussed the presence of antibiotics in milk and milk products. Another review by the same authors (*109*) considered problems which were created by contamination of milk and milk products with antibiotics. The present series of papers summarizes information on *(a)* recent developments in regard to antibiotic contamination of milk, and *(b)* methods for detecting antibiotics in milk and milk products.

Recently published information on various aspects associated with antibiotic contamination of milk is summarized in this section of the present review. The reader who desires a summary of earlier information is referred to previous reviews (*108, 109*).

Surveys of Milk Supplies for Antibiotic Contamination

A recent limited survey was made by Martin (*111*) of penicillin contamination in raw milks produced in Elkhart County, Indiana. Eleven out of 105 samples tested were found to contain penicillin. Most contaminated samples had about 30 units of penicillin per ml. of milk although two contained as much as 300 units per ml.

The Food and Drug Administration, in 1959, conducted its fourth nationwide survey of antibiotic contamination in milk (*77, 121*). Raw milks (1,170 samples) were taken from tank trucks after milk pick-up at dairy farms in 16 areas of the U. S. and tested for antibiotic residues. Penicillin, in the range of 0.006 to 1.22 units per ml., was found in 3.7% of the samples. Streptomycin (1.40 μg. per ml.) was detected in one of the samples which also contained penicillin. Tetracyclines were noted in 22 samples at a concentration of 0.096 to 0.465 μg. per ml. One sample contained 0.155 unit per ml. of bacitracin.

Three surveys on incidence of penicillin in milk supplies of New South Wales, Australia were conducted in 1954, 1957 and 1958 (*145*). The 1954 survey showed penicillin (range: <0.2 to 0.32 unit per ml.) present in 69 out of 242 samples. Eight out of 470 milk samples in the 1957 and 1958 surveys contained from 0.05 to 2.25 units of penicillin per ml.

Trends in Types of Mastitis

Antibiotic therapy has resulted in a shift from streptococci to staphylococci as major etiological agents of mastitis. Other forms of mastitis (bacterial, fungal) also have been recently reported, with some frequency.

Streptococcal Mastitis

Although *Streptococcus agalactiae* still causes some mastitis, one survey showed that its incidence dropped from 34 to 10.5% during the period of 1949 to 1957 (*88*). Other work (*115*) showed similar results.

A recent study in Australia (*120*) indicated *S. agalactiae* could not be completely eliminated from udders of well-managed dairy cattle through use of penicillin. Reinfection from the environment was blamed for the failure.

Research by Das (*38*) showed that penicillin-resistant streptococci caused mastitis among cows in two different herds. These streptococci were more resistant to the antibiotic than staphylococci isolated from other mastitic cows.

S. pneumoniae has been found to cause mastitis (*105*, 147, 177). Some cases responded to penicillin (*177*) but well established infections did not (*105*). Mastitis was experimentally produced by inoculating udders of healthy cows (via the teat canal) with broth cultures of *S. pneumoniae* (*147*).

---

[1]This is the first of a series of two review papers on this subject. Part II will appear in the next issue of this Journal. References cited will be listed in Part II.

Staphylococcal Mastitis

The decrease, in recent years, of mastitis caused by *S. agalactiae* has been accompanied by an increase in staphylococcal mastitis. McCoy (*115*) reported that by 1954 most cases of mastitis were caused by staphylococci. She estimated around 70% of dairy herds to be carrying such infections which, in some instances, could not be eliminated by treatment. A recent three-year survey of more than 2,000 cows around Madison, Wisconsin showed: (*a*) one out of four cows was shedding staphylococci from at least one quarter, (*b*) there was 20 times more mastitis than herd owners recognized, (*c*) many first-calf heifers were shedding staphylococci; sometimes from all four quarters, (*d*) no correlation existed between numbers of staphylococci in milk and Standard Plate Count or methylene blue test results.

Research on mastitis in a dairy herd (*57*), was concerned with 254 cases over a seven year period and showed a reduction in milk production of ten to 28 pounds per day when cows were normally producing about 38 pounds daily. This reduction preceded appearance of clinical symptoms by 24 hours. Bacteriological studies of milks from 15 of the mastitic cows showed *Staphylococcus aureus* was most frequently present.

The incidence of staphylococcal mastitis increased from 20.5 to 48% during the period of 1949 to 1957 according to results reported from investigations of 7,009 clinical cases (*88*). The frequency of mastitis was highest during the months of July through September.

Wallmark and Thorne (*188*) isolated 246 strains of coagulase-positive staphylococci from 165 cows distributed among 56 herds. Further work showed 13.4% of the isolates, all of which produced penicillinase, to be resistant to penicillin.

Examination of 208 composite morning milk samples taken at nine weekly intervals from 24 farms revealed that 61% contained coagulase-positive staphylococci (*189*). Penicillin-resistant, coagulase-positive staphylococci, were recovered from 10% of the samples.

The incidence of penicillin-resistant *Staphylococcus aureus* in herd milks increased from 9 to 37% during the 1954 to 1956 period according to Tee (*179*). It was suggested that widespread use of penicillin for treatment of bovine mastitis caused emergence of resistant staphylococci.

Penicillin-resistant staphylococci were isolated from mastitic cows on two farms in studies by Das (*38*). He reported the staphylococci were less resistant to penicillin than streptococci also isolated from mastitic cows.

The increase in staphylococcal mastitis may give rise to food poisoning outbreaks if contaminated milk is improperly handled (*115*). Recent cases of food poisoning which involved dried milk, Colby and Cheddar cheeses, could have resulted from such contamination (*115*). Consumption of four to eight month old Cheddar cheese, made from raw milk, caused a recent outbreak (200 cases) of food poisoning (*68*). Coagulase-positive, beta-hemolytic *Staphylococcus aureus* of similar phage type was isolated from the cheese and milk from two out of eight herds which supplied the factory where toxic cheese was made. A survey (*51*) of 207 samples of pasteurized dairy products (milk, low-fat milk, chocolate drink, cultured buttermilk, half-and-half, coffee and whipping cream) obtained from 42 plants over a two-month period showed potentially pathogenic staphylococci to be present in some samples of all products tested. Over 3% of all samples checked contained coagulase-positive staphylococci. The bacteriophage pattern of staphylococci isolated from some samples of buttermilk and half-and-half was similar to that of staphylococci involved in hospital nursery outbreaks of enteritis and abcesses.

Coliform Mastitis

Mastitis caused by coliform bacteria has long been recognized. Recent outbreaks have been reported and additional information recorded. *Escherichia coli* caused 25 cases of mastitis in a study by Bellani (*20*) of 1400 cows. The infection lasted from one to eight days with treatment. Mild cases were successfully treated with streptomycin and mepyramine maleate while severe cases required supplementary treatment with sulfonamides, antihistamines and a glucose solution. Mastitis caused by *E. coli* appeared to be either chronic or acute in nature (*138*). Histological examinations showed necrotic udder tissue in 22 out of 30 cows with mastitis caused by *E. coli* (*48*). *Aerobacter aerogenes* caused an outbreak of acute mastitis in a Normandy dairy herd (*59*). Treatment with streptomycin was successful and good results were also obtained with a vaccine. Chloramphenicol, administered intravenously, was reported successful for treatment of coliform mastitis (*130*).

Pseudomonas Mastitis

Two recent reports (*95, 106*) indicate that mastitis caused by pseudomonads (*Pseudomonas aeruginosa* and *Ps. pyocyanea*) failed to respond to antibiotic therapy. Another investigation (*155*) showed milking machines cleaned with chloramine compounds to be constant reservoirs of organisms in herds infected with *Ps. aeruginosa*.

Mastitis Caused by Other Bacteria

A variety of bacteria have recently been implicated in outbreaks of mastitis. Organisms reported as responsible include: *Bacillus cereus* (*127*), *Serratia marcescens* (*15*), *Bacteroides fundiliformis* (*170*), *Corynebacterium pyogenes (52), Leptospira pomona* or *hyos* (*69*) and *Listeria monocytogenes* (*187*).

Mastitis caused by S. *marcescens* was successfully treated with three doses of neomycin (*15*). Early mastitis caused by *C. pyogenes* responded after five to seven days of treatment with a mixture of penicillin, streptomycin, and crystalline trypsin (*52*). Sometimes treatment of lactating animals for periods up to 12 days was not very successful. *B. fundiliformis* infections resisted treatment with oxytetracycline plus polymyxin-B-sulfate, oxytetracycline and polymyxin-B-sulfate plus penicillin, streptomycin, nitrofurazone, and tyrothricin. It was believed capsular material produced by the organism during growth in udder tissue caused the high level of resistance (*170*).

Fungal Mastitis

A number of fungi have recently been reported as etiological agents in outbreaks of mastitis. Included are: *Candida krusei* (*13*), *Candida sp.* (*35*), *Candida tropicalis* (*104, 140*), *Candida albicans* (*137*), *Candida pelliculosa* (*140*), *Crytococcus neoformans* (*137, 139, 143), Saccharomyces fragilis (137), Hansenula anomala* (*137*), *Torulopsis sp.* (*140*), *Pichia sp. (140), Nocardia sp. (132), Nocardia asteroiles (36, 133) and Nocardia brazilensis (40). Candida sp.* infections were encountered after treatment with penicillin (*35, 104*). Actidione and nystatin were effective for treatment of mastitis caused by *C. neoformans.* Infections of *N. asteroides* were successfully treated with a mixture of novobiocin and nitrofurazone. Penicillin, polymyxin, neomycin and streptomycin were ineffective (*133*). Mastitis caused by *N. brazilensis* failed to respond to antibiotic therapy (*40*). *N. asteroides* survived milk pasteurization treatments which suggests possible public health problems (*133*).

Viral Mastitis

No reports were found of naturally occurring viral mastitis. It is possible that such infections have occurred in the past, and have gone undetected. Several recent reports described mastitis which was experimentally produced by means of viruses. Severe mastitis resulted after an emulsion which contained viruses of the psittacosis-lymphogranuloma group was infused into the udder of a cow via the teat canal (*12*). Results indicated that viruses multiplied in the udder and were excreted with milk. Inflammatory reactions appeared after udders of lactating and nonlactating cows were inoculated with vesicular stomatitis, Newcastle disease or vaccinia viruses (*45*). Viruses generally stimulated production of neutralizing antibodies.

Mastitis Treatment

Some specific information on treatment of various infections has been discussed previously in this review. General information and new developments will be considered here.

Five different commercial penicillin preparations were administered to cows by intramammary infusion in doses of 100,000 units (*169*). Six to twelve days had to elapse before penicillin no longer appeared in milk.

Autoradiographic methods were used by Ulberg, *et al.* (*184*) to examine diffusion of aqueous solutions and oil suspensions of penicillin in the udder. In healthy udders, penicillin was found primarily in ducts and parenchyma and none or only insignificant amounts in interstitial tissues. Penicillin was also found in ducts and parenchyma of mastitic udders but a great portion had penetrated into interstitial tissues especially where they were acutely inflammed and where fibrous tissue was not deposited.

The use of proteolytic enzymes in conjunction with antibiotics for treatment of mastitis has been investigated by Jordan (83). Streptokinase, streptodornase and crystalline trypsin produced noticeable improvements in some mastitis cases which were unaffected by antibiotics alone. Papain, however, had no noticeable effect.

Neomycin ointments were used to treat 84 cows with coliform, staphylococcal or streptococcal mastitis (*44*). The treatment gave "poor" results for chronic staphylococcal, "fair" for acute, and "good" for subacute mastitis.

Bakshi (*10*) prepared a mixture of calcium dioxytetracycline and polymyxin-B-sulfate to treat 20 cases of staphylococcal mastitis (*11*). Infected udders responded well after treatment for three consecutive days.

Recently it was reported (*4*) that a staphylococcal-toxoid vaccine has been used successfully to maintain dairy herds relatively free from staphylococcus-induced mastitis. Initially cows received two inoculations spaced one month apart. After that, it is claimed, one vaccination per year maintained immunity.

The use of antibiotics injected intramuscularly for treatment of mastitis has been suggested (*16, 50*). Barr, *et al.* (*16*) found cases of mastitis caused by antibiotic-resistant staphylococci responded well when the cows were injected intramuscularly with one gm. of neomycin and one million units of polymyxin-B-sulfate on two consecutive days. Foley (*50*) reported

streptococcal mastitis responded to intramuscular injection of prednisone (meticorten) and penicillin.

ANTIBIOTICS IN MILK FROM INJECTED COWS

Limited information was presented in a previous review (*108*) on the presence of antibiotics in milk after injection of cows for treatment of disease. Additional data have become available and are summarized below.

Penicillin G was injected intravenously or intramuscularly into healthy and mastitic cows at levels of one, three and ten million units. The antibiotic appeared in the milk of healthy and infected cows for 12 to 24 hours after injection according to triphenyltetrazalium chloride (TTC) test results (*141*). In additional studies 0.056 and 0.044 units of penicillin per ml. of milk were found six and 12 hours after three million units were injected into cows intravenously or intramuscularly (*142*).

The intramuscular injection into cows of 5,000 units of penicillin G per pound of body weight resulted in a blood-serum level of 0.03 units per ml. after four days and a concentration in milk of 0.005 units per ml. after three days (*136*). When the same level of penicillin G in oil with two per cent aluminum monostearate was injected, 0.022 units per ml. was in blood serum after six days and .003 units per ml. in milk after five days.

Penicillin G in aqueous solution was injected into cows intramuscularly at a level of 5,000 units per pound of body weight three times at 24 hour intervals. An oil base suspension with added aluminum monostearate was injected once at the same rate (*185*). The highest level of penicillin in milk from cows treated with the aqueous solution was 0.52 unit per ml. while in milk from cows treated with the oil suspension it was 0.15 unit per ml. Penicillin persisted in milks from cows treated with the aqueous solution for 48 hours after the final injection and for 96 hours when the oil base suspension was used.

Investigations by Hollister, *et al.* (*72*) on the concentration of penicillin in blood and milk after intramuscular injection showed: (a) penicillin appeared longer in milk from distinctly atrophied quarters than from normal ones, (b) fibrotic quarters yielded milk with higher levels of penicillin than nonfibrotic ones, (c) udder secretions of dry cows contained no penicillin, and (d) inflammatory processes, interfered with appearance of penicillin in milk, presumably because of disturbances in secretory function.

When chlortetracycline was injected intravenously into cows at the rate of 6.6 mg. per kg., demonstrable levels (0.034 μg. per ml.) were found in milk after two days (*136*).

ANTIBIOTICS FED TO DAIRY CATTLE

Dairy cattle may ingest antibiotics orally if they are: (a) present as residues on feed such as silage, (b) administered to control bloat, or (c) fed to control diseases, increase milk production or for other reasons. Such uses of antibiotics will be discussed below.

Preservation of Silage with Antibiotics

Bacitracin was suggested by several workers (*3, 153, 154, 194*) for use in preservation of silage, especially grass silage. In one study (*3*) legume silage was prepared with 4, 40 or 400 g. of bacitracin per ton. Satisfactory pH levels in silages were attained with the first two levels of bacitracin, but only if ground corn or molasses was added. The pH never dropped to 5.0 in bacitracin-treated silages to which corn or molasses was not added nor in the silages to which corn or molasses and 400 g. of bacitracin per ton were added. The addition of bacitracin had no effect on composition of silage at the end of 90 days.

Silages, in another investigation (*153, 154*), were prepared with the addition per ton of: (a) 5, 10, or 15 g. of bacitracin, (b) 40 to 80 pounds of molasses, (c) eight pounds of sodium metabisulfite or (d) combinations of bacitracin and molasses. All treated silages had a good odor. When all silages were fed to steers, free-choice, for two weeks, they consumed about twice as much silage preserved with 5 g. of bacitracin per ton as of the others. Similar silages were prepared and fed to dairy cattle (*153*). No differences were noted in quantity or efficiency of milk production when the different silages were fed. Consumption of untreated silage was highest, followed in order by molasses-, bacitracin-, and bisulfite-treated silages.

Wing and Wilcox (*194*) treated Pearl millet with bacitracin, chlortetracycline, oleandomycin, streptomycin, oxytetracycline or penicillin at the time of ensiling. Silages were analyzed and fed to four lactating cows for a period of three days. Consumption of untreated and oleandomycin-treated silages were equal and highest followed in order by penicillin-, bacitracin-, streptomycin-, oxytetracycline- and chlortetracycline-treated silages. There was slight proteolytic activity in the chlortetracycline-treated silage. Other bacterial activity appeared light in the oleandomycin-treated silage and moderate in all others. Oleandomycin was the only antibiotic which appeared to be present in milks of cows fed the different silages.

Alfalfa silages were prepared over a three year period with several antibiotics at concentrations of one to 200 p.p.m. (*39*). The initiation of fermentation

was greatly delayed by antibiotic treatment in 1954 but no differences were noted in 1955 and 1956.

Antibiotics for Bloat Control

Feeding penicillin to grazing cattle has been suggested for prevention of bloat (*17, 46, 78, 81, 82, 198*).

Tetracycline, oxytetracycline, chlortetracycline, bacitracin, streptomycin and penicillin were fed to steers grazing on Ladino clover in attempts to prevent bloat (*17*). Penicillin was the only antibiotic of those studied which appeared useful. Single doses of 25 to 75 mg. of procaine penicillin or potassium penicillin protected steers from bloat for about two days.

Penicillin was fed with grain at the rate 100 mg. per animal (daily or every third day) to 739 cows over a 150 day period (*46*). The incidence of bloat was reduced by two-thirds and a slight decrease in milk production was noted.

Three pair of identical twin dairy cows were used to study effects of administering penicillin orally every third day at a rate of 500,000; 100,000; or 200,000 units per dose for 12 days, 15 days or five months, respectively (*78*). No penicillin was found in milk and there was no adverse effect on health or weight of cattle, milk or butterfat production, composition of milk or butterfat constants. Suggested doses of penicillin up to 500,000 units every third day appeared safe for use in New Zealand to control bloat in dairy cattle.

Two groups of lactating dairy cows were pastured on alfalfa six hours daily for 55 days (*81*). Cows in one group (23 cows) were fed 62,500 units of penicillin daily while the other group (19 cows) served as a control. Eight treated cows bloated 15 times and 11 of the control cows bloated 27 times. Studies by Wooldridge and Bellings (*198*) showed the incidence of bloat to be reduced by a daily feed-supplement of 10 mg. of procaine benzyl-penicillin per cow. The less frequent administration of 40, 50 or 100 mg. of penicillin was also less effective.

Milks from cows fed penicillin were tested for residues by Skaggs and Miller (*171, 172*). They found no penicillin in milk when cows were fed 88.9 mg. per day. When the rate of feeding was increased to 177.8 mg. daily, approximately 0.05 unit of penicillin was present per ml. of milk. The level of antibiotic in milk increased to between 0.10 and 0.15 unit per ml. when 277.8 mg. of penicillin was fed daily.

Steers on alfalfa pasture were protected from bloat for nine days by means of 75 mg. of penicillin fed daily after which its effectiveness diminished rapidly (*82*). A subsequent increase in dosage to 125 mg. per day reduced bloat for two additional days, after which incidence again increased sharply.

Antibiotics as Dietary Supplements

The addition of antibiotics to feed of dairy cattle has been suggested for: (a) reduction of bacterial diarrhea, (b) reduction of losses from respiratory infections, and (c) prevention of foot rot (*165*). Some authors (*96, 107, 178*) claimed an increase in milk production through feeding antibiotics while others (*27, 28, 64, 74, 148, 149, 152*) found no difference.

Haq, *et al.* (*64*) fed 130 mg. per cow daily of either chlortetracycline or tyrothricin. Numbers of bacteria in milks from treated cows were determined initially and after holding at 35°C. for 12 hours. All milks developed lactic acid and produced a normal acid curd. It was concluded that antibiotics, as used in this study, probably did not appear in milk or, if they did, were present in concentrations which did not interfere with acid production. Similar results were also reported by Rusoff and Haq (*152*). Chlortetracycline was fed (240 mg. per heifer daily) to 17 heifers for 15 months prior to freshening and during the first lactation (*74*). No differences in milk or fat production were observed between controls and heifers which received the antibiotic.

Another investigation was conducted in which chlortetracycline was fed to 60 Jersey and Holstein cows (0.1 mg. per pound of body weight per day) for 16 weeks (*148, 149*). No effect was noted on milk yield or on incidence of mastitis, bloat, or foot rot. The antibiotic could not be detected in milk from cows to which it was fed.

Eighteen dairy cows daily received 40 g. per 1,000 pounds of body weight of a residual fermentation product (Aurofac-2A) which contained 8 mg. of chlortetracycline per gram (*18*). Studies continued for 18 weeks showed that cows which received the antibiotic produced an average of 0.15 pounds more fat-corrected milk daily, consumed from 0.2 to 0.4 pounds more alfalfa hay daily, and consumed 0.15 pounds less water daily than controls. These differences were considered not significant. No effect was noted on body weight, rumination, grain and silage consumption, pulse rate, body temperature or general health and well being. It was concluded from results, that neither beneficial or deleterious effects resulted when 300 to 500 mg. of chlortetracycline were fed per cow daily.

Shor, *et al.* (*166*) fed chlortetracycline to lactating dairy cattle at levels of 0.1, 0.5 and 1.0 mg. per pound of body weight per day for two weeks. A depressed appetite was noted initially in two of four cows in each of the two groups which received high-

est doses. Appetites returned to normal after a brief adjustment period. Milk production was also reduced during the adjustment period but returned to normal within a few days. No marked clinical effects were noted in the group which received the 0.1 mg. dosage nor could the antibiotic be detected in milk from these cows. Low levels of chlortetracycline were found in milks from cows fed 0.5 mg. (0.01 to 0.21 μg. per ml.) and 1.0 mg. (0.03 to 0.23 μg. per ml.) doses of antibiotic. Shor (*165*) also reported that feeding antibiotics to dairy cattle was accompanied by an adjustment in rumen microflora. This difficulty was prevented by gradual introduction of antibiotics into feed.

Two experiments were conducted in which 0.1 mg. of chlortetracycline per pound of body weight was fed daily to dairy cattle for 22 or 29 weeks (*96*). Milk production was increased by 0.21 pound per cow per day (not significant) through feeding the antibiotic in the first investigation which involved 18 herds and approximately 1,000 cows. Results of the second study, based on only 11 of the 18 herds, showed an increase in milk production of 1.81 pound per cow per day. Bloating appeared to be associated with feeding chlortetracycline since eight per cent of treated cows were affected.

The response of 62 pairs of cows to feeding chlortetracycline (10 mg. per 100 pounds of body weight daily) was investigated by Boyd, *et al.* (*27, 28*). Feeding the antibiotic to different groups continued for 12, 17 or 25 weeks. No significant differences were found between treated and control cows in milk production, body weight, resistance to mastitis, foot rot or other bacterial disorders.

Oxytetracycline was fed to 2,370 lactating cows in field trials in six states (*107*). The dosage ranged from 75 to 100 mg. per cow per day for an average of 186 days. Cows fed the antibiotic produced an average of 0.87 pounds more per day of milk than controls. Feeding oxytetracycline did not affect bacterial content of the milk, growth of cheese cultures in milk or result in its presence in milk. Socini (*178*) fed oxytetracycline to seven cows and reported increases in total milk yields and in protein and lactose contents of the milk.

The following were listed by Grashuis (*61*) as disadvantages of feeding antibiotics: (*a*) resistant pathogenic bacteria may develop, (*b*) infected animals may not be recognized at time of slaughter, (*c*) favorable effects on growth and feed utilization diminish, and (*d*) antibiotics may lose their therapeutic value. It was felt a stimulation in the rate of growth similar to that obtained by use of antibiotics would result from addition to feed of 0.1 per cent copper sulfate.

Effect of Antibiotics on Rumen Function and Bacteria

Chance, et al. (*30, 31, 32*) studied the effect of chlortetracycline on digestion and synthesis in the rumen. Fistulated steers were fed the antibiotic at the rate of 0.5 g. daily for 15 days and then at a level of one g. daily for the next 15 days. Results showed: (*a*) no incidence of anorexia or diarrhea during the test period, (*b*) dry matter, crude fiber, crude protein and nitrogen free extract were removed from the rumen most rapidly when the 0.5 g. dosage was used and more slowly when one g. was fed, (*c*) ten essential amino acids were removed from the rumen most rapidly when 0.5 g. was fed, and (*d*) nicotinic acid synthesis in the rumen was reduced by the antibiotic. Other observations included: (*a*) reduction in pH of the rumen contents was less during the first six to eight hours after feeding if the antibiotic was present, and (*b*) increases in numbers of bacteria in the rumen content and feces were noted when the antibiotic was fed.

Wiseman, *et al.* (*195*) fed daily doses of 50 and 150 mg. penicillin to two fistulated steers for two weeks. Bacteriological analyses showed no pronounced change in numbers of rumen lactobacilli, streptococci or paracolon bacteria while penicillin was administered. This apparent lack of penicillin activity could not be correlated with the appearance of resistant lactobacilli or streptococci. Since paracolon bacteria can inactivate relatively high concentrations of penicillin *in vitro*, it was thought they may be responsible for its inactivation in the rumen.

The *in vitro* effects of various antibiotics on cellulolytic rumen bacteria was investigated by Hardie, *et al.* (*65*). Little effect was produced by polymyxin-B-sulfate and chloramphenical while bacitracin and dihydrostreptomycin showed slight inhibition. Oxytetracycline and chlortetracycline inhibited bacteria moderately while penicillin did so markedly.

EFFECT OF ANTIBIOTICS ON STARTER CULTURES

The level of antibiotic in milk which inhibits most starter cultures has been discussed previously (*109*). Additional information of this type will be presented here. Other recent work to be discussed deals primarily with starter culture resistance and physiology.

The effect of low penicillin concentrations in milk on acid production by different cheese cultures was investigated by Richards (*144*). It was found that 0.1 unit per ml. inhibited *Streptococcus durans* and *S. thermophilus;* 0.25 unit per ml. inhibited *S. diacetilactis* and *S. cremoris* and 0.5 unit per ml. inhibited

mixtures of S. *cremoris* plus *Leuconostoc* sp. and S. *diacetilactis* plus S. *cremoris*.

Gelsey and Hagen (*56*) examined the effect of seven different antibiotics on three different strains of *Propionibacterium shermanii* and on four strains of propionibacteria isolated from Samsoe cheese. All strains were completely inhibited by the presence per ml. of: 0.6 unit penicillin, 10 to 30 μg. streptomycin, 0.5 to one μg. oxytetracycline, 0.5 to more than one μg. tetracycline, 0.1 to five μg. chlortetracycline, less than one to 10 μg. erythromycin and less than 0.1 to one μg. chloramphenicol.

Data obtained from making cheese with penicillin-contaminated milk (100, 250, and 500 units per l.) suggested that lactic acid bacteria are less sensitive to penicillin today than ten years ago (*76*). Secretion of penicillinase or formation of resistant mutants were suggested explanations.

Verlinski (*186*) reported a commercial starter was made resistant to penicillin over a period of four to five weeks by addition, at each daily transfer, of penicillin in increasing quantities from 0.05 to 0.1 unit per ml. The starter, when fully adapted to the antibiotic and incubated at 26°C., retained normal flavor and developed acid in milk with up to one unit per ml. of penicillin. Attempts were made, in another study, to produce penicillin-resistant cultures (*146*). A selection procedure for isolation of naturally resistant mutants and a training program for induction of resistance were employed. Cultures were obtained which grew in the presence of 0.5 unit of penicillin per ml. of milk although acid production by these strains was reduced 50 per cent compared to sensitive cultures.

Mikolajcik, *et al.* (*118*) found a strain of *Streptococcus lactis* which was resistant to oxytetracycline, produced low levels of acid and possessed the ability to "bind" the antibiotic. It was possible to obtain normal acid development by sensitive cultures in milks with 1 or 10 p.p.m. oxytetracycline if sufficient resistant cells were added first, given time to "bind" the antibiotic and thereby neutralize its effects.

In other investigations (*86*) attempts were made to improve acid production of the oxytetracycline-resistant culture through addition of various nutrients to milk. Peptide-rich extracts, when added to milk at the rate of 0.1 to 0.5%, permitted normal acid production by resistant cultures. Effective additives were yeast extract, liver fraction L, neopeptone, tryptone, milk-protein hydrolyzate, casein hydrolyzate, pancreas extract, tryptose and peptonized milk. Sensitive cultures, however, did not produce acid in antibiotic-contaminated milk when the extracts were added.

Differences between cells sensitive and resistant to oxytetracycline were examined by Mikolajcik (*117*). He found: (*a*) sensitive cells able to tolerate higher concentrations of sodium chloride and alkaline substances than resistant cells, (*b*) sensitive cells had a more diffuse cell wall and more prominent electron dense cytoplasm than resistant cells, (*c*) sensitive cells were less exacting in requirements for anaerobiosis, and (*d*) the medium (containing oxytetracycline) in which sensitive cells grew showed an accumulation of glutamic acid, leucine, acetone and alanine while aspartic and oxaloacetic acids accumulated after growth of resistant cells. Mikolajcik felt that the bacterial cell wall was the probable site of oxytetracycline action. This observation lead to development of the method for antibiotic "binding" previously described.

Shahani (*159*) studied differences in phosphorous compounds present in oxytetracycline-sensitive and -resistant cells of S. *lactis*. More cellular material was consistantly produced by the sensitive strain. Young cells of sensitive strains generally contained higher levels of protein and nucleic acid phosphorous than did similar resistant cells. The nucleic acid content of both types of 24-hour old cells was nearly equal.

Galactokinase and galactowaldenase were detected in *S. lactis* although lactase was not found (*162*). Penicillin and streptomycin had no effect on galactokinase but it was completely inhibited by chlortetracycline and oxytetracycline. Penicillin was found to inhibit 33 to 50 per cent of the galactowaldenase activity.

Effect of Low Temperature Storage on Antibiotics

Studies on storage of antibiotics in milk showed the following were relatively stable for seven days at 8 to 10°C.: penicillin, streptomycin, oxytetracycline, chlortetracycline, magnamycin, bacitracin and polymycin (*87*). Penicillin, streptomycin and a combination of both were checked in another study (*97*) for their ability to retard growth of bacteria in milk during storage in a refrigerator and at 22°C. A combination of the two was found most effective at both temperatures.

Hibbs and Boyd (*70*) reported samples of milk which contained penicillin, oxytetracycline, neomycin, streptomycin or chlortetracycline could be held frozen for at least 12 weeks without appreciable losses of antibiotic activity.

Interaction of Antibiotics and Milk Components

Different workers have shown antibiotics to affect

enzymes in milk and also that they themselves are affected by other milk constituents.

Enzymes

The effect of chlortetracycline and penicillin on the phosphatase enzyme system in milk was investigated by Morr (*119*). He found phosphatase was unaffected by chlortetracycline (up to 25 μg. per ml.) and only slightly by penicillin (up to 25 units per ml.). Enzyme inhibition produced by penicillin was not enough to alter reliability of the phosphatase test. The degree of enzyme reactivation in milk heated to 210°F. for 10 seconds or 145°F. for 30 minutes was not changed by either of the antibiotics studied.

In work on effect of different antibiotics (up to 50 p.p.m.) on milk lipase (*33*) it was seen that the enzyme was inhibited 9 to 42% by chlortetracycline, 7 to 49% by penicillin, 9 to 39% by streptomycin and 7 to 44% by oxytetracycline. The antibiotics were not selective in their inhibitory effects on sites of enzyme action.

Salts and Proteins

The influence of milk components on antibiotic activity was investigated by Price, *et al.* (*135*) and Martin and Harper (*110*). Price, *et al.* (*135*) showed the antagonistic influence of milk on oxytetracycline, chlortetracycline and polymyxin-B could be attributed to the presence of a high concentration of inorganic ions (principally calcium and magnesium). Readily ionizable salts of calcium and magnesium were more inhibitory than poorly ionized ones. Dihydrostreptomycin and neomycin were inhibited by the inorganic ions and also by casein. Magnesium salts were found more antagonistic to oxytetracycline and chlortetracycline and calcium salts were more antagonistic to polymyxin-B, dihydrostreptomycin and neomycin.

The loss of antibiotic activity in milk was markedly different for penicillin than for tetracyclines, according to Martin and Harper (*110*). The decrease in penicillin activity immediately after its addition to milk or whey was small but considerable inactivation occurred during refrigerator storage. Pasteurization of milk or whey prior to addition of penicillin reduced losses in activity during storage. The major loss of oxytetracycline and chlortetracycline activity occurred immediately after addition to either raw or pasteurized skim milk with only slight losses during cold storage of the milk-antibiotic mixture. The immediate loss of oxytetracycline and chlortetracycline activity was much less in whey than in skim milk although losses during refrigerator storage were considerable. Dialysis experiments showed no interaction between penicillin and the protein systems of either whey or skim milk. There was interaction between the protein systems of both whey and skim milk and chlortetracycline with a resultant loss of antibiotic activity in skim milk only. Radioactive tracer studies showed activity of penicillin was decreased by alpha-casein and especially so by aged solutions. Calcium ions together with alpha-casein caused considerable decreases in activity of oxytetracycline and chlortetracycline. Purified beta-lactoglobulin had no significant effect on penicillin or chlortetracycline activity and no chemical interaction was observed between this protein and the antibiotics.

Experiments on the influence of penicillin on hydrogen peroxide added to milk showed the bactericidal efficiency of peroxide to be reduced by 30 to 70 per cent. The interference with the preservative was proportional to the concentration of penicillin but hydrogen peroxide was not directly decomposed by the antibiotic (*9*).

ALLERGIC REACTIONS TO PENICILLIN IN DAIRY PRODUCTS

The majority of a representative group of allergists, whose opinions were sought regarding the current status of the problem of allergic reactions from penicillin-contaminated milk agreed: (*a*) such reactions have occurred and probably have gone undetected in many instances, (*b*) that reactions occurred after ingestion of milk although some felt the small amounts of penicillin in milk were harmless to penicillin-sensitive people except in rare, extremely sensitive individuals, (*c*) an oral dose two to three times as great as an intravenous one was necessary to produce reactions in sensitive individuals, and (*d*) reactions most commonly encountered were chronic or recurrent urticaria (*6*). The Council on Drugs of the American Medical Association has confirmed the occurrence of allergic reactions in sensitive persons who have consumed milk with small amounts of penicillin. Other antibiotics in milk have not caused similar reactions (*5*).

Zimmerman (*199*) reported case studies of four patients who suffered urticaria after ingestion of dairy products. All patients had had previous allergic reactions to penicillin. Reactions were cleared up rapidly by injection of penicillinase, an enzyme which catalyzes the hydrolysis of penicillin to penicilloic acid (*150*), and subsequent prophylactic injections of the enzyme enabled patients to eat dairy products without allergic reactions. Zimmerman suggested that dairy products (including ice cream and cheeses containing molds of the genus *Penicillium*) should be eliminated from the diets of patients with chronic urticaria.

Penicillinase was used to treat 50 other patients

with penicillin reactions (*54*). Rapid improvement after intramuscular administration was observed in some cases although others failed to improve. Local pain, swelling and systemic febrile reactions were commonly encountered after intramuscular injections of the enzyme. The antigenicity of penicillinase is such that sensitization may result from its repeated administration.

Common tests for sensitivity to penicillin use the skin-scratch, intradermal inoculation and conjunctival methods (*47*). A new serological procedure has recently been reported (*47*). The antigen for the test is prepared by coupling the antibiotic to erythrocytes with bis-diazotized benzidine. Hemagglutination occurred when cells prepared in this fashion were mixed with serum from sensitive individuals. The pattern of agglutination resembled that of the virus hemagglutination test.

STUDIES ON THE USE OF SEWAGE EFFLUENT FOR IRRIGATION OF TRUCK CROPS[1, 2]

STUART G. DUNLOP AND WEN-LAN LOU WANG

University of Colorado School of Medicine, and Department of Health and Hospitals, Denver, Colorado

(Received for publication September 2, 1960)

Salmonella, Ascaris **ova and** *Endamoeba coli* **cysts were recovered from more than 50 per cent of irrigation water samples contaminated with either raw sewage or primary-treated, chlorinated effluents. Only one of 97 samples of vegetables irrigated with this water yielded** *Salmonella,* **but** *Ascaris* **ova were recovered twice from 34 of the vegetable samples. The public health implications of these results are discussed.**

The importance of irrigation for the economic and agricultural development of many parts of the world is well recognized. In Colorado, for example, approximately 3,000,000 acres are irrigated, of which over 40,000 acres are devoted to truck crops. Most of this land is irrigated from streams which contain either raw or partially treated sewage. Thus, when the irrigated crops include vegetables or fruits which may be consumed raw, a possible public health hazard is apparent.

Tanner (*8*) and more recently Rudolfs, Falk, and Ragotzkie (*6*) have reviewed the literature on the occurrence and survival of pathogenic enteric microorganisms in soil, water, sewage, and sludges, and on vegetation irrigated or fertilized with these materials. It would appear from these reviews that fruits and vegetables growing in infected soil can become contaminated with pathogenic microorganisms, and that these organisms may survive for periods of a few days to several weeks or more in the soil and on vegetation.

Rudolfs and his co-workers (*7*) have carried on extensive experiments in which growing tomatoes and lettuce, in some cases, were sprayed with suspensions of *Salmonella, Shigella, Ascaris* ova, and *Endamoeba* cysts. The *Salmonella* and *Shigella* could not be recovered one week after spraying. *Endamoeba histolytica* cysts likewise died out within a few days, particularly when the weather was dry. The *Ascaris* ova, however, were still found on the surfaces of the vegetables one month after application, although their numbers had been reduced and the eggs were incapable of development into the infective stage. These authors concluded that if sewage irrigation or night soil application is stopped one month before harvest, the fruit or vegetables would not be likely vectors for the transmission of human enteric disease. In dry climates, however, such as the Western United States, it is common practice to irrigate some crops several times weekly right up to the day of harvest.

The studies reported here were designed to assess the public health hazard of the use of sewage-contaminated irrigation water under actual field conditions.

EXPERIMENTAL

The development of methods for the quantitative estimation of *Salmonella* and animal parasites from sewage, irrigation water, and vegetables has been reported in previous publications (*1, 2, 3, 10*). In 1959, the methods used for isolation of Salmonella were as follows:

[1]Presented at the 46th annual meeting of the International Association of Milk and Food Sanitarians in Glenwood Springs, Colorado, August 27, 1959.

[2]This study was supported by a grant (E-542) from the National Institutes of Health, Public Health Service, Department of Health, Education, and Welfare.

(a) *Settled sewage, effluent, and irrigation water.* Samples of settled sewage, effluent, and irrigation water were taken at timed intervals according to flow rates, and run by direct plating on brilliant green, bismuth sulfite, and SS agar plates, 0.1 ml per plate, and by inoculation of 100-, 10-, 1-, and 0.1-ml quantities each into 3 bottles or tubes of Kauffmann's tetrathionate broth, as modified by Galton (*5, 4*). After 18 to 24 hours incubation at 37°C. a loopful of each enrichment broth culture was streaked onto brilliant green, bismuth sulfite, and SS agar plates, from which representative colonies were picked for identification. This included the usual biochemical tests for *Salmonella* and agglutination with polyvalent *Salmonella* antiserum. All positive cultures were confirmed and identified as to species by the laboratories of the State of Colorado Department of Public Health.

(b) *Vegetables.* Plants were removed from the ground by placing a sterile paper bag over the entire plant and either twisting it from the roots or pulling the whole plant up without touching it directly with the hands. With sterile forceps and knife, 102 grams of the edible portion of each sample were removed in the laboratory to a sterile pan containing 250 ml of buffered glycerol saline[3]; then, using a sterile hand brush and sterile rubber gloves, each portion of the sample was carefully brushed to remove the surface contamination, and rinsed with buffered glycerol saline to make a final volume of 510 ml. One-tenth-ml portions of the washings were streaked directly on brilliant green, bismuth sulfite, and SS agar plates; and five 100-ml portions were inoculated into the modified Kauffman's tetrathionate broth for enrichment of *Salmonella*. The same procedure was then followed with these broths as with the water samples.

In each experiment, a duplicate quantity of the vegetable studied was sprayed with a fecal suspension containing a known inoculum of *Salmonella typhimurium*, allowed to set for 30 minutes to 1 hour, and then handled in the same manner as the natural sample, except that smaller amounts of the washings were inoculated in geometric series into the modified tetrathionate broth for most probable number (MPN) recoveries.

Coliform densities were determined by the MPN technique using lauryl tryptose broth as the presumptive medium and confirmation in brilliant green lactose bile broth.

[3]Formula for buffered glycerol saline:

NaCl	8.5 gm
Potassium phosphate (dibasic)	3.0 gm
Potassium phosphate (monobasic)	1.0 gm
Glycerol	300 ml
Distilled water	700 ml

RESULTS

Over a period of several years it has been possible to isolate *Salmonella* organisms, including the typhoid bacilli, from more than 50 percent of the irrigation water samples examined, but these organisms were recovered from the vegetables irrigated with this water only once. A summary of these early data is presented in Table 1.

TABLE 1—SUMMARY OF SALMONELLA ISOLATIONS (1949-1952)

	Irrigation Water		Vegetables	
Year	Samples Examined	Number of Positives	Samples Examined	Number of Positives
1949-50	113	23	45	0
1951	11	8	14	1
1952	18	14	30	0
Totals	142	45	89	1

TABLE 2—ISOLATION OF SALMONELLA FROM SETTLED SEWAGE, EFFLUENT, IRRIGATION WATER AND VEGETABLES (1959)

Source	Number of Samples	Samples Positive for Salmonella	MPN Range of Positive Samples
Settled sewage	5	5	43.0-360/100 ml
Effluent	5	0	----------
Irrigation water	8	5	1.1-360/100 ml
Vegetables	8	0	----------

TABLE 3—SPECIES OF SALMONELLA RECOVERED FROM SETTLED SEWAGE AND IRRIGATION WATER (1959)

S. *st. paul*	S. *typhimurium*
S. *newport*	S. *reading*
S. *san diego*	S. *oranienburg*
S. *anatum*	S. *kaapstad*
S. *bredeney*	S. *budapest*
S. *newington*	S. *heidelberg*
S. *montevideo*	S. *bareilly*

The experiments carried out in the growing season of 1959 confirm the results obtained previously (see Table 2). *Salmonella* were isolated from 5 out of 5 samples of settled sewage with a range of 43-360 organisms per 100 ml of sample. *Salmonella* were also isolated from 5 of 8 samples of irrigation water with a range of 1-360 organisms per 100 ml among the positives. Fourteen different species of *Salmonella* have been identified from the positive samples (see Table 3). No *Shigella* were recovered from the settled sewage or irrigation water, and no *Salmonella* or *Shigella* were isolated from 5 samples of heavily chlorinated, primary-treated effluent nor from 8 samples of irrigated vegetables (turnips, cabbage, spin-

ach, endive, and lettuce). Recovery experiments in which *Salmonella typhimurium* was added to a duplicate quantity of vegetable, averaged 44 percent by direct streaking on bismuth sulfite agar, 43 percent on brilliant green agar, and only 14 percent on SS agar. The average recovery from the enrichment procedure by MPN counts was 4 percent (range <0.12%-7.67%). Considerable variation was noted with the type of vegetable used, the number of coliform organisms present, and the amount of soil on the vegetables. Usually, the more coliforms and the more soil present, the fewer pathogens were recovered.

Coliform counts were also made on most of the samples in an attempt to relate the incidence of *Salmonella* to these common index organisms. Table 4 shows a summary of the data obtained in 1959. A reduction of more than 99.99 percent of the coliforms in the settled sewage was effected by heavy chlorination (12-18 ppm) following the primary settling, so that an average of only 740 coliforms per 100 ml was recovered from the effluent. The irrigation water, of which this effluent was a considerable part, however, showed coliform densities in the thousands and hundreds of thousands per 100 ml. The vegetables varied widely with an average of 27,000 coliforms per 100 grams of vegetable.

TABLE 4—COLIFORM COUNTS OF SETTLED SEWAGE, EFFLUENT, IRRIGATION WATER AND VEGETABLES (1959)

Source	Number of samples	Avg. MPN/100 ml of water or 100 gm of vegetable	MPN range/100 ml of water or 100 gm of vegetable
Settled sewage	5	2.7×10^7	1.3×10^7 — 3.3×10^7
Effluent	5	7.4×10^2	3.3×10^2 — 23.0×10^2
Irrigation water	7	1.3×10^5	1.3×10^3 — 3.3×10^5
Vegetables	7	27.0×10^3	$<1.0\times10^2$ — 115.0×10^3

The ratio of coliforms to *Salmonella* in the settled sewage was 144,000 : 1. In the irrigation water, the ratio of the median values was 27,000 : 1; or if the arithmetic mean density of *Salmonella* in the irrigation water is calculated by the log probability method of Thomas (*9*), this ratio becomes 41,000 : 1. It was hoped originally that a more constant ratio between these two groups of organisms might be established. However, it appears that the ratio varies with the area studied, with the source of water, the methods used, and undoubtedly with the case and carrier rate of the community.

The studies have also included the incidence of animal parasites (*10*). Table 5 shows the effect of primary sewage treatment, including chlorination, on the removal of animal parasites. Approximately half the *Ascaris* ova and *Endamoeba coli* cysts were removed by the primary settling. In the chlorinated effluent, only 20 percent of the *Ascaris* ova remained, but 46 percent of the cysts were still present. Most of the cysts were apparently still viable at this time. Below the sewage plant, however, in the river and in the irrigation ditch, considerable removal was effected probably by settling. As coliform indices run concurrently on these samples showed an average reduction in the effluent of more than 99 percent of these bacterial organisms, it is clear that primary treatment, even with terminal chlorination, was considerably less effective against these animal parasites than it was against bacteria. Two of 34 samples of vegetables examined for animal parasites were posi-

TABLE 5—THE EFFECT OF PRIMARY SEWAGE TREATMENT ON THE REMOVAL OF ANIMAL PARASITES (DENVER SEWAGE DISPOSAL PLANT—1951)

Ascaris ova—by Zinc Sulfate Concentration Method

End. coli cysts—by Aerosol-ether-xylene Concentration Method

	Ascaris ova				*End. coli* cysts			
Source	No. ova per liter	Range	Pos. samp. No. samp.	% reduction from raw	No. cysts per liter	Range	Pos. samp. No. samp.	% reduction from raw
Raw sewage	30	5-110	11/11	—	52	20-110	11/11	—
Settled sewage	15	2-30	11/11	50	27	5-50	11/11	48
River above	<1	0-<1	2/11	—	<1	0-<1	1/11	—
Effluent	6	0-20	9/11	80	24	6-71	11/11	54
River below	6	0-14	10/11	80	8	6-17	9/11	85
Gardeners' Ditch (flume)	2	0-6	5/6	93	6	0-11	5/6	88
Gardeners' Ditch (Lammer's headgate)	1	0-6	4/6	97	4	1-14	6/6	92

tive for *Ascaris* ova. It should be stated that these 2 samples were collected when raw sewage was being temporarily bypassed into the river by the sewage plant.

No *Shigella* dysentery organisms have been isolated. For the past several years studies have been made on the survival of *Shigella* in sewage, irrigation water, and on irrigated vegetables; and while methods have been developed for recovering, in fair proportion, *Shigella* which have been added to the samples, we have not recovered these organisms from the natural samples themselves. One very interesting point was brought out by these studies, namely that sewage and irrigation water, at least in this area, are low in sodium and potassium ions, and that these ions must be added in definite concentration (minimum 0.035 *M*) to the samples in order that added *Shigella* may be demonstrated on selective media (*11*).

Discussion

It is difficult to explain why with such frequently positive results on irrigation water, it has not been possible to demonstrate significant contamination of the vegetables irrigated with this water. Mention has been made in previous publications that the methods may not be as satisfactory for vegetables as they are for water. For example, more than 1,000 *Salmonella* per gram of vegetable must be added to achieve a significant recovery, while as few as 10 organisms per ml of water are sufficient. Other factors, however, may be: the furrow type of irrigation used in the area studied, the dry climate, and the sandy soil, all of which would tend to minimize both the original contamination and the survival of any pathogens that do get on the plants. Root crops might be expected to be more contaminated, but these also have been negative. Finally, spraying or flooding the field with contaminated water may well present a different situation.

Conclusions

Salmonella, *Ascaris* ova, and *Endamoeba coli* cysts have been recovered from more than 50 percent of irrigation water samples contaminated with either raw sewage or primary-treated chlorinated effluents. Only 1 of 97 samples of vegetables yielded *Salmonella*, but *Ascaris* ova were recovered twice from 34 of the vegetable samples, the latter only when raw sewage was being discharged into the stream. Although this work is not yet completed, it would appear that, under the conditions studied, the use of partially treated, chlorinated sewage effluents diluted in streams does not significantly contaminate the vegetables furrow-irrigated with this water. On the other hand, the presence of pathogenic organisms in most of the water samples represents a potential public health hazard to the farmers and communities using the water.

References

1. Dunlop, S. G., Twedt, R. M., and Wang, W. L. Salmonella in Irrigation Water. Sewage and Industrial Wastes, **23**: 1118-1122. 1951.
2. Dunlop, S. G., Twedt, R. M., and Wang, W. L. Quantitative Estimation of Salmonella in Irrigation Water. Sewage and Industrial Wastes, **24**: 1015-1020. 1952.
3. Dunlop, S. G., and Wang, W. L. A Multiple-Quantity Procedure for the Estimation of Salmonellae in Irrigation Water. Bacteriological Proceedings, 27. 1953.
4. Galton, M. M., Hardy, A. V., and Mitchell, R. B. The Public Health Laboratory Diagnosis of Enteric Infections. American Journal of Tropical Medicine, **30**: 77-90. 1950.
5. Galton, M. M., Stucker, C. L., McElrath, H. B., and Hardy, A. V. A Preliminary Study of Tetrathionate Brilliant-Green Bile Broth with Added Sulfathiazole for the Isolation of Salmonella from Dogs. Bacteriological Proceedings, 115. 1950.
6. Rudolfs, W., Falk, L. L., and Ragotzkie, R. A. Literature Review on the Occurrence and Survival of Enteric, Pathogenic, and Relative Organisms in Soil, Water, Sewage, and Sludges, and on Vegetation. I. Bacterial and Virus Diseases. Sewage and Industrial Wastes, **22**: 1261-1281. 1950. II. Animal Parasites. *Ibid.*, **22**: 1417-1427. 1950.
7. Rudolfs, W., Falk, L. L., and Ragotzkie, R. A. Contamination of Vegetables Grown in Polluted Soil. I. Bacterial Contamination. Sewage and Industrial Wastes, **23**: 253-268. 1951. II. Field and Laboratory Studies on Endamoeba Cysts. *Ibid.*, **23**: 478-485. 1951. III. Field Studies on Ascaris Eggs. *Ibid.*, **23**: 656-660. 1951.
8. Tanner, F. W. *The Microbiology of Foods*. Garrard Press, Champaign, Illinois, 649-664. 1944.
9. Thomas, H. A., Jr. Statistical Analysis of Coliform Data. Sewage and Industrial Wastes, **27**: 212-222. 1955.
10. Wang, W. L., and Dunlop, S. G. Animal Parasites in Sewage and Irrigation Water. Sewage and Industrial Wastes, **26**: 1020-1032. 1954.
11. Wang, W. L., Dunlop, S. G., and DeBoer, R. G. The Survival of Shigella in Sewage. I. An Effect of Sewage and Fecal Suspensions on *Shigella flexneri*. Applied Microbiology, **4**: 34-38. 1956.

ach, endive, and lettuce). Recovery experiments in which *Salmonella typhimurium* was added to a duplicate quantity of vegetable, averaged 44 percent by direct streaking on bismuth sulfite agar, 43 percent on brilliant green agar, and only 14 percent on SS agar. The average recovery from the enrichment procedure by MPN counts was 4 percent (range <0.12%-7.67%). Considerable variation was noted with the type of vegetable used, the number of coliform organisms present, and the amount of soil on the vegetables. Usually, the more coliforms and the more soil present, the fewer pathogens were recovered.

Coliform counts were also made on most of the samples in an attempt to relate the incidence of *Salmonella* to these common index organisms. Table 4

TABLE 4—COLIFORM COUNTS OF SETTLED SEWAGE, EFFLUENT, IRRIGATION WATER AND VEGETABLES (1959)

Source	Number of samples	Avg. MPN/100 ml of water or 100 gm of vegetable	MPN range/100 ml of water or 100 gm of vegetable
Settled sewage	5	2.7×10^7	1.3×10^7– 3.3×10^7
Effluent	5	7.4×10^2	3.3×10^2– 23.0×10^2
Irrigation water	7	1.3×10^5	1.3×10^3– 3.3×10^5
Vegetables	7	27.0×10^3	$<1.0\times10^2$–115.0×10^3

shows a summary of the data obtained in 1959. A reduction of more than 99.99 percent of the coliforms in the settled sewage was effected by heavy chlorination (12-18 ppm) following the primary settling, so that an average of only 740 coliforms per 100 ml was recovered from the effluent. The irrigation water, of which this effluent was a considerable part, however, showed coliform densities in the thousands and hundreds of thousands per 100 ml. The vegetables varied widely with an average of 27,000 coliforms per 100 grams of vegetable.

The ratio of coliforms to *Salmonella* in the settled sewage was 144,000 : 1. In the irrigation water, the ratio of the median values was 27,000 : 1; or if the arithmetic mean density of *Salmonella* in the irrigation water is calculated by the log probability method of Thomas (*9*), this ratio becomes 41,000 : 1. It was hoped originally that a more constant ratio between these two groups of organisms might be established. However, it appears that the ratio varies with the area studied, with the source of water, the methods used, and undoubtedly with the case and carrier rate of the community.

The studies have also included the incidence of animal parasites (*10*). Table 5 shows the effect of primary sewage treatment, including chlorination, on the removal of animal parasites. Approximately half the *Ascaris* ova and *Endamoeba coli* cysts were removed by the primary settling. In the chlorinated effluent, only 20 percent of the *Ascaris* ova remained, but 46 percent of the cysts were still present. Most of the cysts were apparently still viable at this time. Below the sewage plant, however, in the river and in the irrigation ditch, considerable removal was effected probably by settling. As coliform indices run concurrently on these samples showed an average reduction in the effluent of more than 99 percent of these bacterial organisms, it is clear that primary treatment, even with terminal chlorination, was considerably less effective against these animal parasites than it was against bacteria. Two of 34 samples of vegetables examined for animal parasites were posi-

TABLE 5—THE EFFECT OF PRIMARY SEWAGE TREATMENT ON THE REMOVAL OF ANIMAL PARASITES (DENVER SEWAGE DISPOSAL PLANT—1951)

Ascaris ova—by Zinc Sulfate Concentration Method

End. coli cysts—by Aerosol-ether-xylene Concentration Method

	Ascaris ova				*End. coli* cysts			
Source	No. ova per liter	Range	Pos. samp. No. samp.	% reduction from raw	No. cysts per liter	Range	Pos. samp. No. samp.	% reduction from raw
Raw sewage	30	5-110	11/11	—	52	20-110	11/11	—
Settled sewage	15	2-30	11/11	50	27	5-50	11/11	48
River above	<1	0-<1	2/11	—	<1	0-<1	1/11	—
Effluent	6	0-20	9/11	80	24	6-71	11/11	54
River below	6	0-14	10/11	80	8	6-17	9/11	85
Gardeners' Ditch (flume)	2	0-6	5/6	93	6	0-11	5/6	88
Gardeners' Ditch (Lammer's headgate)	1	0-6	4/6	97	4	1-14	6/6	92

tive for *Ascaris* ova. It should be stated that these 2 samples were collected when raw sewage was being temporarily bypassed into the river by the sewage plant.

No *Shigella* dysentery organisms have been isolated. For the past several years studies have been made on the survival of *Shigella* in sewage, irrigation water, and on irrigated vegetables; and while methods have been developed for recovering, in fair proportion, *Shigella* which have been added to the samples, we have not recovered these organisms from the natural samples themselves. One very interesting point was brought out by these studies, namely that sewage and irrigation water, at least in this area, are low in sodium and potassium ions, and that these ions must be added in definite concentration (minimum 0.035 *M*) to the samples in order that added *Shigella* may be demonstrated on selective media (*11*).

DISCUSSION

It is difficult to explain why with such frequently positive results on irrigation water, it has not been possible to demonstrate significant contamination of the vegetables irrigated with this water. Mention has been made in previous publications that the methods may not be as satisfactory for vegetables as they are for water. For example, more than 1,000 *Salmonella* per gram of vegetable must be added to achieve a significant recovery, while as few as 10 organisms per ml of water are sufficient. Other factors, however, may be: the furrow type of irrigation used in the area studied, the dry climate, and the sandy soil, all of which would tend to minimize both the original contamination and the survival of any pathogens that do get on the plants. Root crops might be expected to be more contaminated, but these also have been negative. Finally, spraying or flooding the field with contaminated water may well present a different situation.

CONCLUSIONS

Salmonella, *Ascaris* ova, and *Endamoeba coli* cysts have been recovered from more than 50 percent of irrigation water samples contaminated with either raw sewage or primary-treated chlorinated effluents. Only 1 of 97 samples of vegetables yielded *Salmonella*, but *Ascaris* ova were recovered twice from 34 of the vegetable samples, the latter only when raw sewage was being discharged into the stream. Although this work is not yet completed, it would appear that, under the conditions studied, the use of partially treated, chlorinated sewage effluents diluted in streams does not significantly contaminate the vegetables furrow-irrigated with this water. On the other hand, the presence of pathogenic organisms in most of the water samples represents a potential public health hazard to the farmers and communities using the water.

REFERENCES

1. Dunlop, S. G., Twedt, R. M., and Wang, W. L. Salmonella in Irrigation Water. Sewage and Industrial Wastes, **23**: 1118-1122. 1951.

2. Dunlop, S. G., Twedt, R. M., and Wang, W. L. Quantitative Estimation of Salmonella in Irrigation Water. Sewage and Industrial Wastes, **24**: 1015-1020. 1952.

3. Dunlop, S. G., and Wang, W. L. A Multiple-Quantity Procedure for the Estimation of Salmonellae in Irrigation Water. Bacteriological Proceedings, 27. 1953.

4. Galton, M. M., Hardy, A. V., and Mitchell, R. B. The Public Health Laboratory Diagnosis of Enteric Infections. American Journal of Tropical Medicine, **30**: 77-90. 1950.

5. Galton, M. M., Stucker, C. L., McElrath, H. B., and Hardy, A. V. A Preliminary Study of Tetrathionate Brilliant-Green Bile Broth with Added Sulfathiazole for the Isolation of Salmonella from Dogs. Bacteriological Proceedings, 115. 1950.

6. Rudolfs, W., Falk, L. L., and Ragotzkie, R. A. Literature Review on the Occurrence and Survival of Enteric, Pathogenic, and Relative Organisms in Soil, Water, Sewage, and Sludges, and on Vegetation. I. Bacterial and Virus Diseases. Sewage and Industrial Wastes, **22**: 1261-1281. 1950. II. Animal Parasites. *Ibid.*, **22**: 1417-1427. 1950.

7. Rudolfs, W., Falk, L. L., and Ragotzkie, R. A. Contamination of Vegetables Grown in Polluted Soil. I. Bacterial Contamination. Sewage and Industrial Wastes, **23**: 253-268. 1951. II. Field and Laboratory Studies on Endamoeba Cysts. *Ibid.*, **23**: 478-485. 1951. III. Field Studies on Ascaris Eggs. *Ibid.*, **23**: 656-660. 1951.

8. Tanner, F. W. *The Microbiology of Foods*. Garrard Press, Champaign, Illinois, 649-664. 1944.

9. Thomas, H. A., Jr. Statistical Analysis of Coliform Data. Sewage and Industrial Wastes, **27**: 212-222. 1955.

10. Wang, W. L., and Dunlop, S. G. Animal Parasites in Sewage and Irrigation Water. Sewage and Industrial Wastes, **26**: 1020-1032. 1954.

11. Wang, W. L., Dunlop, S. G., and DeBoer, R. G. The Survival of Shigella in Sewage. I. An Effect of Sewage and Fecal Suspensions on *Shigella flexneri*. Applied Microbiology, **4**: 34-38. 1956.

FREEZING POINT VALUES AND MILK SOLIDS-NOT-FAT CONTENT OF RETAIL MILK[1]

R. W. Henningson

Dairy Department, Clemson College, Clemson, S. Carolina

(Received for publication July 27, 1960)

Observed freezing point and milk solids-not-fat values were determined for approximately 400 retail samples. Most of these samples were systematically collected at monthly intervals over a calendar year from designated processing plants.

The average observed freezing point value found was −0.529°C. The average MSNF value found was 8.88%. No relationship was expected, or found, between the observed freezing point value and the MSNF value of milks. The MSNF value did not assist in explaining high freezing point values or in confirming the presence of added water. It did prevent suspicion which could not be easily confirmed.

A minimum freezing point depression standard, based on area data and administered in a manner similar to a minimum butterfat standard, appears to be the most feasible way of utilizing the cryoscopic method for the determination of added water in milk.

The observed freezing point value of milk has recently been the subject of much investigation. Many (*2, 3, 5, 7, 10, 11, 12, 14*) have shown that the "average" observed freezing point value is not as low as −0.550°C. Several reports (*5, 6, 7, 11*) indicate that the value varies geographically. One extensive report (*11*) of this nature recommends regional or area freezing point standards based on local data. Another (*4*) recommends a minimum observed freezing point depression that might be interpreted in a manner similar to a minimum butterfat requirement.

Most reports dealing with observed freezing point values emphasize the need of corroborative evidence or information where definite proof of adulteration is required. Milk solids-not-fat content is most often determined for supporting evidence of adulteration (*4*) when high observed freezing point values are found.

The observed freezing point value or depression of milk is a result of the lactose, soluble salt, and gas content of milk. Each sample of milk will vary as to the relationship among these components. As a result no precise relationship is expected, or found, between the observed freezing point value and the gross components of milk.

This report deals with the observed freezing point values and the milk solids-not-fat values found in approximately 400 samples of commercial, homogenized, pasteurized milk.

Methods

The observed freezing point values were determined with a Hortvet cryoscope using A.O.A.C. (*1*) procedures and employing thermometer tapping modifications similar to those recommended by Shipe *et al.* (*13*). All samples had a titratable acidity of less than 0.18% calculated as lactic acid.

The Mojonnier method (*9*) was employed for the determination of butterfat and total milk solids and milk solids-not-fat values were obtained by difference.

Milk samples were purchased in retail outlets at monthly intervals over a period of one calendar year. Most of the samples were processed in South Carolina plants but some were from dairy plants located in North Carolina and Georgia.

Results and Discussion

Milk solids-not-fat (MSNF) and observed freezing point (F.P.) value averages for samples from dairy processing plants are presented in Table 1. Samples from several plants, which were not sampled systematically, are designated miscellaneous (Misc.) and included for purposes of comparison.

Samples from most plants had a MSNF range of 0.6% or less and the range was of the same magnitude for each plant. The Misc. samples had a range approximately double those from the individual plants. The exception was plant D-1, whose samples had a MSNF range similar to that of the Misc. samples. The average MSNF range for samples from individual plants was 0.46%, while the extreme range for all samples was 1.24%.

Samples from most plants had observed F.P. ranges of 0.04°C. or less and the range was of similar magnitude for samples from each plant. The Misc. samples had a range approximately double that of those from the individual plants. Plant D-1 was the exception with samples having a range similar to that of the Misc. samples. The average observed F.P. range for samples from the individual plants was 0.02°C. while the extreme range for all samples was 0.06°C.

---

[1]Technical Contribution No. 299, S. C. Agricultural Experiment Station.

TABLE 1—RANGE AND AVERAGE OF MILK SOLIDS-NOT-FAT AND FREEZING POINT VALUES OF RETAIL SAMPLES ARRANGED BY DAIRY PLANTS

Plant	No. samples	Milk Solids-Not-Fat % Range		Milk Solids-Not-Fat % Avg.	Freezing Point —°C Range		Freezing Point —°C Avg.
A	15	8.58 - 9.08	(0.50)	8.83	0.509 - 0.546	(0.037)	0.533
B	15	8.52 - 9.10	(0.58)	8.81	0.531 - 0.544	(0.013)	0.536
C	15	8.52 - 8.94	(0.42)	8.76	0.529 - 0.539	(0.010)	0.535
D	13	8.66 - 9.20	(0.54)	8.88	0.505 - 0.533	(0.028)	0.520
D-1[a]	12	8.53 - 9.45	(0.92)	8.92	0.497 - 0.549	(0.052)	0.524
E	13	8.48 - 9.05	(0.57)	8.73	0.521 - 0.535	(0.014)	0.529
F	12	8.74 - 9.24	(0.50)	9.08	0.521 - 0.540	(0.019)	0.531
G[b]	3	8.83 - 9.13	(0.30)	9.02	0.533 - 0.540	(0.007)	0.536
H	12	8.61 - 8.99	(0.38)	8.77	0.508 - 0.534	(0.026)	0.525
H-1	11	8.67 - 9.15	(0.48)	8.85	0.504 - 0.533	(0.029)	0.522
I	13	8.68 - 9.18	(0.50)	8.87	0.525 - 0.541	(0.016)	0.531
I-1	12	8.77 - 9.27	(0.50)	9.09	0.525 - 0.547	(0.022)	0.536
J	12	8.50 - 8.92	(0.42)	8.69	0.520 - 0.531	(0.011)	0.526
J-1	12	8.75 - 9.08	(0.33)	8.98	0.514 - 0.534	(0.020)	0.528
K[b]	11	8.68 - 9.10	(0.42)	8.88	0.522 - 0.534	(0.012)	0.528
L[b]	8	8.45 - 9.09	(0.64)	8.64	0.515 - 0.536	(0.021)	0.526
M	12	8.82 - 9.17	(0.35)	8.99	0.522 - 0.541	(0.019)	0.533
N[b]	11	8.63 - 9.17	(0.54)	8.89	0.515 - 0.537	(0.022)	0.526
O	12	8.61 - 9.15	(0.54)	8.81	0.530 - 0.538	(0.008)	0.534
P	12	8.68 - 9.05	(0.37)	8.80	0.518 - 0.550	(0.032)	0.528
Q	12	8.56 - 8.98	(0.42)	8.85	0.520 - 0.536	(0.016)	0.529
R	12	9.13 - 9.61	(0.48)	9.34	0.527 - 0.537	(0.010)	0.534
S	12	8.86 - 9.26	(0.40)	9.04	0.518 - 0.538	(0.020)	0.531
T	12	8.67 - 9.07	(0.40)	8.86	0.520 - 0.541	(0.021)	0.532
U[b]	5	8.69 - 9.01	(0.32)	8.84	0.522 - 0.534	(0.012)	0.526
V[b]	2	8.51 - 8.90	(0.39)	8.71	0.512 - 0.539	(0.027)	0.526
W	10	8.59 - 9.05	(0.46)	8.85	0.515 - 0.537	(0.022)	0.529
X[b]	8	8.57 - 8.89	(0.32)	8.72	0.512 - 0.535	(0.023)	0.525
Misc.[b]	67	8.37 - 9.38	(1.01)	8.94	0.505 - 0.558	(0.053)	0.532
[c]24+	376	8.37 - 9.61	(1.24)	8.88	0.497 - 0.558	(0.061)	0.529

[a]—Plant also has other milk segregated.
[b]—See Table 2.
[c]—Total plants & samples, extreme ranges, and unweighted averages.

Samples from most of the plants had MSNF values above 8.7%, a majority being above 8.8%, with several above 9.0%. These average MSNF values are uniformly high and agree well with recent data from this and other regions of the United States (*5, 6, 15*). The unweighted MSNF average for all samples was 8.88%.

Samples from most plants had average observed F.P. values higher than –0.530°C. Approximately 67% of the plants sampled systematically had average observed F.P. values higher than –0.530°C. It is difficult, if not impossible, to find such high values in the literature. Such high values, in this region of the United States, are suggested by Dahlberg *et al.* (*5*). The unweighted observed F.P. average was –0.529°C. Sixty-four percent of all samples had a F.P. value above the A.O.A.C. minimum standard of –0.5335°C. Only 47 of 271 samples with a F.P. value above the minimum standard were considered to contain added water when MSNF content was considered. The samples from several plants had no F.P. values as low as –0.5335°C. but had MSNF contents considered "normal." Samples from most plants had an average F.P. value higher than –0.5335°C., two with MSNF contents above 9.0%. Samples with observed F.P. values higher than –0.5335°C. were found in all but three of 58 dairy processing plants.

The averages and ranges in Table 1 were computed after deletion of samples with both a MSNF value less than 8.5% and an observed F.P. value higher than –0.520°C. All samples meeting both specifications clearly contained added water. These deleted samples, and their effect on MSNF and observed F.P. averages and ranges, are shown in Table 2.

In Table 3 the MSNF content of all samples with an observed F.P. value higher than –0.520°C. is shown. Thirty of 49 samples have MSNF values greater than 8.5%. Nine of these thirty samples have MSNF values above the unweighted average for all samples. Approximately 33% of these samples would be considered "normal" when MSNF content was used as supporting evidence of added water, in spite of the high

TABLE 2—RANGE AND AVERAGE OF MILK SOLIDS-NOT-FAT AND FREEZING POINT VALUES OF RETAIL SAMPLES FROM INDICATED DAIRY PLANTS BEFORE DELETING SAMPLES WITH *both* A FREEZING POINT VALUE ABOVE −0.520°C. AND A MILK SOLIDS-NOT-FAT VALUE LESS THAN 8.5%

Plant	No. Samples	Milk Solids-Not-Fat % Range		Avg.	Freezing Point —°C Range		Avg.
G	4	8.31 - 9.13	(0.82)	8.84	0.509 - 0.540	(0.031)	0.529
K	12	8.48 - 9.10	(0.62)	8.85	0.515 - 0.534	(0.019)	0.527
L	11	8.05 - 9.09	(1.04)	8.51	0.501 - 0.536	(0.035)	0.521
N	12	8.47 - 9.17	(0.70)	8.85	0.515 - 0.537	(0.022)	0.525
U	6	8.48 - 9.01	(0.53)	8.78	0.509 - 0.534	(0.025)	0.524
V	7	8.08 - 8.90	(0.82)	8.44	0.475 - 0.539	(0.064)	0.508
X	10	8.16 - 8.89	(0.73)	8.63	0.501 - 0.535	(0.034)	0.521
Misc.	72	8.16 - 9.38	(1.22)	8.90	0.478 - 0.558	(0.080)	0.530

F.P. values. It is interesting to note in Table 3 the widely different MSNF values found in samples with the same observed F.P. value.

The observed F.P. values for all samples with MSNF contents less than 8.5% is shown in Table 4. Nine of 28 samples have F.P. values of −0.520°C. or less. Four of these nine samples have F.P. values lower than the unweighted average for all samples. Approximately 33% of these samples would be considered "normal" when F.P. values are considered in spite of low MSNF values. It is of interest to note in Table 4 the widely different F.P. values found in samples with the same or similar MSNF contents.

The distribution of observed F.P. values is shown in Table 5. Most of the samples had values between −0.520 and −0.540°C. Only 2 samples had F.P. values as low as −0.550°C. Thirty-three samples had values lower than −0.540°C., while 49 had values higher than −0.520°C.

TABLE 3—FREEZING POINT VALUES ABOVE −0.520°C. WITH MILK SOLIDS-NOT-FAT VALUES (ARRANGED BY FREEZING POINT VALUES)

Plant	Freezing pt. (−°C.)	MSNF (%)	Plant	Freezing pt. (−°C.)	MSNF (%)
V	0.475	8.08	V	0.512	8.51
Misc.	0.478	8.34	V	0.512	8.49
D-1	0.479	8.53	X	0.512	8.57
V	0.498	8.42	X	0.513	8.38
L	0.501	8.05	L	0.514	8.29
X	0.501	8.16	J-1	0.514	8.92
H-1	0.504	8.70	H-1	0.514	8.67
Misc.	0.504	8.46	Misc.	0.515	8.80
D	0.505	8.95	W	0.515	9.00
D-1	0.505	8.73	K	0.515	8.48
Misc.	0.505	8.50	L	0.515	8.69
Misc.	0.506	8.46	N	0.515	8.47
L	0.507	8.16	N	0.515	9.17
H	0.508	8.74	D-1	0.516	8.99
V	0.508	8.26	W	0.516	8.64
A	0.509	8.71	H-1	0.517	8.68
D	0.509	8.71	Misc.	0.517	8.46
D	0.509	8.66	P	0.518	8.57
G	0.509	8.31	S	0.518	8.86
U	0.509	8.48	X	0.518	8.69
Misc.	0.510	8.73	D	0.519	9.06
Misc.	0.511	9.02	P	0.519	8.57
Misc.	0.511	8.95	D-1	0.519	8.95
Misc.	0.511	8.32	X	0.519	8.57
Misc.	0.511	8.44			

TABLE 4—MILK SOLIDS-NOT-FAT VALUES BELOW 8.5% WITH FREEZING POINT VALUES (ARRANGED BY MSNF VALUE)

Plant	MSNF (%)	Freezing pt. (-°C.)	Plant	MSNF (%)	Freezing pt. (-°C.)
L	8.05	0.501	V	8.42	0.498
V	8.08	0.475	V	8.44	0.511
L	8.16	0.507	L	8.45	0.523
X	8.16	0.501	Misc	8.45	0.527
V	8.26	0.508	Misc.	8.46	0.517
L	8.29	0.514	Misc.	8.46	0.506
G	8.31	0.509	Misc.	8.46	0.504
Misc.	8.32	0.511	Misc.	8.46	0.541
Misc.	8.34	0.478	L	8.47	0.530
L	8.36	0.520	N	8.47	0.515
Misc.	8.37	0.527	E	8.48	0.524
X	8.38	0.513	K	8.48	0.515
Misc.	8.39	0.534	U	8.48	0.509
Misc.	8.40	0.536	V	8.49	0.512

The MSNF values were scattered rather uniformly over a wider range than the F.P. values as shown in Table 6. Most samples had MSNF values between 8.6 and 9.1%.

In Table 7 the observed F.P. and MSNF values of all samples from selected plants are tabulated by months. Samples from Plant R had the highest average MSNF values. Samples from Plant O had one of the lowest average observed F.P. values. Samples from Plant J had one of the lowest average MSNF values, while those from plant D had the highest average F.P. value. Samples from Plant D-1 had the widest MSNF range and the widest observed F.P. range.

The average MSNF values found agree with those found in textbooks (*15*). The average F.P. values do not. These F.P. values are much higher than those found in the literature although results reported by Dahlberg *et al.* (*5*) do not make them unexpected. There is no relationship between MSNF and F.P. values (Tables 1, 3, 4, 7).

The samples are pooled retail milk. It is difficult to believe that milks with such high MSNF content contain other than incipient water, peculiar to modern processing practices. The narrow MSNF and observed F.P. ranges also argue against such a view. Samples from Plant A, the college dairy processing plant, have

TABLE 5—DISTRIBUTION OF RETAIL SAMPLE FREEZING POINT VALUES

Freezing Point (—°C.)	0.470-0.479	0.480-0.489	0.490-0.499	0.500-0.509	0.510-0.519	0.520-0.529	0.530-0.539	0.540-0.549	0.550-0.559
No. samples	2	0	2	16	29	119	216	31	2

TABLE 6—DISTRIBUTION OF RETAIL SAMPLE MILK SOLIDS-NOT-FAT VALUES

Milk solids-not-fat %	Below 8.30	8.30-8.39	8.40-8.49	8.50-8.59	8.60-8.69	8.70-8.79	8.80-8.89	8.90-8.99	9.00-9.09	9.10-9.19	9.20-9.29	9.30-9.39	Above 9.40
No. samples	6	7	15	22	43	55	60	78	49	26	18	9	7

an average F.P. value of –0.533°C. which is almost identical with the –0.536°C. average for 545 authentic daily samples from the experiment station dairy herd (7).

The samples from various plants, with MSNF values ranging from 8.70 to 9.17% (Table 3), but with observed F.P. values above –0.520°C. could not be considered to contain added water in view of the unweighted MSNF average of 8.88%. Most of these MSNF values were within one-half of the range from the average plant value (Table 7).

The samples from various plants with observed F.P. values ranging from –0.520 to –0.541°C. (Table 4) but with MSNF values less than 8.5% could not be considered to contain added water on a reasonable basis when the average unweighted freezing point value of –0.529°C. is considered. Most of these values were within one-half of the range from the average plant value. It should be noted that most of these samples were from plants other than those selected for Table 7.

Forty percent of the samples shown in Table 3 were both less than 8.5% MSNF and above –0.520°C. but this was true of 70% of the samples shown in Table 4.

There are many observed F.P. or MSNF values "out-of-line" for samples within a given plant (Table 7). In none of the plants selected are both values for samples "out-of-line" with the plant average. This implies that the MSNF value seldom helped to explain a high F.P. value or confirm the presence of added water. This was true even with periodic, within plant, data available for comparisons. The real value of MSNF data was not in explanation of high F.P. values or confirmation of added water but in the prevention of suspicion of added water which could not be confirmed easily, if at all.

Again, in Table 7, it is interesting to note the variation in F.P. values for samples within a single plant for a given MSNF value and *vice versa*. Samples from Plant D had an average MSNF value of 8.88%, the unweighted average, and the highest average F.P. value for samples from any plant, –0.520°C. Samples from Plant R had the highest average MSNF value found, 9.34%, and one of the lowest average F.P. values found, –0.534°C., which is just the A.O.A.C. minimum freezing point depression value. Samples from Plant J had one of the lowest average MSNF values found with an average F.P. value which matched the unweighted average for all samples. Samples from Plant O having the narrowest F.P. range of 0.008°C., is a marvel of consistency in

TABLE 7—FREEZING POINT AND MILK SOLIDS-NOT-FAT VALUES IN SELECTED PLANTS

Plant	D		D-1		H		H-1		J		O		R	
Month	MSNF	FP	MSNF	FP	MSNF	FP	MSNF	FP	MSNF	FP	MSNF	FP	MSNF	FP
	(%)	(–°C.)	(%)	(–°C.)	(%)	(–°C.)	(%)	(–°C.)	(%)	(–°C.)	(%)	(–°C.)	(%)	(–°C.)
11	9.00	0.533	8.91	0.529	8.62	0.522	8.91	0.528	8.51	0.527	8.67	0.533	9.34	0.536
12	8.71	0.509	8.53	0.479	8.65	0.524	8.97	0.526	8.66	0.528	8.73	0.534	9.16	0.527
1	8.95	0.505	8.73	0.505	8.79	0.528	8.94	0.527	8.65	0.529	8.61	0.530	9.34	0.531
2	8.66	0.509	8.72	0.533	8.84	0.532	8.80	0.523	8.67	0.529	8.61	0.530	9.43	0.533
	8.97	0.527												
3	9.20	0.528	8.95	0.519	8.96	0.528	8.89	0.523	8.75	0.525	8.63	0.534	9.13	0.532
4	9.06	0.519	9.22	0.530	8.99	0.534	9.15	0.533	8.83	0.531	8.79	0.536	9.44	0.537
5	8.69	0.520	8.90	0.531	8.61	0.524	No Sample		8.50	0.523	8.88	0.534	9.22	0.536
6	8.94	0.526	8.98	0.532	8.84	0.527	8.95	0.524	8.72	0.527	8.76	0.538	9.20	0.535
7	8.81	0.522	8.70	0.523	8.71	0.523	8.68	0.517	8.70	0.524	8.88	0.535	9.40	0.537
8	8.97	0.522	9.45	0.549	8.83	0.520	8.67	0.514	8.85	0.520	9.02	0.531	9.41	0.532
9	8.75	0.522	8.91	0.528	8.70	0.533	8.74	0.522	8.52	0.525	9.00	0.532	9.61	0.535
10	8.71	0.520	8.99	0.516	8.74	0.508	8.70	0.504	8.92	0.522	9.15	0.537	9.40	0.531
Avg.	8.88	0.520	8.92	0.524	8.77	0.525	8.85	0.522	8.69	0.526	8.81	0.534	9.34	0.534

this respect but an exception to the general rule, although samples from 14 of 24 plants had a F.P. range of 0.020°C. or less. This upholds the view that the freezing point value is the most constant property of milk but also shows that this property is not as constant as once assumed.

It would seem that −0.529°C. is a valid average freezing point for this state and perhaps for this section of the United States with −0.520°C. a valid estimate of the minimum depression value.

Considering the −0.529°C. average F.P. value found, the high MSNF values found, the agreement of the average F.P. value, for samples from the college processing plant with the average F.P. values of many authentic college herd samples, and the "discrepancies" between high MSNF values and the high observed freezing point values found for samples from individual plants, a minimum freezing point depression standard, as suggested by Dahlberg *et al.* (*4*), seems to be the most feasible way to utilize for regulatory purposes, the cryoscopic method for determining adulteration of milk with added water. As the average F.P. value of retail milk appears to be −0.529°C. in this area the −0.527°C. minimum standard recommended would not be suitable. It would seem that area minimum depression standards, administered in a manner similar to a minimum butterfat standard would best serve the purpose both for the dairy industry and for regulatory agencies.

It should be emphasized that the problem of retail milk and producer milk are separate and distinct even though F.P. values may be closely comparable. Obviously there is much more chance for incipient added water from common trade practices to occur in retail milk than there is in herd milk. The effect of vacuum pasteurization on the freezing point value (*8*) must also be considered in the case of applicable retail milks.

REFERENCES

1. Association of Official Agricultural Chemists. *Official Methods of Analysis.* 8th Ed., Washington, D. C. 1955.

2. Blackmore, R. H. One year survey of Ohio raw and pasteurized milk. Milk Dealer **49** (3): 43. 1959.

3. Bryant, L. R. and Biggs, D. A. Freezing points and solids-not-fat content of some Ontario milks. Can. Dairy and Ice Cream J., **35** (11): 30. 1956.

4. Dahlberg, A. C. Does the freezing point determination tell what we need to know about added water in milk? Lab. Sec., 51st Ann. Conv., Milk Ind. Found. Conv. Proc., p. 29, 1958.

5. Dahlberg, A. C., Adams, H. S., and Held, M. E. Sanitary milk control and its relation to the sanitary, nutritive, and other qualities of milk. National Res. Council, Pub. No. 250. 1953.

6. Freeman, T. R. Effect of breed, season, and stage of lactation on certain constituents and properties of milk. Kentucky Agric. Expt. Sta. Bull. 667. 1959.

7. Henningson, R. W. The freezing point of milk produced and sold in the southeastern United States. J. Assoc. Offic. Agr. Chemists, **42**: 419. 1959.

8. Henningson, R. W. and Lazar, J. T., Jr. Effect of vacuum pasteurization on the freezing point of milk. J. Assoc. Offic. Agr. Chemists, **42**: 417. 1959.

9. Mojonnier, T. and Troy, H. C. *The Technical Control of Dairy Products.* 2nd Ed., Mojonnier Bros. Co., Chicago, Ill. 1925.

10. Pinkerton, F. and Peters, I. I. Conductivity, percent lactose, and freezing point of milk. J. Dairy Sci., **41**: 392. 1958.

11. Robertson, A. H. Cryoscopy of milk, a 1954-1956 survey. I. Distribution of freezing points among 1,627 herd milks. J. Assoc. Offic. Agr. Chemists, **40**: 618. 1957.

12. Shipe, W. F. The freezing point of milk. A review. J. Dairy Sci., **42**: 1745. 1959.

13. Shipe, W. F., Dahlberg, A. C., and Herrington, B. L. A semiautomatic cryoscope for determining the freezing point of milk. J. Dairy Sci., **36**: 916. 1953.

14. Shipe, W. F., Dahlberg, A. C., and Herrington, B. L. Variations in the freezing points of cow's milk. J. Dairy Sci., **36**: 924. 1953.

15. Sommer, H. H. *Market Milk and Related Products.* 2nd Ed., Olsen Pub. Co. Milwaukee, Wis. 1946.

NEW AREAS IN FOOD SANITATION SUPERVISION

SIEGEL OSBORN

Division of Public Health

Health and Hospital Corporation of Marion County, and Indianapolis, Indiana

The job of providing safe food for the eating public is primarily a responsibility of the food service industry. The Indianapolis-Marion County Division of Public Health shares this responsibility with the industry, but a major share of the credit for a job well done can be attributed to the retail food service operators who include food protection controls and good sanitary maintenance as a must in the daily routine of operating their food establishments. The health department can give inspection service and educational guidance. Twenty-seven outbreaks of foodborne illness were reported to the Marion County public health authorities during 1958; in 1959 thirty-seven percent less outbreaks of foodborne illness were reported. Was this the result of a rigid inspection and enforcement program? Hardly. While we do have a system of suspending or revoking permits, no permit is suspended or revoked until every reasonable effort is made to obtain voluntary compliance with the regulations by means of educational persuasion. As is well known, however, some retail food establishment operators are not concerned about sanitation, but they are concerned about their permits.

ADEQUACY OF PROTECTION PROGRAMS

Public health authorities have become increasingly aware of the need for adequate food protection programs. This is evident from the many pronouncements and articles by writers in the field of environmental health. The customer is entitled to this protection whether he obtains his food at a restaurant, retail food market, church bazaar, school festival or benefit fish fry.

The good purposes served by benefit food services which are sponsored by nonprofit educational, religious, fraternal and civic organizations are well known. However, it must be recognized that the hazard of foodborne illness may be present when large numbers of people are served at a mass feeding event, unless necessary precautions are taken to prevent an accident. In too many communities it is evident that health authorities have not faced up to their responsibilities in controlling these types of auxiliary food services. Too many mass foodborne illness outbreaks are reported annually involving food served at social gatherings. In fact, 35 percent of the outbreaks of foodborne disease reported in the United States during 1958 involved food served in private homes, in private clubs, and at social gatherings. Many communities having trained sanitarians capable of carrying on effective educational and consultative type programs to control auxiliary food services have neglected to do so because they fear the adverse criticisms and emotional tensions that might result from such a program. However, ignoring the existence of a problem does not mean that it can be forgotten. Health authorities who have recognized their responsibilities and have taken reasonable steps to prevent foodborne disease outbreaks are in a much better position to answer public criticism if a foodborne illness outbreak should occur.

ORIGIN OF PROGRAM

Recent outbreaks of foodborne illness, affecting thousands of our citizens, have emphasized the need for a re-evaluation of our food sanitation programs. Mass food poisoning of persons who have attended social gatherings has focused attention upon auxiliary food services. Recent food poisoning outbreaks reported in two Indiana communities are notable examples. One outbreak affected 600 girls who attended a social gathering. During 1959, it was reported that 1183 persons who attended an employee's picnic were poisoned by the food served at the outing. The Indianapolis-Marion County Division of Public Health has carried on a program to control auxiliary food services since May, 1959. No fee is charged for permits issued to non-profit educational, religious, fraternal, and civic organizations. Since the program was initiated a significant reduction in the number of foodborne illness outbreaks has occurred. Home-prepared foods, eaten in the home or at social gatherings, accounted for 55 percent of the foodborne illness outbreaks reported for Marion County, Indiana, during 1958. Only 41 percent of the foodborne illness outbreaks reported for Marion County during 1959 involved home-prepared foods.

PUBLIC INTEREST AND SUPPORT

Prior to the initiation of a program to control auxiliary food services in Marion County, health department sanitarians were seldom asked for assistance

and guidance by community groups that sponsor benefit food service events. Now they are frequently asked to meet with church groups, parent-teacher groups, volunteer fire departments, women's organizations, and other community organizations to assist them in making plans for their benefit food service events. The health and safety regulations discussed with these community organization leaders have aroused a great deal of interest in the health department programs, particularly the food sanitation program. This interest has been instrumental in accomplishing a two-fold objective. First, it has helped to reduce the hazard of foodborne illness; secondly, the barrier of public complacency has been broken and a receptive group of adult citizens in the community has exhibited a greater interest in food sanitation. These same citizens have become enthusiastic supporters of the health department food sanitation program. Church, lodge, club, and civic leaders have expressed interest in improving their food service facilities and in many cases they have undertaken the complete remodeling of their kitchens. The Division of Public Health encourages community organizations to submit plans for review and approval prior to the construction or remodeling of a church or club kitchen. Public and parochial school authorities have issued new policies governing auxiliary food services conducted in the schools. Home prepared foods, including readily perishable foods, are prohibited from being sold at school festivals and benefit fish fries sponsored by parent-teachers associations. A school policy applicable to classroom parties prohibits parents and teachers from serving home made cookies, cakes, sandwiches and similar foods to the children. These new policies were written to conform with health department regulations.

ESSENTIAL ELEMENTS OF A FOOD SANITATION PROGRAM

Health department administrative or supervisory personnel who are charged with the responsibility of administering any public health program must frequently inventory their efforts to determine if they are plotting the right course and accomplishing program objectives. They must determine if available personnel and resources are being used to the best advantage. They must ascertain if they are getting the results to justify budget requests for their program. The Indianapolis-Marion County Division of Public Health periodically makes such an evaluation of program objectives and accomplishments. The following activities and accomplishments are, or have, contributed to the attainment of program objectives:

1. Obsolete ordinances, codes and regulations adopted 10 to 20 years ago that were no longer in step with present day needs of a progressive health department have been revised or amended.

2. National Sanitarian Foundation standards for food service equipment have been adopted and uniform inspection and enforcement programs have been implemented.

3. A system of quantitatively and qualitatively evaluating the effectiveness of the food sanitation program has been developed to assure clean, safe food for the eating public.

4. An educational-consultative type program to control auxiliary food services carried on by nonprofit educational, religious, fraternal and civic organizations has been developed. A significant number of mass foodborne illness outbreaks occur annually as a result of carelessness on the part of food caterers or inexperienced persons who prepare and serve food in private clubs or at social gatherings.

5. Efforts have been increased to obtain adequate salaries, a job classification system, job security, and fringe benefits to satisfy the basic needs of a progressive health department. These are of primary importance in maintaining employee morale and efficiency and an absolute necessity if a governmental agency hopes to obtain and retain competent, well-trained personnel.

6. Strict, but uniform enforcement policies that are in the best interests of the public and the food service industry have been put into effect. Diligent and effective follow-up of violations have been carried out. Activity in this regard has been concentrated on substandard establishments rather than frequent inspections of those which have had consistently good records.

7. A continuous effort has been made to assist the food service industry in training new and experienced employees. The food sanitation school for management, supervisory personnel, and employees is supplemented by effective on-the-job training activities conducted by district sanitarians.

8. An effective in-service and on-the-job training program designed to improve the competency of health department sanitation personnel has been developed. The quality of health services rendered to a community is dependent in large part upon the competency of personnel who provide such services. This is no less true of sanitation personnel than it is of medical or nursing staff members.

9. A planning section has been staffed with competent sanitarians who have had special training in restaurant layout, blueprint reading, and interpretation of ordinances, codes, regulations and standards. A good planning section can effectively reduce or minimize the sanitation and public relations problems

before they become problems. A health department that does not provide this important service to architects, builders, contractors, plumbers, equipment dealers, fabricators of equipment, and food service industry management can not hope for a fully effective food sanitation program.

10. Efforts have been increased to control the tuberculosis hazard by requiring annual chest x-rays of all foodhandlers. Statistical data published in the 1958 Annual Report of the Division of Public Health, Health and Hospital Corporation of Marion County, shows that almost twice as many new cases of active tuberculosis were found among foodhandlers as among the general population in Marion County.

LOOKING AHEAD

Health departments of the future, to qualify for a fair share of the tax dollar and the continued support of the food service industry, must prove their worth in services to the communities they serve. Environmental sanitation programs, employing horse and buggy methods that were acceptable a decade ago, are no longer in step with present day needs. Progress in environmental health programs can be attained if we stand ready to question accepted practices, investigate new approaches, test new ideas, and set new objectives.

> *"Give me the serenity to accept what cannot be changed. Give me the courage to change what must be changed. The wisdom to distinguish one from the other."*—REINHOLD NIEBUHR.

REFERENCES

1. National Food & Beverage Council, % The National Sanitation Foundation, School of Public Health, University of Michigan, Ann Arbor, Michigan.
2. Public Health Reports, August, 1959.
3. Adams, H. S., Is your Food Control Program Working, J. Milk and Food Technol., **22**: 279-282, 1959.
4. Annual Reports of the Division of Public Health, Health and Hospital Corporation of Marion County, Indiana. 1958, 1959, 1960.
5. Getting, Vlado A., Survey and Evaluation of Sanitation Services. Address presented at the National Association of Sanitarians Regional Conference, St. Louis, Missouri, October 1958.
6. Walker, Gerald, Good News for Go-getters! This week Magazine, pp 4-5, June 1960.

THE RESPONSIBILITIES OF A SANITARIAN

E. LEE EVERETT

Tri-County Suffolk Health District, Suffolk, Virginia

Local health departments have great responsibilities. Our first concern should be, how can the health department make the maximum contribution to the people it serves, therefore, the first responsibility of each of us is to the department.

In no other vocation are personnel more related than in Public Health. Every person in the department, no matter what his specific job may be, has a mutual interest and a common objective. In order to produce more and better results we must think and work together and utilize the contributions of all.

In the past there have been periodic outbreaks of public interest in sanitation, but during the past several years and particularly during the war, interest has increased. We sanitarians must realize that our programs are largely dependent upon the understanding and support of the public. If we are to succeed the public must understand, appreciate, and apply sanitation. Nothing should ever be done to discourage this growing public interest, on the contrary, we must encourage and stimulate it at every opportunity. This is a responsibility of the sanitarian, and can best be accomplished by education and salesmanship. Just as an industry salesman depends in a large measure upon his attitude, thoroughness, creative imagination, adaptability and knowledge to sell merchandise, so must the sanitarian develop and use these identical characteristics to sell his programs. We must equip ourselves mentally to do this.

Instruction is effective in direct proportion to the skill of the instructor. The field of sanitation is a diversified one. Some of the activities that this occupation embraces are sewage disposal supervision, water supply investigation, food establishment inspection, milk inspection, insect and rodent control, refuse disposal and housing. You can probably think of more. If the sanitarian is to be a skilled instructor in his field, he must have a thorough knowledge of all of these activities. If we are to become competent, we must take advantage of every available means to learn more about our work.

In my opinion the first qualification necessary to a good salesman or teacher is personal interest. Without this attribute you will find it difficult if not impossible to interest other people. Radiation of personal interest is essential. Always remember, if the learner did not learn, the teacher did not teach.

It is realized that education is an essential in carrying out sanitation programs; it is also realized that education alone is not enough. If programs were limited to formal instruction, they would progress very slowly and would not reach some of the worst offenders. It is easy to control things but it is difficult to control people. It is, therefore, necessary to supplement the educational phase with enforcement. If it becomes necessary to resort to legal action in order to accomplish an objective we should not hesitate to do so. The sanitarian should, however, be more interested in leadership than in the application of police power.

All too often sanitarians are prone to criticize without giving the reason for their criticism. Many operators of food establishments and dairies have been requested to do things that they did not understand or did not know how to do. Sometimes this is the reason for failure to comply with our requests. Always remember that criticism should be accompanied by suggestions for the correction of the defects under discussion.

In order to obtain a maximum of results, full utilization of the sanitarian's time is essential. A sanitarian's value can be appraised by how he uses his time. It is often difficult to avoid wasting time. For instance, it often happens that you will be in one section of your county and a call will be received requiring your presence in another section far distant from your present location. This requires a lot of driving, and at first thought we feel it is unavoidable so we answer such calls without a second thought.

Many times we have heard program planning advocated. Very few of us pay much attention to it. Frequently we assume this attitude, "That sounds fine, but it is impossible. With calls coming in from all parts of the County how can you plan any kind of a schedule or program? The only thing I can do is answer them as they come." I wish to defend the policy of program planning. If a schedule is arranged so the sanitarian will be in a certain section of the county on certain days, and if this schedule is made known, those concerned will know when to contact you. In the beginning there might be some difficulty, but as people learn your schedule they will save their time and yours because they will know when to expect you. I have seen this tried and it works. All of the sanitarian's activities are important; however, many of us are sometimes prone to do the things we like and forget others. A planned program, in which all phases of sanitation are considered, will be advantageous in having a well balanced program.

Many sanitarians accept responsibilities that are not rightly theirs. These responsibilities are time consuming and are definitely detrimental to a good sanitation program. For instance, the responsibility of operating clean, sanitary food establishments rests squarely with the management. It is the sanitarian's obligation to make certain that the management accepts and fulfills this responsibility. A sanitarian should do all he can to help operators properly equip their establishments. He should teach them accepted practices and routine operations incident to proper sanitation but he should not waste his time doing work that rightly should be done by the operators. It is not the sanitarians responsibility to get their repair work done for them or purchase their supplies, nor supervise their personnel. If we accept these responsibilities, the operators never will be concerned about them. Why should they? They will always leave it up to us and the overall program will suffer.

In his dealing with operators of food establishments the sanitarian should avoid needless conversations, arguments, and listening to excuses. He should be courteous, positive, and impersonal. A firm, polite approach is much more effective than useless arguments.

There are a number of agencies with which the sanitarian has to deal. Some of these are city councils, boards of supervisors and school superintendents. It is essential to have good relationships with these groups. Keep your council or board advised as to the progress being made. Many of us think of these people only when we need something. If you have an occasion to ask for the passage of an ordinance, and are successful in getting it, then report to appropriate people the results and advantages gained by having it. This will make it a lot easier the next time you want something.

We should strive for a good, cooperative relationship with all of the agencies with which we come in contact. It is a good policy to call occasionally at the office of heads of various agencies with whom you deal. In addition to official reports, talk over a problem with them. Ask their opinion on a subject. Their response often will prevent their building up passive resistance to programs you are attempting to carry out. By all means report to them good things about their agency as well as the bad.

The primary function of the sanitarian is to control the factors in environment that adversely affect public health. We should therefore confine our activities to those things having public health significance. I have had many calls asking to have weeds cut on vacant lots because mosquitos were breeding in them, or to have old buildings torn down, for the same reason. We all know that mosquitos don't breed in weeds and old buildings, and although they are unsightly, they don't cause diseases. If we spend

time beautifying areas, many things of greater public health significance that need attention will go lacking. As long as most areas still have need for more effort in enhancing sanitation, and I confess ours has, we are not ready to undertake refinements which may be only indirectly connected with public health.

The health department, like all public agencies, is always in the public eye. As we go about our daily activities people observe us. We should remember this and never bring reproach upon the department by our conduct. The sanitarian should be rigidly honest and straight forward in his personal dealings with the people of his community.

The sanitarian is in a position to make an outstanding contribution to his community. A recently released definition of sanitation is as follows: "Sanitation is a way of life. It is the quality of living that is expressed in the clean home, the clean farm, the clean business and industry, the clean neighborhood, and the clean community." There is a personal satisfaction in knowing we have a part in making this way of life a reality. We must continue to improve our work and render high quality service to the people. Their confidence in our ability and integrity will increase, and as a result sanitarians will enhance their professional status.

NEWS AND EVENTS

ANNOUNCEMENT CONCERNING THE SANITARIANS AWARD FOR 1961

Announcement is made that nominations will be accepted for the annual Sanitarians Award until May 1, 1961. Members of the International Association of Milk and Food Sanitarians, Inc., are requested to give consideration to the nomination of individuals whose professional work in the field of milk and food sanitation in their communities has been outstanding.

The Award consists of a Certificate of Citation and $1,000 in cash, and is sponsored jointly by the Diversey Corporation, Klenzade Products, Inc., Oakite Products, Inc., Pennsylvania Salt Manufacturing Company, and the Olin Mathieson Chemical Corporation. It is administered by the International Association of Milk and Food Sanitarians, Inc., and is presented annually. The Sanitarians Award was initiated in 1952, and last year it was presented to Mr. James Barringer, director of sanitation for the city of Evansville, Indiana. The next presentation will be at the annual meeting of the Association at Jekyll Island, Georgia, next August.

The Executive Board of the Association has established the following rules and procedures governing the Sanitarians Award.

Eligibility

The rules concerning eligibility of candidates for nomination are:

(1) Any living citizen of the United States or Canada who, at the time of nomination, is employed as a professional milk and food sanitarian, or both, by a county or municipality, is eligible for the Award, except members of the Executive Board and members of the Committee on Recognition and Awards of the International Association of Milk and Food Sanitarians, Inc. Employees of State or Federal agencies and of industry are not eligible for the Award. Membership in the International Association of Milk and Food Sanitarians, Inc., is not a prerequisite of eligibility, and there are no restrictions as to race, sex, or age.

(2) A candidate shall have made a meritorious contribution in the field of milk and food sanitation to the public health and welfare of a county or municipality within the United States or Canada.

(3) The achievements and contributions on which the Award is to be based, must have been completed during the five-year period immediately preceding January 1 of the year during which the Award is to be made. Under special circumstances, consideration will be given to related work accomplished by the candidate during the seven-year period preceding January 1 of the year during which the Award is to be made.

(4) Co-workers are eligible for nomination if both have contributed equally to the work upon which the nomination is based.

(5) No person who has once received the Award shall be eligible for nomination.

Nominations

Nominations of candidates for the Sanitarians Award may be submitted by the Affiliate Associations of the IAMFS, or by any member of the Association in good standing except members of the Executive Board, members of the Committee on Recognition and Awards, and emyloyees of the sponsoring companies. Nominations from persons who are not members of the Association cannot be accepted. No member or Affiliate may nominate more than one candidate in any given year.

Each nomination must be accompanied by factual information concerning the candidate, a resume of his work and achievements, evidence supporting his achievements and if, available, reprints of publications. A form for the submission of nominations may be obtained upon request from H. L. Thomasson, Executive Secretary, International Association of Milk and Food Sanitarians, Inc., P. O. Box 437, Shelbyville, Indiana.

Deadline for Submission of Nominations

The deadline for submission of nominations is set annually, and all nominations and supporting evidence must be postmarked prior to midnight of that date.

Selection Of The Recipient

The Committee on Recognition and Awards of the International Association of Milk and Food Sanitarians, Inc., has full responsibility for selecting from among the candidates nominated the recipient of the Sanitarians Award. In judging the contributions of each candidate, the Committee will give special consideration to (a) originality of thought, mode of planning, and techniques employed, (b) the comprehensive nature of the candidate's achievements, and (c) their relative value as they affect the health and welfare of the candidate's community. The Committee will give consideration also to the efforts of the candidate to establish professional recognition in the community in which he serves, as well as to his research, administrative development, program operation and educational achievements. Additional information or verification of submitted information will be requested when considered necessary by the Committee. Testimonial letters in behalf of a candidate are not desired.

If, after reviewing the nominations with supporting evidence, the Committee decides that the work and achievements of none of the candidates has been significantly outstanding, the Award shall not be made. In this connection, it is fundamental that if meritorious professional achievement cannot be discerned the Award shall be omitted for a year rather than lower the standards for selection of a recipient.

The 1961 Committee on Recognition and Awards consists of:

Dr. Franklin Barber, Chairman, National Dairy Products Corporation, 260 Madison Avenue, New York City.

William V. Hickey, Paper Cup and Container Institute, 250 Park Ave., New York 17, N. Y.

Cameron S. Adams, State Department of Agriculture, Old Capital Building, Olympia, Washington.

Dr. Robert Holland, Department of Dairy Industry, Cornell University, Ithaca, N. Y.

Larry Gordon, Albuquerque Health Dept. Albuquerque, N. Mexico.

Faegen Parrish, State Health Dept., Atlanta, Georgia.

ANNOUNCEMENT CONCERNING THE CITATION AWARD FOR 1961

Each year the International Association of Milk and Food Sanitarians awards to one of its members a citation in recognition of outstanding service to the Association and its members. Recipients must be members of the Association in good standing and have a record of constructive service on behalf of the Association and its member sanitarians. Last year's award was presented to Dr. Luther Black, of the Public Health Service for his service as a member and for outstanding contributions in laboratory procedures and for leadership as chairman of the committee on applied laboratory methods.

The award will be presented again at this year's meeting in Jekyll Island, Georgia next August. Any member of the Association or an Affiliate Association can nominate an individual for the Citation Award.

Nominations must be accompanied by supporting evidence of an individual's past contributions and services to the Association. Nominations for the 1961 Citation Award should be sent to Dr. Franklin W. Barber, National Dairy Products Corporation, 260 Madison Ave., New York 17, N. Y., not later than May 15, 1961.

Selection of the recipient of the Citation Award will be made by the Committee on Recognition and Awards.

SURVEY REVEALS MAJOR PROGRAM AREAS OF MEMBERSHIP

The major area of responsibility and the employing agencies of International members has been a question of considerable interest for sometime. Through a post card survey which resulted in a return of about twenty-five per cent of the membership, some rather interesting results are now available. The survey was conducted during 1960.

Total membership in round numbers is 4400. Based on returns, and expressed on a percentage basis, employing agencies of members are as follows:

EMPLOYING AGENCY	PERCENT OF MEMBERS
Departments of Health	46.70
Industries (all categories)	32.40
Universities or University Affiliated	9.80

Departments of Agriculture (State and Federal)	7.20
Not designated	3.90
	100.00

It is interesting to note that official health departments and industry represent the employing agencies for better than three-quarters of the membership.

Available data was further broken down to ascertain the major fields of activity in which the membership is engaged.

This analysis revealed the following:

MAJOR FIELD OF ACTIVITY	PERCENT OF MEMBERS SO ENGAGED
Milk Control	34.20
General Sanitation	19.50
Laboratory	12.20
Educational Institutions	9.70
Milk and Food Control	9.50
Industry (other than milk and food control)	9.40
Food Control	5.50
	100.00

While the largest single field of major activity is milk control, general sanitation and food control show a combined figure of twenty-five percent.

These figures seem particularly significant from the viewpoint of annual meeting program planning and the kind and content of technical articles appearing in the Journal.

PUBLIC HEALTH SERVICE TO HOLD FIRST DISASTER TRAINING COURSE FOR ENVIRONMENTAL HEALTH PERSONNEL

The Division of Health Mobilization of the Public Health Service will present for the first time a training course titled, "Environmental Health Aspects of Health Mobilization," April 23-28, 1961, in Battle Creek, Michigan. The course will be held in cooperation with the Office of Civil and Defense Mobilization at the OCDM Staff College. Tuition and housing are provided at no cost at the school and travel expenses are partially reimbursable under the OCDM Student Expense Program.

The course is designed to familiarize environmental health personnel with their responsibilities both before and after disaster and to provide general and technical information incident to fulfilling these responsibilities.

Subject matters include: basic civil defense, emergency water supply and treatment (classroom sessions and field exercises); emergency food supply, sanitation and decontamination, emergency wastes disposal; emergency vector control; chemical, biological and radiological warfare agents; and community environmental health services planning for disaster.

For further information write the Office of Defense Mobilization, Battle Creek, Michigan.

QUESTIONS AND ANSWERS

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

QUESTION:

Can you give me some information on the preservation of foods by radiation?

ANSWER:

Bacteria are destroyed by gamma rays or electron beams. Both have similar effects but differ in the manner in which they penetrate the food and are absorbed. Except where the energy level of the rays is extremely high, the energy is dissipated as harmless heat. Gamma rays are derived from radioactive materials, such as Co^{60}, which emit gamma radiation in their decay. Electron beams, however, are best secured from man made electron generators. These accelerate electrons by high voltages of the order of a million volts or more.

The amount of radiation needed varies with each organism. For example, 4,500,000 rads are required to destroy *Clostridium botulinum*, one the most resistant of the sporeforming bacteria. The rad is a unit of measure which represents the absorbed dose of any ionizing radiation which is accompanied by the liberation of 100 ergs of energy per gram of absorbing material. For soft tissue, the rad closely approximates the roentgen equivalent physical (rep). Usually less than 1,000,000 rads will suffice for nonsporeformers.

An effect known as radiation pasteurization can be produced with smaller quantities. As with many things, some difficulties are encountered, and with radiation there may be adverse effects on flavor, enzymes, palatability, and appearance. In addition, there are safety problems involving control of radioactivity since high energy rays might convert certain elements in the foods into radioactive isotopes. The method appears to be several years away from commercial utilization.

QUESTION:

What is the chemical that butchers use to "tenderize" meats? Are there any toxic effects from this chemical?

ANSWER:

A solution of the enzyme papain is most commonly used commercially for tenderizing meat. Papain is obtained from the papaya plant. The enzyme softens the connective tissue as well as the muscle protein. Cooking inactivates the enzyme, and no harmful effects have been reported from its use in such a manner.

FIRST NATIONAL WATER POLLUTION CONFERENCE SETS DEFINITE GUIDE LINES

The first National Water Pollution Conference was held in Washington, D. C., early in December and ended its three day session with recommendations for a vigorous program on the Conference theme, *Clean Water—A Challenge to the Nation.* There was unanimity from the first that pollution is bad and clean water is good, but the crucial question remained: How clean is clean? Who shall be in charge? With how much authority?

"How clean and pure we attempt to maintain our streams," said one speaker, "is a matter of economics and realities, and of values both tangible and intangible. If our objective be pristine purity, we can easily 'price' ourselves out of progress. If our objective be the dollar sign, continually to undercut the necessary cost of controls, we can easily 'prosper' ourselves out of critically essential water resources. Between the two extremes come the tough hard choices."

At the end of the Conference, after "250,000 words of prepared text and three times as many in private opinions expressed in coffee shops and corridors," spokesmen for subcommittees from the three simultaneous panels reported the choices on which there seemed to be agreement, basing their conclusions on papers presented, on discussion of these papers, and on questions and statements from the floor.

CONFERENCE RECOMMENDS

The Conference agreed that the goal of pollution abatement is to protect the capacity of water resources to serve the widest range of human needs; that a national credo stress that 1) users of water do not have an inherent right to pollute, 2) users of public waters have a responsibility for returning them as clean as is technically possible, and 3) prevention of pollution is as important as control.

All groups agreed that research must be increased, supported in large measure by the federal government. Recommended were extension of water-quality monitoring programs, accelerated collection of information on all wastes, improvement in measuring pollution abatement progress. Of especial interest was the recommendation that basic research to determine the effect of industrial products (e. g., detergents, pesticides, fertilizers) on the public welfare should be considered an obligation of industry.

It was agreed that more engineers and scientists must be trained for work on water resources, particularly on pollution control; greater support should be given to university staffs, students, research facilities; research grants-in-aid, with particular emphasis on interdisciplinary areas, should be increased.

Members will be encouraged by Conference recommendations that each federal installation should be required by Congress to treat its wastes in accord with standards for cities and industries in the area; construction of municipal waste-treatment facilities should be expanded immediately, with continued increases to keep up with population growth and abate the backlog by 1970, and a similar program expansion should be applied to industry.

Also concluded was that the federal grants-in-aid program has provided a valuable stimulus to control of stream pollution. Among methods of financing suggested were cheaper and easier marketing of revenue bonds under a federal system of guarantees similar to FHA-guaranteed mortgages and creation of a "Water RFC" to discount, purchase, or collateralize such bonds for loan purposes.

It was further agreed that some incentive should be provided to encourage industry to install needed waste-treatment facilities, perhaps by allowing industry, for corporate income tax purposes, to charge the cost of nonproductive waste-water treatment facilities as expense.

LEFT UNRESOLVED

Which level of government should be in charge of pollution abatement? Extension of federal authority over pollution control was opposed by many representatives of state agencies and by many industrialists, the latter stressing the amount of abatement already undertaken by industry at great cost. Extension of federal enforcement authority to intrastate streams, even with the consent of the state, and setting of water quality standards by the federal government were opposed by these same groups.

The contrasting point of view was that the controversial power to enforce is the most necessary element in an abatement program, that it must be possible—after everything else has been tried—to get to some enforcement authority divorced from local influence.

In a masterly summation of the Conference it was suggested that the question might well be changed from "Who is in charge?" to "How can we work together?" for without doubt those attending the Conference were in accord that control of water pollution should be of great concern, and efforts augmented.

Reprinted from The National Voter, Jan. 1961

OREGON MILK SANITARIANS ASSOCIATION DEVELOPS PRELIMINARY REPORT ON AIR-MILK CONTACT

The Oregon Milk Sanitarians Association, through a special committee, has recently completed a preliminary but extensive report covering the subject, *Air Under Pressure in Contact with Milk, Milk Products and Product Contact Surfaces.* Mr. A. E. Parker, President of the Oregon Association has graciously made a copy of this report available to the Journal and it is printed herewith. We believe this subject is both timely and interesting and should assist many member sanitarians who may be dealing with this type of problem.

The recommendations of this committee shall pertain to the equipment used in the supplying of air under pressure which comes in contact with milk products and for any product contact surface.

These recommendations define the following subjects, pertaining to all equipment for supplying air.

1. Material
2. Fabrication and Installation
3. Applicable Special Considerations

Air under pressure is defined as "Air," the pressure of which has been increased by mechanical means to exceed atmospheric pressure and which is used for agitation of milk and milk products, the movement of milk and milk products, incorporation of air into ice cream and frozen dessert mixes, the automatic opening of containers, the drying of product contact surfaces, and other purposes where specifically directed at a product or product contact surface.

Product shall mean milk and milk products.

Product Contact Surface: Shall mean any surface which the product or products may contact.

AIR SYSTEMS:

1. Central systems shall mean those which furnish air to more than one piece of equipment.

2. Individual systems shall mean those which furnish air to one piece of equipment or an integral part of such equipment.

MATERIAL:

A. Filter media for intake and airline filters shall consist of the following:

1. Single service cotton flannel.
2. Electrostatic.
3. Other equally acceptable filtering media, which are non-shedding and which do not release to the air toxic volatiles, or volatiles which may impart any flavor or odor to the product.

B. Disposable Filters, single service type:

1. Cotton Flannels
2. Non-woven fabric U.S.P. absorbent cotton fibre
3. Suitable non-fibrous materials which are non-toxic and non-shedding under conditions of use.

Binding materials contained in the media shall be non-toxic and non-volatile under all conditions of use.

C. Piping: Air distribution piping and fittings from the terminal disposable media filter to the actual point of contact with the product or where such may form a part of the product contact surface shall conform to the following:

1. Shall be of stainless steel.
2. Shall meet 3-A Sanitary Standards for piping, fittings and gaskets used on sanitary lines conducting milk and milk products.
3. Approved type flexible tubing, not to exceed 8 ft. in length.

FABRICATION AND INSTALLATION:

A. Air Supply Equipment: The compressing equipment shall be of oil free design, and shall be located in a clean dry room or area, which is free of contaminated air, such as lubricated vapors, fumes, or any odor which might contribute to an unclean air.

B. The air supply system intake shall be provided with a filter. The air supply intake shall be piped to the outside air or other approved clean air supply. To prevent contamination this filter shall be located at a safe distance from floor and be easily accessible for examination, and the filter media be easily removable for cleaning or replacement, shall de dated at time of installation and at the time of each replacement thereafter.

C. Moisture Removal Equipment: If air supply design is such that moisture is not eliminated from the compressed air, a liquid cooled *after cooler* shall be installed between the compressor and air storage tank for removing moisture from the compressed air. The condensation from the *after cooler* shall flow to a properly automatic trapped outlet, to be disposed of to the atmosphere and from the system.

D. Air line filters, moisture trap and piping.

1. There shall be an oil free airline filter and moisture trap through which air under pressure shall pass, located in the airline downstream from the compressor and to a tank if one is used. The filter shall be readily accessible for examination, cleaning and replacing and shall be dated when installed and when replaced thereafter. The filter body trap shall be equipped with an automatic valve for draining accumulated water.

   Compressed air piping shall slope downward from the compressing equipment to the filter and moisture trap.
2. A disposable media filter and moisture trap shall be located in the sanitary air line upstream from and as close as possible to each point of application or ultimate use of the air.
3. Where air under pressure is less than 2 psi. such airline filters downstream from compressing equipment shall not be required.
4. The air piping shall enter the product zone from a point higher than the product overflow level, except in the case of equipment which is designed to incorporate air

into the product. In order to prevent backflow of the product into the air lines, a product check valve of sanitary design shall be installed downstream from the disposable media specified in D 2.

SPECIAL CONSIDERATIONS APPLICABLE TO AGITATION BY AIR:

1. Tubing used to introduce air into the product zone shall be of stainless steel and shall conform to 3-A Sanitary Standards for fittings used on milk and milk products equipment and used on sanitary lines conducting milk and milk products.
2. No threaded fitting shall be used in the product zone.
3. Where drilled or perforated pipe is used, internal drilling burrs shall be removed and the orifices shall be chamfered, on the outer surface of the pipe.
4. The air piping system shall be designed to prevent siphoning or backflow of product into the air system. The air agitating equipment shall be designed to provide adequate agitation as defined in 3-A Sanitary Standard ("3-A Sanitary Standards for storage tanks for milk and milk products" Amended Nov. 9, 1955).
5. If the compressing equipment volume is in excess of that required for satisfactory agitation, suitable means shall be employed to eliminate the excess volume.
6. Two sections of approved type of flexible tubing may be used in case of unloading mobile tanks providing an easily detachable clamp or coupling be used to permit proper cleaning.

SPECIAL CONSIDERATIONS APPLICABLE TO THE MOVEMENT OF MILK AND MILK PRODUCTS BY THE AIR DISPLACEMENT METHODS.

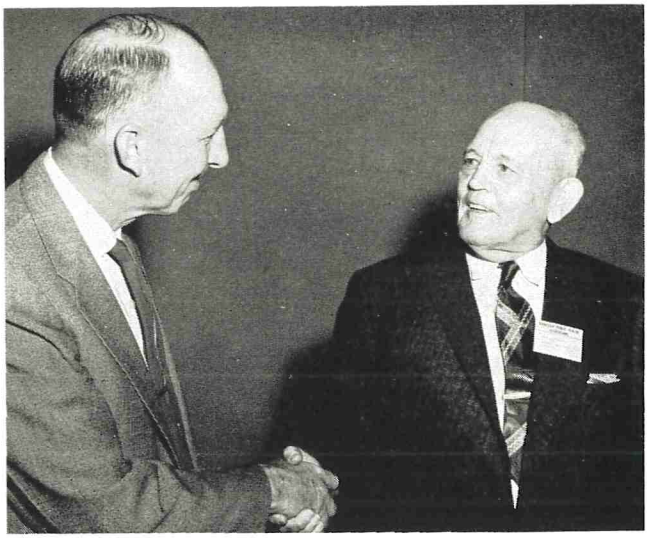
1. The conditions applying to air agitation shall also apply to air displacement.
2. A safety (pressure relief) valve shall be installed in the air line. This valve shall be set to open upon reaching a pressure greater than that, according to manufacturer of the vessel from which the product is to be moved is the maximum allowable internal working pressure to which the vessel can be subjected. This safety valve shall be of ample size to pass freely the entire output of the compressor.

SPECIAL CONSIDERATIONS APPLICABLE TO AIR WHICH IS TO BE INCORPORATED.

1. In Products, air which is compressed by sanitary rotary pumps shall require only a disposable media type filter installed at the air intake.

CARAWAY SELECTED OUTSTANDING SANITARIAN OF TENNESSEE FOR 1960

In 1958, the Tennessee Association of Sanitarians set up a program by which an award was to be made each year to the Sanitarian who was to be selected by a committee as the Outstanding Sanitarian of that year. The committee is composed of five members, who hold office on the committee by virtue of their official capacity as full time employees or officers of a local or state health organization.



John Caraway (right) receives congratulations on outstanding Sanitarians Award.

Principal qualifications for the award include employment as a full time sanitarian in a local health department in Tennessee, at least two years of past full time service, and not more than the immediate past five years included in the record for qualifications for the award. Each In-Service Training unit in the state is allowed to submit not more than two names as candidates. The Sanitation Consultant who serves that area of the state then assembles data on the candidate and submits it to the committee. The final choice is made by the committee.

The first award was made in 1959 to Mr. Dorcie Lee Yates of the Humphreys County Health Department of Waverly. The second award was made in 1960 to Mr. John Caraway, Sanitarian of the Obion County Health Department, Union City. Mr. Caraway is one of the real oldtimers in public health work in Tennessee, having been with the Obion County Health Department for a period of 37 years beginning in 1923. The list of his qualifications as submitted to the committee is a long and very impressive one, of which the following excerpts are a summary.

His work has long been noted for the carrying on of a sound and well rounded program in environmental sanitation. He is a hard worker, and has a contagious enthusiasm about his work that helps to sell his programs. In addition, he is zealous about enforcement of matters that pertain to public health when enforcement is the only available means of solution. He has not hesitated to use legal measures when there was no reasonable alternative. The respect and liking of the people he serves have come to John Caraway as a result of these characteristics

he possesses, along with an inherent fairness that causes him to treat all people the same, regardless of social or economic status.

Some of the activities which he has promoted, or in which he has actively participated, include the construction of an average of 85 pit privies, 100 septic tank disposal systems for sewage, 110 individual water supplies, and 1400 vaccinated dogs each year for the past five years. Most of this work has been done in the rural sections of Obion County. He has carried on an excellent program of supervision of the rural schools and their cafeterias. Because of his efforts more than 85% of the people living in Obion County have safe water supplies and approved septic tank sewage disposal systems.

His hard work in the field of milk sanitation has helped greatly to give Union City the outstanding program that it now has; it was the first town in West Tennessee to adopt an ordinance requiring compulsory pasteurization of milk sold there. He assisted in development of the excellent sanitary landfill that Union City now has, along with an outstanding program for the collection and storage of garbage and refuse. He helped to promote the new and modern sewage treatment plant and the new iron removal filter plant for water treatment that Union City now has in operation. He has promoted a program of mosquito control for Union City and other areas in the county.

He has actively promoted programs to secure a modern sewage treatment plant, a complete sewage collection system, a sanitary landfill, an adequate system of garbage collection, and a mosquito control program for South Fulton.

SPECTRE OF PESTICIDE RESIDUES PLAGUES FOOD PROCESSORS

Many of the food processing industries face a difficult problem as a result of their position as "low man on the totem pole." The flow of agricultural commodities from the farm through transportation channels and intermediate storage facilities to the final processor is often so devious that pinpointing a particular lot in relation to its farm origin is impossible. It thus becomes largely a matter of faith, in the absence of a specific test, that Farmer Brown's pest control program did not result in an illegal pesticide residue on his crop.

Despite carefully detailed directions for use and supervision at the County Agent level, several recent surveys have demonstrated that faith alone is not a sufficient safeguard. Since the processor is legally responsible for the conformance of his finished product with pesticide tolerance regulations, he faces the necessity of ensuring not only that his raw materials are within legal limits but that his own manufacturing procedures do not raise the concentration of a permissible residue with the result that the tolerance will be exceeded in the processed food.

Because of their wide use and relative stability, the chlorinated hydrocarbon pesticides are currently of greatest concern. A considerable degree of progress has been made in developing quick and inexpensive analytical methods for detecting and estimating the presence of these substances in almost any food crop. These depend primarily on the determination of total organic chlorine and, while not specific for any individual pesticide, the finding of a low value can be relied upon as proof that illegal residues are absent.

Problems of simple logistics, however, render even the most expeditious analytical tests almost useless as control procedures in those industries where large tonnages of materials are handled daily. The milling and oil seed processing industries are good examples since storage facilities for individual lots are not available which would permit holding material pending laboratory approval. The most that can be accomplished by a testing schedule, even were it to include every incoming lot, is to establish, *post hoc*, the real magnitude of the problem. Fortunately, of course, the effects of scattered lots having high residues may be expected to be substantially diluted by mixing during processing.

All of the evidence presently available indicates that the true significance of this problem is principally technical, in the legal sense. It is not correct to imply that residues currently encountered, even when in excess of tolerances and hence illegal, necessarily constitute a significant hazard to the health of the consumer.

UNIVERSITY OF NEBRASKA TO SCHEDULE TWO-DAY MARKET MILK CONFERENCE

The Dairy Husbandry Department of the University of Nebraska has scheduled a two day conference on market milk and milk products to be held April 4 and 5, 1961. The conference will be held at Lincoln.

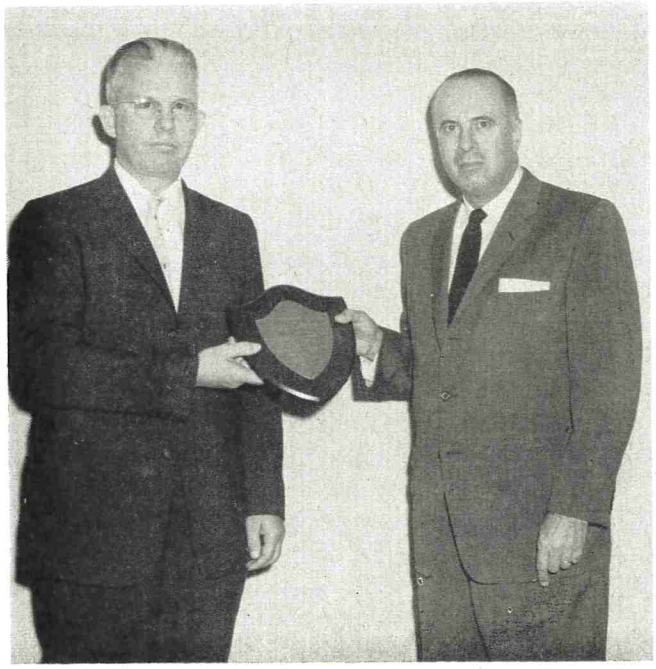
The first day's program will be devoted to market milk problems; the second day will cover problems relating to cottage cheese and cultured milk. Material will be presented through lectures, demonstration, panel discussions and clinics. For further details and a copy of the program inquiries should be addressed to T. A. Evans, Extension Specialist, College of Agriculture, Lincoln 3, Nebraska.

Reprinted from Food and Drug Research Vol. 7 :4, December, 1960

GEORGIA SOCIETY OF SANITARIANS HONORS OUTSTANDING MEMBERS

The Georgia Society of Sanitarians recently honored two of its members and presented to a third an honorary lifetime membership during the annual meeting.

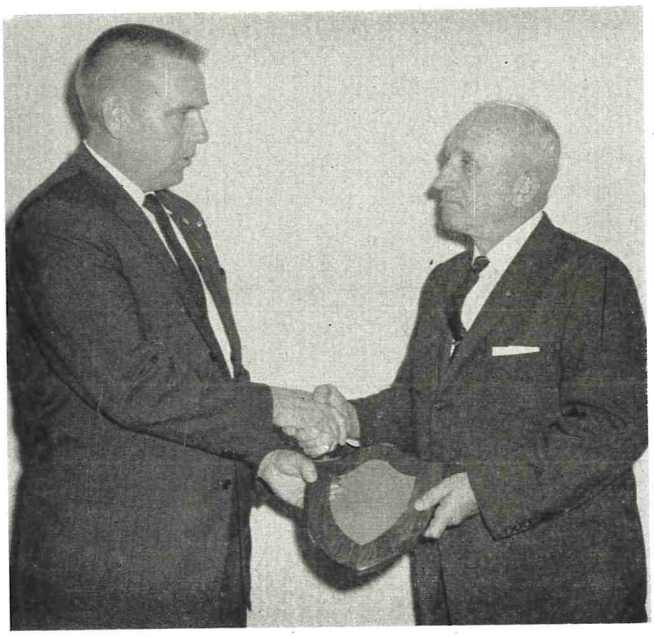
Honored for outstanding achievement in Food Sanitation was Furman B. Hendrix of Cobb County. Cited for an efficient and effective food service sanitation program, establishments under his supervision improved from a rating of 51.71 percent in 1957 to 91.99 percent in 1959. Cobb County is the first to attain a rating of 90 percent or above in the U. S. for a county with a population of 100,000 and over.



Furman B. Hendrix (left) receives citation and award for outstanding accomplishments in food service sanitation. The preesntation was made by John D. Evans, President of the Georgia Restaurant Association. The presentation made at the 1960 meeting of the Georgia Society of Sanitarians.

For outstanding accomplishments in the field of milk sanitation, the 1960 award went to Edward A. Wilder of the Valdosta-Lowndes County Health Department. Mr. Wilder's citation highlighted the improvement in the rating of the milk shed under his jurisdiction from less than fifty percent in 1956 to ninety six percent in 1958. In addition, through his efforts the County milk ordinance and code was revised to prohibit the sale of raw milk and to bring it into compliance with the 1953 recommended ordinance and code of the Public Health Service.

The third award recipient was Louva G. Lenert who received an Honorary Lifetime Membership.



James E .Quintrell of Sealtest Foods, Atlanta, (left) presents outstanding milk sanitarian award to Edward A. Wilder of the Valdosta-Lowndes County Health Department at the annual meeting of the Georgia Society.

Mr. Lenert is the Director of Public Health Engineering Services for the Georgia Department of Public Health. His award citation recognized his undaunted leadership in securing adequate public health protection for Georgia's citizens and for his devotion in raising the quality and quantity of sanitation services in the State.

INTERNATIONAL congratulates and salutes these men for their noteworthy and outstanding accomplishments.

Louva G. Lenert (right) receives honory lifetime membership from E. Frank Golden, 1960 president of the Georgia Society of Sanitarians.

MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

The Annual Meeting of the American Dairy Science Association will be held at the University of Wisconsin, Madison, Wisconsin, June 11 - 14, 1961. On November 28th, the Program Committee met in Chicago and arranged for an excellent program that will be of interest to educators, research workers, and those engaged in industry. Further details will appear at a later date.

The American Dairy Science Association now has approximately 2,600 members and 600 Student Affiliate members. The membership has gradually changed so that 40% are engaged in teaching and research and 60% are engaged in various types of industry. Among this latter number are 580 who are engaged in dairy manufacturing and 148 who are engaged in the manufacture or distribution of dairy equipment and supplies. Every phase of the business is represented from company Presidents to Production Managers.

MARKET MILK AND ICE CREAM CONFERENCES TO BE HELD AT PURDUE

F. N. Andrews, Head of the Dairy Department at Purdue University, has anounced two, one-day meetings to be held in March 1961. The Market Milk Conference will be held on March 15 and the Ice Cream Conference on March 16, in the Memorial Center at Purdue University. The conferences are an annual affair sponsored in cooperation with the Indiana Dairy Products Association.

The Market Milk Conference will include discussions on High Temperature Pasteurization of Milk, Operation of Federal Milk Marketing Orders, Recent Developments in Milk Cartoning and Accounting for Bulk Tank Milk Receipts. The program will be concluded with a milk and buttermilk clinic.

The Ice Cream Conference will include a Purdue research report on "Least Cost Ice Cream Ingredients" and discussions on "Applications of Automation in Ice Cream Processing," "The Kentucky Fair Trade Practices Law" and "Pasteurization of Ice Cream Mix." The meeting will be concluded with an ice cream clinic.

Members of Purdue's Dairy Department and Agricultural Economics Department will participate, as well as other recognized university and dairy industry authorities.

For further information write to: Mr. H. F. Ford, Dairy Department, Smith Hall, Purdue University, Lafayette, Indiana.

CHEMISTS ASSOCIATION TO GIVE ATTENTION TO TASTE AND ODOR PROBLEMS OF WATER

A research project to determine adequate standards for testing taste and odor in our public water supplies is now being carried out at the Franklin Institute, Philadelphia, under the sponsorship of the Manufacturing Chemists' Association.

According to Institute spokesman Robert A. Baker, who is directing the study, the project will attack the highly complex problems of what is a "bad" taste or odor, and how it can be measured.

The laboratory program is a part of an over-all effort by the Water Pollution Abatement Committee of the national chemical manufacturers' organization to accumulate meaningful and useful information for the public, the chemical industry and government regulatory bodies interested in the control of water pollution.

An earlier project by the Institute for the MCA consisted of a critical evaluation of the technical literature in this field and a survey of available laboratory data. This study has just been completed and a comprehensive report will be available for distribution through MCA in the near future.

The new phase of the program will look at various aspects of the taste and odor problem: chemical, biological, psychological and physiological. A special, air-conditioned panel testing laboratory for the experimental work is nearing completion. In this lab, Franklin Institute will attempt to pin down some of the subjective aspects of taste and odor.

Panels composed of persons of various ages, smoking habits and medical histories will be used to determine the effect of various types and intensities of odors, the differences between persons and their response to odors, time relationships, and complicated interactions among these factors.

According to the Institute, the first aim is to find some reproducible method for measuring the intensity of an odor. Later, Institute researchers will attempt to create a system for characterizing — or labeling — odors, so that all scientists working in the field will have some common terms of reference.

According to J. T. Garrett, Monsanto Chemical Company, industrial hygenist and chairman of the MCA subcommittee supervising this project, regulatory bodies need scientifically sound information about water taste and odor in order to properly evaluate public complaints or lay down adequate bases for control of water pollution.

He emphasized that the chemical industry, aware of the problems and wishing to cooperate fully with the regulatory groups, is financing basic research to dig out the answers.

MEET OUR NEWLY ELECTED OFFICERS

At the IAMFS Annual Meeting last October John H. Fritz and Karl K. Jones began their service to the Association as newly elected officers, Mr. Fritz as *Second Vice-President* and Mr. Jones as *Secretary-Treasurer.*

JOHN H. FRITIZ

John H. Fritz was born in Butte, Montana on July 27, 1918. In 1941 he graduated from Montana State College with a B.S. degree in Agriculture with a major in Dairy Industry Manufacturing. Between July 1941 and November 1945 he served on active duty with the U. S. Army. During most of this time he was engaged in food inspection duties with the Veterinary Corps and gained the rank of T/Sgt. Mr. Fritz was employed by the Department of Health, Kansas City, Missouri, between 1946 and 1957, during which time he served first as Chief, Food Section, Division of Public Health Engineering, and later as Chief of the Milk and Food Section. In 1951, while on leave of absence, he earned the Master of Public Health degree at the University of Minnesota. In 1957 he joined the Department of Public Health of the District of Columbia as Chief, Food and Public Health Inspection Division. Mr. Fritz held that position until August 1959 when he entered on active duty with the U. S. Public Health Service and was assigned to the Headquarters office of the Food Sanitation Section, Milk and Food Program, Division of Engineering Services, Bureau of State Services.

Mr. Fritz has been actively engaged in numerous committee activities with the Association having served as Chairman, Food Equipment Sanitary Standards Committee and as a member of the Membership Committee and the Awards Committee. Currently he is serving as Chairman of the Committee on Communicable Diseases Affecting Man. Mr. Fritz has also served as a representative of the Association to the National Industry-Health Council on Food and Beverage Sanitation and the U. S. Public Health Service's Food Establishment Sanitation Advisory Committee. In 1956 Mr. Fritz was presented the Association's "Sanitarian's Award" and in 1959 was appointed as an Associate Editor for the Journal of Milk and Food Technology.

Mr. Fritz is a Past President of both the Missouri Association of Milk and Food Sanitarians and the Mid Continental Association of Food and Drug Officials. He is married and has seven children. He and his family reside at 5904 62nd Ave., Riverdale, Maryland.

Karl K. Jones is Chief of the Retail Food Section, Division of Food and Drugs, Indiana State Board of Health. Prior to this assignment, he served for several years as the State Retail Food Survey Officer with the Division of Food and Drugs. In 1950, Mr. Jones received the Bachelor of Science Degree in Public Health from Indiana University and since then has been with the Indiana State Board of Health. He is certified by the Indiana Association of Sanitarians as a public health sanitarian. Mr. Jones served with the U. S. Army from 1942 to 1946 and has spent most of his life in Indiana. He is married and lives at 2645 West 22d Street, Indianapolis, Indiana.

Mr. Jones has been a member of the International Association of Milk and Food Sanitarians for the past ten years and has served on several committees.

KARL JONES

He has been a member of the Committee on Education and Professional Development, and for the past several years has served as Chairman of the Subcommittee on Registration and Standards. He is Chairman of the Committee on Food Equipment Sanitary Standards and in that capacity serves as a member of the National Sanitation Foundation's Joint Committee on Food Equipment Standards and also as a member of the National Automatic Merchandising Association's Automatic Merchandising Health-Industry Council.

For the past eight years, Mr. Jones has been Secretary of the Indiana Association of Sanitarians and is the current President of the Ohio Valley Conference of Food, Drug and Health Officials. He is also a member and contributor to many other technical and scientific organizations, including the American Public Health Association, Middle States Branch of the A.P.H.A., the Indiana Public Health Association, and the Central States Association of Food and Drug Officials.

8TH NATIONAL CONFERENCE ON INTERSTATE MILK SHIPMENTS ST. LOUIS, MISSOURI, APRIL 4-6

The Eighth National Conference on Interstate Milk Shipments will be held April 4-6 at the Statler Hotel in St. Louis, Missouri. Participants from 35 States and the District of Columbia, representing public health and agricultural agencies, industry and others concerned with the interstate shipment of milk, are expected to attend.

Harold J. Barnum, Denver City Department of Health and Hospitals, who is Chairman of the Conference, announced:

"The purpose of the National Conference on Interstate Milk Shipments is to provide a means whereby health authorities of milk importing areas can accept with confidence the milk shipped into their jurisdictions, without the necessity of making direct inspections of the distant source. Under this voluntary program, based on agreements developed by the NCIMS, inspection, laboratory control, and certification of interstate milk supplies are performed by the State and municipalities in which the source of milk is located. The 1953 edition of the United States Public Health Service *Milk Ordinance and Code*, and the rating method developed by the United States Public Health Service are used as uniform criteria for the evaluation and certification of interstate milk supplies.

"Supplies of milk certified as meeting Conference agreements are published quarterly by the U. S. Public Health Service in the 'Sanitation Compliance Ratings of Interstate Milk Shippers.' This publication includes over 700 interstate milk shippers who market the milk production of approximately 125,000 dairy farms, and lists the sanitation compliance ratings of milk supplies submitted by State milk sanitation rating officers who have been certified by the Public Health Service."

Ray A. Belknap, Iowa State Department of Health, who is Program Chairman for this year's meeting, reported:

"Conference objectives are to be reviewed and discussed with emphasis toward more understanding and wider acceptance of Conference agreements. Reports from standing committees concerning recodification of agreements, non-biological contaminants in milk and milk products, bulk milk driver training, continuous survey and rating, uniform labeling, laboratories, and uniform bill of lading will be presented to the general assembly for consideration and action.

"To facilitate the function of the NCIMS, task committees have been appointed for the purpose of considering improvements and modification of Conference agreements. Problems submitted by Conference members will be assigned to the respective task committes. Anyone desiring to introduce changes in existing basic agreements must present such changes at the opening session of the Conference to allow the general assembly to vote on whether or not such proposals will be acceptable for consideration."

PROGRAM

NATIONAL CONFERENCE ON INTERSTATE MILK SHIPMENTS

Hotel Statler, April 4, 5, 6-1961, St. Louis, Missouri

TUESDAY — APRIL 4, 1961

8:00 -9:00 a.m. Registration

9:00 a.m. General Meeting

Call to Order — H. J. Barnum, *Chairman*

"Objectives of the Conference — Revilalization and Challenge to Leaderership" — Panel Discussion. K. G. Weckel, University of Wisconsin — *Moderator*. Panel Members will represent a shipping state, a receiving state, a local health department, and the dairy industry.

"Views of the Association of State and Territorial Health Officers on the Use of Health Regulation as Trade Barriers" — Dr. Russell E. Teague, Commissioner of Health, State of Kentucky, and Chairman, Standing Committee on Environmental Sanitation of the A.S.T.H.O.

Appointment of Nominating Committee.

1:00 p.m. Reports of Committees

Recodification — Darold Taylor,

Chairman
Non-Biological Contaminants in Milk and Milk Products — H. E. CALBERT, *Chairman*
Bulk Milk Driver Training — EARL WRIGHT, *Chairman*
Continuous Survey and Rating — JOHN SCHLEGEL, *Chairman*
Uniform Labeling — PARK LIVINGSTON, *Chairman*
Laboratory Committee — LUTHER BLACK, *Chairman*
Uniform Bill of Lading—S. J. WOLFF, *Chairman*

Special Reports

Progress Report of the National Mastitis Action Committee — ROBERT METZGER, *Chairman*
Progress Report of P.H.S. Bulk Milk Shipment Studies—A. RICHARD BRAZIS, *Chairman*
Report on the Use of the Methylene Blue Test — ROBERT MCFATE
Progress Report on P.H.S. Activities Related to the Interstate Milk Shipments Program — JOHN FAULKNER
Presentation to the Conference of Problems Relating to the Interstate Milk Shipper Program
Consideration of any Proposals to Change Existing Agreements

WEDNESDAY — APRIL 5, 1961

8:00 a.m.-4:30 p.m. General Assembly
Consideration of Problems by Task Forces
Committee on Supervision
Committee on Rating and Certification
Committee on Responsibilities of Participating State Agencies
Committee on Responsibilities of USPHS
Committee on Laboratory Control and Certification
Committee on Application of Agreements
Committee on Special Assignments
Each Task Committee will be assigned a Chairman, Co-Chairman, Secretary and Consultant prior to the meeting.

7:00 p.m. Social Hour—Film: "The Milk Man to Malaya"

THURSDAY — APRIL 6, 1961

8:30 a.m. Business Meeting
Adjournment

PAPERS PRESENTED AT AFFILIATE ASSOCIATION MEETINGS

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

Connecticut Association of Dairy and Food Sanitarians, Inc.

(36th Annual Meeting, January 18, 1961)
(Secretary, Dr. R. M. Parry, Dept. of Agriculture, State Office Bldg. Hartford, Conn.)

DAIRY SECTION

Problem of Watered Milk. Blanton C. Wiggins, President, Advanced Instruments, Inc., Newton Highlands, Mass.

Q Fever and the Dairy Industry. Earle K. Borman, Dir., Div. of Laboratories, Conn. Dept. of Health, Hartford, Conn.

Proposed changes in the Dairy Laws. Joseph N. Gill, Commissioner, Dept. of Agriculture, Conservation and Natural Resources, Hartford, Conn.

FOOD SECTION

Policies and Practices in the Handling of Readily perishable Foods. Panel Discussion
Eric W. Mood, *Moderator*
Patrick Carroll, *Large Food Store Chains*
John Kelleher, *Smaller Food Store Chains*
Cornelius P. Courtney, *Individual Food Store Chains*
Kenneth W. Crane, *State Regulatory Agencies*
Dr. Leonard Parente, *Municipal Regulatory Agencies*

JOINT SESSIONS

My Experiences with World Health Organizations. Eric Mood, New Haven Public Health Dept., New Haven, Conn.

Washington Milk Sanitarians Association

(Southwest, Northwest, Southeast, Northeast Sectional Meetings December 5, 6, 7, 9, 1960, respectively)
(*Secretary,* W. R. Knutzen, 125 Ferry Terminal, (Pier 52) Seattle, Wash.)

Mastitis Control. Dr. Daniel O. Noorlander, Research, Dept., Univ. of California, Davis.

Central Ontario Milk Sanitarians Association

(Third Annual Meeting, January 25, 1961)
(Secretary, William D. McCorquodale, 409 Huron Street, Toronto, Ont., Canada)

Greetings from the International Association of Milk and Food Sanitarians, H. L. Thomasson, Exec. Sec. of the International Association of Milk and Food Sanitarians, Inc. Box 437, Shelbyville, Ind.

Is Cooling of Milk Overemphasized? Dr. C. K. Johns, Dir., Research Branch, Central Experimental Farm, Ottawa, Ont., Canada.

Evaluation of U.H.T. Processing of Milk and Related Products. Dr. D. L. Gibson, Head of Dept. of Dairy Science, Univ. of Saskatchewan, Saskatoon, Sask., Canada.

Cultures and Cottage Cheese. Dr. D. Irvine, Head of Dept. of Dairy Science, O. A. C., Guelph, Ont., Canada.

A Look into the Future of Dairying. Dr. A. C. Dahlberg, Professor of Dairy Industry, Cornell Univ., Ithaca, N. Y.

INDEX TO ADVERTISERS

Classified Ads

FOR SALE

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

POSITION AVAILABLE

A young man, trained in Public Health & Sanitation, for the position as Sanitarian to the Borough of Hanover. The work deals with food, dairy, and water bacteriology; isolation and identification, plate counts, swab testing and chemical testing; establishment and operation of a laboratory; restaurant control; and advisor for the Board of Health on all Public Health and Sanitation Programs in co-operation with the Health Officer. The Borough has a population of 15,000. The Sanitarians starting salary will be $5,500. Please communicate with: Dr. Gabriel Zelesnick, M.D., Borough Offices, 108 Railroad Street, Hanover, Pennsylvania.

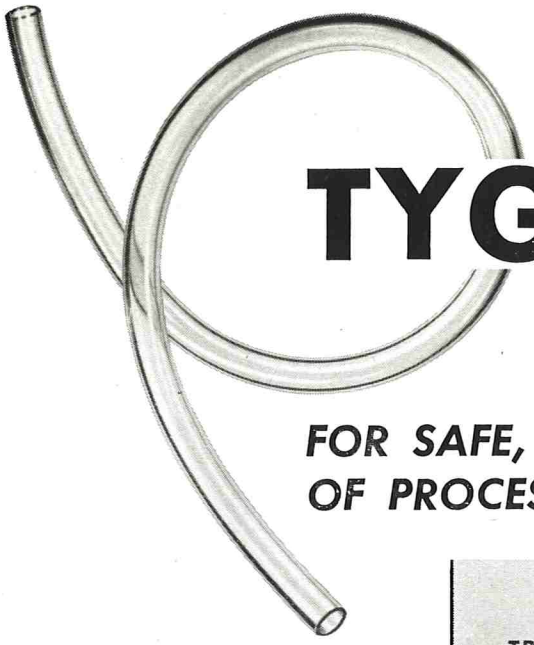
Canny users use Stainless Steel milk dispenser cans

Never will one milk can go through so much with so little damage. Even after 10, 15, 20 years of hard usage a Stainless Steel milk dispenser can will still be in its prime. And it will have a perfect attendance record—not one day's work lost . . . and no leakage. It will keep milk clean and pure. That's because Stainless Steel can be thoroughly cleaned thousands of times and still retain its smooth impervious surface. You don't have to baby Stainless Steel; it's strong. Stainless Steel milk cans mean economy in the long run. Generally speaking, there are practically no replacement costs because Stainless Steel milk dispenser cans just won't wear out. If you'd like to be a canny milk can user and save money, too, check with your equipment distributor.

USS is a registered trademark

United States Steel Corporation—Pittsburgh
American Steel & Wire—Cleveland
National Tube—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

United States Steel



Specify

TYGON® B44-4X

Flexible Plastic Tubing

FOR SAFE, EFFICIENT, ECONOMICAL HANDLING OF PROCESSED MILK AND MILK PRODUCTS

FLEXIBLE — Tygon's rubber-like flexibility — retained throughout the full range of normal operating temperatures — speeds set-ups, requires few fittings and couplings, simplifies revisions as needs change.

TRANSPARENT — Tygon's transparency permits visual inspection and control of flow, facilitates maintenance of high standards of cleanliness. Used as recommended, the tubing retains its transparency throughout its service life.

NON-TOXIC—Tygon Tubing Formulation B44-4X complies fully with the F.D.A.'s Food Additive Amendment and hence is sanctioned as completely harmless and non-toxic.

TASTE- AND ODOR-FREE — Flavor- and odor-sensitive milk and milk products are completely safeguarded by Tygon B44-4X. The tubing will neither impart nor absorb taste or odors.

EASILY CLEANED AND SANITIZED — The mirror-smooth bore of Tygon B44-4X cannot trap minute particles, is quickly and easily flushed clean, will withstand harsh cleaners and sanitizing agents. Low surface tension, hence excellent wetting properties, assures thorough and complete drainage.

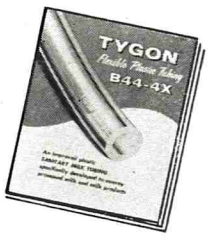
LONG SERVICE LIFE — Non-aging, non-oxidizing, physically tough and abrasion-resistant, Tygon Tubing B44-4X assures the user of a long, trouble-free, *economical* service life.

FOR YOUR PROTECTION

. . . every foot of Tygon Tubing is permanently branded with the name "TYGON" and the Formulation Number.

RANGE OF SIZES—Running lengths of Tygon Tubing, Formulation B44-4X, are available in more than 65 standard sizes with bores from 1/16" to 4", in convenient packaged forms through virtually all dairy supply houses. Upon request, we'll be glad to furnish you the names of distributors in your area.

GET COMPLETE DETAILS and technical information on Tygon Tubing, Formulation B44-4X. Write today for free Bulletin T-91.



285-G

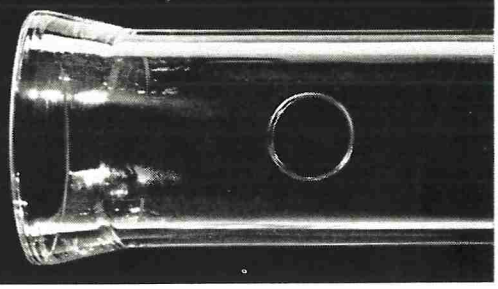
Plastics and Synthetics Division

U. S. STONEWARE

AKRON 9, OHIO

SURGE glass milk lines

. . . see through cleanliness



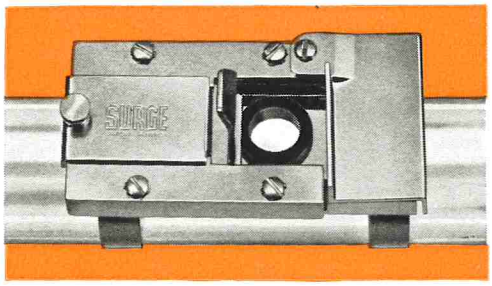
plus simplicity equal to any other line, whether you use milk valves or tees.

NOW, from Surge, glass milk lines with a choice of fused tee inlets or fire-polished holes for Surge clamp-on milk valves. Extra couplings are eliminated, no added tee sections are required, and the entire milk line gets see-through cleanliness from end to end.

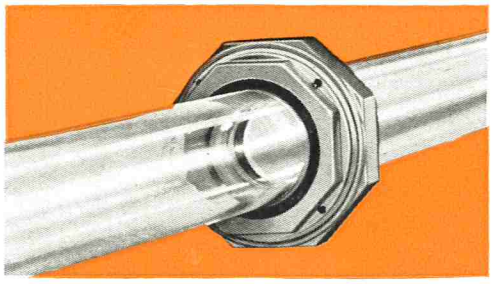
With the new Surge glass line, Clean-In-Place washing becomes more effective than ever before because there are fewer joints and fewer cracks and crevices.

Every type of pipe-line installation, stanchion or milking parlor, can now be fitted with this advanced new glass milk line. Or if the customer chooses, he can have quality stainless steel lines from Surge.

Fused inlet tees eliminate extra couplings, wash thoroughly with Clean-In-Place systems.



New glass pipe with factory-made holes uses Surge clamp-on milk valves.



Surge pipe greatly reduces the number of couplings required in any pipe-line system.

BABSON BROS. CO.

2843 West 19th St., Chicago 23, Illinois

ATLANTA • DALLAS • KANSAS CITY • MINNEAPOLIS
SACRAMENTO • SEATTLE • SYRACUSE • TORONTO