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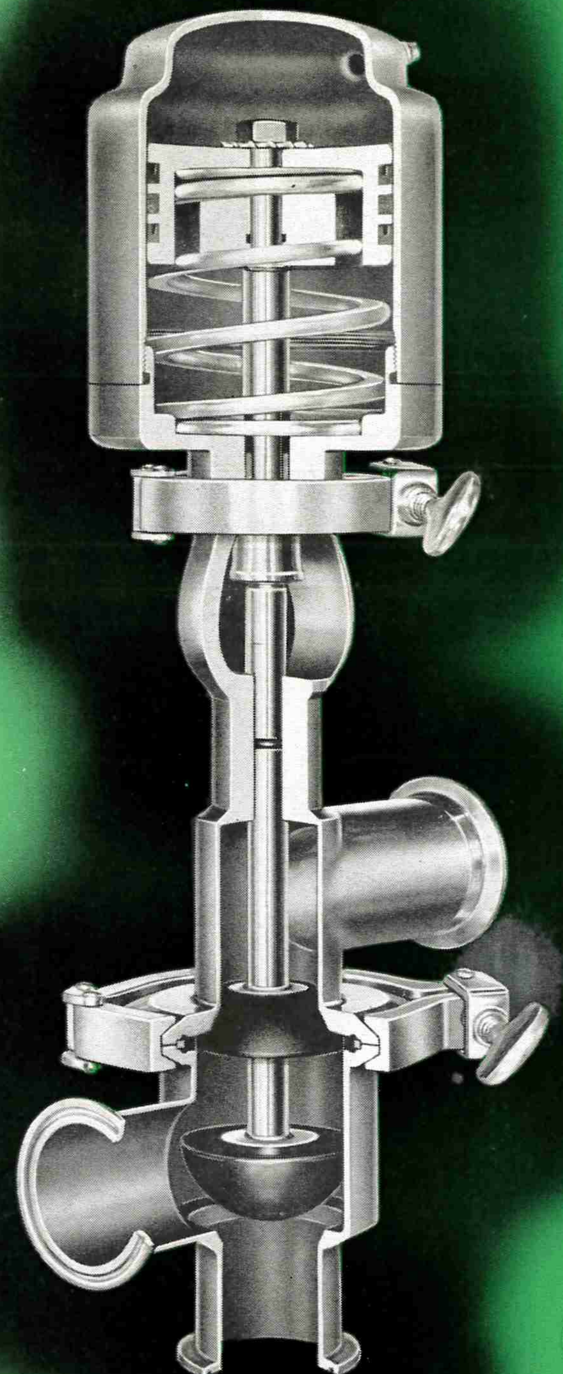

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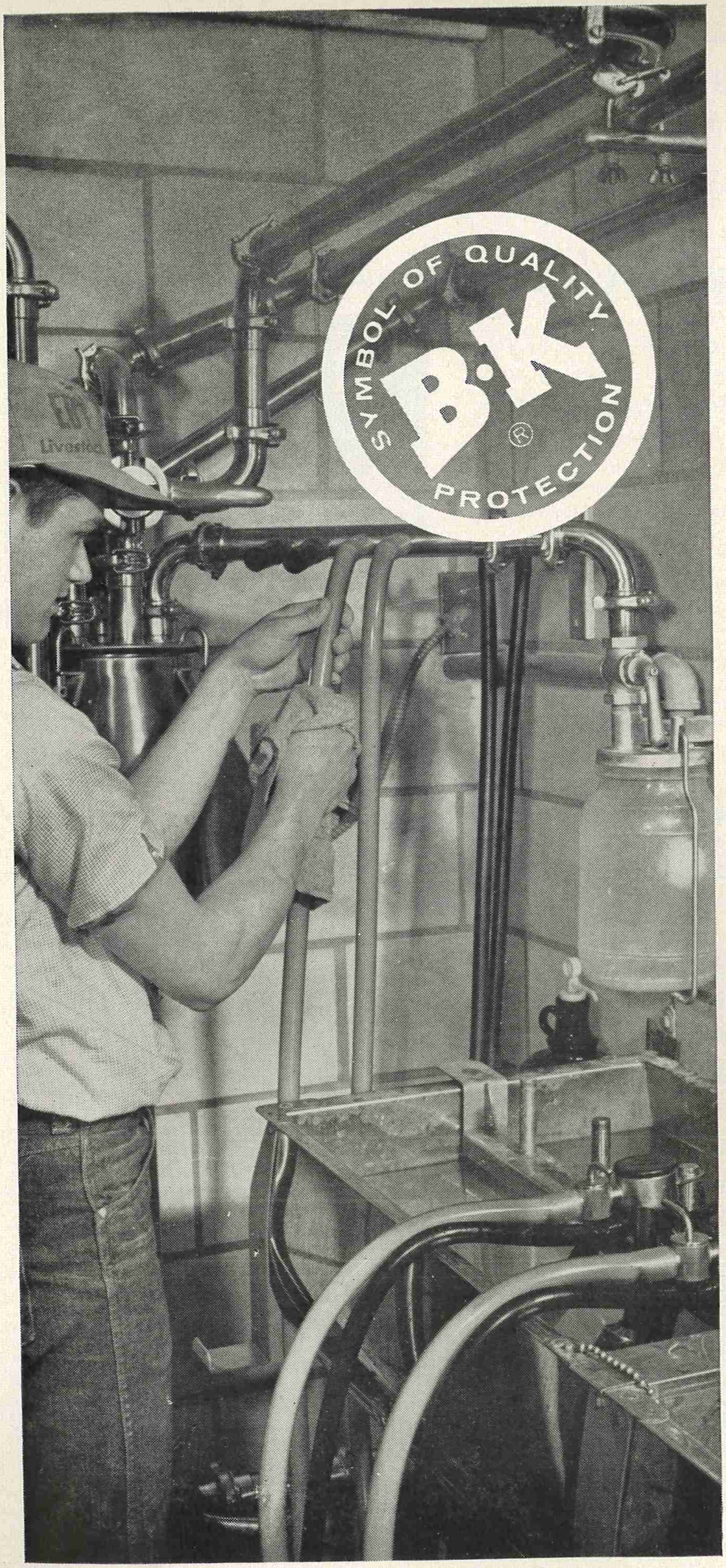
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INDEX TO ADVERTISERS

CONTAMINATION OF FROZEN VEGETABLES BY COAGULASE-POSITIVE STAPHYLOCOCCI[1]

D. F. Splittstoesser, G. E. R. Hervey, II, and W. P. Wettergreen[2]

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(Received for publication January 10, 1965)

Summary

The incidence of coagulase-positive staphylococci was determined in 112 samples of peas, green beans, and corn collected during different stages of processing for freezing. The highest staphylococcal counts were found in peas, 7.3 per g, while the greatest percentage of staphylococcal contaminated samples, 64%, was obtained with corn. The data indicated that although the hands of employees were a major source of these organisms, other factors were also involved. The gravity separator, used in the processing of peas, was found to be a potential area for staphylococcal build-up.

Contamination of foods by coagulase-positive strains of *Staphylococcus aureus* is of concern because of the organism's potential to produce entertoxins. While in our present stage of technology it is difficult to prevent consistently contamination of foods with these organisms *(2)*, only low numbers should be permitted.

Various studies have dealt with the numbers and sources of staphylococci in precooked frozen foods *(6, 7)*. Little attention has been given to their presence in commercially frozen vegetables, probably because these foods are thought to present slight hazard to the consumer. Frozen vegetables, however, are often ingredients of precooked frozen foods and have been reported to be a major source of microorganisms in these products *(3)*.

The purpose of this investigation was to estimate the incidence of coagulase-positive staphylococci in certain frozen vegetables and to determine whether specific processing conditions were responsible for their presence.

Methods

Vegetables in different stages of processing were collected from the lines of area factories. The samples were transported to the laboratory over ice and then frozen in a -23 C room. Eleven-gram samples were blended, diluted, and plated the following day for "total" counts *(8)* and again when the vegetables were cultured for staphylococci. The lengthy procedures for identification and enumeration of staphylococci resulted in some samples being stored as long as six months at -23 C before being examined for these organisms. Since no significant decrease in the average "total" counts was observed during this storage, it is probable that there also was little decrease in the numbers of the relatively freeze-resistant staphylococci.

A most probable number (MPN) technique was used for estimating numbers of staphylococci. One ml of a given decimal dilution was inoculated into each of 10 tubes containing 2 ml of an enrichment medium. This medium consisted of brain heart infusion broth (Difco) to which had been added 20 g of d-mannitol and 80 g of sodium chloride per liter *(9)*. Following 48-hr incubation at 35 C on a rotary shaker, tubes showing growth were streaked on staphylococcus-110 agar (Difco). The plates were incubated 24 hr at 35 C and then colonies resembling the staphylococcal group were picked and stabbed into d-mannitol agar *(5)*. The catalase-positive cocci that attacked mannitol either oxidatively or fermentatively were subsequently propagated in brain heart infusion broth 18 hr and then tested for free coagulase using the tube method recommended for the commercially prepared plasma (Difco).

The efficiency of the above methods was evaluated by determining the MPN of staphylococci after blended vegetables were inoculated with known numbers of these organisms as reflected by plate counts. The results of these trials indicated that approximately 50% of the staphylococci was being counted.

Results

During the 1962-64 processing seasons, samples of frozen peas, green beans, and whole-kernel corn were examined for staphylococci. The vegetables were collected in 42 separate surveys conducted at three processing factories. A summary of the results (Table 1) shows that 31 to 64% of the samples contained coagulase-positive staphylococci, and that the vegetables yielding these organisms were not contaminated with large numbers. The highest staphylococcal counts were found in peas, 7.3 per g, while the greatest percentage of positive samples, 64%, was obtained with corn. The staphylococcus-positive samples showed higher average total counts than the negative samples in three out of four instances. These differences, however, were not statistically significant.

Since staphylococci have been shown to be common contaminants of the human hand *(1)*, it seemed likely that the hands of employees were the source of the small numbers that were being recovered. This was investigated by comparing the incidence of staphylococci in peas and beans subjected to varying degrees of human contact. These vegetables provided an excellent opportunity for this study because

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TABLE 1. THE INCIDENCE OF COAGULASE-POSITIVE STAPHYLOCOCCI IN FROZEN VEGETABLES

Vegetable	No. of samples	% staph. positive	Av. MPN staph./g[a]	Av. "total" count/g x 10^3 [a]: Staph. positive samples	Av. "total" count/g x 10^3 [a]: Staph. negative samples
Peas	51	39	7.3 ± 2.4	75 ± 15	95 ± 25
Green beans French	31	39	1.7 ± 0.2	530 ± 130	260 ± 66
Cut green beans	16	31	1.4 ± 0.2	370 ± 87	230 ± 70
Corn	14	64	1.9 ± 0.3	600 ± 290	360 ± 140

[a]±standard error of the mean.

TABLE 2. EFFECT OF HUMAN CONTACT WITH THE PRODUCT ON THE AMOUNT OF CONTAMINATION BY COAGULASE-POSITIVE STAPHYLOCOCCI

Degree of human contact	Sampling areas	Staphylococcus-positive: %	Staphylococcus-positive: Av. MPN/g.	Staphylococcus-positive: Staph. per 10^5 "total" count/g
Peas				
Slight	Flumes, belts, quality graders	12	6	31
Heavy	Inspection belts	80	6	28
After areas of heavy contact	Hoppers, filling machines, final package	45	13	12
Green beans				
Slight	Conveyors, slicers	8	1	2
Heavy	Inspection belts, weighing reserves	28	2	0.3
After areas of heavy contact	Hoppers, final package	65	2	0.3

during a number of operations following the blanch only incidental human contact occurred. Contrast was provided by later stages, such as inspection and filling, where the vegetables were subjected to considerable handling by employees.

An increase in the incidence of staphylococcus-positive samples appeared to result from human contact (Table 2). The percentage of staphylococcal contaminated pea samples rose from 12 to 80% at the inspection belts, the first point of human handling. The percentage of beans contaminated with staphylococci also increased but not to the extent found with the peas. Fourteen out of 18 of these bean samples were "weighing reserves" which were beans used to adjust the cartons to the correct weight. Since the weighing reserves were exposed to repeated contact with ungloved hands, staphylococcus contamination had been expected to be most heavy in those samples.

Vegetables collected from points following the areas of heavy human contact continued to show elevated numbers of staphylococci. Additional contamination of peas by other organisms occurred which accounts for the lower ratio of staphylococci to total count even though the MPN figures increased. The doubling of the percent of staphylococcus-positive beans is not understood but may merely reflect variations in sampling and counting procedures.

Peas were the least heavily contaminated vegetable according to the total counts (Table 1). In spite of this, however, the percentage of staphylococcus-positive pea samples was not appreciably lower, and the average staphylococcal count was actually higher than obtained with beans and corn (Tables 1 and 2). A possible explanation for this was obtained during the 1963 season when line surveys were made twice a week at one factory. The results showed a significant build-up of microorganisms in the gravity separator as the processing season progressed (Figure 1). Since this unit contained NaCl brine at a concentration of 8-10%, a study of the contaminants was made after the increase in total counts was noted. Forty isolates, randomly selected from plates cultured on the 25th processing day, were studied. Catalase-positive cocci that grew well on media containing 10% NaCl made up 85% of the isolates. Although all

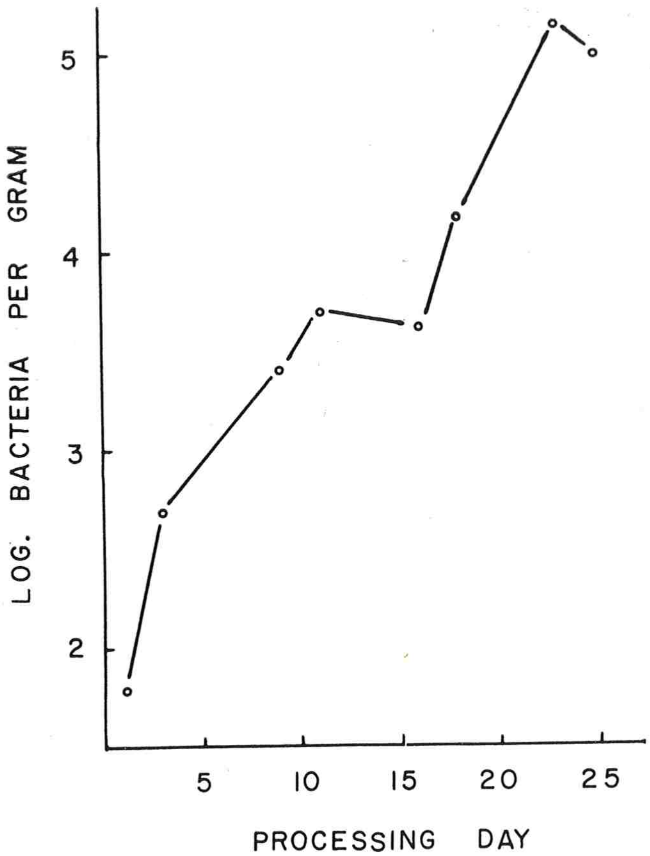

Figure 1. Increase in contamination of peas at the gravity separator as the processing season progressed.

proved to be coagulase-negative, five of the cultures fermented mannitol and thus appeared to be staphylococci.

Discussion

The results of this study indicate that frozen peas, beans, and corn should contain only low numbers of coagulase-positive staphylococci when prepared under normal commercial conditions. Even though the total counts of many samples were in the hundred-thousands per g, none yielded staphylococcal counts as high as 100 per g. It is of interest that this level of staphylococcal contamination appears to be considerably lower than that reported for vegetables processed in a pilot plant *(4)*. These workers found over 12% of the organisms enumerated by plate count to be toxin producing micrococci.

The data support the idea that the hands of employees are a major source of staphylococci. The fact that the greatest numbers were not recovered from French-style beans, the vegetable receiving the most human contact, suggests that other factors influence growth and survival of these organisms.

The build-up observed in the gravity separator illustrates that certain processing conditions may favor the growth of undesirable organisms such as staphylococci. The fact that only chance human contact occurred between the blanch and the gravity separator may explain why no coagulase-positive staphylococci were found in the sample examined. One can speculate about the microflora that might predominate had the inspection belts preceded the gravity separator.

Acknowledgment

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SANITATION IN SEAFOOD PRODUCTION AND DISTRIBUTION[1, 2]

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The seafood industries are concerned with the harvesting and processing of a very wide range of marine animal products. Processes are extremely diverse and sometimes complex, involving most of the traditional methods of food preservation and some of the most modern techniques. The size of the individual production units varies from small one-man fishing boats through highly mechanized factory fishing vessels at sea and from family operated shellfish or fish house plants to large fish canneries and frozen prepared seafood operations on shore. This general diversity and unevenness within the industry is reflected in the varied approaches observable towards the problems of sanitation. These range from complete indifference to a keen appreciation of the necessity for a high level of sanitary control. As might be expected, more emphasis generally is placed upon good sanitation by the larger operators. However, the nature of the raw material and the processing operation also tend to influence the degree of emphasis.

No general program for sanitation in the fishing industry has ever been developed and the few rather limited studies which have been undertaken of scientific cleaning and sanitizing methods have been concentrated on specific sectors of the industry.

Public health requirements and maintenance of high quality in the product are two main stimuli toward good sanitation in a food operation. With the exception of molluscan shellfish (mainly mussels and oysters), seafoods never have presented a major public health problem in most Western countries, though the recent outbreak of Type E botulism from smoked fish and tuna may have altered the picture *(20)*. This (formerly) healthy situation was probably a result of the general practice of keeping fish and fish products at low temperatures. The public health incentive to good sanitation was thus largely absent in fish operations. Again, quality in most fish products is primarily dependent on the extent to which endogenous bacterial growth may be inhibited. Typically, sanitation is concerned with the control of exogenous contamination which is of little concern to many fish processors and thus the other stimulus to good sanitation was also lacking.

[1]Presented at the 51st annual meeting of the International Association of Milk, Food and Evironmental Sanitarians, Inc., August 18-24, 1964, at Portland, Oregon.

[2]Contribution No. 192, College of Fisheries, University of Washington.

Capture and Harvest

Uniquely among modern food industries, the seafood industry is based on a hunting economy. It is only in the case of the molluscan shellfisheries that a controlled system of culture and harvest directly analagous to agricultural methods on land exists. Marine fish and shellfish such as shrimp, crab and lobsters must, therefore, be located, captured and transported in fishing vessels to the processing plants. Sanitation procedures on board the vessel will obviously influence the bacteriological quality of the fish reaching the shore plant.

Fortunately, fish caught in unpolluted waters carry no bacteria of public health significance on their skin and other external surfaces and the flesh and internal organs are sterile *(10, 11)*. The natural flora of fish, exclusive of the intestine, consists principally of psychrophilic bacteria of the genera *Pseudomonas, Achromobacter,* and *Vibrio* plus a few eurythermic types such as *Micrococcus.* This has been confirmed by numerous investigations (see Table 1). The numbers of such organisms found on freshly caught fish range from about 10^2 to 10^5 per cm^2 of skin surface. In feeding fish, the intestine may contain very large numbers of bacteria, up to 10^7 per g of gut content. Again most of these bacteria are gram negative psychrophilic types but potentially hazardous organisms such as *Clostridium tetani* and *Cl. botulinum* have been isolated from fish intestine *(16, 20)*. The microflora of crustacean shellfish seems to be similar to that of fish *(6)*. It is not generally recognized that the natural microflora of sessile shellfish such as oysters is also similar, for the most part, to that of free swimming fish *(6)*. However, as is well known, these shellfish by their mode of feeding, tend to concentrate within them bacteria present in the surrounding water and since they are grown normally in inshore or brackish waters subject to considerable terrigenous contamination from land drainage and sometimes from sewage outfalls, they readily accumulate detectable numbers of coliform and other more dangerous enterobacteria such as *Salmonellae.*

There is thus little or no intrinsic public health hazard associated with fish which can be controlled by good sanitation. Most fish in the North American fisheries are landed in uneviscerated condition; a notable exception is Pacific halibut. Therefore, the sporing anaerobes in the intestine cannot be disregarded at this point; though, of course, by contrast these organisms may be distributed over the surface

TABLE 1. FLORA OF SEA FISH ACCORDING TO VARIOUS AUTHORS, AS SHOWN BY PERCENT ISOLATIONS IN THE VARIOUS GENERIC GROUPS[a]

Author	Micro.[b]	Achro.[b]	Flavo.[b]	Pseudo[b].	Bacillus	Misc.
Reed and Spence (1929) Haddock	4	23+[c]	8	22	24	18
Stewart (1932) Haddock	22	57+	11	5		5
Bedford (1933) Halibut	16	34+	30			20
Shewan (1938b) Herring	24	43+	13	11		9
Thjøtte and Sømme (1938) Cod	14	48+	25	5		8
Thjøtte and Sømme (1943) Misc. species	3	21+	6	4++[d]	2	64++ (chiefly *Vibrio*)
Wood (1940) Misc. species	48	19	17	7	9	
Aschehoug and Vesterhus (1943) Herring	17	25+	18	40		1
Snow and Beard (1939) Salmon	13	54+	5	8	2	19
Dyer (1947) Cod	73	5	3	4		16
Gianelli (1957) Porgy	53	21	7	6		13
Liston (1957) Skate	3	19	9	65		4 (including *Coryne*[b])
Liston (1957) Lemon sole	1	22	5	69		3 (including *Coryne*)
Georgala (1958) Cod	1	32	6	50		11 (including *Coryne*)

[a]Taken from Colwell *(5)*.
[b]Micro. = *Micrococcus;* Achro. = *Achromobacter;* Flavo. = *Flavobacterium;* Pseudo. = *Pseudomonas;* Corye. = *Corynebacterium.*
[c]+Probably includes organisms classed as *Pseudomonas* by current methods.
[d]++Note that most of the bacteria in the Miscellaneous classification, should be added to *Pseudomonas.*

of iced fish by contact with intestinal material squeezed out under the pressure of fish and ice. The hazard associated with molluscan shellfish is well understood and an excellent control system to ensure the cleanliness of shellfish growing waters is in operation in the USA and many other countries of the world. The recent outbreaks of infectious hepatitis due to consumption of oysters harvested from polluted waters *(8)* serves to point up the need for continued close surveillance and indicates the possible emergence of a new problem associated with the transmission of viruses by foods. It would seem advisable that more information be obtained on the survival of virus particles in marine environments.

Once they are brought aboard the fishing vessel shrimp and fish are most commonly packed down in ice in the fish hold. Crabs and lobsters are transported live or, in a few cases, butchered and processed aboard the vessel (e.g., some Alaska King crab). Some small vessels operating day fisheries carry no ice while an increasing number of larger vessels freeze the fish at sea. This may be done using whole fish, as in the tuna industry, or after partially or completely processing the fish, as in the large factory trawlers operated by many European companies. Increasing use is being made in Pacific

Coast fisheries of refrigerated sea water tanks in which fish may be held at 30 F, an optimum storage temperature.

Most fish boat holds are constructed of wood and conform to the shape of the hull. They are usually divided into pounds or pens which range along the side of the vessel separated from the central aisle by removable pen boards which fit into slotted stanchions. The entire area is very difficult to clean. The wooden walls and boards tend to become permeated by fish slime and bacteria which thus come to lie below the surface and cannot be effectively killed or dislodged. In most cases the fish boat holds are washed out between voyages but the methods used range from simple hosing down with water (often harbor water or sea water) to detergent and sanitizer treatments. An interesting study by Bureau of Commercial Fisheries personnel in this country confirmed the effectiveness as a sanitizing method of a simple procedure for continuous chlorination with sodium hypochlorite of the sea water used for washing down fish and fish holds *(11)*. The method seemed to give very satisfactory results in terms of improved fish quality and general cleanliness of the vessel but unfortunately does not seem to have been very widely adopted by the fishing industry.

Good sanitary conditions in fishing vessel holds can be achieved most readily by the use of lining materials such as aluminum or plastic faced boards which provide cleanable surfaces rather than wooden boards which are essentially uncleanable. Most modern European fishing vessels are being fitted with aluminum fish holds but they are not yet a common feature of North American vessels which tend to be smaller and wood hulled.

The bacteriological quality of the ice or brine used to cool fish on board fishing vessels also has sanitary significance. Fresh ice made from water of good quality normally carries few bacteria but large populations accumulate in ice in contact with fish *(9)*. The reuse of ice is an undesirable and insanitary procedure. However, this is a very minor problem in practice. Refrigerated brine or sea water tanks also develop high populations of bacteria but these are almost exclusively psychrophilic types derived from the fish. A number of attempts have been made to control bacterial populations in brine tanks both on ships and on shore by the use of ultra violet germicidal lamps. These have met with variable success. The numbers of bacteria in the brine are reduced by the method but there is no effect on the development of bacteria on the fish itself *(2)*. A variety of preservative chemicals have been proposed for incorporation in ice or brine to reduce bacterial growth *(19)*. However, none has proved to be satisfactory in practice though tetracycline antibiotics, particularly Aureomycin (chlortetracycline) and Terramycin (oxytetracycline) have been used with some success particularly in Canada *(27)*. As might be expected, such aids to preservation are most effective when applied under clean conditions and are in no way a substitute for an effective sanitation program.

Another shipboard sanitation problem which is well recognized is the danger of contamination of the catch by bilge water. Most fish holds are so contructed that this rarely happens.

TABLE 2. INCIDENCE OF COLIFORM CONTAMINATION ON PORT MARKET FISH[a]

Experiment	No. of fish swabbed	Percentage carrying: coliforms	Percentage carrying: faecal coli
a	103	100	92
b	148	96	78
c	150	99	68

[a]Taken from Spencer and Georgala *(26)*.

There is surprisingly little information available concerning the extent of shipboard contamination of fish by bacteria of public health significance. That some contamination does occur, however, may be inferred from the observations of Spencer and Georgala *(26)* (reproduced in Table 2), and the repeated isolation of *Erysipelothrix rhusiopathiae* from the fish market but not from fish sampled aseptically at sea *(23)*.

PRIMARY PROCESSING

The unloading of fish from the vessel and its primary processing through such operations as heading, evisceration and steaking or filleting involves a great deal of direct handling of the product. This is true also of the primary processing operations applied to shellfish which include shucking of oysters and clams, shelling of shrimp and picking of crabmeat. Moreover, because of the somewhat erratic supply of raw products to the processing plants most incoming seafoods and often primary processed materials are subject to variable intervals of buffer storage in a variety of containers or storage rooms. Since the duration of an average fishing voyage may range from a few days to several weeks fish arriving at the processing establishment are likely to represent a wide range of quality including relatively high count fish caught early in the voyage and lightly contaminated fish caught shortly before arrival in port. These fish are usually sorted into storage areas according to species, size or some similar criterion, so that fresh and less than fresh fish are often mixed indiscriminately. Moreover, as fish pass along the processing line spoilage bacteria may be transferred from longer stored to fresh fish and subsequently to fillets or steaks of both types. Under these conditions there are numerous opportunities for contamination of the seafood by bacteria of human origin. Again there is remarkably little information on the real extent of such contamination in practice, except in the case of oysters where under poor sanitary conditions very high levels of fecal bacteria have been detected in the shucked meats. In one study of filleted fish 38% of the fillets carried fecal *E. coli* which may have been present on the landed fish and 30% carried coagulase-positive staphylococci which are certainly absent from freshly caught fish *(25)*. Early studies in USA indicated that fish fillets may be contaminated by coliform bacteria *(9)*.

The sources of contamination during primary processing are numerous. The baskets, boxes or conveyors used to transfer fish from ship to shore may provide an initial source of contamination which can be supplemented by storage bins or boxes. Where such containers are made of wood the danger of contamination is particularly great. The extensive studies by Spencer *(24, 25)* on the cleanability of fish boxes clearly indicate the extreme difficulty involved in cleaning and sanitizing wooden surfaces contaminated by fish slime and experiments in our laboratories and by other workers have confirmed this *(15)*.

The butchering of fish and shellfish is still essentially a manual operation in most plants, though recently some mechanization has been introduced by a few firms. Notable exceptions are provided by the salmon canning industry in which the Iron Chink introduced in the early part of this century efficiently eviscerates and trims fish completely mechanically. Also the peeling of shrimp largely is effected by machines nowadays.

A number of studies have been made on the bacteriology of the butchering process but these have been concerned primarily with psychrophilic spoilage bacteria *(3, 4)*. The flesh of fish stored for only a few days in ice or brine is essentially sterile. Consequently any contamination of the fillet must be exogenous in the sense that the bacteria are transferred from the skin slime to the flesh surface via knives, filleting boards, gloves, etc. Essentially continuous sanitation procedures are necessary to reduce contamination at this stage. Unfortunately many smaller and older fish filleting plants include many untreated wooden surfaces which never can be completely sterilized. More modern plants make extensive use of metal (usually stainless steel) in the construction of tables and conveying lines but the wooden board still is the only generally acceptable support for the actual filleting operation. Because incoming fish carry more or less heavy loads of bacteria into the plant the primary processing lines show a rapid build-up of bacterial contamination *(4, 26)*. Recent studies in the Pacific Northwest provide confirmation of the earlier reports and reveal that fish may pass through a brief period at the point of filleting where they are essentially sterile and indicate quite clearly the source and nature of subsequent contamination which includes fillet boards, knives, gloves, hand rinse water, etc.

Copious amounts of cold water are used in most fish filleting operations and this serves to depress bacterial contamination somewhat in most plants. An increasing number of plants are adopting in-plant chlorination. Usually a final concentration of about 5 ppm chlorine is maintained. This level of chlorine has no deleterious effect on the fish but effectively reduces the bacterial populations. Processors using in-plant chlorination will usually use an increased level of chlorine for clean-up purposes.

The disposal of waste from primary processing operations in fish plants has produced problems in the past. Most seafood plants are built close to the ocean. In earlier times most of the gurry was dumped directly into the sea. This is still done in the case of plants situated in remote areas such as Alaskan salmon canneries and South (West) African pilchard canneries. In such plants, sea water often is used for washing the fish and trouble has developed where the intake for this water was situated so that it received water from the gurry dumping area.

Processing plants situated in less remote areas usually have little trouble disposing of the waste since there is a ready market for such material as animal feeding stuff. For example, in the Pacific Northwest much of the waste is purchased and used by mink farmers. Nevertheless, waste must be disposed of quickly (or frozen) since it rapidly decays and can create a public nuisance as well as a source of undesirable contaminants for incoming fish.

SECONDARY PROCESSING

Canning.

Except that the primary processing referred to above constitutes an integral part of most fish canning operations and, therefore, introduces its attendant problems to the situation, fish canneries are faced with sanitation problems similar to those found in establishments canning other foods. Due to the very serious consequences which may result from poor sanitation in canned food preparation, fish canners are more aware of the need for good sanitary control than their colleagues in the fresh and frozen fish field. Moreover, the National Canners Association and the major can companies are engaged in educational and technical assistance programs which serve constantly to emphasize the principles and practices of scientific cleaning and sanitation. In addition some states (e.g., California) operate an active program of regulation and inspection of canning operations and since canned goods generally enter interstate markets, plants and products also are subject to Federal Food and Drug Administration surveillance. Current problems in canned seafood products are, in general, less a product of poor sanitation practices than of the nature of the raw material leading to difficulties such as struvite (magnesium ammonium phosphate) formation in various products.

Frozen and Precooked Frozen Products.

A very high proportion of seafoods is now retailed as frozen or frozen precooked products, i.e., fish, molluscs and crustaceae.

In the case of frozen but uncooked seafoods such as "green" shrimp, fillets, fish portions, etc., there are few additional sanitation problems beyond the primary processing stage. Sometimes dips are used on seafoods destined for freezing. These can be a source of contamination unless they are changed quite frequently. Packaging materials generally are quite free from bacteria but there is opportunity for contamination of the product from the hands of personnel engaged in packaging. This is of more significance in the case of precooked products.

The enormous expansion over the past few years in precooked or convenience frozen foods has affected the seafood industry profoundly. Large quantities of fish and shellfish now are retailed in precooked form. These include crabmeat (a traditional item), shrimp, fishsticks, prepared portions, fish and chips, fish dinners and prepared fish dishes of various kinds. The sudden increase in production of these items has introduced a new dimension of hazard to a section of the fish industry which previously had produced only raw products subject to the protective effect of home cooking before consumption. Moreover, new and potentially more hazardous food ingredients such as egg, milk powders, etc., have been introduced into seafood processing in the form of breading and batter mixes.

A number of studies have been made of the bacteriology of prepared frozen seafood products and it is clear that contamination of the raw material can and does occur during preparation and processing *(17, 18)*. During the last ten years or so, there has been a very marked improvement in the final bacteriological quality of such foods. This is undoubtedly due to a variety of factors, such as: increasing experience and sophistication on the part of processors; technical advances in equipment design and operation; the efforts of trade bodies such as the NAFFEM; and of the state and federal regulatory agencies. Our own studies have convinced us that the bacteriological problem in precooked frozen seafoods is primarily one of sanitation and hygiene *(14)*. The raw materials are, in most cases, of good bacteriological quality. The build-up of organisms of public health significance occurs only in the course of handling. Such bacteria are obviously derived principally from operating personnel. This is illustrated in Tables 3 and 4. The data derived from the studies on batter are particularly illustrative of the importance of extrinsic factors in controlling contamination.

TRADITIONAL SECONDARY PROCESSING

The traditional preservative processes—pickling, salting and smoking—are of decreasing significance in the North American seafood industry but are still major factors in the seafood industries of many other countries of the world.

Sanitary control in such operations is often minimal since it is widely and erroneously believed that the processes themselves are sufficiently bactericidal to

TABLE 3. EFFECT OF PROCESSING ON BACTERIA OF PUBLIC-HEALTH SIGNIFICANCE[a]

Stages of processing[b]	Percent samples at indicated count levels per g: Coliforms					Enterococci					Hemolytic streptococci					Percent samples showing: Coag.+ staphylococci	Sporing anaerobes	*Salmonella-Shigella* group
	<1	<10	10^1	10^2	10^3	<1	<10	10^1	10^2	10^3	<1	<10	10^1	10^2	10^3			
A	6	27	41	13	13	0	73	20	0	7	–	–	–	–	–	7	–	0
B	6	12	41	35	3	9	19	44	22	6	0	22	39	39	0	64	42	0
C	3	10	42	29	17	0	8	39	37	17	11	23	31	30	3	73	54	0
D	47	29	14	6	0	8	17	30	41	3	35	22	31	6	4	52	76	0

[a]Taken from Raj and Liston *(17)*.

[b]A = raw blocks *(15)*, B = raw sticks, *(32)*, C = battered and breaded sticks *(101)*, D = precooked sticks *(63)*. The figures in parentheses indicate the number of samples tested.

TABLE 4. BATTER SAMPLES BEFORE AND AFTER RECONSTITUTION[a]

Count per gram	Total counts 20 C I[b]	20 C II[c]	35 C I	35 C II	Enterococci I	Enterococci II	Coliforms I	Coliforms II	E. coli I	E. coli II	Hemolytic streptococci I	Hemolytic streptococci II
	Percent samples at various count levels											
< 1	0	0	0	0	0	0	0	0	30	9	50	0
<10	0	0	0	0	10	0	0	0	40	9	50	0
10^1	0	0	0	0	60	3	90	3	30	57	0	21
10^2	0	0	0	0	20	18	10	12	0	24	0	7
10^3	10	0	20	0	0	58	0	61	0	0	0	72
10^4	90	6	80	9	0	21	0	24	0	0	0	0
10^5	0	40	0	49	0	0	0	0	0	0	0	0
10^6	0	54	0	42	0	0	0	0	0	0	0	0

[a]Taken from Ray and Liston *(17)*.

[b]I = dehydrated batter mix (10 samples). Showed no incidence of coagulase-positive staphylococci, sporing anaerobes, and *Salmonella-Shigella* group.

[c]II = reconstituted batter from the line (33 samples). Showed 100% incidence of coagulase-positive staphylococci, 50% incidence of sporing anaerobes, and none of *Salmonella-Shigella* group.

control any public health risk. Though it is doubtful that poor sanitation practices were entirely to blame, the recent tragic outbreaks of botulism caused by smoked fish demonstrate the nature of the fallacy.

Earlier work has shown that organisms of public health significance may accumulate and persist in brines and on the surface of salted fish *(1)*.

An important reason for emphasizing better sanitation in traditional fish processing is the reduction in the severity of the processes which are used today. Indeed regimens of salting and smoke curing now are used which serve principally to flavor rather than to preserve the product.

NEW PROCESSES

New processes being applied to seafoods or in prospect for them include freeze drying and radiation pasteurization.

Little is yet known concerning the specific problems of freeze drying though a commercially successful freeze-dry shrimp operation has been running for some time in this country. It seems apparent that sanitary control of the primary processing operations would be of most importance here.

Radiation pasteurization using gamma radiation from Cobalt 60 presently is being studied very intensively. Many early studies indicated the suitability of seafoods for this kind of process and the more recent studies have amply confirmed these findings. Sanitation problems associated with radiation pasteurization again are mainly confined to the primary processing operation. It is important that good control of contamination be exercised here since the radiation process results in a sharp reduction of the natural microflora. Recent studies in our laboratory have indicated that under comparable conditions staphylococci will grow out in irradiated fish but not in unirradiated *(21)*. Thus, the desirable restrictive influence of the natural microflora toward certain pathogens, at least, is minimized. Another possible consequence of poor sanitation in plants operating the process could be a build up of radiation resistant bacteria. Of course, it is proposed that radiation pasteurized fish be held at temperatures below those at which potential pathogens can grow, so that it is only in the event of mishandling that contaminant organisms could or would grow out.

DISTRIBUTION AND RETAIL

Seafoods are widely regarded as highly perishable food products and the necessity for rapid and expeditious distribution of wet fish is well known. Nevertheless, the handling of many fish products in retail trade leaves a great deal to be desired. Frozen fish products share the common fate of frozen foods being occasionally subject to widely fluctuating temperatures of storage which sometimes reach above the melting point. However, it is the unprocessed or traditionally processed seafood which suffers the greatest indignity. These items are generally tucked away in a corner of the meat counter where they lie exposed to temperatures which often are too high. Though such temperatures may effectively inhibit the growth of dangerous mesophiles, they do not sufficiently depress the growth rate of psychrophilic bacteria which abound on fish.

This brief survey of some of the sanitation problems of the seafood industry obviously is not intended to be comprehensive. The industry is too large and too diversified to be adequately dealt with in a single short paper. However, the author hopes that sufficient material has been covered to enable the reader to obtain some idea of the peculiar and yet often familiar nature of the sanitation problems which exist in the fishing industry.

It is noteworthy that, despite the strictures which have in the past been (rightly) laid on the fishing industry for poor sanitation practices, the record of fish as a safe food is even yet (recent botulism notwithstanding) unsurpassed by most other products. At the same time it is encouraging to record that the industry as a whole is moving toward a better appreciation of the need for good sanitation practices. An acceleration of this could be achieved through the advice and active assistance of qualified sanitarians of local, state and national agencies. It is doubtful that a true appreciation of the nature and role of bacteria in causing spoilage of seafoods or even the real nature of the bacterial hazards to the public health resulting from poor sanitation practices is really widespread among fishing industry personnel. Certainly there is a very poor understanding of the principles and practice of modern cleaning and sanitation systems. Dissemination of accurate information at the grass roots level by education of actual plant operators is greatly needed in the industry. This can be carried out most effectively by trained sanitarians in close and constant contact with the food industries.

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UTILIZATION OF RESEARCH IN THE OPERATION OF FOOD PROTECTION PROGRAMS[1]

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As we look at the past in terms of present knowledge about our environment, we recognize that technological advances have greatly changed man's living conditions. Applications of research on the farms, the highways, the airways, and in homes, factories, and offices have greatly reduced the physical effort required of the individual to sustain life, and, at the same time, have increased the amount and variety of essential goods, conveniences, and luxuries. In our eagerness to take advantage of these developments, we have been little concerned until recently about their subtle effects on health. Whether we regard the changing environment with apprehension, or with enthusiasm, there is nothing to suggest that this trend will be reversed. On the contrary, all indications point to more rapid changes in the future. We are already encountering almost daily innovations and modifications of our surroundings that may have direct effect upon physical vigor, mental alertness, longevity, and susceptibility to degenerative diseases.

These changes have occurred in all fields of endeavor, and the food field has by no means been neglected. In no facet of his environment has man wrought more dramatic and important changes than in feeding the urban population. The traditional simplicity of food preparation in the home from staples and local produce is being replaced rapidly by complex new systems of food production, manufacturing, distribution, and serving, which now represent an 80-billion dollar segment of our economy *(13)*.

The major trend in the food field today is toward centralized processing and widespread distribution of commercially prepared convenience foods, which minimizes or eliminates culinary work in the preparation of meals. The ready availability and general acceptance of these products, including foods from foreign sources, has further complicated the already difficult task of assessing the sanitary quality of foods at the State and local levels.

This trend has not developed overnight, but has been brought about by research and development within the food industry and by the changing socioeconomic patterns of our population. The development of technical criteria for public health evaluation of foods has not kept pace fully with industrial development, but many research findings have been utilized for this purpose. Much remains to be done which we shall touch upon later, but let us explore first where research findings have already been applied successfully to ongoing programs, and then see if we can identify new areas where existing knowledge may be applied.

Our primary objective in food protection programs is the prevention of outbreaks of foodborne illness. One practical method of preventing such outbreaks is the application of temperatures that will inhibit or destroy the causative organisms in perishable foods.

For many years, 50 F was regarded as an acceptable upper limit for refrigeration of perishable foods. These limits were regarded as safe temperatures for the refrigerated storage of such food and were based upon data which indicated that 50 F was sufficient to prevent the growth and toxin formation by *Cl. botullinum* types A and B. Until recently, very little information was available which would give a true picture of the time-temperature relationship needed to effectively control or kill other organisms that are frequently associated with foodborne disease outbreaks.

Research in this area has demonstrated that a temperature lower than 50 F is necessary to effectively control the growth of salmonellae and staphylococci in foods held for extended periods of time. These research findings *(2)* have been utilized in the development of standards and guides incorporating the recommendation that all potentially hazardous foods be held at 45 F or below, and have further stimulated industry and food equipment manufacturers to design equipment which will assure that these temperatures can be met. The popularity of precooked, chilled products, the increased use of automatic vending machines for dispensing perishable meals, and the extended storage of convenience foods, have complicated the time-temperature control problems and made the general application of this information very important.

A relatively new practice in the preparation of meals for service aboard airplanes, is to precook and freeze the meals for defrosting and serving in flight.

[1]Presented at the annual meeting of the American Public Health Association, New York, New York, October 8, 1964.

Since the meals may be prepared considerably in advance of being placed aboard the plane, and may be subject to wide temperature variations, it is important that some method be employed which will indicate any major temperature variations within the package. In other words, a device is needed which will operate continuously and will indicate whether the temperature of the food has exceeded a predetermined level. Several devices that depend upon temperature levels to cause a color change have been developed through research by industry, and one is now in experimental use by an airline company. With such a device the stewardess could inspect the packages of meals and instantly be assured that the meals coming aboard her plane have been stored at the proper temperature since being prepared. She can, therefore, reject those that show too great a temperature fluctuation during storage.

Even though such devices have not gained widespread acceptance in the frozen food industry, they do offer a method to monitor the temperature of frozen foods which will assure the consumer of a product that has been properly stored while being held in the frozen state.

Assessment of the sanitary quality of food presently depends primarily on visual inspection of the environmental conditions under which food is prepared or served. In light of the changing technology which permits food to be prepared by centralized processing, this method cannot always be relied upon to assure the consumer that the food is safe and wholesome at the point of final preparation for service. Additional laboratory examinations of vulnerable commercial products for potentially hazardous microbiological and chemical contaminants may be necessary to minimize the risk of serious outbreaks of staphylococcal food poisoning, salmonellosis, or other common foodborne diseases. Recent developments in methodology and instrumentation have made feasible the examination of selected food items for compliance with specific microbiological and chemical criteria which are indicative of sanitary quality. It is only a matter of time until research produces simple tests that can be applied routinely, with appropriate modifications, to a wide range of food items.

Experience indicates that in order for the public health laboratory to lend reliable assistance to the operating food protection program, a detailed analysis of food involved in outbreaks of gastroenteritis is necessary *(1)*. In this regard, a comparative review and manual of methods and media for detection of pathogenic and indicator bacteria in foods has recently been published by the Public Health Service *(14)*.

This manual highlights some of the problems encountered in the microbiological examination of foods and presents bacteriological methods that are applicable to samples of food implicated in disease outbreaks or collected for survey purposes. The methods outlined are currently being used with success in PHS Laboratories, and their use by other public health laboratories may be expected to improve the detection of bacterial agents of foodborne diseases. Although the methods in this manual undoubtedly can be improved by further research, they are regarded as sufficiently useful to serve as reference procedures for the comparative evaluation of other methods.

Knowledge that the laboratory can, in fact, provide definitive information about causes of foodborne illness will no doubt induce persons with knowledge of suspected or proven outbreaks to notify appropriate officials so that laboratory and field investigations can be undertaken to elucidate circumstances surrounding the outbreaks and the control measures needed to prevent further trouble.

The accelerating rate of research utilization by the food industries accentuates the problem of informing personnel in operating food protection programs about recent technological changes and their public health implications. Of necessity, new methods must be employed to disseminate this information quickly. In addition to the development of specialized training courses and seminars, some organizations are beginning to use programed instruction. closed circuit television, recordings that can be distributed by mail, telephone conferences, and other devices which accelerate communication and increase the efficiency of instruction.

The results of one research program can and do stimulate research by others on the same problem. In the field of microbiology, several investigators are working on the important problem of staphylococcal food poisoning. Their efforts have resulted in the purification of one toxic protein and partial purification of others, so that specific serological identification of at least two types of enterotoxin is now possible in food extracts. Steps are being taken to develop additional type-specific antisera and to make them available in other laboratories. When completed, these studies will constitute an important advance in food protection by providing a sensitive method for detection of staphylococcal enterotoxins without resorting to the use of human volunteers, primates, or cats *(9)*.

Other examples of recent improvement in laboratory methodology for food protection include the development of simplified chemical procedures for analysis of radioactive fallout in foods, a differential test for reactivation of phosphatase in pasteurized dairy products, chromatographic detection of pesticide residues in foods and drinking water, standardization of the bioassay for paralytic shellfish poison, and development of selective methods for the isolation and identification of foodborne pathogens such as *Clostridium perfringens* or *Staphylococcus aureus*. These research findings are continually being made available for application in food protection programs through technical publications and laboratory training courses sponsored by the Public Health Service as well as other organizations. There is, however, a substantial lag in adoption of new methods because of the natural reluctance of some individuals to accept changes as well as the difficulties of getting the necessary fiscal and administrative support. In our opinion the food protection organizations of State and local government, as well as industry, need to participate more actively in the evaluation and uniform application of new procedures.

It has long been suspected that the reporting of foodborne disease outbreaks is far from complete. There are many reasons why this may be true, but the Salmonella Surveillance Reports *(17)*, which were started by the PHS Communicable Disease Center in 1962, are an excellent example of improved reporting in response to a cooperative mechanism provided by the epidemiologist to solicit information from other investigators such as bacteriologists, physicians, and veterinarians throughout the country. This is a good beginning for one important group of disease organisms that might well be extended in principle, to other areas of food protection. These efforts would help the participants to better understand their local problems and would stimulate them to find and report more suspected outbreaks, thereby establishing a basis for further investigation and corrective action.

Research findings have resulted in multilateral benefits to all concerned in food protection, from the producer to the manufacturer of food processing equipment, to the official agencies, and to the consumer.

The consumer has profited greatly because of the protection built into health-related equipment and products by industry based on research findings. In addition, official agencies have been appreciably benefited by industry's observance of acceptable standards and practices, and industry has experienced improved stability, provided by the assurance of sound, practical, and uniform standards, program guides, and recommended ordinances and codes which industry itself had an opportunity to help develop.

The primary purpose of food protection is, of course, to prevent unsafe foods from reaching the consumer; however, acute illness represents but one facet of the total problem. To this should be added the possibility of subacute or chronic effects from repeated exposure to chemicals or microorganisms that do not produce immediate responses in the individual. Such substances may be introduced at different stages of the food chain; e.g., during production, processing, storage, and preparation for serving. Study of the accumulative effects from repeated exposure to small amounts of food contaminants has only begun, but animal experiments suggest they may influence growth rate, longevity, and other physiological processes that influence the physical vigor and mental attitudes of the individual.

The foregoing is one of many problems that need further investigation. To cope effectively with the public health problems associated with the changing food industry, responsible agencies at all levels of government and the total food industry must place significantly more emphasis on food protection programs. Perhaps the magnitude of the work to be done can be best illustrated by mentioning some of the broad areas of concern to industry and the agencies responsible for the development and maintenance of food protection programs.

Since our basic concern is the prevention of foodborne disease, there must be developed new and improved methods for the recognition, investigation, and reporting of foodborne outbreaks. Such tools would permit better definition of the health hazards with which we are confronted today and allow better direction of a concerted attack on those problems.

Changing technology has taken a large part of the production of food away from strictly local control and increased the importance of establishing broad, nationally accepted criteria which will assure us that food has been produced, processed, stored, and distributed under acceptable standards. This will require a new look at present food sanitation practices and the operating programs designed to implement them. For the most part, many such existing programs and practices were developed before World War II and have not kept pace with the technological or socioeconomic changes.

Since research findings are valuable only to the extent to which they are utilized in the day-to-day operation of the protection of food by the industry and regulatory agencies, emphasis should be given to educational and training programs which will provide personnel at all levels of concern in the food field with a basic knowledge of the principles of sanitation and the new developments to which they must be applied. Industry and official agencies must share in the responsibility for such programs. One method which might be considered for this purpose is programed instruction. This educational tool, in its various forms *(12, 15)*, is gaining increased acceptance in our schools and industries as a teaching method and could be utilized in the teaching of principles of sanitation to food industry personnel. In addition, educational seminars, workshops, conferences, etc., which will keep food protection program personnel abreast of up-to-date food protection measures, must be instituted on a wider scale than is now available.

Substantial information has been acquired through past research in food technology; however, it is essential that we continue to extend our basic knowledge about health hazards associated with foods. In addition to studying the individual constituents and contaminants of food, work is needed on the interactions of foods with other environmental factors in order to understand the impact of complex environmental situations on human health.

As yet, not all causes of foodborne disease are well known. Recent research suggests that the aflatoxins of *Aspergillus flavus (5, 8, 10, 19)* the enteric viruses *(4, 6, 7)*, enteropathogenic *E. coli (16)*, and other *(18, 11)* foodborne microorganisms may cause illnesses that have not previously been considered foodborne. We also lack the basis for assessing the health effects of numerous foreign chemicals in food *(3)*. Quantities that caused acute illness can, of course, be judged hazardous, but lesser amounts of many substances in use today cannot be properly evaluated until more is known about these compounds when taken into the body.

In the past 20 years man has, through technological applications, brought about greater modification of his environment than he had in the previous 100 years. The industrial research and developments which assisted in bringing this change about, have been at least as prominent in the field of food technology as they have in other fields. Although the United States probably has today the most plentiful and varied food supply on earth, the means to protect the public from unsafe innovations has not kept pace with industrial developments. Each of us who is responsible for food safety, must cooperatively strive for extension of our knowledge, through research and education, to provide methods of food protection that can be effectively applied to improve the consumer's health and the industry's good reputation.

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DETERMINING TUBING LENGTHS AND SOLUTION VELOCITIES IN VACUUM FARM MILK TRANSFER SYSTEMS

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Summary

A formula and graphs are presented showing the relationship between pipe or tubing size and length, amount of vacuum and the rate of solution flow in the cleaning-in-place (CIP) of vacuum milk transfer systems.

Some milk transfer systems have excessive length of pipe or tubing or insufficient inside diameter (ID) to enable the operator to obtain accepted cleaning solution velocities (5 ft/sec) under the existing vacuum conditions. Inspectors and fieldmen cannot determine maximum allowable length in many cases by a casual inspection. The purpose of this report is to make it easier to get correct installations and proper cleaning of milk transfer systems and provide service people, salesmen and inspectors with the same minimum standards. It may also protect the farmer from being sold equipment that does not meet standards. A formula and graphs are presented to simplify the checking of solution velocities in vacuum milk transfer systems.

Procedure

The flow of liquids in gallons per minute (GPM) or ft/sec is affected by such factors as type and size and length of pipe or tubing; friction; static suction lift and viscosity of the liquid involved. Since there is so little practical difference in the viscosity of water and the cleaning solutions normally used in the CIP of milk transfer systems, consideration of viscosity is omitted in this article.

A hydraulics formula is available that includes the various flow factors, thus enabling the user to determine the maximum allowable length of pipe or tubing at any given rate of solution velocity. In conjunction with the formula, a table of friction losses for the flow rates in the given pipe or tubing size is also used (Table 1). The formula can be used in one of two ways:

1. The individual assumes a standard set of conditions such as 15-in. vacuum and 5 ft/sec velocity in 5/8-in. ID flexible tubing and computes the maximum allowable length of tubing permitted under the conditions. The installation then proceeds on this basis.

Table 1. Friction Losses in Tubing Used in Vacuum Milk Transfer Systems

	5/8 in. ID tubing[a]		1 in. OD tubing[b]		1½ in. OD tubing[b]	
Flow gal/min	Velocity ft/sec	Head loss ft/100 ft	Velocity ft/sec	Head loss ft/100 ft	Velocity ft/sec	Head loss ft/100 ft
0.5	0.52	0.35				
1.0	1.04	1.26				
1.5	1.57	2.67				
2.0	2.09	4.56				
2.5	2.61	6.88				
3.0	3.13	9.66	1.52	1.6		
3.5	3.66	12.90	1.77	2.3		
4.0	4.18	16.40	2.02	2.7		
4.5	4.70	20.40	2.27	3.3		
5.0	5.22	24.80	2.53	4.1		
6.0			3.03	5.8		
7.0			3.54	7.8		
8.0			4.04	9.8	1.66	1.2
9.0			4.55	12.0	1.87	1.4
10.0			5.05	15.1	2.08	1.7
12.0			6.06	22.0	2.50	2.4
14.0			7.07	29.2	2.91	3.2
15.0					3.12	3.6
20.0					4.16	6.2
25.0					5.20	9.3
30.0					6.24	13.5

[a]Flexible tubing – From Cameron Hydraulic Data, published by Ingersoll Rand Company, 1962

[b]Sanitary tubing – 18 Gauge. From data supplied by Cherry-Burrell Corporation, "Capacity Head Loss Curves in Sanitary Tubing" A-2957

2. To check an existing installation, the equivalent length of tubing or pipe plus elbows and tees is measured together with its ID. The operating vacuum and suction lift are also noted. With this data the theoretical solution velocity or GPM is computed and compared with that desired. If the velocity has to be increased and the tubing length cannot be shortened, it becomes necessary to change to a larger diameter which will greatly reduce the friction factor (F) in the divisor of the formula.

Illustration

To determine the maximum length of 5/8-in ID flexible tubing under the standard conditions given in (1) above, apply the following formula and factors:

$$L = \frac{100 \times (Hg \times FAC - S)}{F}$$

where:

L = Maximum allowable length of tubing, including equivalent lengths of tees and elbows. (No allowance for tees and elbows necessary for flexible tubing)
Hg = inches of vacuum. May be varied from 10 to 25 inches.
FAC = factor (1.133) to convert inches of mercury to head in feet.
S = static suction lift in feet (5 feet taken as an average figure).
F = friction loss in ft/100 ft of tubing (interpolate from Table 1).

Solution:

$$L = \frac{100 \times (15 \times 1.133 - 5)}{22.9}$$

$$L = 52.2 \text{ feet}$$

An example of how the formula might be used in the field on an existing installation to determine the velocity of flow follows. By inspection it is found that there are 60 ft of 5/8-in. ID flexible tubing.

Hg = 14 (by actual check)
S = 6 (the vertical rise from the dump tank outlet to the greatest height of tubing)

Solution:

$$60 = \frac{100 \times (14 \times 1.133 - 6)}{F}$$

or

$$F = \frac{100 \times (14 \times 1.133 - 6)}{60}$$

$$= 16.44$$

By referring to Table 1 it can be readily interpolated that with an F value of 16.44, the velocity in the tubing would be approximately 4.2 ft/sec, which does not meet the accepted standard. In order to increase the velocity to 5 ft/sec with the same tubing and S-factor, the vacuum (Hg) might be increased to 18 by substituting the 18 for the 14 in the formula and obtaining the new F-value of 23.99. This would then give a solution velocity of approximately 5.25 ft/sec.

Figures 1, 2, and 3 were constructed to avoid having to use the formula for each problem. Data for these were computed with the formula wherein S was taken as 5 feet. Thus, if the static suction lift is other than 5 feet on an installation, interpolation would be necessary. One foot of head is equivalent to 0.88-in. Hg; thus for each foot S exceeds five, the effective vacuum on the graphs should be reduced by 0.88-in.

TABLE 2. FRICTION LOSSES IN TUBING FITTINGS

Fitting size-in.	Equivalent length of tubing — ft	
	90° Sweep ell	Sanitary tee
1	2	5
1½	3	8

In the above installation problem with a 14-in. vacuum and 6 ft suction, the vacuum from which to interpolate would be 14 minus 0.88 or 13.12-in. Instead of increasing the vacuum to 18 in., the tubing size could be increased to 1 in. Figure 2 shows that an effective vacuum of 13.12 in. would give at least 5 ft/sec flow through a 100-ft length of tubing, or considerably more than 5 ft/sec with the 60 ft of 1-in. tubing. For installations having 1½-in. tubing, Figure 3 is available for determining velocities and pipe lengths.

CHECK FOR TROUBLE AREAS

There are some parts that require hand-washing. These should be specified on the manufacturer's direction sheets as they cannot be assumed by the

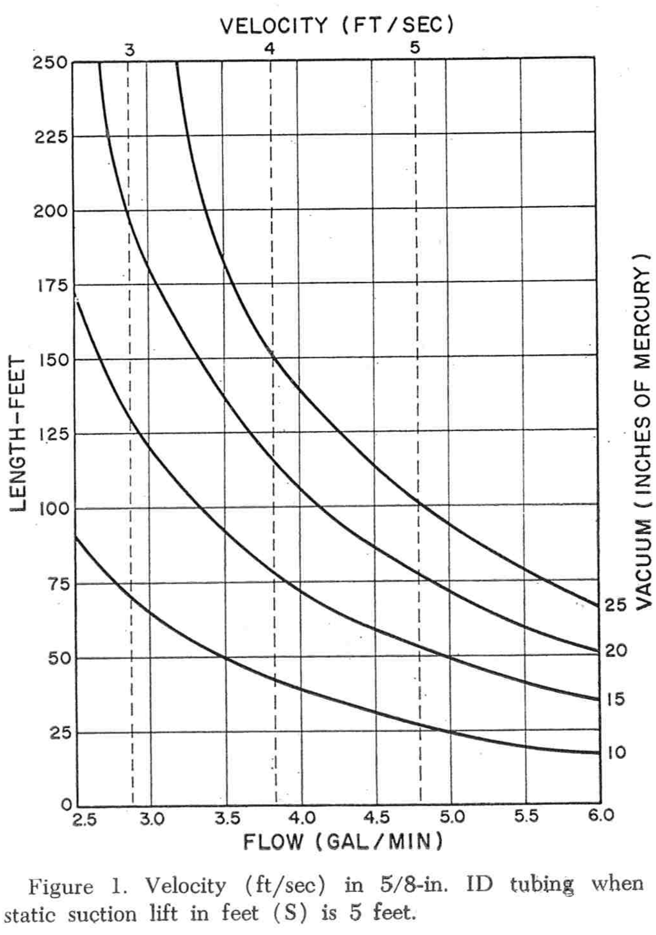

Figure 1. Velocity (ft/sec) in 5/8-in. ID tubing when static suction lift in feet (S) is 5 feet.

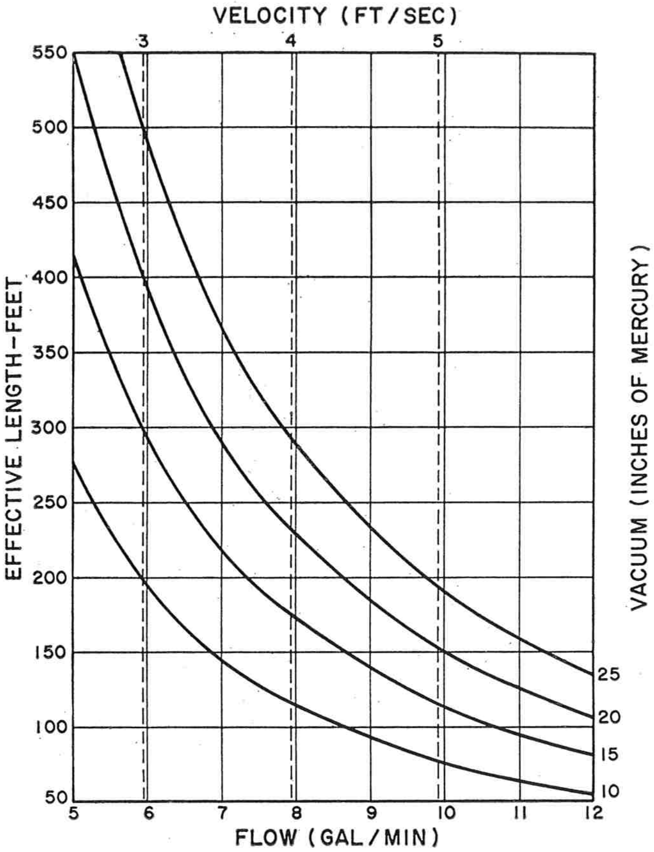

Figure 2. Velocity (ft/sec) in 1-in OD sanitary tubing when static suction lift in feet (S) is 5 feet.

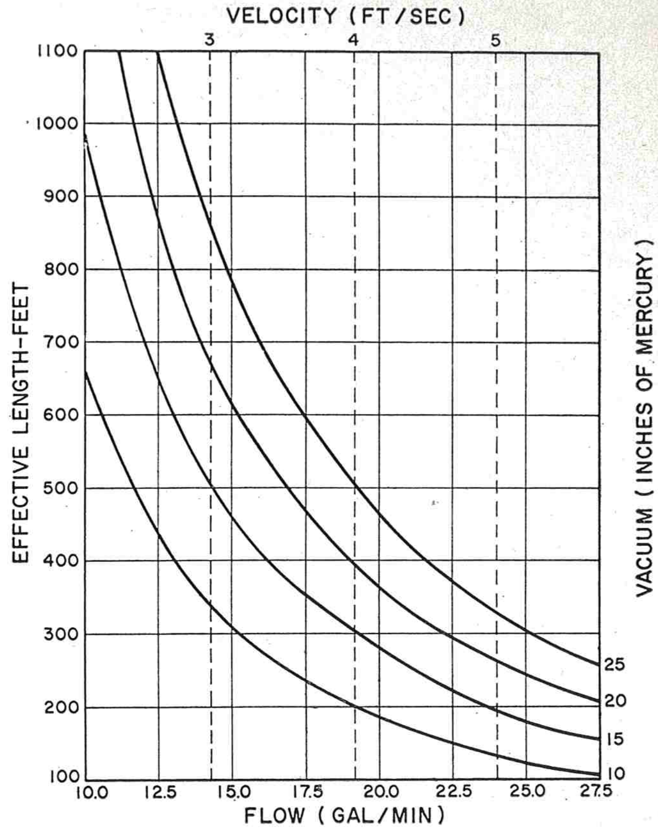

Figure 3. Velocity (ft/sec) in 1½-in. OD sanitary tubing when static suction lift in feet (S) is 5 feet.

user. It is also best to have a consultant in sanitation present to supervise and inspect the installation, thus insuring satisfactory operation.

One of the most troublesome areas is the vacuum releaser jar, because while it is included in the CIP circuit, the cleaning solution velocity through it is variable and at times very low. When bacteria counts indicate trouble, inspection of the system often reveals a need for acid-treatment. If twice-weekly acid-wash does not improve the counts sufficiently, hand-washing of the releaser jar may be necessary. Where acid sanitizers are used twice daily, acid washes should not be necessary.

One general reason for cleaning failures is the percentage of time solutions are not in motion or at full velocity. Each time the vacuum releaser jar empties, vacuum is broken and the flow in the CIP line stops. Depending on the unit, this flow stop amounts to one-half to two-thirds of the total circulation time, by actual check. On this basis, if directions specify a 10-min wash, it will be necessary to increase to 20-30 minutes. Perhaps manufacturers should indicate these times more specifically in order to obtain more uniform results.

Acknowledgments

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The writer appreciates the help of William Hinckley, Engineer, Cherry Burrell Corporation, Burlington, Massachusetts and Lynn R. Glazier, Associate Professor, Animal Industries Department, University of Connecticut, Storrs, Connecticut.

ENGINEERING ASPECTS OF MILKING MACHINE RESEARCH

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Summary

Research was undertaken to learn more precisely the physical aspects of mechanical milking. Attempts to measure the instantaneous flow rate have not been successful. A technique to measure precisely the vacuum at the teat end was developed and several measurements made. The work indicates previous assumptions regarding teat end pressures may have been in error. Limited work to date indicates a need for continuing efforts.

Many references to machine milking investigations can be found in the literature. Apparently, a great deal of this work was done without full knowledge of how machine adjustments affect the mechanics of milking. Many measurements of variables now deemed essential to the study of the mechanics of milking were not previously recognized, accurately measured, nor conveniently obtainable. Results could be no better than the measurements. An example of this was the use of the line vacuum gage reading as an indication of the vacuum applied to the teat.

It appears that a stage has been reached where better and additional measurements are needed in order to determine improved design criteria. Refinements or changes in design will likely come as a result of better research techniques rather than by trial and error.

Milking machine research in Agricultural Engineering at Cornell is directed toward developing techniques to obtain pressure measurements in and about the teat, and to measure the spurt flow pattern from the teat during machine milking. It is felt that this information, accurately and reproducibly obtained, is a prerequisite to improved performance.

After attempts to measure the instantaneous flow rate of each individual squirt or stream of milk, Switzer *(3)* resorted to the collection of many (10 or more) squirts which were then weighed. The cycle was repeated throughout the milking operation. This method falls short of producing the flow rate pattern for each squirt which is considered to be a measurement of importance. When this can be done the affect of the many variables can then be observed.

In general, in. Hg vacuum is the most widely accepted measurement unit for air pressures greater than absolute zero, but less than atmospheric pressure (14.7 psi or 29.92 in. Hg pressure). Perhaps the more serious error occurs between in. Hg vacuum and in. Hg.

The in. Hg vacuum notation uses the inch scale with atmospheric pressure being the reference zero (see Figure 1).

In. Hg (pressure) is usually measured from absolute zero so that at sea level atmospheric pressure, the scale reading is 29.92 in. Hg. Therefore it can be seen that 15 in. Hg vacuum is equivalent to 15 in. Hg (absolute pressure).

Negative pressure is somewhat of a misnomer. To understand this term atmospheric pressure must be made the zero reference point. Pressure readings (vacuum) below atmospheric are then called "negative".

Pressure measurements may be made by differential manometers which are inexpensive, rugged and very sensitive. Their accuracy makes them valuable for calibrating other devices under static conditions.

The Bourdon tube gage is an elastic deflection type. Because of its size and convenience of use, it is commonly used for making vacuum measurements on milking systems in the field. It was designed for relatively high pressures and static conditions. For measuring rapidly changing or pulsing vacuum levels such as in the pulsating and milk tubes of milking machines, it leaves much to be desired. Vibrations, pressure surges, and corrosion detract from its accuracy. It needs frequent calibration.

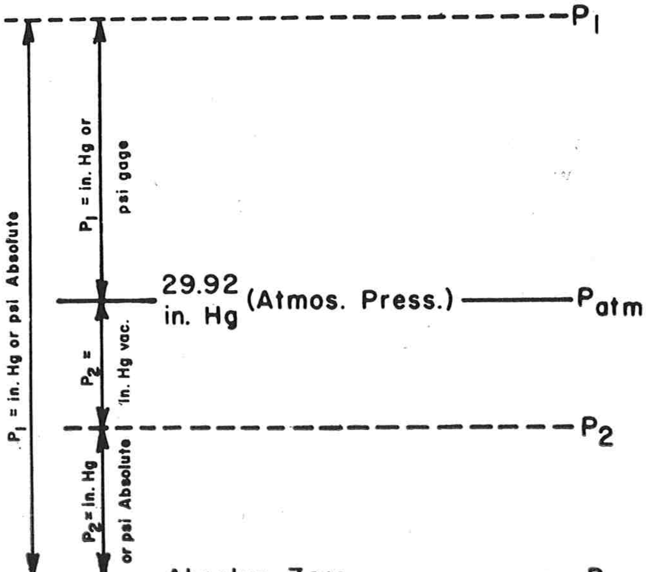

Figure 1. Pressure Measurement References.

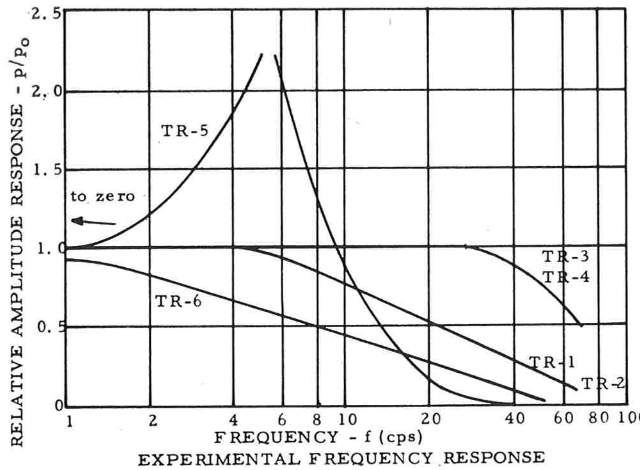

Figure 2. Frequency Response Plot for Four Systems.

1. TR-1 and TR-2, diaphragm-bellows type, LVDT[1] transducer, Schaevitz Engineering Type P476A, used in conjunction with Sanborn amplifiers and recorder.

2. TR-3 and TR-4, diaphragm type, unbonded strain gage transducers, CEC[2] Types 4-312 and 4-325, respectively, used in conjunction with Sanborn amplifiers and recorder.

3. TR-5, Bourdon tube type vacuum recorder, model AW, Esterline-Angus.

4. TR-6 diaphragm type vacuum recorder, Detco.

From the test results of figure 2 it was concluded that *(a)* all the units can be used for static measurements, *(b)* only TR-3 and TR-1 give good results for input frequencies up to 5 cycle/sec, *(c)* only TR-3 can measure vacuum up to 25 cycle/sec with no attenuation or magnification, and *(d)* at frequencies above 40 cycle/sec none of the systems give good results. Calculations indicated the system producing the TR-3 trace to be satisfactory for these measurements.

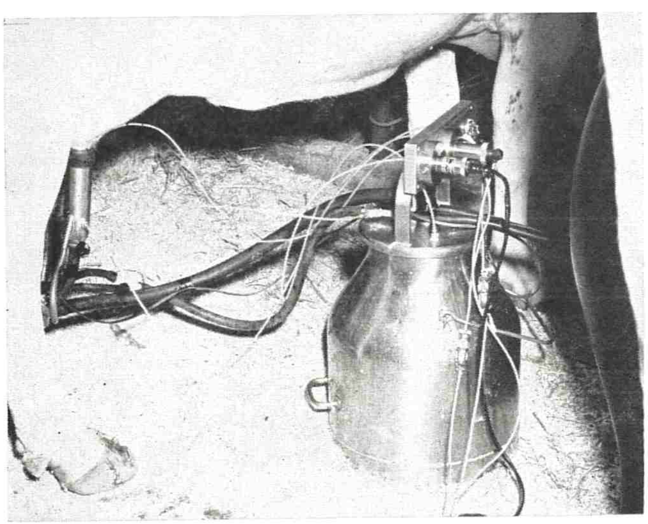

Figure 3. Equipment in use. Note location of vacuum measurement points, transducers and equal length of vacuum probes.

The time lag of the measuring system is also an important consideration. For example, TR-1 at 10 cycle/sec lags the event by approximately 45 degrees.

In order to measure vacuum at the teat end, Switzer *(3)* tapped small plastic tubes through the side of the liner. This method gave reproducible results that showed large vacuum fluctuations. These large fluctuations appeared to be present even under normal milking conditions.

Subsequent work by Townsend *(5)* re-evaluated the

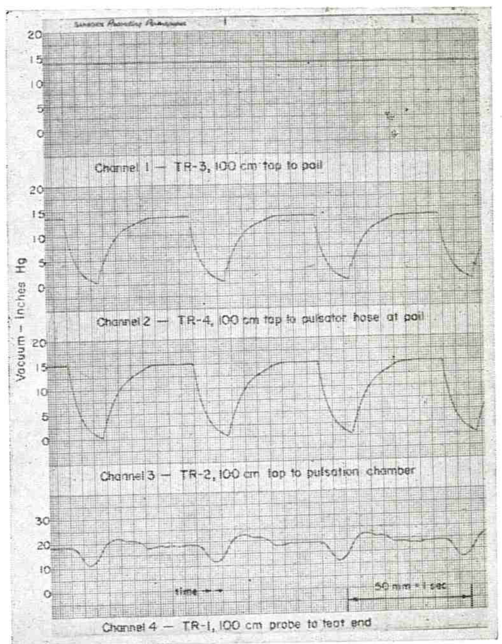

Figure 4. Recording chart showing simultaneous vacuum levels at four locations. Pail vacuum was 13-3/4 in Hg vacuum. Pulsator rate was 60 pulsations per minute.

method of tapping through the liner wall. To avoid modification of the liner which might change operating characteristics, a semi-rigid polyethelene probe was inserted through an air tight hole punched in the soft rubber mouth piece of the liner.

Following are charts obtained in experimental work at Cornell. The records were obtained by the above mentioned technique and instrumentation with additional measurements taken at the pail, the pulsation chamber, and in the pulsator hose at the pail as illustrated in Figure 3. All readings were taken with 100 cm taps (probes) for uniformity and interchangeability.

In Figures 4 and 5, note the vacuum fluctuations at the teat end. In Figure 4 the vacuum fluctuates between 11 and 22½ in. Hg vacuum. In Figure 5 a different machine with a different pulsator ratio

[1]LVDT—linear variable differential transformer.
[2]CEC—Consolidated Electrodynamics Corporation.

and a different liner was used. The vacuum at the teat was lower with fluctuations from 8 to 16½ in. Hg vacuum.

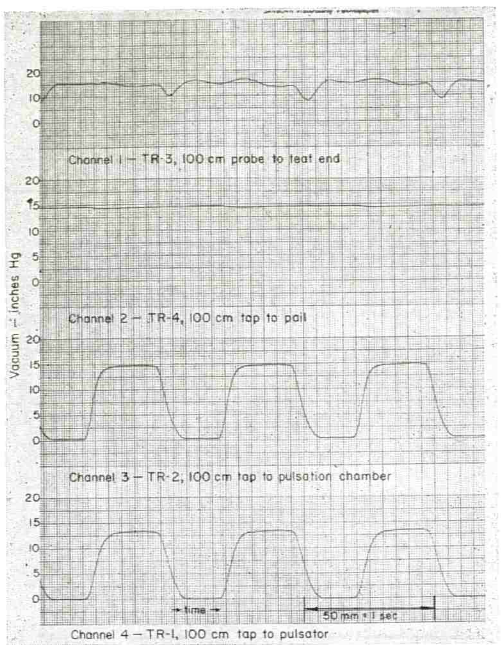

Figure 5. Recording chart showing simultaneous vacuum levels at four locations. Pail vacuum was 14-1/2 in Hg vacuum. Pulsator rate 58 pulsations per minute.

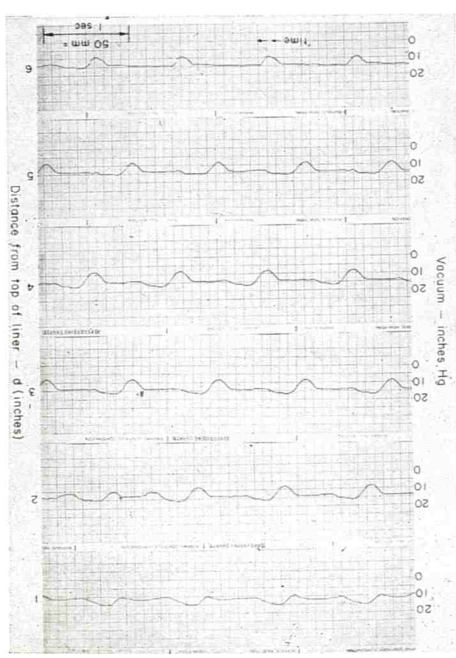

Figure 6. Recording chart showing vacuum traverse inside the liner.

Certain elastic deflection gages of the diaphragm type limited to small deflections can give good dynamic response. These small deflections are converted to an electrical signal usually requiring amplification which may introduce some associated difficulties.

Recording instruments producing a graphic record of pressure changes with time are being widely used to measure pressures in machine milking systems. These instruments have as their sensing element either a Bourdon tube, bellows or diaphragm and are under the same serious handicap as the Bourdon tube gage. Furthermore, the instrument should record in true rectangular coordinates.

Schalm and Noorlander *(2)* were among the first to use the more sensitive transducers (diaphragm type above), electronic amplifiers and recorder to obtain pulsator pressure graphs and pressure graphs from the annular chamber of the teat cup shell.

It is logical to assume that there might be a time lag between the pressure changes and liner movement. The degree of time lag is effected by the type, size, shape and tension of a liner, among other factors. Presence of milk in the inflation and milk tubes and the resulting pressure changes in this area also effect this time lag.

RESULTS AND DISCUSSION

Hundtoft *(1)* developed a liner wall position indicator, and recorded the vacuum and liner movement simultaneously. Results indicated that liner position could not be predicted from a pulsator graph and that pulsator graphs should be re-evaluated.

Measurement of the vacuum level changes on the inside of the inflation is somewhat more difficult to obtain. References can be found in the literature, *(a)* assuming the vacuum at the teat end to be constant, *(b)* indicating that the vacuum at the teat cannot exceed the vacuum level in the pail, and *(c)* further reporting that the vacuum variation at the teat is caused by air inlets in the claw and the hydraulic head of milk in the hose. Again Schalm and Noorlander *(2)* were perhaps among the first to attempt this measurement. Since that time Switzer *(3)* and Townsend *(5)* using electronic equipment, have recorded these vacuum changes. Theil *(4)* using an oscillograph writing instrument, has also recorded these vacuum fluctuations.

The limiting characteristic of the measuring and recording system for measurements of this nature frequently is the method of application rather than the sensing instrument or the recorder.

A frequency response plot was used to evaluate measuring and recording systems. Figure 2 compares four systems as follows:

Figure 6 is a vacuum traverse of consecutive readings taken at one inch intervals in the liner. The end of the teat in this instance was at approximately the two inch position. The greatest vacuum fluctuations appear to be found one to two inches below the teat end.

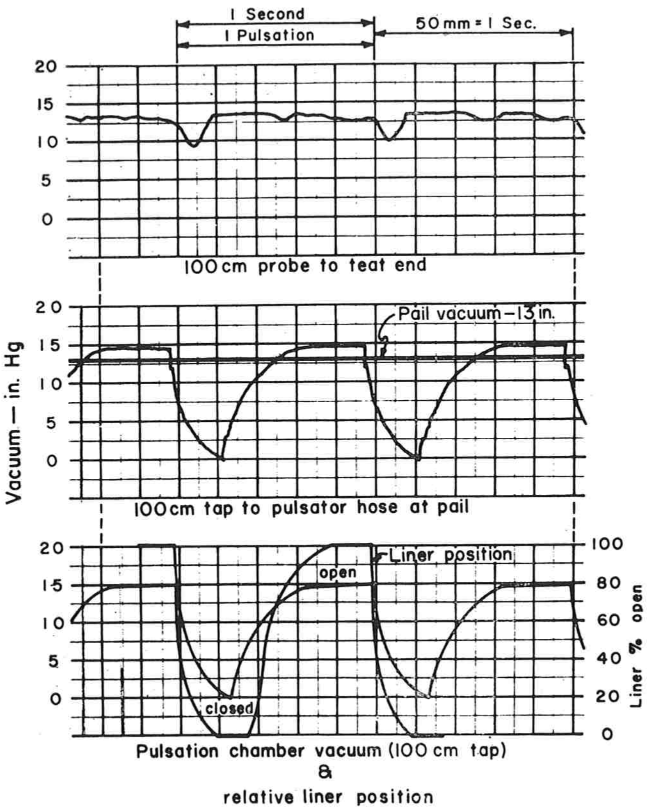

Figure 7. Liner position and pulsation chamber vacuum Liner position and pail vacuum have been superimposed on a retraced vacuum chart.

Figure 7 is a liner position curve superimposed on a pulsation chamber vacuum trace. Liner position was obtained by photographing liner movement through a clear shell. Synchronization was achieved by a timing light in camera view. The light was flashed by the magnetic pulsator impulse. With the camera at approximately a right angle to the liner collapsing plane, 0% open was the narrowest position observed, and 100% open was the widest position observed. The liner appears to respond immediately on the collapse phase but lags the pulsation chamber vacuum change on the opening.

Some points stand out in these recordings. The vacuum at the teat end during the milking operation is not constant. Different vacuum level patterns can be found at different positions within the liner. It varies widely, from several in. Hg vacuum below the operating level to several inches above. Many factors may effect this pattern of vacuum change. The type, size, shape and tension of the liner, pulsation rate and ratio as well as the physical and physiological properties of the cow's teat and the rate of milk extraction are some of these factors. An important factor in this work is the reproducability of the record from day to day on the same cow, with other factors held constant, as far as possible. It was also found that each cow produced a characteristic trace pattern.

CONCLUSIONS

It can be concluded that instrumentation and a technique now exists for making precise pressure measurements at the teat end heretofore not possible. Wide variations have been found between what has been thought to exist and what has now been measured. Limited results to date indicate that a great deal more work needs to be done before complete design criteria for improved mechanical milking can be determined.

Many routine measurements with present equipment and its variations, as well as with experimental equipment, are needed. The effect on the cow will need to be known, too.

Before the work can be completed a way will have to be found for measuring instantaneous flow rate from the teat.

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PROTECTION AND DEVELOPMENT OF KENTUCKY WATER SUPPLIES[1]

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Communities throughout Kentucky have come to the full realization that an abundant supply of pure clean water is of the utmost importance to their growth and development as well as to their health and welfare. The future of any community, to a great extent, is dependent upon a water system that will adequately meet its domestic and industrial needs. Through the combined efforts of federal and state programs and agencies, communities in Kentucky are making headway and are succeeding as never before in getting new water supply systems. Most of us are aware of our state's rich water resources, but few of us realize that in order to attract new industries and provide for the growth of our community that the existance of natural water sources is not enough. Public water plants must be designed and operated by qualified persons. Routine inspections of these water supplies must be made by the state engineers to assure good service. It is the responsibility of the Sanitary Engineering Program of the Division of Environmental Health in the State Department of Health to protect and improve the health of the public by upholding and enforcing the regulations affecting the health and safety of public water supplies.

As I have mentioned previously, a community must be able to provide an adequate supply of good water in order to attract industries and encourage the general economic and social development. The one single and almost insurmountable obstacle appears to be that of financing. However, since the passage of the Accelerated Public Works Act in 1962, sixty-six Kentucky communities have received grants for the construction of new water treatment plants or for the improvement of existing systems. Over ten million dollars have been provided under APW and seven and one-half million dollars by local sources, bringing the total construction cost made possible under the Federal Public Works Act to seventeen and one-half million dollars. Funds for the APW program have now been exhausted. However, we hope appropriations will be made in the future for additional grants.

When a community proposes to build or improve a water plant, the engineers of the Kentucky State Department of Health review for approval the plans and specifications before construction begins. Sanitary features of design are carefully evaluated. Inspections are conducted regularly upon completion of the plant to assure proper maintenance and operation of these water plants. At the present time there are 335 Kentucky communities that have public water supply systems. A total of one and one-half million people or 50% of the population of the state are being served by public water supplies. The other one and one-half million residents of Kentucky receive their water from private systems consisting of wells, cisterns and springs, or from surface sources such as ponds. These rural water supply systems are often subject to surface and subsurface contamination. Much has been done to provide water for rural areas through water districts. In Kentucky today, there are sixty-three operating water districts. Some of these districts have their own water treatment facilities and some are merely extensions to existing municipal supplies. Although over 700 water districts have been formed in Kentucky throughout the years, a relatively small number, as I have indicated, are actually functioning. This is due to several factors but primarily to lack of adequate support and in some cases it has been discovered that the cost is considerably out of proportion to the overall benefits to be expected. By far, many have found that financing is the biggest problem. However, in most cases, well informed leadership has overcome these obstacles. Since the creation of water districts in Kentucky has proved to be one of the most popular and suitable means of obtaining water for rural areas, I would like to dwell a little on their creation.

The formation of water districts is covered in the Kentucky Revised Statutes, Chapters 74 and 106. As most of you probably know, a water district is created by an order of the County Court upon petition of seventy-five property owners within the proposed district. The court makes the order designating the district by name. The County Judge appoints the Board of Commissioners who supervise the operation of the district. When organized, the district has authority to issue bonds, the retirement of which is derived from revenues of the district.

It is possible for municipalities to acquire water districts and water districts to acquire city water systems by mutual consent. As a matter of fact, sewerage systems may be acquired by water districts

[1]Presented at Annual Meeting of the Kentucky Association of Milk and Food Sanitarians, February 25, 1965.

by virtue of a 1962 amendment to the Water District Law.

Financing for water districts is commonly obtained by assistance from the federal government in grants and/or loans, or public sale of bonds. The federal agency usually involved is the Farmers Home Administration with offices in Lexington, Kentucky. In addition, loans are available from Community Facilities of the Housing and Home Finance Agency, Atlanta, Georgia. Until December 31, 1964 loans were also available under the Area Redevelopment Administration of the Depressed Area Act. However, at the present time, the most popular means of financing water districts is the Farmers Home Administration. This agency is specifically authorized to finance water districts for farmers and rural residents. This includes towns of under 2500 population. In Kentucky the financing of water districts has been with revenue bonds sold on the open market but insured by the federal government. Interest rates to the districts have been under 4%. At the present time, thirteen water districts have been completed or under construction which have received assistance from the FHA. Five other districts have received tentative approval and seventeen applications have been received for future water districts. The remaining fifty water districts in the state have received financial aid from other agencies besides FHA.

I would like to briefly mention the role of the Public Service Commission in the regulation of water districts. Prior to 1964, a water district was not considered a utility. The 1964 General Assembly enacted House Bill 493, thereby placing the water districts under the jurisdiction of the Public Service Commission, which includes the setting of rates and charges of utilities. In effect, a water district is now a utility in the meaning of that term as it relates to the P. S. C. A Certificate of Convenience and Necessity is required to be issued by the Commission prior to commencement of construction.

The role of the consulting engineer in the construction of a water district starts after the water district has been legally established with boundaries and the number of customers that it will serve. The consulting engineer determines the best available source of water and the feasibility of developing the project. The source may be wells, lakes or springs. Connection to an existing water system may be recommended as the most feasible arrangement in some cases.

Since we of the Kentucky State Department of Health have been repeatedly requested to outline our requirements in the development of water districts, I would like to review step by step what information should be provided. Under the Kentucky Public Water Supply Regulations KRS 211, plans and specifications for all public water supply systems must first receive approval from the Kentucky State Department of Health before construction begins. This provision is covered under item 2, page of the regulations as follows:

> "No municipality, county, public institution, firm, corporation, officer or employee thereof, or other person shall install or start construction of any public water supply facilities, or make any material change in any such existing facilities or works, until plans and specifications, together with an engineering report supporting in detail the design set forth in such plans, have been submitted to the State Department of Health and approved in writing. Plans, specifications, reports and other information shall be submitted of such form and contents as may from time to time be specified by the Department."

A public water supply is any water supply serving the public irrespective of its ownership or operation and made available for drinking and/or domestic use. All public water supply systems therefore, whether they are designed to serve a water district or a city, must conform to the above requirements. The facilities may consist of a complete water treatment plant or merely an extension to an existing water system. Essentially, the following steps must be followed after the water district has been legally formed:

1. A professional consulting engineer or engineering firm, registered in the State of Kentucky, must be employed by the water district to prepare a preliminary engineering report. The consulting engineer must submit a one gallon sample of the water of the proposed raw water source, whether it be a deep well or a surface source, to the State Laboratories at the Kentucky State Department of Health, Frankfort, Ky., for a routine chemical examination. The water sample must be properly tagged as to name of water district; date of collection; point of collection; and name of collector. A report of the laboratory results with interpretation and recommendations for proper treatment or rejection will be made by the office of Sanitary Engineering to the consulting engineer.

2. Following the recommendations of the State Department of Health as to the extent and degree of treatment necessary to produce a safe and potable water, the type of treatment must be incorporated in the final plans by the consulting engineer. Plans and specifications must be submitted in triplicate to the office of Sanitary Engineering of the Ken-

tucky State Department of Health through the local health department. Upon review and approval of these plans, one set of plans will be retained by the State Department of Health, one set will be returned to the local health department, and one set forwarded to the consulting engineer.

3. Fluoridation, if desired, may be provided in a new water treatment plant serving a water district when approved by the Kentucky State Department of Health.

4. Water treatment plants serving a water district must be operated and supervised by a certified operator. Examinations for certificates are given at the State Department of Health.

5. Monthly water plant operation reports must be submitted to the State Department of Health on forms provided by the Department.

6. A minimum of 2 water samples per month for bacteriological analyses must be submitted to the State Laboratories of the State Department of Health by a water district in containers obtained from the local health department.

7. Requirements for distribution systems in water districts including elevated storage tanks and standpipes must conform to AWWA specifications.

8. The use of plastic pipe for water distribution systems shall be permitted only in pipe sizes not exceeding 3 inches. Plastic piping used in such cases must be NSF approved (National Sanitation Foundation).

9. Upon completion of the water plant and/or distribution system, disinfection shall be strictly in accordance with the procedure designated in the Kentucky State Department of Health Regulations, which reads as follows:

> "All new water distribution systems including storage distribution tanks and repaired portions of, or extensions to existing systems shall be thoroughly disinfected before being placed in service, by the use of chlorine or chlorine compounds in such amounts as to produce a concentration of at least 50 ppm and a residual of at least 25 ppm at the end of 24 hours and followed by thorough flushing."

10. When the project is completed, a letter must be submitted by the consulting engineer to the office of Sanitary Engineering of the Kentucky State Department of Health certifying that the project has been constructed in accordance to approved plans and specifications.

I have devoted considerable time on water districts since they have enjoyed unprecedented popularity in Kentucky and seem to be the answer in providing safe water to our rural areas. Now, I would like to discuss briefly the actual treatment required for ground and surface water supplies.

Surface water supplies derived from lakes and impoundment, rivers and streams must be given complete treatment. This includes quick mix, 40 to 60 minutes coagulation, 4-hours settling, gravity filtration at 2 gal. per sq. ft. per minute (slow sand filtration at 2 gal. per 25 sq. ft. per minute), and chlorination. All deep well supplies must be chlorinated allowing a minimum of 30-minutes contact time. However, additional treatment for well supplies, such as iron and manganese removal, may also be required if the chemical analysis indicates this to be necessary. Low productivity, high chloride and nitrate content will be the basis for rejection of a well supply.

Since a considerable number of the rural water supplies are derived from wells, I would like to confine the last part of my discussion to ground water supplies. A safe well water supply depends on good location and construction. Ground water obtained from properly located and constructed wells is generally free from disease-production bacteria. However, in Kentucky due to the sedimentary rock type formation and relatively thin layers of top soil, it is not always possible to obtain safe water from a well. Therefore, precautions in protecting the well and chlorination of the water becomes necessary. Wells must be constructed in such a way as to exclude surface and ground water above the levels of water producing formations.

Additional security can be obtained by removing known sources of contamination as far possible from the well or constructing a new well a safe distance from such sources. The well site should not be subject to flooding. It should be properly graded and drained to facilitate the rapid removal of surface water. To assure protection against the entrance of surface and subsurface water, the well should be located uphill with the following minimum distances from sources of pollution:

Pit privies and septic tanks	50 ft.
Subsurface sewage lateral fields and barnyards	70 ft.
Seepage pits	100 ft.
Cesspools	150 ft.

If it is necessary for sewer or drain lines to pass closer than 50 ft. from a well, the sewer must be constructed of cast iron pipe with leaded joints. Under no condition should any pipe carrying sewage pass within 20 ft. of a well.

Proper construction of a well depends on a number of items, some of which I would like to mention:

1. The suction pipe of a well within 10 ft. below the ground surface should be surrounded by a water

tight casing extending above the ground, platform or floor surface.

2. Every pump platform or pump room floor should be water tight and elevated above the land level.

3. Water tight concrete platforms should be properly reinforced and sloped to drain off surface and waste water from the center of the well casing to the outer edges of the slab.

4. The slab or pump room floor should have a minimum thickness of 4-inches and extend not less than 2 ft. from the well casing in all directions.

5. The pump's base should form a watertight seal with the well covering or casing. In instances where the pump is not installed directly over the well, the well casing should extend at least 6-in. above the pump house floor and a watertight packing should close the space between the casing and section pipe.

6. No well casing, pump, pumping machinery, or exposed suction pipe should be located in any pit or space below ground level or any space above the ground which does not have free drainage by gravity to the ground surface.

A pitless adaptor which provides heavy castiron housing to well casing below the frost depth may be used as a safe and sanitary seal against surface contamination.

Last, I would like to emphasize the importance of chlorination. Automatic chlorination is mandatory for all public water supplies and is recommended for all private supplies. A new well or one which has recently been repaired or cleaned usually contains contamination which may remain for weeks unless the well is thoroughly disinfected. Disinfection may be accomplished by the use of any one of many chlorine compounds available. Continuous application of chlorine usually ranges from one to several parts per million, depending upon the amount of chlorine absorbed by the material in the water and the chlorine residual necessary to keep the water safe. A 0.2 ppm of chlorine residual in drinking water is required at all times. The chlorine is applied to the water on the well pump discharge side and before the water enters the pressure tank. The pressure tank must be of such a capacity as to provide a minimum of 30-minutes contact time between the water and chlorine.

In closing, let me add that bacteriological testing should be conducted at regular intervals to assure the safety of our drinking water. The State Laboratories offer this service at no cost. Sample containers may be obtained from the county health department or directly from the State Department of Health.

ASSOCIATION AFFAIRS

PAPERS PRESENTED AT AFFILIATE ASSOCIATION MEETINGS

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

KENTUCKY ASSOCIATION OF SANITARIANS

Annual Conference
Lexington, Kentucky
February 24 and 25, 1965

(Program sponsored jointly by the Department of Dairy Science, University of Kentucky and Kentucky Association of Sanitarians.)

(*Secretary,* Dudley J. Conner, 275 Main St., Frankfort, Ky.)

Effect of the Feeding Program on Fat Content of Milk—*Don Jacobson.*
Forage Production Potential for Increasing Milk Yield—*Warren Thompson, Russell Cornelius, Delbert Stempfly, George Depp.*
Problems Encountered in Converting Manufacturing Milk Producers to Use of Bulk Tanks—*Ed McDavitt*
Identifying Quality Problems in Manufacturing and Fluid Milk Supplies—*C. K. Johns*
Sediment Testing Bulk Tank Milk—*Bernard J. Liska*
Protecting Stainless Steel from Corrosion—*R. E. Kastendieck*
Pesticide Residues in Food Products—*Bernard J. Liska*
Protective Coatings for Surfaces in Milk Houses and Milk and Food Processing Plants—*Leon F. Baker*
The Relationship of Milking Practices to Abnormal Milk—*Joe Johnson*
Sanitation for Dairy and Food Processing Plants—*A. W. Rudnick*
Products for Cleaning and Sanitizing Dairy and Food Equipment—*C. K. Johns*
Development and Protection of the Water Supply—*Ralph C. Pickard*
Responsibilities of the Modern Sanitarian—*R. L. Cooper* and *Irving L. Bell*

WASHINGTON MILK SANITARIANS ASSOCIATION

1965 Annual Meeting
Seattle, Washington
April 7, 1965

(*Secretary,* Ben Luce, P. O. Box 1122, Olympia, Wash.)

Sanitation in the Manufacture and Distribution of Ice Cream Mix—*Paul Stocklin.*
Sanitation for Counter Freezers—*John W. Lorenz*
Sanitation in Relation to New Plant Processing Equipment—*Bob Bovey*
Producer Water Supply Problems—*Tom Wilson*
Mastitis Screening Tests—*Dr. L. O. Luedecke, Dr. T. L. Forster*

MISSOURI ASSOCIATION OF MILK AND FOOD SANITARIANS

Annual Conference
Columbia, Mo.
April 5, 6 and 7, 1965

(Program sponsored jointly by Department of Dairy Husbandry, University of Missouri, the Missouri State Division of Health and the Missouri Association of Milk and Food Sanitarians.)

(*Secretary,* Edwin P. Gadd, 424 Ridgewood, Coumbia, Mo.)

Pesticides and Pest Control—*Richard Heuermann, C. W. Robinette*
What is (is not) Evidence?—*George F. Nicholaus*
Septic Tanks vs. Lagoons—Suburban—*J. Warren Smith*
Cross-Connections and Backflows—*Harold Patrick*
Panel—Swimming Pools:
Construction—*Robert Miller*
Regulation—*Carl Potter*
Sampling—*Charles Wells*
Missouri Nursing Home Program—*A. Z. Tomerlin*
Accident Prevention—*Elmer Wood*
Sanitizers and Their Effectiveness—*Frank B. Engley, Jr.*
Detergents and Water Supply—*Joe Edmondson*
Factors Affecting the Freezing Point of Milk—*Robert T. Marshall*
Abnormal Milk Control Program for Missouri—*Gene Vietz*
Factors Affecting the Vitamin Content of Fortified Milk and Milk Products—*David Weddle*
Administration of Milk Marketing Orders—*Stephen Whitted*
Dishwashing Machines—*Howard Hutchings*
Antibiotics: Value and Usage—*Herbert S. Goldberg*
The F. D. A. Consumer Consultant Program—*Mrs. Loretta Johnson*
Problems in Retail Meats—*Floyd E. Carroll*
Trends and Expected Problems in the Restaurant Industry—*Max Koerner*
Meat and Poultry Plant Sanitation—*Gene R. Shipley*
Mosquito Control—*John A. Rowe, John Sadowski, Jerry Lemonds*
Epidemiology—*Henry M. Parrish*
Ordinance Promotion—*George Bauer*
Understanding the People We Work With—*Schell Bodenhammer*

MICHIGAN ASSOCIATION OF SANITARIANS

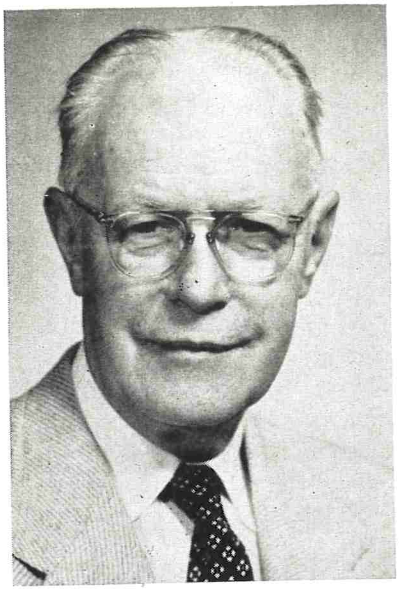
21st Annual Conference
Gull Lake, Mich.
March 16, 17, 1965

(Sponsored cooperatively by Michigan State University and Michigan Association of Sanitarians)

(*Secretary,* T. J. Kilmer, Oakland County Heath Dept., 1200 N. Telegraph Road, Pontiac, Mich.)

Today's Problems with Residues in Food and Milk—*Ray L. Janes*
Use of Stainless Steel for Sanitary Requirements—*William Baldwin*
"Portrait" of a Sanitarian—*Carl Gregory*
Swimming Pool Guidelines—*Arthur Alm*
What Does "B.O.A.C." Mean?—*Sam Stephenson*
The Food Industry Looks at the Regulatory Agency—*Robert Peranes*
Evaluation of "Package Plants" for Sewage Treatment—*Walter Holz*
Biological Recovery of Waste Waters—*Karl Schulze*
Better Use of Public Communications—*John Cook, William Spagnuolo*
Can We Recover All the Microorganisms from Food and Water?—*W. L. Mallmann*

NEWS AND EVENTS



C. A. ABELE—50 YEARS A SANITARIAN

It was quite fitting and appropriate last March 31 to find C. A. Abele winding up his fiftieth active year as a sanitarian "on the job" participating in a meeting of sanitarians. It was also most appropriate that the meeting was the Steering Committee of the 3-A Standards Committees, an organization to which he has devoted much time and energy and leadership in the last 25 years of his career.

C. A. "Abe" Abele is well known in the field of sanitation and his accomplishments have been outstanding. After having received a B. S. degree in Chemical Engineering from the University of Alabama, "Abe" began his career as a local sanitarian on April 1, 1915 covering an assigned territory of seven coal mining villages in the Birmingham, Alabama, area. His "covering" was done on horseback for six months and then by motorcycle.

In search of more training and knowledge, "Abe" resigned to attend a school for health officers in 1916-1917 conducted in Boston at the Massachusetts Institute of Technology, Harvard Medical School. Among his teachers were Dr. Milton J. Rosenau and William T. Sedgewick, authors of the first text books on sanitation. This school was the forerunner of current schools of public health.

In 1917 Abele joined the Public Health Service and in 1919 became Director, Bureau of Inspection, in the State Health Department in his home state of Alabama. No doubt because of his early out-standing work in milk sanitation, Alabama became the scene of the development of what is now known as the U. S. Public Health Service Milk Ordinance and Code. The "father" of the ordinance, Leslie C. Frank, utilized "Abe's" office and facilities for much of the formulation of the standards embodied in the ordinance. Under his supervision seven Alabama counties were the first to adopt and enforce the standards.

In 1940 Abele moved to Chicago to become Director of the Country Dairy Section of the Chicago Board of Health. During a period of eight years he was successful in bringing much improvement in milk production quality for this important market which has long been considered a leader in enforcing the highest milk standards. In 1948 "Abe" left the official agency field after some 33 years and became Director of Public Health Research for the Diversey Corporation, his present position in which he continues his service to the dairy and food industry.

"Abe", of course, is known to all IAMFES members, having been President in 1942-44 and the second recipient of the Award of Merit (1952). For twenty years (1941-1961) he served most effectively as Chairman of the Committee on Sanitary Procedures and is presently active as a representative on the 3-A Symbol Council.

Many honors have come to "Abe" during his 50 active years and his intensive participation in the work and programs of various public health organizations is evidenced by the positions he has held in these organizations. In addition to his activities on behalf of IAMFES these assignments include:

American Public Health Association (Life Fellow; Referee, Committee on Standard Methods for Dairy Products, 1936-54)

Chicago Dairy Technology Society. (President, 1947)

Member, U.S.P.H.S. Sanitation Advisory Board, 1932-44; 1947 to 1950

American Dairy Science Association (Member of Committee on Public Health)

Associated Illinois Milk Sanitarians. (President, 1955)

National Mastitis Council. (Director, 1965)

Following the 3-A meeting in Kansas City, Mr. Joseph S. Cunningham, Executive Vice President of Dairy and Food Industries Supply Association, Inc., wrote Abele stating "While I know that you did receive general acknowledgement from the people attending the 3-A Meeting in recognition of your completion of 50 years service to the dairy industry, I wanted to add my own personal congratulations for the compiling of such an enviable record. Few of us are privileged to be able to give 50 years of service and only a small percentage of that privileged few can look with such satisfaction upon their accomplishments. We all know that the 3-A Standards in which we take such pride owe much of their importance and effectiveness to you".

We all join Mr. Cunningham in wishing "Abe" many more years of opportunity to continue his outstanding service in the field of dairy and food sanitation.

3-A STANDARDS COMMITTEES COMPLETE PRACTICES FOR PERMANENT CIP PIPELINES

The text of proposed 3-A Accepted Practices for Permanently Installed Product-Pipelines and Cleaning Systems was completed by the 3-A Sanitary Standards Committees at a regular semi-annual meeting March 30-April 1, at the hotel Muehlebach, Kansas City, Missouri. Nearly 80 delegates were present, representing regulatory sanitarians, U. S. Public Health Service, and industry.

The strong industry trend toward welded pipelines made it desirable to develop sanitary criteria for the design and installation of such equipment. In progress for nearly two years, these guidelines completed at the Kansas City meeting still have to be signed by representatives of all participants and published.

Also completed at this meeting was an amendment to the 3-A Pump Standard which provides for the optional use of plastics as rotors or stators in sanitary pumps.

Both of these new 3-A documents should be ready for signing by late spring and publication in the Journal of Milk and Food Technology around the end of the year. 3-A Standards and Practices become effective one year after signing.

Other subjects on the Kansas City agenda which were reviewed and carried over to the next meeting included considerations of cleanability evaluation techniques, stainless steel, butter packaging equipment, dry milk fillers, and amendments to the 3-A Fittings Standard. These subjects will be scheduled for further action at subsequent meetings of the 3-A Committees.

3-A Sanitary Standards are developed by the Dairy Industry Committee with the collaboration of the U. S. Public Health Service and the International Association of Milk, Food and Environmental Sanitarians.

SPOKANE AND ALBUQUERQUE HEALTH AGENCIES WIN CRUMBINE AWARDS

The Health Departments of Spokane County, Wash., and the City of Albuquerque, N. M., were named today to receive national awards for developing exceptional programs in food and drink sanitation and environmental health. The two departments were chosen in a competition, open to some 1,200 local health agencies, by a jury of public health officials and educators to receive the Samuel J. Crumbine Awards for 1965.

The Spokane agency's entry impressed the jury with the vigorous measures taken to prevent a recurrence of outbreaks of food poisoning which plagued the area in 1962 and 1963, according to Howard E. Hough, secretary of the Paper Cup and Container Institute's Public Health Committee. The Committee sponsors the awards.

In Albuquerque, the emphasis was on winning widespread support of businesses and the general public for an effective environmental health program which, the jury found, was administered in a highly judicious manner. The city's entry indicated that, as a result, disciplinary action against violators is rarely necessary.

Albuquerque is a second-time winner in the competition, having received the food-and-drink sanitation award for 1961. For 1958, the Spokane City Health Department won the food-and-drink award, but the Spokane County agency is a first-time winner. Last year both awards went to the Orange County Health Department, Santa Ana, Calif.

"The jury felt that the Spokane agency, although it represents a relatively small, principally suburban area had performed outstandingly in recognizing a food-borne disease problem and meeting it head-on. The department immediately sought and obtained help from federal, state, and other local agencies. The result is a greatly improved food-and-drink sanitation program which has produced excellent results," Mr. Hough said.

Much of the improvement was credited to adoption of a modern sanitary code promulgated by the U. S. Public Health Service. In Spokane County, regular food service inspections are now made at schools, nursing homes, child day care centers, and other institutions, as well as public eating places.

Features in the Albuquerque program that were considered outstanding are a comprehensive pre-service and in-service training plan for health department personnel and a fixed policy of delegating authority to properly trained and supervised personnel. Lower echelon officials may even take disciplinary or legal action on their own initiative.

"The jury noted that Albuquerque's population increased tenfold in a 20-year span, in part because military and atom energy installations are concentrated in the area. The high standards achieved in the environmental health program are therefore considered all the more remarkable. That the program is so well accepted is a tribute to a carefully developed plan for keeping the public well informed," Mr. Hough said.

The Crumbine Awards, now in their 11th year, honor the late Dr. Samuel J. Crumbine, pioneering Kansas Health Officer. Until his death at 91, Dr. Crumbine was a vigorous foe of the "common" public drinking cup and sought to educate the public to the value of the paper cup as a disease-preventive measure.

Judges for the 1965 awards were Ralph T. Fisher, director, Division of Special Consultant Services, New Jersey Department of Health; Verdun Randolph, assistant chief, Division of Sanitary Engineering, Illinois Department of Health; Mrs. Winona Banister, executive secretary, Society of Public Health Educators, Rye, N. Y.; Dr. George J. Kupchik, director of environmental health, American Public Health Association, New York City; Dr. Harald H. Graning, chief, Division of Hospital and Medical Facilities, U. S. Public Health Service, and Morton S. Hilbert, associate professor of public health engineering, University of Michigan School of Public Health.

FDA REPORTS ON PESTICIDES IN FOODS

Pesticide residues are detectable in the American food supply by today's highly sensitive analytical methods, but the amounts of such residues are insignificant from a health standpoint, according to findings recently announced by the Food and Drug Administration, U. S. Department of Health, Education, and Welfare.

FDA made public the results of the latest of its continuing "total diet" studies undertaken to discover the quantity of pesticides in all kinds of food and drink consumed daily. Through the tests FDA is able to evaluate broadly the results of all efforts made to keep pesticide residues below legal tolerance levels. The studies also provide clues as to which pesticides may be getting into the food supply in excessive amounts.

Pesticide levels found in the test samples were generally less than one percent of the safe legal tolerance. Many of the most commonly used pesticides were not found at all.

The FDA studies are made on market-basket samples collected from grocery stores in three major U. S. cities. Groceries selected are representative of those that would be in a nutritionally satisfactory diet of a hypothetical average 16-to-19-year-old boy—biggest eater in the U. S. population.

Unlike previous total diet studies, the 1964 tests were made on composite samples representing 12 major food groups, for example, root vegetables, dairy products, and grain and cereal products. In previous years the contents of the market-basket were blended together in a single composite. The effect of the new procedure is to increase the sensitivity of the tests, and make their results more significant. Results of the 1964 tests showed pesticide levels lower than in the earlier studies.

All pesticides detected were at very low levels. Twenty-four different chlorinated pesticide residues would have been found had they been present but only seven were detected in tested samples. In 1963, comparable tests for 20 chlorinated pesticides detected nine kinds. No one sample contained all of the kinds found in either year. Tests made for organophosphate pesticides in 1964 detected no residues at the established detection levels; eight kinds were found in the 1963 tests.

The diet samples were also examined to detect herbicides and fungicides. These results were similar to those reported in previous years. Of 72 composites tested 13 contained detectable residues which were well within safe limits established for individual crops.

Method and Details of 1964 Study

The 1964 study was conducted in three FDA District laboratories, representing northeastern, midwestern, and western regions of the United States. It covered foods being marketed in Boston, Kansas City, and Los Angeles. In each of these cities FDA Inspectors purchased a typical market basket sample of many kinds of fruits, vegetables, dairy products, meats, and other commodities. These were prepared for the table by trained dieticians to eliminate variations in food preparation practices. Composite samples of the prepared foods representing 12 major food categories were then tested in the FDA laboratories.

Following are the residues reported:

DDT, and its homologues (DDE and DDD), were most frequently found but at low levels ranging from 0.001 ppm (parts per million) to a maximum of 0.396 ppm.

Seven other chlorinated organic pesticides were found in the 72 commodity composites examined. Lindane was found in 11 composites at levels 0.001 ppm to 0.210 ppm. Heptachlor epoxide was found in 10 composites at levels from 0.002 ppm to 0.057 ppm. Dieldrin was found in 10 composites at levels from 0.003 ppm to 0.033 ppm. BHC was found in four composites at levels from 0.015 ppm to 0.141 ppm. Aldrin was found in three composites at levels from 0.001 ppm to 0.005 ppm. One composite contained 0.166 ppm of Kelthane. One composite contained 0.011 ppm TCNB (tetrachloronitrobenzene).

The chlorinated residues in the dairy products, meat, fish and poultry, and oils, fats and shortening were determined on the fat basis and would be much lower if the entire weight of the food were considered.

No organic phosphates were found in any of the 72 composites.

Four composites were found to contain 2,4 D at 0.03 ppm or less. Two composites were found to contain 0.01 ppm and 0.02 ppm PCP (pentachlorophenol).

Four composites contained residues of cabaryl ranging from 0.19 ppm to 0.42 ppm. Two composites contained dithiocarbamates at 0.4 and 0.5 ppm.

Bromide residues were found in 56 composites, with residues above 30 ppm in only four composites.

No arsenic residues were found at level above 0.1 ppm.

In addition to the total diet studies, FDA laboratories continuously test individual samples of fruits, vegetables, and other foods for pesticide residues. In the past fiscal year the Administration's laboratories analyzed 32,678 samples of raw agricultural commodities for excessive residues. Only 34 lots of high-residue commodities had to be seized in Federal Court actions. Under FDA's system of reporting high-residue lots to both the owner and to State officials, some other illegal lots were not shipped.

Pesticide tolerances are established on the basis that the commodity will be safe to eat as it is shipped to market. Normal trimming, peeling, washing, and cooking substantially reduces the amount of pesticide residue actually consumed.

OCCUPATIONAL HEALTH ACTIVITIES

Following are some interesting observations on state and local programs in the field of Occupational Health taken from a recent Quarterly Report of the Division of Occupational Health, U. S. Public Health Service:

Hazards in drycleaning. (California)—The California State Health Department continues to cooperate with the State drycleaning board in the control of hazards related to the drycleaning industry. Recently, the health department, at the request of the drycleaning board, was represented at a judicial hearing concerning an injunction to restrict a coin-operated drycleaning machine owner. The question at issue concerned the potential hazard involved in the use of large quantities of perchlorethylene cleaning solution. The outcome of this case may be of considerable significance in California since efforts are being made to promote the development and sale of drycleaning machines for use in motels, hotels, apartment houses, and private homes in California.

Survey of car washing establishments. (District of Columbia)—Two employees complained of dermatitis from using detergents at two car washing establishments. An investigation by the Industrial Safety Board revealed that many employees using the detergents did not have proper protective covering. In one car washing establishment as many as 3 different kinds of detergents with mild to strong chemical irritating properties were being used. Corrective measures by the managements were ordered by the safety inspector during these inspections.

A joint investigation of a railroad car washer was requested by the Industrial Safety Board. Oxalic acid, a local and systemic chemical irritant was being used as one of the detergents in the process. Proper protection of the employee mixing the chemical was lacking. Adequate protective covering and availability of eye lotion were recommended for improvement.

Microwaves in warming ovens. (Pennsylvania).—An investigation is underway in Pennsylvania to determine if a hazard due to microwave exposures exists for the public in self-service food vending establishments. An inquiry made by a sanitarian prompted the investigation. Microwave ovens are used in these establishments for heating foods purchased from vending machines. The ovens operate at a frequency of 2,450 megacycles per second, the same frequency as is used on medical diathermy units. The frequency range has been approved by the Federal Communications Commission.

To date 8 units have been surveyed. Most levels found vary from no detectable microwave radiation to 5 mw/cm^2. The construction of the doors seems to be an important factor. One unit could be activated with the door open and a level of 20 mw/cm^2 was found. The study is continuing and the results will be published upon completion.

Ammonia leak. (Pennsylvania)—One of the Division's industrial hygienists inspected a relatively small milk processing plant some months ago. During the course of the inspection it was noted that ammonia was used in the refrigeration unit but that no one had anticipated what would happen should a leak develop in any of the many pipes, joints and fittings inherent in the system. The plant manager was advised to obtain an ammonia gas mask as a precaution against such an emergency and did so immediately. On a recent reinspection of this plant the manager beamingly thanked the industrial hygienist for his prior recommendation. One of the pipes *had* sprung a bad leak and, by donning the mask, the manager had been able to shut down the equipment and thus avert a possibly serious accident.

Pesticide problems, (Texas)—Numerous cases of parathion poisoning in the Rio Grande Valley during recent months prompted the initiation of a survey to determine the cause and method of personnel exposure. After numerous interviews were conducted with attending physicians, as well as persons receiving exposures, it was concluded that the majority of reported poisonings were the result of carelessness on the part of persons mixing, using or applying the parathion to various crops.

NEW INSTRUMENT DETECTS INSOLUBLE IMPURITIES IN ALL TYPES OF LIQUIDS

An automatic instrument that detects, measures and records even the minutest insoluble impurities in liquids has been developed by the Graver Water Conditioning Company, Division of Union Tank Car Company. It is one of the first units to detect insoluble impurities in liquids and the first to measure infinitesimal quantities. It is so sensitive that it can note the presence of two solid particles in a billion parts of water.

The instrument, called the Automatic Tape Analyzer, promises to simplify drastically industrial quality control procedures and may provide municipalities with a round-the-clock check on pollutants. Since the device performs a basic test and has high resistance to most chemical attack, it can test practically any type of liquid. The unit can measure impurities in drinking and process water; milk and other beverages including beer, wine and soft drinks; foods processed in the liquid form and a host of other applications.

In addition to monitoring impurities, the device registers color variation, thereby indicating the proper or improper ingredient content in products. In basic research, the unit can serve as a tester or a sample gatherer. With the incorporation of other testing instruments, the analyzer can become a miniature laboratory.

The tape analyzer derives its versatility from the basic method it employs—a membrane filter test. In this test, insoluble solids are removed from a liquid or gaseous sample by an ultra-fine filter membrane and retained on the filter surface where they are easily identified, sized, and counted. The analyzer automates the membrane test by periodically filtering samples through a nylon-backed tape of filter membrane, and recording the time each operation takes. The basic data produced is a circular stain or discoloration on the tape made by the solids extracted from a known volume of filtered fluid, and the time required to do same. The degree of discoloration is proportionate to the suspended solids concentration and the volume filtered. It can be calibrated by chemically analyzing a portion of a sample and then running another equal portion through the tape analyzer.

Beyond the basic data it provides, the stain on the tape can be used for further testing and analysis by various laboratory methods. The tape analyzer was developed to provide an accurate, reliable, inexpensive means of testing ultrapure condensate at power stations. Many industrial, chemical and municipal applications have since become evident. The unit will have many applications in industrial quality control.

Graver, a leading manufacturer of liquid treatment systems for over fifty years, makes a full line of equipment for industrial and municipal water treatment, industrial waste treatment, boiler feedwater treatment and chemical processing operations. For further information, contact: Martin Stern, Publicity Department, Graver Water Conditioning Company, 216 W. 14th Street, New York, N. Y.

MINNEAPOLIS—ST. PAUL MILK SHED STUDY

A study of the organization, operation and cost aspects of the Minneapolis-St. Paul Milk Regulatory and Quality Control Program has been completed and a most comprehensive and informative report, including supporting data and exhibits, has been published. Much of the data and information is of more than local interest and is not available elsewhere.

The objectives of the study were: (a) to determine the amounts, sources, and uses of all monies spent on the milk regulatory and quality control program within the Minneapolis-St. Paul market during 1961; (b) to determine the administrative and operational practices and procedures of each participating entity in the program; and (c) to give consideration to possible means of enhancing the efficiency of the program.

By way of introduction the authors review the development of sanitation control practices, the establishment of recognized ordinances and attempts to achieve uniformity in regulatory programs. The question of financing adequate controls is considered as well as the changes in the milk industry in recent years which have affected the operation of an adequate program for the metropolitan area.

The findings of the study are reviewed and summarized in some detail. Various factors are weighed according to their effects, including industry and public agency expenditures in the interest of product quality, milk shed and marketing area peculiarities, inter-city correlations and other elements. Unit costs for various aspects are established whenever practicable and a wealth of data of interest to regulatory and quality control agencies as well as production and marketing phases of industry is assembled.

The report offers suggestions and recommendations for effective utilization of the results of the study. To make use of available funds and facilities to the best advantage the recommendations include: a single administrative system of regulatory control; better utilization of industry field men and of quality control laboratories in analysis of finished products; avoidance of duplication of official laboratory and inspection facilities; and use of commercial laboratories by producer groups and processors in quality improvement. From the taxpayers standpoint some observations are made concerning sources of tax and other funds supporting the control agencies and the inclusion of suburban residential areas in financing a regulatory program.

The study was conducted by staff members of the Department of Dairy Industries, the School of Public Health and the Department of Agricultural Economics at the University of Minnesota and was supported in part by a Public Health Service research grant. Information concerning the report can be obtained from Prof. J. C. Olson, Jr., Dept. of Dairy Industries, University of Minnesota, St. Paul.

NEW FARM TANK INSTALLATIONS LEVELING OFF

The tenth annual Farm Milk Tank Survey, conducted by Dairy and Food Industries Supply Association with the cooperation of National Association of Dairy Equipment Manufacturers, shows 205,254 farm tanks installed and in use in the United States as of January 1, 1965. This represents an increase of 5,276 over the 199,978 which were installed as of January 1, 1964. The percentage increase for the country nationally is slightly above 2.6 percent.

Canadian figures indicate a total of 13,268 farm tanks installed and in use as of January 1, 1965. This figure represents an increase of 360 farm tanks over the 12,908 installed as of January 1, 1964.

Earlier United States annual figures on farm tank installations are: 193,580 on January 1, 1963; 179,878 on January 1, 1962; 160,805 on January 1, 1961; 140,795 on January 1, 1960; 117,103 on January 1, 1959; 91,096 on January 1, 1958; 57,386 on January 1, 1957; and 29,885 on January 1, 1956. The widespread adoption of the farm bulk system of milk handling has been one of the most rapid and revolutionary changes within the dairy industries in recent years. The number of new installations seems to be leveling off, as the 5,276 installed in 1964 represents the lowest number of new installations since the gathering of these statistics began.

The ten leading states and the number of tanks in each on January 1, 1965 are as follows: Wisconsin, 29,093; Ohio, 14,960; Minnesota, 13,384; Michigan, 13,100; New York, 12,984; Illinois, 11,402; Pennsylvania, 8,106; Iowa, 7,852; Indiana, 7,571; and California, 5,152.

DFISA PICKS NEW DIRECTORS, RE-ELECT OFFICERS

Seven Directors were elected to the Board of Dairy and Food Industries Supply Association and all officers were re-elected at the 46th annual meeting of the supplier-equipper organization March 24-26, 1965, in Clearwater, Fla. Officers re-elected are: F. M. King, Wyandotte Chemicals Corporation, President; George L. Huffman, Ex-Cell-O Corporation, Pure-Pak Division, Vice President; and Roy E. Cairns, Waukesha Foundry Company, Treasurer.

Of the seven directors elected, two join the Board for the first time—At-Large Directors G. A. Houran, The DeLaval Separator Company; and Edward K. Walsh, American Can Company. Other directors elected are: At-Large: Ralph F. Anderson, Anderson Bros. Mfg. Co.; Roy E. Cairns; and George L. Huffman. Commodity: J. H. Brunt, Jr., Hackney Bros. Body Co., Delivery; and D. G. Colony, Manton-Gaulin Manufacturing Company, Inc., Processing and Handling Equipment and Components.

The association's 18-man Board of Directors is now comprised of the following: George A. M. Anderson, The King Company; Ralph F. Anderson; Roy E. Cairns; Paul K. Girton, Girton Manufacturing Company; G. A. Houran; George L. Huffman; R. E. Olson, Taylor Instrument Companies; Edward K. Walsh; J. W. White, Fibreboard Paper Products Corporation; R. B. Wilhelm, Owens-Illinois; James H. Brunt, Jr.; D. H. Carter, Kelvinator Division, American Motors Corporation; D. G. Colony; Hunt Hamill, Krim-Ko Corporation; F. M. King; Joe Larson, Sparta Brush Co., Inc.; M. C. Strickland, Smith-Lee Co., Inc.; and John J. Weldon, Bessire & Co., Inc.

POCKET-SIZE TAPE RECORDERS AID INSPECTIONS

According to the March, 1965, issue of Public Health Inspector, the journal of the Association of Public Health Inspectors, published in London, England, something new has been added to increase the efficiency of the inspector.

Two years ago the public health department of Shoreditch Borough Council began a novel experiment. They introduced pocket-size tape recorders for house inspection. In instituting this departure from established procedure, Mr. T. H. Marshall, the Chief Public Health inspector, was aiming at the following objectives: To make the fullest possible use of the technical qualifications and professional experience of qualified public health inspectors and to relieve them of an abundance of paper work which could be just as well done by non-technical staff; to overcome the shortage of efficient shorthand typists; and to eliminate the near impossibility of making adequate notes in cold or wet weather during outdoor inspection.

Now, at the end of two years, it is obvious that the method has been an outstanding success. It has, in fact, doubled the output of inspection reports with a very marked increase in efficiency. "We are employing the ability of a qualified man on the work for which he is qualified, and he does not have to waste his time going back to the office and transcribing his notes", says Mr. Marshall. Once the inspector has put his remarks on tape he can get on with the next job without delay. Before the tape recorders were introduced it was common for an inspector to spend as long on transcription as he did on the inspection of the premises.

The tape recording method has, as Mr. Marshall forecast, been applied to factory, office and shop inspection in addition to houses. In every case, time has been saved and the public health inspector enabled to devote the whole of his attention to the work in hand without the distraction of note-taking.

LITTERBUGS COST $1 BILLION ANNUALLY

Litterbugs cost Americans a billion dollars a year, according to estimates released by Keep America Beautiful, Inc., the national anti-litter organization. Taxpayers foot half this litterbug bill, through the cost of cleaning up streets, highways, beaches, parks and other public areas.

The other half is paid by business, industry and individuals in the form of losses and expenses attributable to litterbugs. Trash-fed fires, of example, damaged or destroyed 17,000 homes in a recent twelve-month period. Litter can also cause devastating forest fires.

Industry spends untold millions cleaning up litter in plants and offices and from plant property. One Texas manufacturer estimated that litter removal costs $22,000 a year in his relatively small plant.

Property values decline in a littered neighborhood, and littered highways drive away tourists. Litter is not only an aesthetic offense and a menace to health and safety, but is also bad for business.

Littering is one of our most expensive vices. But fortunately it is not as hard to break as some other vices. Experience has proved that the litterbug mends his way in the face of public education programs that dramatize his bad habit.

TWO NEW KENDALL FILTER DISPENSERS

Two sturdy new metal wall dispensers for socks and large disk-type milk filters are now marketed by The Kendall Company, makers of Kendall *non-gauze* Milk Filters, who also market a durable plastic filter dispenser for 6-inch and 6 1/2-inch disks and squares. An ingenious wire adapter also allows it to hold the smaller 4 9/16-inch disks used in in-line filter systems.

The use of these dispensers by dairymen is highly recommended because they protect milk filters from dust, dirt, insects, moisture, and extra handling. The filters are kept fresh and clean in their original cartons until the moment they are needed.

Kendall's new Sock Dispenser is designed for use with all sock filters up to 25 inches in size. It may be permanently mounted on a wall in the most convenient location. A carton of filters is inserted easily at the top of the dispenser, and the door at the bottom is hinged for quick opening and snug closing.

The new Kendall Large Disk Dispenser holds a cartonful of the 12 or 15-inch disks used in milk transfer systems. Mounted on a wall, it folds down out of the way when not in use.

For further information about the new metal wall dispensers for socks and large disks, write to The Kendall Company, Fiber Products Division, Walpole, Massachusetts.

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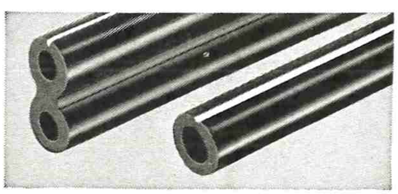

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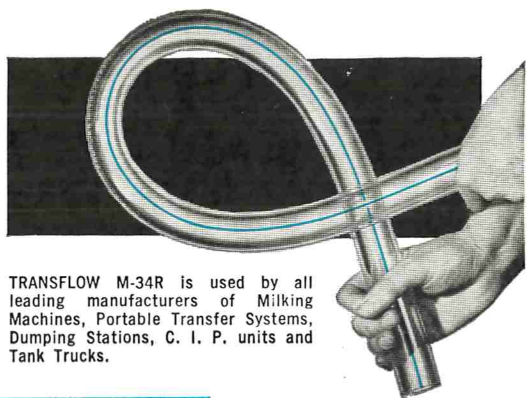

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