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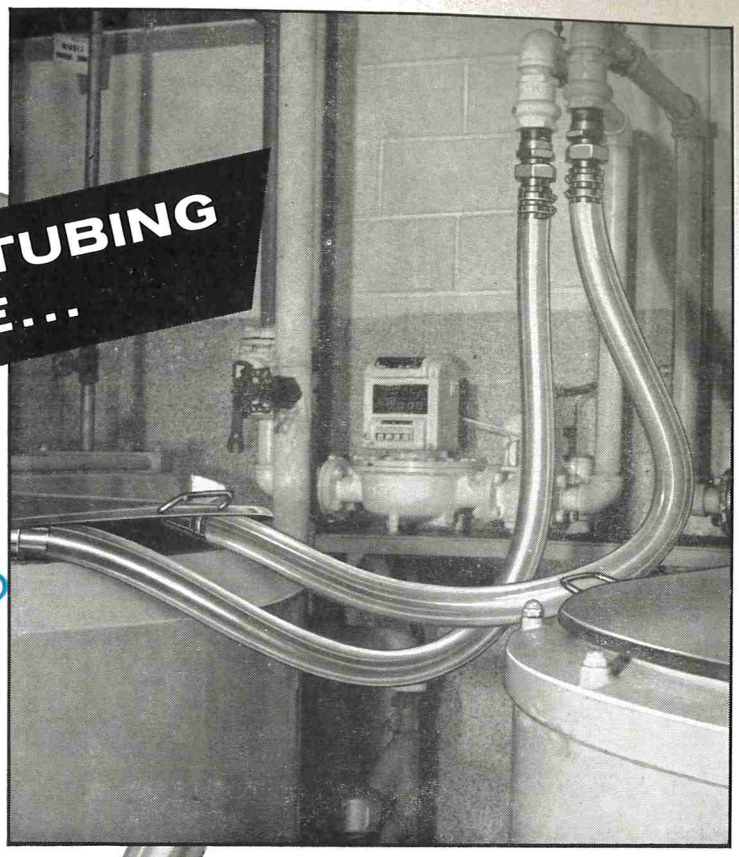

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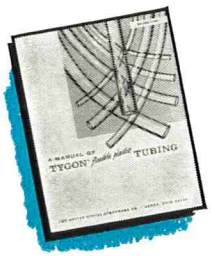

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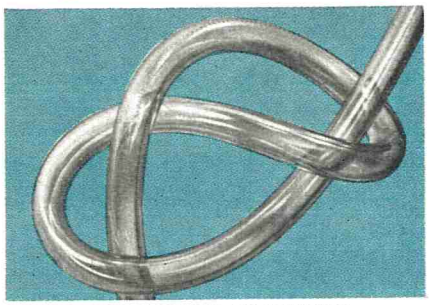

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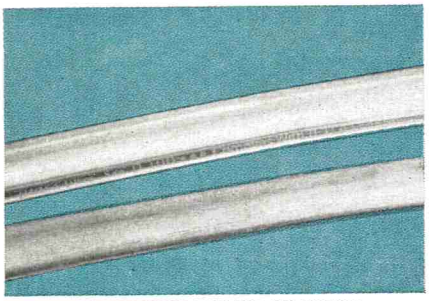

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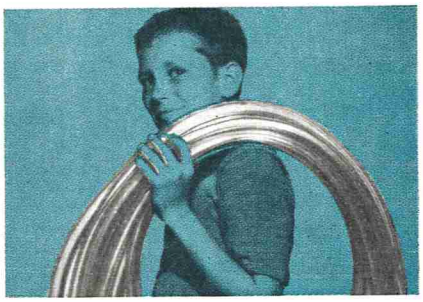

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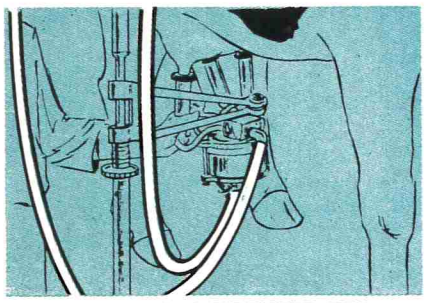

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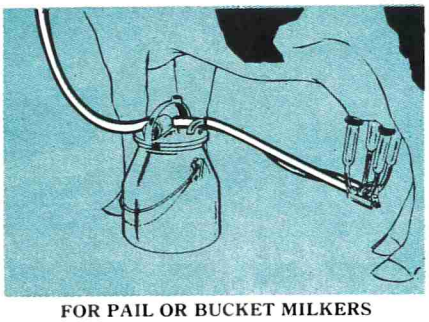

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Editorial

On Journal and Annual Meeting Coverage

I recently received a note from a member, indicating he was terminating his membership in IAMFES because of the increased emphasis on dairy subjects. I took this to mean increased emphasis on dairy sanitation at our annual meeting and in the Journal. As this seems to be an increasing topic of conversation, I decided to investigate the facts and see if the criticism is valid, as it is surely not the intent of the Board to narrow our range of interest, but rather to broaden our scope to recognize the changing conditions under which sanitarians work.

A careful study of the program at the 1964 annual meeting in Portland, Oregon, revealed some interesting facts. A total of 24 papers were actually presented. Of this total, only six were related to milk in any way. There were nine talks on subjects concerned with food sanitation, and six on subjects related to environmental sanitation. There were also three talks on general subjects that could not be classified into any of the three groups.

This breakdown certainly does not indicate undue emphasis on dairy subjects. In fact, when we consider that *over 50 percent* of our membership is made up of dairy sanitarians, these people may have some justifiable criticism of a program that has only 25 percent of the subject matter in their area.

A further study of the Journal itself and an analysis of the major papers published in 1964 showed that a total of 59 papers appeared. Of this number, 30 were on dairy subjects, and 29 on other subjects, broken down as follows:

Dairy products, bacteriology and subjects related to dairying	24
Subjects related to food	11
General and environmental subjects	18
3-A Standards	6

This would appear to be a very even division of material according to membership interests, and should certainly give the environmental sanitarians, who are working in a variety of fields — possibly to some extent in food and dairy, as well as others — no cause for concern.

From this rather brief analysis of the Association's efforts to disseminate and publish worthwhile information during the past year, I do not believe that anyone can support with facts any statement that International is not making a concrete, effective effort in covering fields of activities outside the milk field.

In the final analysis, we must all remember that articles and papers on sanitation must be written and talks must be given by people. If any of you feel you are being slighted by a lack of publications in your field, I am sure the Journal editor would welcome research papers or other types of well-known articles on any subject relating to sanitation.

I would like to make a strong plea to those of you who feel that your particular area of interest is not being adequately covered in the Journal, or in the meeting program, or activities of the Association, to attempt to make some contributions in this area yourselves. The formation of the annual meeting program is always a difficult task, primarily because we have received practically no response to our questionnaires and requests for suggested topics, and as such must rely on the program committee's evaluation of the membership's desires to formulate such a program.

There are a few individuals who consistently make suggestions and contributions to the program. If we had a number of such individuals making specific recommendations, along with suggested speakers in the field in which you are interested, I am sure that over a period of years topics relating to all fields of endeavor would be even more adequately covered.

Also, any individual who feels the Association is not adequately providing the necessary information for his particular use, should make a careful evaluation over a period of time of what actually is being covered, rather than making rather broad, unsupported assumptions to justify a postion that may or may not be valid.

W. C. Lawton, President
IAMFES, Inc.

The opinions expressed in this editorial are those of the author and do not necessarily represent those of the Association.

SALMONELLAE IN FOOD–A REVIEW[1]

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Food should be nourishing and attractive; it must also be clean and free from harmful substances. Despite new sanitary methods for producing, handling, preparing, cooking, storing, displaying and serving foods the number of reported incidents of food poisoning increases each year throughout the world. In his review of the problems of salmonella food poisoning in Britain in 1956 the late Sir William Savage *(76)* considered that: "The important problem in food poisoning today is the salmonella outbreak and its elimination or material reduction would help to reduce food poisoning to manageable limits."

Salmonellosis is a communicable disease usually transmitted from vertebrate animals to man in food or drink; its world-wide prevalence has shown a dramatic increase in man and in animals during the past two decades. Nearly all the 800 types of *Salmonellae* so far discovered have been recovered from the intestinal contents of animal hosts; these bowel contents readily infect other animals or contaminate the environment. The cycle of infection involves the transfer of viable *Salmonellae* from one host to another: directly, when one host ingests the feces of another; indirectly, when the victim ingests contaminated material. Man may become infected at any stage of this natural cycle and may, himself, act as a reservoir of infection. Feces from infected animals and man readily contaminate human food, animal feed, rivers, water supplies, sewage and soil, any of which may act as vehicles of infection. Because of its universal incidence, its diverse manifestations and its complex epidemiology, salmonellosis now constitutes a serious threat to the health of man and animals *(12, 80)*.

Twenty-five years ago typhoid fever caused by *Salmonella typhi* was a common and frequently fatal disease; food poisoning caused by other *Salmonellae* was relatively uncommon. The steady decline in the incidence of typhoid fever contrasts sharply with the marked increase in the incidence of salmonellosis. To illustrate, the annual reported incidence of typhoid fever in the United States decreased from 3,268 cases in 1946 to 608 cases in 1962; concurrently, the annual reported incidence of infections with other *Salmonellae* increased thirteenfold from 723 cases in 1946 to 9,680 cases in 1962. In this 17-year period about 32,000 cases of typhoid fever were reported, compared with over 75,000 cases of salmonellosis (Table 1).

The remarkable improvement in the typhoid picture has been attributed to: *(a)* more adequate investigation and reporting; *(b)* better methods for laboratory diagnosis; *(c)* better general hygiene and sanitation; *(d)* more widespread use of pasteurized milk and chlorinated water; *(e)* prophylactic immunization with T.A.B. vaccine; and *(f)* more thorough tracing of typhoid carriers. However, these measures, highly effective in reducing the incidence of typhoid fever, have completely failed to influence the incidence of salmonellosis *(12)*.

The many factors responsible for the increase in the occurrence of salmonella incidents, particularly

TABLE 1. REPORTED CASES OF TYPHOID FEVER AND OF OTHER SALMONELLOSES: UNITED STATES, 1946-1962[a]

	Typhoid Fever	Salmonellosis
1946	3,268	723
1947	3,075	951
1948	2,840	882
1949	2,795	1,243
1950	2,484	1,233
1951	2,128	1,733
1952	2,341	2,596
1953	2,252	3,946
1954	2,169	5,375
1955	1,704	5,447
1956	1,700	6,704
1957	1,231	6,693
1958	1,043	6,363
1959	859	6,606
1960	816	6,929
1961	814	8,542
1962	608	9,680
Total	32,127	75,646

[a]See reference *(58)*.

[1]Presented at 51st Annual Meeting of the INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS, INC., at Portland, Oregon, August 18-21, 1964.

[2]Present address: 828 W. 10th Ave., Vancouver 9, B. C., Canada.

sporadic cases, include *(76)*: *(a)* changes in the feeding habits of the population with communal feeding and increased use of ready-cooked foods in the home; *(b)* improved laboratory facilities and better techniques for the isolation and identification of *Salmonellae; (c)* improved reporting and epidemiological investigation of food poisoning incidents; *(d)* centralization and extension of bulk preparation and mass distribution and consumption of human food and animal feed; *(e)* increased international traffic in bulk food for human and animal consumption, especially bulk egg products; *(f)* increased incidence of *Salmonellae* in the animal reservoirs; *(g)* "build-up" of *Salmonellae* in livestock and poultry as animals pass from farm, through market and abattoir or processing plant to be distributed locally, nationally or internationally to kitchens and dining rooms; and *(h)* increased incidence of human excreters especially those responsible for handling food of man and animals.

In this review the epidemiological categories within the genus *Salmonella* will be discussed. Some consideration will be given to the animal reservoirs that provide the natural habitat of most *Salmonellae.* The commoner food vehicles of *Salmonellae* will be classified and examples of transmission described. Animal feed will be included to emphasize its importance in the cycle of infection. Finally, some of the broad principles of control will be considered.

THE *Salmonellae* IN FOOD

The *Salmonellae* that occur in food may be classified in 4 epidemiological categories: *(a)* S. *typhi* (and the uncommon S. *paratyphi A* and *C*); *(b)* S. *paratyphi* B; *(c)* the so-called 'food poisoning' *Salmonellae;* and *(d)* the relatively host-specific 'animal' *Salmonellae.*

S. *typhi in food.*

The only permanent reservoir of this organism is the chronic human carrier who excretes S. *typhi* in feces or urine indefinitely. Carriers or cases readily contaminate the common vehicles: water, milk and food. As very small numbers of typhoid bacilli are able to initiate typhoid fever, there is no need for bacterial multiplication in the vehicle. Although the classical outbreak of typhoid fever was local and either waterborne or milkborne, in recent years the disease has increasingly been spread by organisms introduced from a distance or from abroad in foods such as canned meat and desiccated coconut *(42).*

Salmonella paratyphi B in food.

The common paratyphoid organism in North America is S. *paratyphi* B. Its only permanent reservoir is man; domestic animals are occasionally infected and may develop symptoms. Because large doses of paratyphoid bacilli are necessary to initiate infection, food is the usual vehicle. Savage *(75)* found that 32 (80%) of 40 outbreaks reported in Britain between 1923 and 1941 were foodborne. The common foods were milk and milk products (13 outbreaks), synthetic cream (9 outbreaks) and confectionery (7 outbreaks); water was implicated only once.

'Food poisoning' Salmonellae in food.

The reservoirs of *Salmonellae,* other than S. *typhi* and S. *paratyphi,* are animals. The vehicles of infection are foods derived from animals, especially meat, eggs and milk which when contaminated and stored at room temperature encourage bacterial multiplication. The most prevalent organism in most countries is S. *typhimurium.* S. *heidelberg,* unknown in Canada before 1952, is now second only to S. *typhimurium* as a cause of human salmonellosis. Other common endemic types are S. *thompson,* S. *newport,* S. *oranienburg,* S. *tennessee* and S. *montevideo.*

'Animal' Salmonellae in food.

S. *pullorum* and S. *gallinarum,* causing pullorum disease and fowl typhoid in poultry, are relatively host-specific but may be recovered from food and occasionally cause disease in man. S. *choleraesuis* is common in pigs and may be transmitted to man in pork products, causing serious focal lesions or septicemia.

ANIMAL RESERVOIRS

The most important reservoirs of human salmonellosis are livestock and poultry. *Salmonellae* are common in pigs and poultry; they are frequent in rodents, not uncommon in cattle, sporadic in sheep and horses, and occasional in various wild mammals, birds and reptiles *(46).* These organisms are carried in the intestines and, occasionally, in the tissues of substantial percentages of apparently healthly livestock and poultry destined for human consumption, as well as of rodents and of household pets which mingle with farm animals and their future consumers *(22).* Surveys conducted in the United States have revealed a widespread distribution of *Salmonellae.* From 47 animal species Edwards et al. *(24)* isolated 111 different types, 61 of which were also recovered from man; these 61 types were responsible for 93% of human infections.

Moran *(57)* analyzed the types and distribution of 5,000 cultures of *Salmonella* (excluding the avian species S. *pullorum* and S. *gallinarum*) recovered from animals between 1957 and 1961; there were 84 different types from 35 animal species. The most common types were S. *typhimurium* (28%); S. *choleraesuis* (8%); S. *anatum* and S. *heidelberg* (each 6%);

S. enteritidis, *S. newport* and *S. san diego* (each 5%); *S. infantis* (4%); *S. chester* and *S. saint paul* (each 3%); and *S. blockley*, *S. derby* and *S. muenchen* (each 2%). These 13 types accounted for 78% of the animal isolations.

Fifty-five different types were isolated from turkeys, 50 from chickens, 35 from cattle, 25 from pigs and 23 from dogs. Other species yielding *Salmonellae* included guinea pig, rabbit, squirrel, fox, nutria, chinchilla, skunk, opossum, elephant, rhinoceros, kangaroo, gorilla, loris, sloth, seal, reptile and fish. The animal sources of *S. typhimurium* indicate the wide dispersal of this pathogen in nature. *S. typhimurium* was recovered from 612 turkeys, 282 chickens, 67 pigeons or doves, 22 geese, 9 ducks and 22 other birds; and also from 185 cattle, 49 horses, 45 pigs, 40 mice, 12 guinea pigs, 11 sheep, 9 dogs, 7 mink, 4 monkeys, 2 nutrias, 2 cats, 1 fox, 1 chinchilla, 1 skunk, 1 opossum and 1 reptile.

An anonymous ditty that appeared in the Lancet some years ago illustrates the ubiquity of this pathogen:

> "An infection in beavers was transmitted to retrievers,
> And carelessly contracted by a vet.,
> While the organism injected in a toad in Timbuctoo
> Was recovered from a tadpole in Tibet."

Salmonellae in livestock and abattoirs.

Pigs. Of the domestic animals commonly slaughtered for human consumption, pigs are most frequently infected with *Salmonellae*. Pigs are an important reservoir not only of the relatively host-specific *S. choleraesuis* and the universal, multi-host *S. typhimurium*, but also of *S. senftenberg*, *S. bredeney*, *S. enteritidis*, *S. anatum*, *S. derby*, and *S. newport*, the particular type depending on the locality.

In Florida, Galton et al. *(32)* found that 27 (7%) rectal swabs from 374 pigs on 11 of 28 farms yielded *Salmonellae*. To determine the distribution of *Salmonellae*, swabs were collected from pigs in transit between farm and consumer. Of 189 specimens collected at the lairages 148 (78%) yielded *Salmonellae*. Twelve (75%) of 16 samples of drinking water were positive. In uncemented lairages the soil was also contaminated. Swabs from 100 live pigs in lairages yielded 25 positives. Swabs from 98 pigs on the killing floor yielded 51 positives. Rectal and cecal swabs collected from 89 slaughtered animals yielded 17 (19%) rectal and 71 (80%) cecal positives. Rectal swabs were also collected just before evisceration. In the abattoir a total of 1,883 postmortem swabs yielded 966 (51%) positives. Swabs from the dehairing machine yielded 20% to 68% positives; swabs from the evisceration area yielded 74% positives; swabs from the cutting room and sausage room yielded 36% positives; and swabs from tables, knives and equipment yielded 25% to 43% positives.

In 1961 and 1962 Shotts et al. *(78)* surveyed abattoirs in Kentucky and recovered *Salmonellae* from 95 (54%) of 176 samples. The contaminated areas included mud in the lairage, the ramp to the kill room, the dehairing machine and chute, the scraping table, the hand saw and the edible viscera pan. Before operations began, 34% of the samples were positive, indicating inadequate cleaning and consequent carry-over of *Salmonellae* from the previous day. After operations were completed but before clean-up, *Salmonellae* were found in 28 (58%) of 48 samples. Rectal swabs were cultured from the same pigs at the sale barn, on arrival at the abattoir and after slaughter. *Salmonellae* were isolated from 9% of swabs at the barn, 26% at the abattoir and 80% after slaughter.

A small proportion of pigs on the farm are asymptomatic carriers of *Salmonellae*. When these infected pigs are herded together with healthy pigs during transportation, at the local market, in the lairages or holding pens, and in the abattoir itself, *Salmonellae* are readily disseminated directly from pig to pig by fecal contamination or indirectly through widespread contamination of the environment. The extent of this contamination in the lairage and abattoir depends on the local conditions, on the number of animals handled by the abattoir and on the length of time animals are held in lairages. Under unhygienic conditions there is a very real danger of serious spread of infection with the possibility of surface contamination of carcasses and widespread distribution of contaminated meat *(52)*.

Cattle. Among large meat animals cattle are the second most common reservoir of *Salmonellae*. The types most often recovered are *S. typhimurium* and *S. dublin*. Recent reports indicate that salmonellosis among dairy and beef cattle is becoming a major problem. During 1959 and 1960 Ellis *(25)* reported in Florida 40 isolations of *Salmonellae* from cattle with enteritis, many of which continued to excrete *Salmonellae* indefinitely. When subjected to the stress of clipping, branding or undue exposure during shipping, many such carriers develop acute salmonellosis which may prove fatal.

Anderson et al. *(2)* studied the effect of transportation and holding on the incidence of salmonella infection in calves taken to abattoirs in England. As with pigs, infection rates increased between the farm and the abattoir. The mean infection rate in calves on the farm was 0.5%, rising to 35.6% in calves slaughtered two to five days after entering the lairage at the abattoir.

Salmonellae in poultry and processing plants.

Salmonellae are frequently recovered from the intestinal tract of fowl at necropsy and most flocks are exposed to these organisms at some stage of their

lives. Salmonellosis in chickens may cause mortality rates of up to 80% in the first 2 or 3 weeks of life: survivors may serve as intestinal carriers for long periods *(85)*. Adult birds exposed to infection may harbor organisms indefinitely without exhibiting symptoms.

In a survey of American processing plants, Galton et al. *(31)* found *Salmonellae* in 11% of 118 swabs from tubs holding iced birds; these organisms were also recovered from swabs from the sides of 3% of 292 birds. At a new English plant processing 12,000 broiler chickens daily *(20, 21)*, *Salmonellae* were isolated from 75 (14%) of 544 specimens. Eight different *Salmonellae* were isolated, S. *typhimurium* on 17 occasions and S. *thompson* on 11. On 13 of 23 weekly visits to the plant *Salmonellae* were isolated from eviscerated carcasses and from water tanks in which carcasses were cooled. Almost 10% of eviscerated carcasses and edible viscera harbored *Salmonellae;* there was therefore ample opportunity for widespread contamination.

FOOD VEHICLES

The most important vehicle of *Salmonellae* is human or animal food (Figure 1) *(8)*. The responsible foods are either derived from intravitally infected animals (endogenous) or they are exposed to contamination by infected animals, infected persons or contaminated objects during preparation or storage (exogenous) *(16)*. The foods most commonly contaminated with *Salmonellae* include *(1, 28)*: *(a)* meat (including poultry) and meat products such as meat pies, brawn, pressed beef, sausages, cold cooked meats, reheated meat and gravies; *(b)* eggs and egg products such as duck eggs, dried egg powder, egg albumen, frozen egg and synthetic cream, often prepared from frozen egg; *(c)* milk and milk products such as ice-cream, cream, custard filled confectionery, salad creams and trifles; *(d)* fish such as made-up fish dishes and shellfish especially oysters from uncontrolled beds; and *(e)* canned foods such as meats. The most vulnerable foods are those which are lightly cooked and subject to much handling. Once contaminated, such foods favor the multiplication of bacteria. The number of *Salmonellae* present in a food depends on the nature of the food and the temperature and time of storage. All the common vehicles are produced in bulk, which probably accounts for their high rate of contamination. The appearance, smell and taste of food contaminated with *Salmonellae* are usually unaltered *(38)*.

The known ways in which food may become contaminated with *Salmonellae* are *(19)*: *(a)* by intravital infection of poultry and livestock resulting in sick animals or asymptomatic carriers; *(b)* by failure to pasteurize milk from infected cows; *(c)* by infection of eggs in the oviduct or by contamination of eggs by feces; *(d)* by use of contaminated egg products in processed foods; *(e)* by food preparation in an already contaminated area; *(f)* by contamination with feces from infected rodents; *(g)* by contamination with organisms from flies and other arthropods; and *(h)* by human excreters—cases, convalescents or asymptomatic carriers.

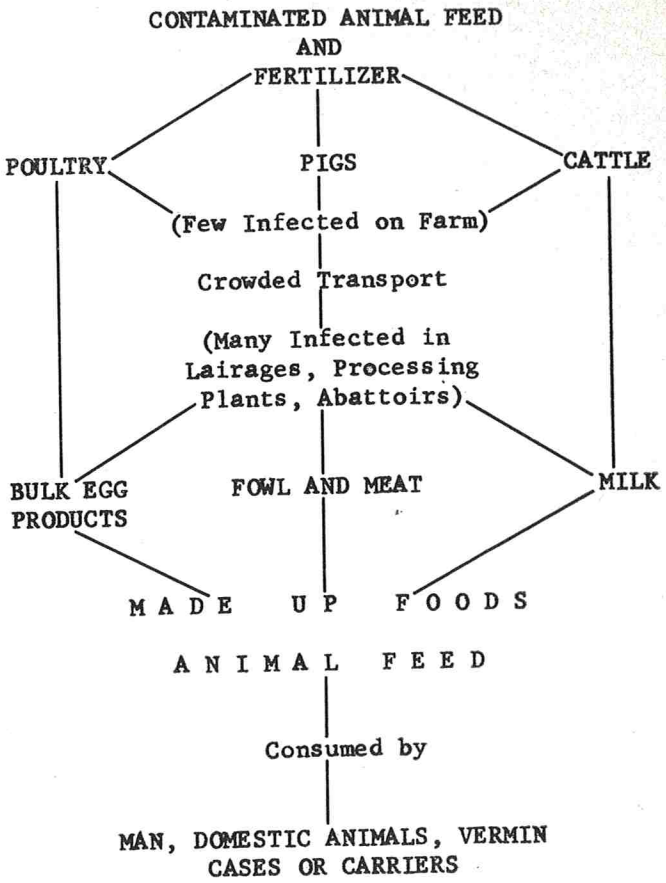

Figure 1. Salmonellae in Food—Cycle of Infection.

Statistics of the prevalence of salmonellosis in the United States are based on the number of foodborne and waterborne disease outbreaks reported to the United States Public Health Service. In Table 2 the reported occurrences of typhoid fever, by outbreaks and cases, is compared with that of salmonellosis for the 5-year period 1956 to 1960 *(17)*. The disparity in the figures presented in Tables 1 and 2 is difficult to explain; it is probably due to failure to report outbreaks and to the prevalence of sporadic cases. By contrast, statistics of the prevalence of salmonella infection in England and Wales (where more comprehensive records are maintained) are based on the number of food poisoning incidents reported to the Ministry of Health and to the Public Health Laboratory Service. Table 3 compares the reported occurrences of food poisoning incidents, by presumed causes, in the same 5-year period. Food poisoning *incidents* comprise *general outbreaks* (two

TABLE 2. OUTBREAKS OF FOODBORNE AND WATERBORNE DISEASES REPORTED TO THE UNITED STATES PUBLIC HEALTH SERVICE FROM 1956 TO 1960, TYPHOID FEVER AND SALMONELLOSIS[a]

	Typhoid Fever		Salmonellosis	
	Outbreaks	Cases	Outbreaks	Cases
1956	7	52	23	1,999
1957	4	70	30	1,607
1958	1	30	27	1,043
1959	5	43	19	1,428
1960	4	49	16	619
Total	21	244	115	6,696

[a] See reference *(17)*.

TABLE 3. FOOD POISONING INCIDENTS REPORTED IN ENGLAND AND WALES GENERAL OUTBREAKS, FAMILY OUTBREAKS, AND SPORADIC CASES FROM 1956 TO 1960, BY PRESUMED CAUSES[a]

	General outbreaks	Family outbreaks	Sporadic cases	All incidents
Salmonella	465	1,762	20,147	22,374
Staphylococcus	203	146	251	600
Other organisms	374	64	53	491[b]
Not discovered	832	1,027	11,029	12,888
All agents	1,874	2,999	31,480	36,353

[a] excluding chemical.

[b] includes 465 *CL. perfringens*.

or more cases or excreters from different families), *family outbreaks* (two or more cases or excreters from the same family), and unassociated *sporadic cases or excreters (12)*.

In England and Wales between 1949 and 1960 there were just over 3,100 general and family outbreaks (28% of the total) in which there was reasonable certainty that the food vehicle had been identified. Of these outbreaks, 73% were associated with meat; 8% with sweetmeats; 6% with fish; 6% with egg and egg products; 3% with milk and milk products; 2% with vegetables; 1% with fruit; and 1% with other foods *(12)*.

Meat and meat products.

Of the outbreaks in England and Wales associated with meat, less than 2% were caused by fresh meat; 86% by "processed and made-up" meat; 8% by canned meat; and 4% by "meat" with no further description. Freshly cooked meat is clearly much safer than processed meat.

The degree of contamination of fresh meat depends on the type of product. Wilson et al. *(88)* isolated *Salmonellae* from 17% of raw poultry samples, from 4% of raw pork products, from 3% of lamb samples, and from 1% of beef samples. The isolation rate from healthy pigs was 0.4% at the time of slaughter, but rose to 4.9% in sausages prepared from the same carcasses. The contamination rate was 4% in carcass meat and 10% in boned-out meat *(41)*. In Northern Ireland Newell et al. *(63)* found *Salmonellae* in 3% of pork samples and in 70% of pork sausage samples. In England Hobbs and Wilson *(41)* regularly isolated *Salmonellae* from 3% to 4% of sausage samples. The salmonella recovery rate was 5% for manufactured bulk sausages and 11% for bulk sausages prepared in the retail market *(88)*. Processed fresh meat, such as minced meat, boned-out meat and sausages, is liable to contamination during processing as the carcass of a single infected animal may contaminate the whole environment which may in turn contaminate subsequent batches of meat, unless plant sanitation is exceptionally thorough *(52)*. Contaminated raw meat may be responsible for the transfer of *Salmonellae* to the environment of the butchers' shops, to kitchens, to a variety of cooked products and to hands. Food handlers may ingest small doses of *Salmonellae* and become asymptomatic carriers liable to contaminate any food they handle.

A variety of meatborne outbreaks are summarized to illustrate some of the links in the chain of infection due to contaminated meat and meat products.

Fresh meat outbreak. Meat was the probable vehicle in this smoldering outbreak that lasted for 6 months. In Wales 105 widely scattered incidents were due to *S. typhimurium*. This agent was isolated in a neighbouring abattoir from 14 floor drains, from 6 samples of human sewage and from 1 rat. The same phage-type had been isolated from livestock on 3 farms in the previous year. Feces were therefore collected from 201 cattle and 69 pigs: all the cattle were negative, only one pig was positive. Of 54 local food establishments examined by the drain swab technique *(35, 56)* 13 butchers' shops and 2 bakehouses yielded this organism. At another butcher's shop one employee, who was also an apprentice slaughterman at the abattoir, was positive *(36)*.

Ham outbreak. Smoked ham was the vehicle in a family outbreak due to *S. infantis*. Eight persons fell ill after eating raw or lightly fried slices of ham. Culture of the ham revealed the presence of 23,000 organisms per gm. Inadequate refrigeration and cooking were responsible for this incident *(3)*.

Turkey outbreaks. Turkey meat was the suspected vehicle in two explosive outbreaks of salmonella gastroenteritis in British Columbia in 1960 and 1962. The first incident was due to infection with *S. heidelberg* and *S. thompson*, both of which were recovered from turkey stuffing *(6)*. The second incident was due to *S. heidelberg*. No food remnants were available for culture, but the same salmonella type was recovered from abdominal swabbing of 1 of 4 turkeys from the same batch *(7)*.

Roast turkey outbreak. The vehicle again proved to be turkey in an outbreak due to *S. typhimurium* involving 300 inmates of a penal institution. Cold roast turkey was sliced on the same chopping block used for preparing the uncooked

birds. The agent was recovered from more than 100 of the patients and from raw frozen turkey necks *(53)*.

Roast pork and turkey sandwich outbreak. Two cooked meats were the probable vehicles of infection in an extensive outbreak of gastroenteritis on board a ship. The outbreak occurred in 2 phases. In phase 1, turkeys, presumably contaminated with S. *chester,* were removed from frozen storage and allowed to thaw on a table. During the thawing process, roast pork was carved on a cutting board adjacent to the turkeys. It was presumed that juice from the thawing turkeys contaminated the cutting board with S. *chester* and that the roast pork acted as the vehicle of infection. In phase 2, the same cutting board was used, presumably without adequate cleaning, to slice left-over turkey for sandwiches, the presumed vehicle in phase 2 *(72)*.

Chicken salad sandwich outbreak. Home-made chicken salad sandwiches were responsible for causing typhoid fever in 31 of 88 persons who attended a wedding reception. One of the women who prepared the sandwiches was a typhoid carrier excreting organisms of the same phage-type as those recovered from the victims *(11)*.

Cooked meat outbreak. The food implicated in this outbreak of typhoid fever was cooked meals served at a restaurant in Alaska and in an aircraft bound for Seattle. There were 3 local cases, and 4 passengers subsequently fell ill, 1 in Alaska, 2 in Washington and 1 in California. The meals had been prepared by an itinerant cook who proved to be a typhoid carrier. This is an excellent example of the part played by air transportation in the dispersal of persons already exposed to infection *(87)*.

Meat pies outbreak. Meat pies eaten without further heating were the cause of an epidemic affecting 50 persons in 11 families and one group of boys. *Salmonellae* were recovered from the stools of patients and asymptomatic carriers and from 13 meat pies. A dog developed gastroenteritis after eating one of the pies. At the bakery, pastry blocks were hand-filled with prepared meat by 3 cooks. The pies were baked for 25 to 30 minutes at 232 to 246°C. Warm gelatin was added after baking. *Salmonellae* were recovered from the stool of one cook. The source of infection was either the meat or the infected cook *(38)*.

Potted meat outbreaks. Sandwiches containing potted meat, reconstituted dried egg or meat extract were the vehicle of an outbreak that affected the residents of a hostel. The sandwiches, prepared in the afternoon by a woman with diarrhea for 5 days, were eaten for lunch the following day after storage at room temperature. S. *typhimurium* was recovered from the woman, from 75 men who had eaten sandwiches, from 4 other residents who probably ate sandwiches, from meat extract and from one trapped mouse. The 3 predisposing factors in this outbreak were the presence of infected rodents in the hostel, the presence of a food handler with salmonellosis and exposure of a suitable food vehicle to conditions of time and temperature conducive to bacterial growth *(28)*.

Poultry feed, duck and prepared meat outbreak. Prepared meat was the vehicle in this outbreak involving 20 persons due to S. *saint paul.* The epidemiology was complex. Farm ducks in England became asymptomatic carriers of this organism after eating contaminated meat meal imported from America. After slaughter these ducks were eviscerated in the room of a butcher's shop where cooked meats were prepared. Fecal material from the ducks was inadvertently transferred to the cooked meat being prepared for sale. The meat was purchased by a number of families and eaten without further cooking *(30)*.

Eggs and egg products.

Salmonellae readily gain access to bulk egg products when eggs are broken out commercially *(16, 80)*. As these commercial products are used in the mass production of many foods eaten without adequate cooking, they represent a serious health hazard *(39, 68)*.

During World War II, *Salmonellae* were isolated from approximately 10% of samples of spray-dried egg imported into Britain from the United States, Canada and the Argentine. Of the 33 types isolated 22 were new to Britain. Because the number of *Salmonellae* never exceeded 30 per g, unrestricted distribution of this product was permitted *(54)*. After the War 1.2% of English egg products from small packing plants yielded *Salmonellae,* while 2.6% of samples from large English frozen egg plants *(70)* and 7% of imported frozen egg samples were positive *(68)*. Between 1955 and 1958 approximately 382 tons of dried egg products and 3,000 tons of frozen liquid egg were imported by the Port of Liverpool. *Salmonellae* were recovered from 13% of dried egg and 27% of liquid frozen egg samples *(64)*. The salmonella contamination rate of imported bulk egg products in 1961 was: frozen whole egg, 16%; frozen white, 6%; dried white flakes, 13%; dried whole egg, 12%; dried white powder, 8%; and dried yolk, 5% *(86)*.

The role played by egg-containing cake mixes in the transmission of salmonellosis in Canada is illustrated by two recent outbreaks. In Newfoundland, S. *thompson* was recovered from 29 persons and from six commercial cake mixes *(9)*. In Saskatchewan a second outbreak was traced to contaminated cake mix *(79)*. Seven of the 22 men at a camp became ill following the consumption of angel food cake contaminated with S. *thompson* and S. *heidelberg*. S. *thompson* was recovered from the seven victims and from baked angel food cake similar to that consumed by them. S. *thompson* and S. *heidelberg* were isolated from two cake mixes. An additional danger of such contamination lies in the dissemination of contaminated powder in stores, in kitchens and in the home. To discover the extent of the problem, a survey of commercial egg products was undertaken in Canada: 21% of 114 samples of frozen egg products and 54% of 119 samples of cake mix yielded *Salmonellae (83)*. Accordingly, the Canadian Department of National Health and Welfare introduced a new regulation making it an offence to sell egg products that contain *Salmonellae*. The immediate effect of this regulation was encouraging: the contamination rate of egg products was reduced from 38% to 2% *(81, 82)*.

Fresh shell eggs from hens are rarely responsible for human salmonellosis, but raw or undercooked duck eggs are a common vehicle of infection. Egg-nog prepared from fresh duck eggs was the vehicle of infection in a large outbreak that affected 104 of 1,850 patients in a mental hospital in Massachusetts. S. *typhimurium* was isolated from the patients and from 3 duck eggs from the neighbouring farm; 5 of 27 birds yielded this agent at necropsy *(66)*. Raw or undercooked eggs were responsible for an interstate outbreak of hospital-associated infections. Between March and August, 1963, 822 isolations of S. *derby* were made from patients and staff of 53 hospitals in 13 states. This agent was also recovered from 4 of 42 slurries (15 to 18 whole eggs per slurry) of

cracked eggs and from one sample of poultry feed. No *Salmonellae* were recovered from intact eggs. In this epidemic extensive secondary spread of infection, presumably from person to person, became the major problem *(73)*.

Queen's pudding made of egg yolk, milk, breadcrumbs and egg white was responsible for an outbreak involving 136 patients and staff in an English hospital in 1949. The yolks of 200 duck eggs were lightly cooked and the whites were merely browned. All who ate the pudding were ill. Duck eggs should always be adequately cooked; this involves boiling for 15 minutes or frying on both sides *(38)*.

Frozen egg is a common source of *S. paratyphi* B *(62)*. This product is one of the constituents of synthetic cream widely used in the manufacture of confectionery. Four outbreaks of paratyphoid fever in the United Kingdom between January and May, 1963, involving 250 human infections were traced to 3 shipments of frozen whole egg from China contaminated with *S. paratyphi* B. The responsible foods were cream trifles, cream cakes and chocolate eclairs. The association of bakery products with paratyphoid fever was first noted in World War II; it was later suggested that the organism was introduced into bakeries by some commonly used product *(13)*. *S. paratyphi* B has been isolated from Chinese egg products in the United Kingdom every year since 1955 *(77)*.

In a survey of an English bakehouse *Salmonellae* were isolated from 31 (28%) of 111 swabs from floor drains and from 15 (16%) of 93 swabs from staff toilets. *Salmonellae* were also recovered from the outflow water of staff wash basins and from swabs wiped over machinery, even after routine cleaning. Chinese frozen egg was in daily use and was visible on the floors and tables and on the hands and arms of bakery staff *(35)*. Trifle including cake made with an egg product was responsible for an outbreak involving over 100 school children. *S. typhimurium* and *S. thompson*, both commonly found in egg products, were recovered from the patients, from the trifle, from stools of bakery personnel and from drain swabs *(37)*.

Milk and milk products.

Milk and milk products caused only 3% of the general and family outbreaks in England and Wales between 1949 and 1960. Raw milk from a cow with mastitis was the vehicle of infection in a typical explosive outbreak comprising 77 cases and 46 asymptomatic carriers *(47)*. *S. heidelberg* was isolated from the patients, from the udder of the cow at necropsy, from filters and churns at the farm, and from animal feed similar to that supplied to the farm *(18)*. Only one case was reported after pasteurization was instituted *(47)*. Raw milk was responsible for another outbreak due to *S. heidelberg*. The interesting feature of this epidemic was that raw cow's milk from herds yielding *S. heidelberg* and *S. montevideo* was being sold in vending machines. Of the 28 persons infected with *S. heidelberg* 20 drank milk from the vending machine, 4 acquired infection by family contact and 4 had no obvious mode of infection. Of the 2 persons infected with *S. montevideo* the father drank contaminated milk; two weeks later his 15-month old son acquired the infection probably by contact *(43)*. Raw milk supplied to schools and the public also caused an explosive outbreak due to *S. dublin* affecting at least 610 people. This agent was isolated from all the patients with symptoms, from the milk, and from the udder and feces of the affected cow *(50)*. Raw milk from a small dairy was also the vehicle responsible for at least 16 cases and 5 asymptomatic carriers. *S. typhimurium* was isolated from the patients, but not from the milk or milk handlers. Nevertheless, the circumstances surrounding the illness and death of one of the cows strongly suggested that the cow was the source of infection *(65)*.

Pasteurized milk was the vehicle in an outbreak of paratyphoid B fever in South Wales. On inquiry it was found that polluted river water was used as the final rinse for milk bottles, after they had been cleaned and heat-treated. The rinse water was chlorinated, but not always adequately; consequently, paratyphoid organisms occasionally escaped destruction and were able to multiply in the pasteurized milk after the bottles were filled *(84)*.

Fish.

Freshly cooked fish is rarely the vehicle of salmonella food poisoning, but processed fish products such as fish pies and fishcakes may readily be contaminated. Between 1919 and 1934 it was estimated that more than 100,000 cases of typhoid fever due to the consumption of shell-fish occurred in France: 25,000 were fatal *(38)*. Fifteen types of *Salmonellae* were isolated from the intestinal contents of fresh fish sold in a fish market at Colombo, Ceylon: 39 fish of 24 species and 5 samples of fish-washings yielded *Salmonellae (34)*.

Vegetables.

Vegetable products are rarely contaminated with *Salmonellae;* the only important exception is desiccated coconut *(80)*. In 1953 an outbreak of typhoid fever and salmonellosis, associated with contaminated desiccated coconut, occurred in Australia. *S. typhi*, *S. paratyphi* B and 12 other salmonella types were isolated from samples of coconut imported from Papua. *Salmonellae*, including one strain of *S. paratyphi* B, were also isolated from Ceylonese coconut *(48)*. In 1961 two packets of desiccated coconut purchased from a retail store in British Columbia both yielded *Salmonellae* on culture.

In 1959 and 1960 a bacteriological survey of desiccated coconut imported into England from Ceylon revealed that 9% of 851 samples contained *Salmonellae*. Of the 18 different types found, *S. paratyphi* B and *S. bareilly* were the most common *(29)*. Contamination from man, animals or water probably occurred during manufacture. The chief hazards from contaminated coconut arise when it is used uncooked in foodstuffs which support the multiplication of *Salmonellae*, when it is eaten raw, and

when it cross-contaminates other foods in the kitchen or the bakehouse either directly or by way of utensils or hands.

Potato salad was the common vehicle of infection in an extensive outbreak of typhoid fever in an American youth camp in West Germany in 1958. The salad was prepared by a female civilian cook on the evening before it was to be eaten and left at room temperature. More than 400 persons consumed this salad and about 15% acquired typhoid fever.

Canned food.

Canned foods rarely transmit *Salmonellae*, unless the contents are contaminated after the tin is opened. The standard of commercial canning is high; it is therefore unusual to discover under-processed cans or cans with structural defects. Occasionally cans are badly manufactured, but these are usually discovered by the manufacturer, the retailer or the health inspector. A contaminated can of ox-tongue was, however, responsible directly or indirectly for 33 cases in an English typhoid epidemic. The tongue had been cut up in a shop and the same knife had been used for slicing ham on the counter. The can had been processed in South America, but it had been cooled by immersion in heavily contaminated river water below the inflow of the town sewage *(15)*.

It is rare to recover *Salmonellae* from canned cream; there is on record in England one instance in which *S. typhi* was recovered from an ineffectively sealed can of cream. As there had been complaints of the odor of this product, nearly 1,000 cans of the same batch were examined bacteriologically: 17% were contaminated with sporeforming and non-sporeforming bacteria. The cans had been processed in Ireland and cooled in water from a well subject to fecal pollution. The batch was withdrawn from the market and no cases of typhoid fever resulted *(74)*.

Cross-contamination of canned meat was the probable cause of infection in an English epidemic of salmonellosis involving 3,000 to 4,000 persons with 3 deaths. Portions of the carcass of an infected pig were distributed to several butchers' shops where they were handled in conjunction with canned meat. The infective raw meat and the cold cooked meats were weighed on the same balances, cut with the same knives and served by the same hands. The contaminated pressed beef and other cooked meats were eaten without further heat-treatment, often after storage at a temperature favourable for bacterial multiplication *(10)*.

The excellent keeping quality of canned food is illustrated by the following anecdote. Two cans, one of carrots in gravy and one of roasted veal, which had formed part of the stores taken by Sir Edward Parry on his Third Expedition in search of the North West Passage in 1824, were opened and cultured in 1939, 115 years later. Both foods were appetizing: the carrots were sterile; only aerobic spore-bearers were grown from the veal *(38)*.

Other foods.

In carrying out epidemiological studies on the spread of foodborne *Salmonellae* it is a sound principle to investigate first those foods that are most readily contaminated by *Salmonellae* and those foods which readily support the multiplication of pathogens. Such foods have already been discussed. The following foods rarely act as vehicles for *Salmonellae*: jams, fruits, vegetables, pickles, sauces, dry powdered foods, bread and fats. Some do not support growth and multiplication of pathogenic bacteria; others may slowly destroy them. Jams contain too much sugar. Acid fruit dishes do not support growth, though the skins of fresh fruit and vegetables may transmit typhoid and paratyphoid bacteria. Freshly cooked vegetables may be eaten with safety. Pickles and sauces are too acid. Powdered foods are usually safe if kept dry, but cake mixes and other powder containing unpasteurized egg products are a major vehicle of infection. The unwrapped loaf of bread is not the potential vehicle of *Salmonellae* that many suppose it to be. Fats do not encourage the growth of *Salmonellae (38)*.

Animal by-products.

In the past 5 years many surveys have been conducted to discover the prevalence of *Salmonellae* in animal by-products and their importance as a source of salmonellosis in animals and, indirectly, in man. An English survey revealed *Salmonellae* in a wide variety of products, including raw and processed materials, imported bones, bone products, fish meal, complete feeds and fertilizers. Altogether 24% of 1,279 samples yielded 88 different types of *Salmonellae (69)*. In a further study of 4,140 samples *Salmonellae* were present in 9% of raw ingredients, in 3% of finished meal and in 0.3% of pelleted food. The bacterial counts were low, usually less than 10 salmonellas per 100 g *(71)*.

In the United States 59 types of *Salmonellae* were demonstrated in 13% of 5,700 samples, including bonemeal, feather meal, fish meal, and complete feeds; in dog food, meat scraps and egg products (egg concentrate, frozen whites, dried whole eggs, frozen yolk and dried yolk), and in poultry by-products, poultry feed and tankage *(59)*. In a Florida survey 14 feed samples were found to contain *Salmonellae (25)*. Similar results were obtained in Canada *(44, 89)*. Dry rendered tankage samples yielded *Salmonellae* in 18 (15%) of 78 samples and wet rendered tankage, bone, liver and lung, blood, feather and fish meals in 8 (8%) of 101 samples. Of particular

interest was the isolation of *Salmonellae* from 4 samples of meal after 12 months' storage at 8°C, whereas no *Salmonellae* were recovered from portions of the same samples stored at room temperature for a similar period *(89)*.

Many animal feeds are treated with heat at temperatures high enough to destroy *Salmonellae;* they may, however, be re-contaminated by dust or from containers *(69)*. Such feed is a common source of infection and results in the asymptomatic carrier state. In this manner contaminated animal feed may be the primary source of infection in human outbreaks and sporadic cases *(31, 32, 40, 63)*.

Occupational hazards.

Although it is often impossible to determine whether the infected food handler is the source of infection or the innocent victim, Galton and Steele *(33)* found that the carrier state occurred much more frequently in those who handled food than in the general population. Over 60% of salmonella cultures isolated from known human sources were derived from symptomless excreters many of whom were food handlers.

In an attempt to estimate the occupational hazard of food handling, Newell *(61)* interrogated food handlers and their families. He discovered that 80% of the indicator patients leading to households were children under 10 years of age; on further inquiry, he discovered that the fathers of 43% of these children were employed as food handlers. In a group of 100 men who handled contaminated fish meal only one gave a history of gastroenteritis in the previous month; nevertheless, 14 of these men reported diarrhea in their family contacts during the previous month. This suggests that the infected but asymptomatic handler of contaminated food may carry infection home to his family *(61)*. Similarly, Edwards *(23)* considered the carrier state to be an occupational hazard to persons who handle uncooked meat and meat products. If asymptomatic carriers were regularly investigated epidemiologically, it is probable that an animal source of infection would often be disclosed *(61)*.

CONTROL AND PREVENTION

There are thus many means whereby *Salmonellae* gain access to the food of man and his domestic animals. There is an obvious and urgent need for detailed study, in all parts of the world, of the transmission of salmonellosis with the object of breaking the links in this complex chain of infection. This can only be achieved if epidemiologists, bacteriologists and clinicians, both medical and veterinary, work in close co-operation and follow-up the epidemiological leads in every salmonella incident. As new means of transmission are disclosed and proved, regulations for control should be introduced. In this connection the food industry is faced with a major task in the production and distribution of clean, safe food. In his review of the health problems of this industry, Thatcher *(82)* concluded that distribution of new forms of food, such as frozen foods, without adequate bacteriological control was hazardous. Industry should therefore be encouraged to set up laboratory facilities to ensure the safety of their products, to assess the standard of sanitation in their plants and to determine possible avenues of contamination *(51)*.

Ideally, only animals known to be free from *Salmonellae* should be used for the production of human and animal food. Moreover, food must be protected at all stages of production, distribution and consumption from the farm to the table. This is no easy matter as problems arise with intravitally infected or contaminated raw materials; with processing, manufacturing and packaging; and with distribution, marketing and consumption. The aim is to raise salmonella-free animals in a salmonella-free environment on salmonella-free diet and, thereby, to ensure that human food is salmonella-free. To achieve this ideal, concerted action at the local, state, national and international level is required of all those agencies, official and commercial, responsible for the health and feeding of man and his food animals *(8)*.

As a first step in the war on salmonellosis the basic principles of food hygiene for the control of this communicable disease should be rigorously instituted at all stages in the food production line from farm to table. There are 4 general procedures or practices that should be followed in the handling of food *(26)*: *(a)* introduction and maintenance of a high standard of hygiene; *(b)* minimal holding of food in the "incubation danger zone"; *(c)* universal use of low temperature storage; and *(d)* application of physical agents for the destruction of *Salmonellae*.

Sanitation.

A high standard of hygiene and sanitation is necessary to minimize the opportunities for contamination of the environment. All buildings used for housing or slaughtering animals and all rooms in food establishments should be planned so that good sanitary practices can be maintained. Infestation with rodents and insects should be prevented. Personnel should be taught to observe strict personal hygiene and to report illnesses promptly. Regular medical examinations of all food handlers have been advocated. Every endeavor must be made to prevent "seeding" of the environment with living *Salmonellae* liable to contaminate batches of food being processed and to infect employees. The food-han-

dling public should be educated by all available media in modern food hygiene practices. The housewife should appreciate the hazards of unhygienically handled food to the health of her family. Instructions for cooking and storing foods liable to contamination should be issued to the housewife at the retail store. Cleanliness in the plant and rapid handling of food are also important measures.

Incubation danger zone.

Holding temperatures that encourage growth of *Salmonellae* should be avoided, wherever possible. The temperature range which supports growth is 10 to 49 C; this is the incubation danger zone. When food is exposed to temperatures within this range, the holding time must be kept to a minimum and in no case should it be allowed to exceed 4 hr.

Low temperature storage.

Storage at low temperatures whether by freezing or by refrigeration at 0 to 5 C is effective in preventing growth of *Salmonellae,* but neither method has any appreciable effect on the viability of these organisms. Many outbreaks of foodborne salmonellosis occur in the warmer summer months when foods may be exposed to temperatures in the incubation danger zone for long periods. Adequate refrigeration facilities should be provided in all foodhandling establishments including the home.

Prompt refrigeration of foods as soon as they are prepared and refrigeration of leftover foods will reduce the risk of outbreaks of food poisoning. Perishable foods must be kept as cool as possible during preparation. Under no circumstances should they be held at room temperature for more than the shortest time consistent with good handling procedures. Foods to be stored in the frozen state should be chilled or frozen rapidly so that the temperature at the center is reduced to 50 C or lower within 4 hr.

Heat.

Salmonellae are susceptible to heat and radiation. Most *Salmonellae* are killed by exposure to a temperature of 55 C for 1 hr or of 60 C for 15 to 20 min *(19);* all are killed by exposure to the time-temperature effect of pasteurization *(80).*

Adequate cooking destroys *Salmonellae.* To be effective, however, temperatures of 74 to 77 C must be reached in the center of the food during the cooking period. Although adequate cooking will kill vegetative organisms, it cannot be relied on to destroy any toxins that may be present. Leftover foods should be reheated to at least 74 C as there is a danger of *Salmonellae* surviving in food subjected to irregular heat *(55).* Beloian and Schlosser *(5)* demonstrated experimentally that cakes containing dried egg contaminated with *Salmonellae* could be rendered safe by baking if the center reached a temperature of 71 C or above. Murdock et al. *(60)* showed that *Salmonellae* were eliminated from liquid whole egg by pasteurization at temperatures of 64 to 65 C for 2½ min. Angelotti et al. *(4)* studied the effects of time and temperature on the survival of *Salmonellae* in common perishable foods. *Salmonellae* multiplied in the 3 foods at temperatures between 7 and 46 C. In custard they multiplied at a temperature of 45 C but the numbers decreased at temperatures between 47 and 49 C; in chicken à la king, they were killed at temperatures above 46 C; in ham salad the numbers of organisms decreased at temperatures between 44 and 49 C.

Radiation.

Salmonellae vary in their sensitivity to gamma radiation. Comer et al. *(14)* and Ley et al. *(49)* estimated the dosage required to eliminate *Salmonellae* from whole egg, frozen horsemeat and bone meal. At the recommended dosages the quality of these foods was unaffected.

NEED FOR ACTION

These basic principles of food hygiene must be taught to all who are concerned with the provision of safe, clean food *(1).* There must be a greater awareness of the hazards inherent in the changing habits of human feeding, in the changing patterns of animal husbandry and processing, and in the increased distribution of foods susceptible to contamination. Much has already been done. In 1957, the International Association of Milk, Food and Environmental Sanitarians produced an excellent monograph entitled "Procedure for the investigation of foodborne disease outbreaks" *(67).* This is a standard work now widely used by epidemiologists throughout the world. In April, 1960, the Royal Society for the Promotion of Health, London, England, presented a symposium on Food Poisoning at their annual Health Congress *(12, 80).* Because of the increased prevalence of salmonellosis the Health Branch in British Columbia, Canada, introduced in August, 1961, a pilot study to determine the most important reservoirs and vehicles of human salmonellosis; a salmonella project was set up in April, 1962, and a salmonella Working Party established. The U. S. Livestock Association at its 65th annual meeting in Minneapolis, October to November, 1961, presented an extensive salmonella symposium. The U. S. Communicable Disease Center started a trial surveillance program for salmonellosis in April, 1962, and by January 1, 1963, a formal program was introduced with the cooperation of all 50 states, the District of Columbia and the Virgin Islands. In October, 1962, the Conference of Public Health Veterinarians, American Public Health Association, selected as their

discussion topic The Epidemiology of Salmonellosis. The World Health Organization and the Food and Agriculture Organization have shown considerable leadership in the field of food poisoning and have published comprehensive reports: European Technical Conference on Food-borne Infections and Intoxications *(27)*, Joint WHO/FAO Expert Committee on Zoonoses Second Report *(46)* and Joint FAO/WHO Expert Committee on Meat Hygiene Second Report *(45)*. In August, 1962, the Standing Committee on Food Microbiology and Hygiene of the International Association of Microbiological Societies (I.A.M.S.) met in Montreal, Canada, to discuss the Microbiology of Frozen Foods *(81)*. The U. S. National Conference on Salmonellosis met at the Communicable Disease Center, Atlanta, Georgia, in March, 1964.

National and international interest in the salmonella problem is now focussed on methods for preventing the spread of salmonellosis which will achieve not merely its control but its ultimate eradication.

Water supplies and milk have been made safe by the efforts of health officers, bacteriologists and veterinarians. It is now time to pay more attention to bringing other foods up to the same high standards *(12)*.

CONCLUSION

It would be appropriate to close in a lighter vein.

In these days of indigestion
It is oftentimes a question
As to what to eat and what to leave alone;
For each microbe and bacillus
Has a different way to kills us
And in time they always claim us for their own.
Some little bug is going to find you some day
Some little bug will creep behind you some day.

Let us therefore insist that all possible efforts are made to ensure that salmonellosis is controlled before the salmonella bug follows Roy Atwell's advice and creeps up behind us[3].

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CLOSTRIDIUM BOTULINUM FOOD POISONING[1, 2]

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SUMMARY

The outbreaks of botulism in the United States during 1963 stimulated renewed interest in this food-borne disease, primarily because commercially prepared foods were involved. Three of the outbreaks were caused by *Clostridium botulinum* type E in fishery products. Two of these resulted from the consumption of smoked fish from the Great Lakes.

A survey has been started to see if *C. botulinum* type E is common on fish from the Great Lakes. Toxin neutralization tests have shown the organism to be present in cultures from nine of ten locations sampled in Lake Michigan. The organism was found more frequently in the intestinal tract than on gills, livers or the external surfaces of the fish. Over 75% of the cultures prepared from the intestines of fish caught in one large bay of Lake Michigan proved to contain type E toxin. The incidence of the organism in fish from the main body of the lake has been much lower than this.

The first recognized outbreak of botulism was observed over 200 years ago *(10)*, although the causal organism was not isolated until 1895 *(9)*. The disease is caused exclusively by the ingestion of food in which *Clostridium botulinum* has grown and produced its toxin.

According to Lamanna *(18)*, botulinum toxin is the most potent poison known to man. Less than 1 x 10^{-10} gram will kill a mouse. Although the toxin is a protein and therefore a large molecule, it somehow passes into the lymphatic system from the upper part of the intestinal tract *(18)*. By means that are not yet understood, the toxin acts on certain myoneural junctions, interfering with the release of acetylcholine and thus preventing the passage of nerve impulses. The muscles involved in respiration are particularly affected, and death results from asphyxiation.

Gastric symptoms frequently are the first sign of botulism, with nausea and vomiting often appearing in 12 to 18 hr. Patients may complain of a dry mouth during this time. Neurologic symptoms soon develop, with double vision, muscular weakness, and difficulty in talking and swallowing. Respiratory paralysis follows, with death in fatal cases usually coming in three to six days. Complete recovery in non-fatal cases may require several months *(4, 5, 26)*.

Botulism is a disease of both man and animals. Reports of human botulism have come mainly from North America, Europe and Japan, although two outbreaks have been recorded in Argentina and two in Australia *(19)*. The true incidence is unknown because of frequent failure to recognize the disease. In the United States there are usually no more than

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10 or 12 verified outbreaks with 20 to 25 cases each year. For the past quarter century Germany has had 9 to 15 outbreaks with 30 to 40 cases annually *(19)*.

Since World War II the incidence in France has been similar to that in Germany *(19)*. Botulism was first recognized in Japan in 1951, but subsequently that country has averaged four outbreaks with about 25 cases per year *(23)*. Between 1919 and 1954 Canada suffered a total of 14 known outbreaks, with an average of four cases each *(19)*.

Although the incidence of botulism is low, the mortality rate is high. Almost two-thirds of the 1350 cases reported in the United States between 1899 and 1954 resulted in death *(19)*. In Europe the mortality rate is much lower, averaging 19% for the more than 4,000 cases recorded by Meyer *(19)*. The average mortality rate in Japan has been 26% *(23)*. In some outbreaks the number of fatalities may be much higher or lower than the average figures.

The foods incriminated in outbreaks of botulism almost invariably are: *(a)* given an inadequate preliminary treatment such as heating, salting, smoking, drying or pickling; *(b)* allowed to stand at a temperature that will permit the growth of *C. botulinum;* and *(c)* eaten without cooking. In the United States, home canned vegetables are incriminated in the vast majority of cases *(20)*. Pork products are the major vehicles in Europe, with salted or pickled fish also frequently involved *(19)*. A pickled relish called "izushi", which is made of raw fish, rice and diced vegetables, has caused over 90% of the outbreaks in Japan *(23)*.

Botulism in animals has great economic importance *(19)*. Feeding spoiled, discarded food to barnyard fowl has caused many outbreaks of "limberneck" with high losses in flocks of chickens, turkeys and geese. Mass intoxication of thousands of aquatic wild birds occurs with disturbing frequency on lakes and mud flats in the western United States. Fur ranchers have suffered enormous losses from feeding botulinogenic food to mink. Sheep ranchers in Australia and cattle ranchers in South Africa sometimes lose animals from feeding on forage or even carrion that contains botulinum toxin.

Clostridium botulinum is a gram positive, anaerobic, sporeforming rod-shaped organism *(3)*. Its spores are widely distributed in nature, having been found commonly in soil, mud, and the intestinal contents of animals. Thus the opportunity for contaminating food exists almost everywhere.

Botulinum toxin is stable in acid but is readily destroyed by alkali. Heating to 80 C for 30 min will inactivate it *(26)*.

Six distinct types of *C. botulinum* now are recognized. They are designated by the letters A, B, C, D, E and F, and are differentiated by the serological specificity of their toxins. Type C actually consists of two subtypes, C_α and C_β, which differ in their effects on various animal species and in several other features *(8, 19)*.

Types C and D only rarely have been implicated in outbreaks of human botulism *(8)*, but they have caused huge losses in wild and domestic animals. Type F was first recognized in 1958 and has been involved in only one known outbreak, this being caused by home-prepared liver paste in Denmark *(8)*. Thus, types A, B and E have been responsible for all but a few of the known outbreaks among humans *(18, 27)*.

In addition to their serological differences, types A and B are distinguishable from type E by several other features.

1. *Heat resistance.* The spores of types A and B will survive boiling for several hours, whereas type E spores usually are killed by heating to 80 C for 30 min or less *(4, 5, 28)*.

2. *Minimum growth temperature.* Types A and B grow slowly if at all at 50 F, whereas certain strains of type E have been observed to grow down to 38 F *(21)*.

3. *Toxicity of cultures and activation of toxin by trypsin.* Cultures of type E show relatively much lower toxicities than types A and B when injected into mice *(27)*. The potency of type E cultures can be increased 10 to 100 fold, however, by treating with trypsin. Trypsin does not ordinarily "activate" the toxins of types A and B, presumably because these organisms produce their own proteolytic enzymes, which may perform the same function as trypsin. However, Bonventre and Kempe *(2)* have shown that young cells of types A and B contain a toxic "precursor" that can be released by sonic disruption of the cells. The potency of this material, like that of type E toxin, can be increased by treatment with trypsin.

TYPE E BOTULISM IN RELATION TO FISHERY PRODUCTS

Before last year the American public was hardly aware that type E botulism existed. Excluding a few small outbreaks in Alaska between 1950 and 1960, there had been only five known episodes of type E botulism in the United States. These involved a total of 15 cases with 6 deaths *(22)*.

In March of 1963, however, three women in Detroit, Michigan, ate a lunch of tuna fish salad and two of them died *(14)*. Type E botulism was diagnosed, and the causal organism was isolated from the empty can. Other cans from the same lot were recovered from grocers' shelves and some of them also contained the organism. Therefore, all cans bearing the incriminated code number were recalled from the market. The resulting publicity served effectively to

TABLE 1. GEOGRAPHIC DISTRIBUTION OF VERIFIED TYPE E BOTULISM OUTBREAKS

Place of occurrence	Outbreaks	Cases	Deaths
Japan: Hokkaido	29	222	42
Northern Honshu	20	82	37
U. S.: Alaska	7	19	6
Other states	8	36	15
Canada: British Columbia	8	20	11
Labrador	3	10	8
Sweden	3	6	1
Denmark	2	7	0
U.S.S.R.	2	2	2
TOTALS	82	404	122

Figures from Dolman and Iida (7) supplemented by more recent data for Japan (23) and the United States (22).

introduce *C. botulinum* type E to the general public. In this instance, the organism is believed to have entered the cans through defective seams after heating *(14)*.

In late September and early October of 1963 two additional outbreaks of type E botulism occurred almost simultaneously. Both were traced to the consumption of smoked fish from the Great Lakes *(22)*. A man and wife from Kalamazoo, Michigan, purchased a smoked whitefish while taking a motor trip through upper Michigan. Both contracted botulism and died. *C. botulinum* type E was recovered from the remains of the fish *(15)*.

Immediately thereafter botulism was diagnosed in several patients at hospitals in Nashville and Knoxville, Tennessee. This outbreak eventually involved 17 patients with 5 deaths in the states of Tennessee, Alabama, and Kentucky *(22)*. A single shipment of smoked whitefish chubs packed by a firm in Michigan was incriminated *(1)*. All packages of the fish remaining in the stores were recalled, and the public was warned not to eat the product. *C. botulinum* type E was isolated from the remains of fish consumed by some of the victims *(15)*. Samples of commercial smoked fish processed by three Michigan firms were incubated and proved to contain type E toxin *(1)*.

On the basis of this experience, plus an earlier outbreak in Minneapolis, Minnesota, in 1960 *(1)*, the Food and Drug Administration issued a warning on October 25, 1963, against the consumption and distribution of smoked fish from the Great Lakes area. Housewives were advised not to use smoked fish from the Great Lakes unless the product was known to have been either; *(a)* heated to at least 180 F for 30 min after packaging and thereafter kept under refrigeration, or *(b)* frozen immediately after packaging and maintained continuously in a frozen condition.

This action of the Food and Drug Administration promptly stimulated the issuance of processing regulations by several state and municipal regulatory agencies. The states of Michigan, Wisconsin, Minnesota and Illinois, and possibly others, have established requirements that smoked fish must be heated to an internal temperature of at least 180 F for 30 min during processing. The temperature requirements during distribution and the permissible methods of packaging vary considerably among the states. Freezing as an alternative to the heating requirement generally is allowed as originally suggested by the Food and Drug Administration.

Heretofore, there have been no processing regulations for smoked fish produced in the Great Lakes states. Each processor salted and smoked his product as he saw fit. There were no standards for salt, moisture, or heat treatment. The introduction of processing controls has revealed numerous technological problems, and until these are solved the Great Lakes smoked fish industry will have a difficult time.

The sudden awareness of type E botulism coming from the wide publicity given to the outbreaks in 1963 has led many people to wonder if the organism has been recently introduced into this country. Actually, the first outbreak of type E botulism ever recorded anywhere occurred in New York State in 1932. The vehicle was smoked salmon imported from Labrador *(7)*. A second outbreak in New York State in 1934 was caused by canned sprats imported from Germany, and a third occurred in 1941 in California. The latter was traced to mushrooms from Yugoslavia and canned in San Francisco. Thus, the first outbreak of type E caused by a native U. S. food was the one in Minneapolis in 1960. This outbreak resulted from the consumption of smoked ciscoes from Lake Superior *(1)*.

Type E botulism has occurred in many parts of the world. Table 1 lists the known outbreaks through 1963. These figures are taken from the review by Dolman and Iida *(7)*, but are modified to include more recent outbreaks in Japan *(23)* and the 1963 smoked fish episodes in the United States.

C. botulinum type E has been found wherever outbreaks have occurred and the organism has been sought. Japanese workers *(16, 24)* have demonstrated its presence repeatedly in soil and mud samples on Hokkaido. Johannsen *(11, 12)* has isolated the organism from large numbers of soil, seashore, and sea bottom samples in and near Sweden. Pederson *(25)* has found it in soil and bottom mud in Denmark. And Dolman *(7)* has isolated the organism repeatedly from bottom samples off the coast of British Colum-

bia. Several of these workers also have demonstrated *C. botulinum* type E in the intestinal contents of fish.

OCCURENCE OF *C. botulinum* TYPE E IN FISH FROM LAKE MICHIGAN

The outbreaks of type E botulism that were traced to smoked fish from the Great Lakes strongly suggest that the organism occurs naturally in the northern United States. It is now generally accepted that type E is of terrestrial origin rather than marine, as was first supposed *(6, 11, 16)*. There is no obvious reason, therefore, why the organism should not be native to the Great Lakes area.

To see if this is true, an intensive sampling program was begun on Lake Michigan in October, 1963. Most of the samples consisted of fish, water and mud. The results reported here will deal only with fish.

Methods.

Parts of fish (liver, gills, skin and contents of the intestinal tract) were inoculated into tubes of brain heart infusion broth (Difco) and incubated anaerobically at 30 C for three days. Each culture was centrifuged and 0.5 ml of the supernatant was injected intraperitoneally into a single mouse. Cultures that killed mice within 48 hr were subjected to routine mouse protection tests with antisera for types A, B and E toxin. For this purpose, each of four mice received 0.25 or 0.5 ml of culture supernatant. Three of the mice were protected with one international unit each of the respective antisera.

Results and discussion.

Results for almost 600 samples are given in Table 2. Over one-fourth of the cultures were toxic to mice on the initial test, at least 85% of them causing death in less than 24 hr. However, only a small fraction of the toxic cultures inoculated with gills, skin and liver gave typing patterns that suggested the presence of type E botulinum toxin. A few killed all of the mice and were classed as "nonspecific". About one-fourth to one-third were classed as "atypical", meaning that they killed one, two or three mice out of four but in no significant pattern. By far the greatest percentage of cultures from gills, skin and liver proved to be completely atoxic in the tests with antisera.

By contrast, almost one-third of the toxic cultures inoculated with intestinal contents gave typing patterns characteristic of *C. botulinum* type E toxin. But even in this group two-thirds of the cultures proved to be atypical or atoxic when tested with antisera.

The figures in Table 2 clearly indicate that intestinal contents of fish are more likely to give rise to cultures in which type E toxin can be demonstrated than are gills, skin or livers. Therefore, further tests

TABLE 2. OCCURRENCE OF *C. botulinum* TYPE E TOXIN IN CULTURES INOCULATED WITH PARTS OF FISH FROM LAKE MICHIGAN

	Gills	Skin	Liver	Intestinal contents
No. of samples tested	102	103	137	250
No. of cultures toxic on initial test	25	24	40	78
% of toxic cultures classed as:				
Type E	5	5	3	31
Type B	5	0	3	1
Nonspecific	0	5	6	3
Atypical	29	32	23	25
Lost toxicity	62	58	66	40
% of all cultures tested shown to contain type E toxin	1	1	<1	9

TABLE 3. REPRESENTATIVE TYPING PATTERNS OF TOXIC CULTURES INOCULATED WITH THE INTESTINAL CONTENTS OF FISH

Sample number	Death times of mice (hr) Initial test	Typing with antisera[a] U	A	B	E	Classification of sample
989	3	4	2	2	—	Type E
1072	8	10	10	10	—	" "
1143	4	4	4	2	—	" "
1226	4	6	6	6	—	" "
1198	3	2	2	2	—	" "
1368	2	3	2	2	—	" "
1504	19	6	6	6	—	" "
2096	3	3	3	3	—	" "
1389	2	3	4	4	15	Nonspecific
1523	11	5	12	12	12	"
1532	27	12	12	12	12	"
2014	2	3	2	3	2	"
2177	20	15	15	15	21	"
735-H	15	10	15	15	10	"
1028-H	7	10	10	10	10	"
2168	12	15	15	25	15	"
2181	7	16	—	—	—	Atypical
1544	5	—	4	—	—	"
2186	12	—	—	28	—	"
2226	19	—	—	—	30	"
1565	5	—	16	16	—	"
1433	21	6	—	16	—	"
985-H	8	—	4	5	5	"
1013-H	7	—	6	—	6	"
474-H	3	—	—	—	—	Lost toxicity
401-H	4	—	—	—	—	" "
2205	6	—	—	—	—	" "
350-H	9	—	—	—	—	" "
23-H	14	—	—	—	—	" "
1501	19	—	—	—	—	" "
1580	32	—	—	—	—	" "
2086	21	—	—	—	—	" "

[a]U = Unprotected mouse. A, B and E refer to mice protected with antisera for types A, B and E toxins.

were made with intestinal contents as the inoculum.

Examples of typing patterns are shown in Table 3. Experience has revealed that the majority of samples which give a pattern characteristic of type E toxin cause death of mice with typical symptoms of botulism in less than 10 hr. This is true in spite of wide variations in toxin levels, which have been found to range from 3 to more than 1000 mouse MLD per ml at the time of typing. Occasional cultures that contain type E toxin have been observed to take longer than 10 hr to kill an individual mouse (see sample 1504, Table 3). However, cultures that kill slowly rarely prove to contain type E toxin.

The typing pattern labelled "nonspecific" might result from several causes: the culture could contain a serological type of *C. botulinum* other than A, B or E; it might contain a mixture of serological types; or it could contain a toxic substance produced by an organism other than *C. botulinum*.

The "atypical" samples obviously contained very small amounts of toxin, since some of the mice survived without reference to the protective antisera. These results could represent extremely low levels of botulinum toxin, but judging from the relatively long death times they probably indicate toxins produced by other anaerobic organisms. Many species of clostridia produce substances that kill mice *(3)*.

Loss of toxicity has been the most troublesome problem in the identification of lethal agents in mixed cultures. It has been observed with cultures that killed mice initially in as little as one or two hr, and has occurred in as little as one day. On the other hand, some cultures have remained toxic for weeks. Toxin destruction has been observed even at temperatures below 0 C.

Johannsen *(13)* and Kamizawa *(16)* also have observed loss of toxin from crude mixed cultures, the latter author attributing the destruction to enzymes produced by other organisms. This study has revealed nothing to contradict Kamizawa's suggestion. Attempts to isolate type E from enrichment cultures *(15)* often show a predominance of other anaerobic sporeformers, many of which resemble *Clostridium bifermentans (17)*. Much more needs to be learned about the nature of the organisms in the mixtures and their effect upon *C. botulinum* type E and its toxin.

Unfortunately, the transient nature of type E toxin was not fully realized at the beginning of this study, and some of the toxic cultures were held for several weeks before typing with antisera. This fact probably accounts in part for the high percentage of atypical and atoxic cultures in Table 2. From the death times in the initial toxicity tests it is probable that some—but by no means all—of these cultures originally contained type E toxin.

In further testing, special efforts have been made to record the death times accurately during the first 10 hr following injection and to look for symptoms of botulism in the mice. Because of the diversity of toxic agents that may be present, it is important, as Johannsen has suggested *(13)*, to observe the symptoms preceding death. Merely finding a dead mouse in a cage on the morning following injection is little indication that the animal died of botulism. To minimize loss of toxicity it is also important to run the protection tests as quickly as possible after toxin is first demonstrated.

On the basis of toxin neutralization tests, fish from nine of ten locations sampled in Lake Michigan have yielded cultures that contained type E botulinum toxin. Little reliability can be placed on the percentages of positive cultures from some of the locations, although the overall incidence of *C. botulinum* type E likely is higher than the figures in Table 2 would indicate. Up to now little effort has been made to isolate the organism from the mixed cultures, but the alcohol method of Johnston, Harmon and Kautter *(15)* has been used successfully with a relatively small number of samples.

Evidence has been obtained to indicate that fish from certain locations may harbor *C. botulinum* type E in their intestines more frequently or possibly in greater numbers than do fish from other locations. Table 4 shows a comparison of the incidence of type E in fish from one place in Lake Michigan and of the same variety of fish taken at the same time from a large bay nearby. Fish from the lake gave the usual diversity of results with evidence of low toxin levels in many cultures, as judged by the percentages that were atypical or atoxic. By contrast, over three-fourths of the cultures prepared from fish in

TABLE 4. OCCURRENCE OF *C. botulinum* TYPE E TOXIN IN CULTURES INOCULATED WITH THE INTESTINAL CONTENTS OF FISH FROM A BAY OF LAKE MICHIGAN AND FROM THE MAIN BODY OF THE LAKE

	Fish from lake	Fish from bay
No. of samples tested	109	94
No. of cultures toxic on initial test	56 (51%)	81 (86%)
% of toxic cultures classed as:		
Type E	11	90
Type A	2	0
Nonspecific	4	1
Atypical	29	1
Lost toxicity	55	7
% of all cultures tested shown to contain type E toxin	5	78

the bay clearly contained type E botulinum toxin.

There were two differences in this experiment, either or both of which might have influenced the outcome of the tests. First, the fish from inside the bay were filled with food, whereas those from the lake contained very little material in the intestinal tract. Second, the temperature of the water in the bay was about 47 F, whereas that in the lake was 41 F.

The results of this study, while illustrating the inadequacy of present methods of demonstrating *C. botulinum* type E in samples from nature, leave little doubt that the organism is a common contaminant of fish in Lake Michigan. Thus, Johannsen's suggestion *(12)* that *C. botulinum* type E may be rare or nonexistent in the United States clearly was premature.

Further work is in progress to see if the organism is common in the other Great Lakes. Ecological studies are planned to learn how fish become contaminated and how the organism persists in the natural aquatic environment. Meanwhile, efforts are being made to improve the methods of demonstrating *C. botulinum* type E in samples from nature. These efforts will include attempts to isolate the organism in pure culture.

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KEEPING QUALITY OF MARKET MILK OBTAINED AT RETAIL OUTLETS AND AT PROCESSING PLANTS[1]

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Summary

A study was made of the keeping quality of market milk obtained from retail outlets and processing plants in Lexington, Ky., during 1963. Included were a total of 144 samples from retail outlets processed by 9 commercial plants and 92 samples obtained at 5 commercial processing plants.

Approximately 7, 16, 31, 58 and 74% of the retail outlet samples did not have a satisfactory flavor score after storage for 0 (date purchased), 4, 7, 10 and 14 days, respectively, at 40-42 F. The average keeping quality was 7.7 days from the date of purchase. The samples ranged from 0 to 14 days old when purchased, the average being 3.9 days. Approximately 2, 8, 52, and 83% of the samples obtained at the processing plants did not have a satisfactory flavor score after storage for 0 (date obtained), 3, 5, and 7 days, respectively, at 50 F. The majority of the samples possessed "psychrophilic" type defects at the time the flavor quality was judged unacceptable.

Initial standard plate, coliform, and psychrophilic counts were generally low. Standard plate counts (SPC) on the samples after storage were rather high.

Highly significant correlations were observed in samples obtained at retail outlets between the following individual factors: Initial SPC and age; initial SPC and SPC after storage; initial SPC and keeping quality; SPC after storage and age; SPC after storage and keeping quality; and age at purchase and keeping quality. The multiple correlation between keeping quality and age, initial SPC, and SPC after storage was 0.64. Highly significant differences were observed between plants with respect to age of samples when purchased, SPC after storage, and keeping quality.

There was a highly significant correlation between the keeping quality of the samples obtained from processing plants and the Moseley count. No significant correlations between keeping quality and SPC and psychrophilic counts were detectable. The multiple correlation between keeping quality and SPC, psychrophilic count, and Moseley count was 0.30. Highly significant differences were observed between plants with respect to keeping quality.

The Dairy Industry has made many changes in recent years in methods of production, handling, processing, and distribution of dairy products. Several changes, particularly the trend toward wider marketing areas and less frequent deliveries, have increased greatly the importance of the keeping quality of processed milk. Recently, Elliker et al. *(6)* suggested that flavor deterioration and high bacteria counts in the product as used by the consumer are more common than generally recognized. A recent report by Kepner and Slatter *(9)* indicates that significant quality differences exist among fluid milk brands and processors.

The effects of psychrophilic bacteria and storage temperature on the keeping quality of commercially processed milk have been demonstrated by numerous investigations *(2, 3, 4, 5, 6, 7, 8, 11, 12, 13)*. However, samples obtained fresh from the processing plant have been utilized in all of the previous studies. Consequently, information concerning the keeping quality of milk as obtained by the consumer is lacking. The temperature of milk during distribution has been shown to vary considerably *(10)*. Variations in the temperature of milk during distribution and the age and bacteriological quality of the milk when purchased by the consumer would be important factors affecting keeping quality.

The purpose of this investigation was to obtain information relating to the keeping quality of market milk obtained at retail outlets and at processing plants.

Experimental Procedure

Two types of samples were studied: *(a)* Samples obtained at retail outlets and *(b)* samples obtained at the processing plants.

Sampling at retail outlets.

One-half gallon samples of market milk representing nine commercial plants were obtained from retail outlets in Lexington, Ky., at approximately bi-weekly intervals during 1963. As far as possible, the samples were obtained from supermarket-type outlets. The milk from a specific plant was obtained from the same retail outlet each time. Samples were obtained from the front of the display case and taken immediately to the laboratory for examination. From the code numbers of the samples, processing dates were obtained from the plant managers.

Sampling at processing plants.

Six consecutive one-half pint samples of market milk were obtained from the filler line of each of five commercial plants in Lexington at approximately bi-weekly intervals during 1963. Samples were not collected until at least 25 gallons of milk had passed through the filler. The samples were taken immediately to the laboratory for examination.

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Flavor evaluation and keeping quality.

All flavor evaluations were made by a panel of two or more judges experienced in the scoring of milk. The samples were transferred into plain one-half pint bottles prior to evaluation. Samples receiving a score below 36.0 were considered to have an unacceptable flavor quality.

Samples obtained from retail outlets were examined for flavor quality on the day purchased, and after 4, 7, 10, and 14 days storage at 40-42 F. All flavor evaluations were made on the original one-half gallon container of milk.

Samples obtained from the processing plants were examined for flavor quality on the day obtained, and after 3, 5, and 7 days storage at 50 F. A separate one-half pint sample was utilized for each scoring.

Bacteriological examinations.

Official procedures *(1)* were used for standard plate (incubation at 32 C) and coliform counts. Psychrophilic counts were made according to the official procedures except that the plates were incubated at 6 C for 14 days. Samples obtained from retail outlets were subjected to standard plate and coliform counts on the date obtained and again after 7 days' storage at 40-42 F. Samples obtained from the processing plants were subjected to standard plate, psychrophilic, and Moseley *(6)* counts on the date obtained. The latter test involves making a standard plate count on the sample before and after 5 days of storage at 45 F. The number of bacteria shown by the second plate count minus the initial count is an expression of psychrophilic contamination.

RESULTS AND DISCUSSION

Age and initial flavor scores.

Plant managers supplied the processing dates corresponding with code numbers appearing on cartons purchased at retail outlets. Results pertaining to the age of samples when purchased are summarized in Table 1.

TABLE 1. AGE AND INITIAL FLAVOR SCORE OF MARKET MILK SAMPLES OBTAINED AT RETAIL OUTLETS[a]

Plant	Age of samples on date purchased		Flavor score of samples on date purchased	
	Range	Average	Range	Average
	(*Days*)			
A	0 - 7	2.1	30.0 - 40.0	37.3
B	1 - 5	2.9	35.0 - 40.0	38.7
C	1 - 7	4.0	36.0 - 40.0	38.7
D[b]	—	—	30.0 - 37.5	35.8
E	1 - 14	4.6	36.0 - 39.0	38.3
F	2 - 8	3.7	37.0 - 40.0	39.0
G	1 - 7	4.0	35.0 - 39.0	37.7
H[c]	2 - 11	4.6	30.0 - 39.5	37.8
I	2 - 8	5.1	34.0 - 40.0	38.1
All samples	0 - 14	3.9	30.0 - 40.0	37.9

[a]Each plant sampled 16 times.
[b]Processing dates were not available.
[c]Processing dates for 2 of the samples were not available.

The samples ranged from 0 to 14 days old when purchased, the average being 3.9 days. The average age of samples from individual plants ranged from 2.1 (Plant A) to 5.1 days (Plant I). These differences among plants (age of sample when purchased) were highly significant. Such results indicate that dairy plants need to devote more attention to the rotation and stocking of products in stores if the customer is to be assured of a fresh product.

Initial flavor scores (Table 1) of the samples obtained at retail outlets ranged from 30.0 to 40.0. The average flavor score of samples from individual plants ranged from 35.8 (Plant D) to 39.0 (Plant E). The average flavor score of all samples on the date purchased was 37.9. Initial flavor scores of the samples obtained at the processing plants showed only small variations. The average initial flavor score of all samples obtained at the processing plants was 38.5.

TABLE 2. KEEPING QUALITY AT 40-42 F OF MARKET MILK SAMPLES OBTAINED AT RETAIL OUTLETS[a]

Plant	Number of days samples scored 36 or above — from date of purchase					Average keeping quality
	0 (Initial)	4	7	10	14	
	(*% of samples*)					(Days)
A	87.5	87.5	87.5	68.8	43.8	9.9
B	93.8	93.8	56.3	0.0	0.0	5.4
C	100.0	87.5	87.5	62.5	25.0	8.8
D	81.3	81.3	68.8	62.5	25.0	8.0
E	100.0	87.5	68.8	31.3	12.5	7.4
F	100.0	93.8	93.8	93.8	87.5	12.9
G	93.8	62.5	31.3	6.3	6.3	3.9
H	87.5	81.3	56.3	25.0	18.8	6.4
I	93.8	81.3	68.8	31.3	18.8	7.0
All samples	93.1	84.0	68.8	42.4	26.4	7.7

[a]Each plant sampled 16 times.

Keeping quality.

Results of the keeping quality of samples obtained at retail outlets are shown in Table 2.

Considerable variations are evident in the keeping quality of samples from the different plants. The average keeping quality of samples from individual plants ranged from 3.9 (Plant G) to 12.9 days (Plant F), the average being 7.7 days. When all of the samples from all of the plants are considered, approximately 7, 16, 31, 58, and 74% of the samples did not have an acceptable flavor score after storage for 0 (day obtained), 4, 7, 10, and 14 days, re-

spectively. Statistical analysis revealed a highly significant negative correlation (-0.30) between the age of the samples on the date of purchase and keeping quality.

Variations in the keeping quality of samples from certain plants should be noted. None of the samples from Plant B had a satisfactory flavor score after 10 days' storage, whereas 87.5% of the samples from Plant F had a satisfactory flavor after 14 days' storage. Variations in keeping quality of samples from these two plants is not explainable on the basis of differences in age and flavor scores on the date purchased (Table 1). The average keeping quality of samples from Plant D of 8.0 days is somewhat misleading since the average initial flavor score (35.8) was quite low. The defects present in samples from this plant at the initial scoring usually were stale, unclean or oxidized and did not increase rapidly in intensity.

Table 3 presents the results of the keeping quality of samples obtained at the processing plants. The average keeping quality of samples from individual plants ranged from 3.3 (Plant B) to 5.7 (Plant A) days, the average being 4.2 days.

The shorter shelf life of the samples obtained from the processing plants as compared with that of the samples obtained at the retail outlets resulted, of course, from the higher storage temperature used with the former (2, 4, 7). It should be noted that the five plants sampled both at retail outlets and at the processing plant had milk of approximately the same relative keeping quality order regardless of where the samples were obtained. For example, of the five plants, milk of Plant A had the best keeping quality when sampled at retail outlets and at the plant, while that of Plant B had the poorest keeping quality in both types of samples.

TABLE 3. KEEPING QUALITY AT 50 F OF MARKET MILK OBTAINED FROM PLANT ON DAY PROCESSED[a]

Plant	Number of days scored 36 or above				Average keeping quality
	0 (Initial)	3	5	7	
	(% of samples)				(Days)
A	100	100	86	43	5.7
B	100	83	35	0	3.3
C	100	94	65	24	4.4
D	93	87	36	7	3.7
E	100	94	37	12	4.1
All samples	99	91	55	16	4.2

[a]Each plant sampled 14 to 18 times, for a total of 82 samples.

Variations between plants in the keeping quality of samples were highly significant. Therefore, these results indicate that certain plants are doing a better job of quality control than others.

Flavor defects.

The predominant flavor defects present in milk samples at the time they were considered to have unacceptable flavor are shown in Table 4.

The most common defects in the samples at the time of spoilage were those resulting from the growth of psychrophilic type organisms—unclean, bitter, putrid, fruity, stale, and "psychrophilic." Over 80% of the samples obtained at retail outlets and at the processing plants possessed one of these flavor defects at the time the samples were considered to have an unacceptable flavor. The next most common defect was high acid. Approximately 17% of the samples obtained at retail outlets and about 39% of the samples obtained at plants were criticized for this defect at the time of spoilage. The higher percentage of the samples obtained from processing plants criticized for high acid as compared with the samples obtained from retail outlets is probably due to the higher storage temperature employed. Less than 10% of the samples obtained from retail outlets and less than 15% of the samples obtained at the processing plants were criticized for the non-bacterial type flavor defects (rancid, oxidized, metallic, and foreign) at the time of spoilage.

Bacteriological quality.

The results of the bacteriological examinations of the samples obtained at retail outlets are shown in Table 5. The data reveal considerable variations in the bacteriological characteristics of samples from different plants and among different samples from a single plant. The coliform counts on the samples were rather low. Only 8 of the 144 samples had a coliform count of >10 per ml on the date purchased, and only 20 samples had a count of >10 per ml after 7 days of storage at 40-42 F. The standard plate counts on the date of purchase ranged from <3,000 to >300,000 per ml. Twenty of the samples had a count of >10,000 per ml on the date purchased. After 7 days of storage at 40-42 F the standard plate counts again ranged from <3,000 to >300,000 per ml. However, over 50% (73 samples) had a standard plate count in excess of 300,000 per ml after storage. It is interesting to compare the standard plate counts of samples from Plants B and F. Both plants had only one sample with a standard plate count of >10,000 per ml on the date of purchase. After 7 days of storage, however, 15 of the samples from Plant B had a count of >300,000 per ml, whereas only one sample from Plant F exceeded 300,000 per ml.

Differences between plants in the standard plate

TABLE 4. PREDOMINANT FLAVOR DEFECTS PRESENT IN SAMPLES AT THE TIME OF SPOILAGE

Flavor defect	Samples obtained at retail outlets		Samples obtained from plant	
	Number of samples	Per cent of samples[a]	Number of samples	Per cent of samples[b]
Unclean	32	22.2	19	25.7
Bitter	29	20.1	14	18.9
Putrid	23	16.0	6	8.1
Fruity	23	16.0	9	12.2
"Psychrophilic"	16	11.1	9	12.2
Stale	13	9.0	6	8.1
High Acid	24	16.7	29	39.2
Malty	7	4.9	3	4.1
Cheesy	1	0.7	1	1.4
Rancid	4	2.8	—	—
Oxidized-Metallic	5	3.5	6	8.1
Foreign	5	3.5	5	6.8

[a]Based on total of 144 samples. Samples were held at 40-42 F.
[b]Based on total of 74 samples. Samples were held at 50 F.

TABLE 5. BACTERIOLOGICAL QUALITY OF MARKET MILK SAMPLES OBTAINED AT RETAIL OUTLETS[a]

Plant	Coliform count (No samples >10/ml)		Standard plate count			
			Date of purchase		After 7 days storage	
	Date of purchase	After 7 days storage	Range	No. samples >10,000/ml	Range	No. samples >300,000/ml
A	0	0	<3000 - 26,000	1	<3000 - >300,000	2
B	1	5	<3000 - 16,000	1	67,000 - >300,000	15
C	0	0	<3000 - >300,000	3	<3000 - >300,000	7
D	0	3	<3000 - 100,000	1	<3000 - >300,000	3
E	1	3	<3000 - >300,000	2	<3000 - >300,000	11
F	1	2	<3000 - 60,000	1	<3000 - >300,000	1
G	2	7	<3000 - >300,000	5	<3000 - >300,000	14
H	2	3	<3000 - >300,000	2	<3000 - >300,000	13
I	1	1	<3000 - 200,000	4	<3000 - >300,000	7
All samples	8	24	———	20	———	73

[a]Each plant sampled 16 times.

counts after storage were highly significant. The initial standard plate counts varied as much among samples of an individual plant as between plants.

There were highly significant correlations between the initial standard plate count, the standard plate count after storage, age of samples when purchased, and the keeping quality. The correlations were: initial SPC and age, 0.43; initial SPC and SPC after storage, 0.25; initial SPC and keeping quality, -0.38; SPC after storage and age on date purchased, 0.24; and SPC after storage and keeping quality, -0.55. The multiple correlation between keeping quality and the three other variables (initial SPC, SPC after storage, and age on date of purchase) was 0.64.

Table 6 shows the results of the bacteriological examinations of the samples obtained at processing plants. Approximately 90% of the samples had a standard plate count <10,000 per ml. Psychrophilic

TABLE 6. BACTERIOLOGICAL QUALITY OF MARKET MILK SAMPLES OBTAINED AT PROCESSING PLANTS

Plant	Standard plate count				Psychrophilic count					Moseley plate count			
	No. samples	Samples with counts/ml			No. samples	Samples with counts/ml				No. samples	Samples with counts/ml		
		<10T[a]	10T-30T	30T>		<1	1-5	6-10	>10		<10T	10T-100T	>100T
		(%)				(%)					(%)		
A	16	94	6	None	13	23	61	8	8	15	60	13	27
B	20	95	None	5	18	6	33	33	28	18	22	6	72
C	20	75	25	None	17	18	18	18	46	19	32	10	58
D	17	88	6	6	15	27	20	40	13	16	44	19	37
E	19	95	5	None	16	19	25	44	12	18	39	22	39
All samples	92	89	9	2	79	19	29	29	23	86	38	14	48

[a]T = thousand

counts revealed the presence of psychrophilic organisms in over 80% of the samples. Approximately 23% of the samples had a psychrophilic count of >10 per ml. The proportion of samples from individual plants having psychrophilic counts of >10 per ml ranged from 8% (Plant A) to 46% (Plant C). The Moseley plate counts were very high, the number of samples from individual plants having a Moseley count of >100,000 ranging from 27% (Plant A) to 72% (Plant B). Approximately 47% of all samples had a Moseley count of >100,000. Differences observed between plants in the standard plate, psychrophilic, and Moseley counts were not significant.

When all of the samples obtained from the plants were considered, there was no significant correlation between keeping quality and SPC; keeping quality and psychrophilic count; SPC and psychrophilic count; and SPC and Moseley Plate count. There was a highly significant correlation between keeping quality and the Moseley Count (-0.28) and between the psychrophilic count and the Moseley count (0.43). The multiple correlation between keeping quality and the other three variables (SPC, psychrophilic count, and Moseley count) was highly significant (0.30).

The results of the bacteriological examinations reveal considerable variations in the sanitation programs of the different plants and provide explanations for the differences observed in keeping quality. The fact that a majority of the samples contained organisms capable of growing at 40 to 45 F, which is indicative of the presence of psychrophilic organisms resulting from post-pasteurization *(5, 6)*, suggests that considerably more care is needed to avoid contamination of the pasteurized product.

ACKNOWLEDGMENT

The authors gratefully acknowledge the assistance of Mr. Tommye Cooper, of the Department of Dairy Science, in the statistical treatment of the data reported in this paper.

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A MODIFIED STAIN AND PROCEDU RE FOR THE DIRECT MICROSCOPE METHOD OF COUNTING BACTERIA IN DRY MILK AND OTHER MILK PRODUCTS

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Summary

The preparation of a stain and its method for use in the direct microscopic examination of milk smears is given. Included are some figures arising from a study in which the new stain was compared with the Levowitz-Weber stain. The new method was found to yield higher counts of bacterial clumps and of leucocytes than the standard stain and this was accomplished more quickly and with less fatigue on the part of the observer.

Our experience in this laboratory with the Levowitz-Weber stain recommended by Standard Methods *(1)* for the microscopic examination of dry milk has not been favorable. Organisms which are lightly stained are particularly hard to discern, the background, on occasion, tends to be unevenly stained, in many cases it was difficult to distinguish dirt from bacterial cells, and the conscientious examination of reconstituted milk films was time consuming and inducive of eye strain. These objections led to trials of other stains recommended for the examination of milk films. Staining methods employing contrast stains such as those suggested by Broadhurst and Paley *(2)*, Gray *(3)* and Charlett *(4)* were tried and discarded in favour of the following stain and technique.

Stain as Modified

Preparation

Mix 0.6 g methylene blue (Bacto-Methylene Blue certified) in 52 ml 95% ethanol and 44 ml tetrachloroethane.

Let stand in water bath at 45 C until methylene blue is completely dissolved, agitate occasionally.

Cool.

Add 4 ml glacial acetic acid.

Filter.

Add 2 ml *saturated* alcoholic solution of basic fuchsin (1 g in 15 ml 95% ethanol).

Technique

1. Prepare smears.
2. Dry smears at room temperature or in warming oven at 35-37 C.
3. Immerse slide in acetone for 2 minutes; for reconstituted milk immerse for one minute.
4. Allow acetone to evaporate to dryness.
5. Apply stain for 2 min.
6. Dry stained smears at 35-37 C within 2 min. *It is important not to dry for too long* otherwise smears may crack and excess methylene blue cannot be removed.
7. Wash with gentle agitation in warm water until excess methylene blue is removed.
8. Dry and examine.

Cells will be blue against a pink background.

NOTE: It is very important to use clean slides to prevent lifting of the smears when washed. It is believed that the treatment with acetone increases the permeability of the cells for the stain.

This stain and method when properly prepared and applied invariably gave fields which could be scanned thoroughly, rapidly and with less eye strain and most important with less doubt in the mind of the observer than any we had used formerly.

On the strength of these observations three other laboratories engaged in the examination of dried milk tried the method and reported satisfaction with it, particularly its superiority to the standard stain in ease and rapidity of reading.

The results from a comparative study in which three observers independently examined milk smears in duplicate for each stain from nine different milk samples are depicted in Table 1. In this study the smears were coded so that none of the observers knew their origin. Thirty fields were counted in each smear. Both bacterial clumps and leucocytes were counted and the counts, thus arrived at, per ml of milk were divided by 10^3 for presentation in Table 1.

From these data it will be noted that the counts by the modified stain almost invariably exceeded those obtained with the standard. This increase is further shown by taking the arithmetic mean of all smears read by each observer for both stains as given in Table 2.

While in our hands the use of the modified stain has yielded similar and frequently higher counts than the L.W. stain, it is mainly to be recommended on the basis of the less fatiguing and more rapid examination of milk smears arising from its use.

Acknowledgments

We are grateful to Dr. D. H. Bullock for his help in reading the smears.

TABLE 1. A COMPARISON BETWEEN THE MICROSCOPIC COUNTS YIELDED BY TWO STAINS ON NINE MILK SAMPLES IN DUPLICATE BY THREE OBSERVERS

Sample		Obs. A Bact x 10^5 Mod.	Obs. A Bact x 10^5 L.W.	Obs. A Leuc. x 10^5 Mod.	Obs. A Leuc. x 10^5 L.W.	Obs. B Bact x 10^5 Mod.	Obs. B Bact x 10^5 L.W.	Obs. B Leuc. x 10^5 Mod.	Obs. B Leuc. x 10^5 L.W.	Obs. C Bact x 10^5 Mod.	Obs. C Bact x 10^5 L.W.	Obs. C Leuc. x 10^5 Mod.	Obs. C Leuc. x 10^5 L.W.
	a	2.0	3.5	5.5	7.5	3.3	3.0	5.9	7.7	2.4	2.1	5.4	3.6
1	b	3.5	2.5	6.5	7.0	2.2	3.0	5.5	7.2	4.8	1.2	5.7	6.0
	av.	2.75	2.0	6.05	7.25	2.75	3.0	5.7	7.45	3.6	1.65	5.55	4.8
	a	3.0	2.0	7.5	7.0	4.1	2.1	9.0	8.7	3.3	1.5	7.2	5.7
2	b	3.0	1.1	6.5	4.5	3.9	1.2	6.8	5.4	4.8	1.8	4.8	4.5
	av.	3.0	1.55	7.0	5.75	4.0	1.65	7.9	7.05	4.05	1.65	6.0	5.1
	a	3.0	2.5	9.0	11.0	5.9	9.0	8.6	8.4	4.8	2.7	4.2	6.0
3	b	3.0	2.0	7.0	7.5	5.9	2.7	5.9	9.9	4.5	2.7	5.9	4.8
	av.	3.0	2.25	8.0	9.25	5.9	5.85	7.25	9.15	4.65	2.7	5.05	5.4
	a	4.8	1.1	8.0	7.0	4.6	4.5	11.0	8.4	2.7	1.2	6.6	4.5
4	b	2.5	1.0	8.5	8.0	2.9	3.6	9.9	9.9	2.7	2.1	4.5	3.6
	av.	3.65	1.05	8.25	7.5	3.75	4.05	10.45	9.15	2.7	1.65	5.55	4.05
	a	1.5	2.0	8.5	6.5	1.8	2.4	8.4	7.2	1.8	1.2	6.0	5.4
5	b	1.4	3.5	6.5	6.5	1.5	2.4	8.4	8.4	2.1	0.9	3.9	3.6
	av.	1.45	2.75	7.5	6.5	1.65	2.4	8.4	7.8	1.45	1.05	4.95	4.5
	a	2.0	1.7	14.0	13.0	5.1	1.8	17.0	10.8	4.2	1.5	7.8	6.3
6	b	1.5	1.2	8.5	8.5	3.9	2.3	11.0	9.0	1.5	1.5	6.9	4.8
	av.	1.75	1.45	11.25	10.75	4.5	2.05	14.0	9.9	2.85	1.5	7.35	5.55
	a	1.5	2.0	7.0	5.5	2.4	1.1	8.1	5 4	1.8	0.9	1.8	2.1
7	b	2.0	0.9	3.2	4.5	1.5	1.1	8.6	5.4	1.8	2.1	2.1	1.8
	av.	1.75	1.45	5.1	5.0	1.95	1.1	8.35	5.4	1.8	1.5	1.95	1.95
	a	1.0	1.4	7.0	7.0	3.9	2.7	9.9	5.6	2.1	0.6	4.2	3.3
8	b	1.5	2.0	6.5	8.5	3.3	3.2	8.1	6.8	2.4	0.9	4.2	3.3
	av.	1.25	1.7	6.75	7.75	3.6	2.95	9.0	6.2	2.75	0.75	4.2	3.3
	a	2.0	1.5	14.0	10.0	1.8	1.1	15.0	12.6	4.2	1.2	11.0	9.0
9	b	1.2	1.0	11.0	13.0	0.9	.9	14.0	11.3	1.8	0.3	7.5	6.0
	av.	1.6	1.25	12.5	11.5	1.35	1.0	14.5	11.95	3.0	0.75	9.25	7.5

TABLE 2. ARITHMETIC AVERAGE FOR ALL COUNTS DEPICTED IN TABLE 1 FOR EACH OBSERVER

	Clump Count x 10^5/ml		Leucocytes x 10^5/ml	
	Mod. stain	L. W. stain	Mod. stain	L. W. stain
Obs. A	2.24	1.83	8.20	8.00
Obs. B	3.28	2.67	9.50	8.23
Obs. C	2.98	1.97	5.54	4.68

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AMENDMENT TO 3-A SANITARY STANDARDS FOR INTERNAL RETURN TUBULAR HEAT EXCHANGERS FOR USE WITH MILK AND MILK PRODUCTS

Serial #1202

Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

The "3-A Sanitary Standards for Internal Return Tubular Heat Exchangers for Use with Milk and Milk Products," approved April 29, 1952, Serial #1200, are hereby amended by adding the following sentence to subsection D. 3:

Plastic gasket material shall conform to the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Serial #2000".

This amendment shall become effective July 9, 1965.

AMENDMENT TO 3-A SANITARY STANDARDS FOR FARM MILK COOLING AND HOLDING TANKS–REVISED

Serial #1303

Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

The "3-A Sanitary Standards for Farm Milk Cooling and Holding Tanks – Revised, Serial #1301," are hereby amended by adding the following paragraph at the end of Section A-7:

If made of plastic material, they shall conform to the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Serial #2000".

This amendment shall become effective July 9, 1965.

AMENDMENT TO 3-A SANITARY STANDARDS FOR MILK AND MILK PRODUCTS EVAPORATORS AND VACUUM PANS

Serial #1602

Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

The "3-A Sanitary Standards for Milk and Milk Products Evaporators and Vacuum Pans," Serial #1600, are hereby amended by substituting the following for subsection (c) in section C.(1):

(c) Plastic materials used for non-metallic parts having product contact surfaces shall conform to the applicable provisions of "3-A Sanitary Standards for Multiple Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Serial #2000".

This amendment shall become effective July 9, 1965.

AMENDMENT TO 3-A SANITARY STANDARDS FOR STORAGE TANKS FOR MILK AND MILK PRODUCTS

Serial #0102

Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

The "3-A Sanitary Standards for Storage Tanks for Milk and Milk Products," dated November 9, 1955, Serial #0101, are hereby amended in the sections indicated below:

Substituting the following for subsections B. (5), B.(6), and B.(13):

B. (5) BEARINGS

Bearings which are within the milk zone shall be made of stainless steel or other equally corrosion resistant metals; or plastic. If made of plastic materials they shall conform to the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Serial #2000".

B. (6) UMBRELLA FOR VERTICAL AGITATOR ASSEMBLY

The umbrella shall be made of 18-8 stainless steel, rubber or rubber-like material, or plastic. If made of rubber or rubber-like materials they shall conform to the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Rubber and Rubber-Like Materials Used as Product Contact Surfaces in Dairy Equipment, Serial #1800". If made of plastic materials they shall conform to the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Serial #2000".

B. (13) GASKETS

Gaskets shall be made of a resilient rubber, or rubber-like, or plastic material. If made of rubber or rubber-like materials they shall conform to the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Rubber and Rubber-Like Materials Used as Product Contact Surfaces in Dairy Equipment, Serial #1800". If made of plastic materials they shall conform to the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Serial #2000".

This amendment shall become effective July 9, 1965.

AMENDMENT TO 3-A SANITARY STANDARDS OF PLATE TYPE HEAT EXCHANGERS FOR MILK AND MILK PRODUCTS

Serial #1102

Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

The "3-A Sanitary Standards of Plate Type Heat Exchangers for Milk and Milk Products," dated September 1951, Serial #1100, are hereby amended in the sections indicated below:

Add the following words to the end of Section D. 1.:

", or a plastic material".

Add the following sentence to subsection D. 2.:
Plastic gasket material shall conform to the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Serial #2000".

This amendment shall become effective July 9, 1965.

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

Serial #0506

Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

The 3-A "Sanitary Standards for Stainless Steel Automotive Milk Transportation Tanks for Bulk Delivery and/or Farm Pick-Up Service," amended April 28, 1954, Serial #0501, are hereby further amended in the sections indicated below:

The following new paragraph, A-10, is added:

10. PLASTIC MATERIALS:

All plastic materials when used for specified applications shall conform to the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Serial #2000".

The following sentence is added to paragraph H-5:

When plastic materials are used they shall conform to the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Serial #2000".

The following words are deleted from the first sentence of Section K — Electric Motors, Pumps, and Fittings:

"shall conform to the 3-A Sanitary Standards for Motors and"

This amendment shall become effective July 9, 1965.

AMENDMENT TO 3-A SANITARY STANDARDS FOR BATCH AND CONTINUOUS FREEZERS FOR ICE CREAM, ICES AND SIMILARLY-FROZEN DAIRY FOODS

Serial #1901

Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

The "3-A Sanitary Standards for Batch and Continuous Freezers for Ice Cream, Ices, and Similarly-Frozen Dairy Foods, Serial #1900," are hereby amended by substituting the following for subsections (e) and (f) in section C. (1), and deleting the footnote referring to section C. (1) (e).

(e) Rubber and rubber-like materials may be used for bearings, metering devices, air tubing, port covers, and multi-use gaskets, seals and parts used in similar applications. These materials shall conform to the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Rubber and Rubber-Like Materials Used as Product Contact Surfaces in Dairy Equipment, Serial #1800".

(f) Plastic materials may be used for bearings, metering devices, air tubing, port covers, and multi-use gaskets, seals and parts used in similar applications. These materials shall comply with the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Serial #2000".

(g) Single-service sanitary type gaskets may be used.

This amendment shall become effective July 9, 1965.

AMENDMENT TO 3-A SANITARY STANDARDS FOR FILLERS AND SEALERS OF SINGLE SERVICE CONTAINERS FOR MILK AND MILK PRODUCTS

Serial #1702

Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

The "3-A Sanitary Standards for Fillers and Sealers of Single Service Containers for Milk and Fluid Milk Products, Serial #1700," are hereby amended by substituting the following for subsection (b) in section C.(1)

(b) Plastic materials may be used for filling nozzles, plungers, gaskets, diaphragms, sealing rings, drip shields, container opening and closing parts, filling valve members, seals and parts used in similar applications. These materials shall comply with the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Serial #2000".

This amendment shall become effective July 9, 1965.

AMENDMENT TO 3-A SANITARY STANDARDS COVERING HOMOGENIZERS AND HIGH PRESSURE PUMPS OF THE PLUNGER TYPE

Serial #0402

Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

The 3-A "Sanitary Standards Covering Homogenizers and High Pressure Pumps of the Plunger Type," Serial #0400, are hereby amended by adding the following sentence to section D. 1:

If of plastic material, they shall conform to the applicable provisions of "3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Serial #2000".

This amendment shall become effective July 9, 1965.

3-A SANITARY STANDARDS FOR SIFTERS FOR DRY MILK AND DRY MILK PRODUCTS

Serial #2600

Formulated by
International Association of Milk, Food and Environmental Sanitarians
United States Public Health Service
The Dairy Industry Committee

It is the purpose of the IAMFES, USPHS, and DIC in connection with the development of the 3-A Sanitary Standards Program to allow and encourage full freedom for inventive genius or new developments. Dry Milk and Dry Milk Products Sifters specifications heretofore or hereafter developed and which so differ in design, material, construction or otherwise so as not to conform with the following standards, but which in the opinion of the manufacturer or fabricator are equivalent to or better, may be submitted at any time for the consideration of IAMFES, USPHS, and DIC.

A. *SCOPE*

This standard covers the sanitary aspects of sifters used for processing dry milk and dry milk products. In order to conform with these 3-A Sanitary Standards, sifting equipment for dry milk and dry milk products shall comply with the following in design, material, and fabrication criteria.

B. *DEFINITIONS*

(1) *Product*: Shall mean dry milk or dry milk products.

(2) *Product Contact Surfaces*: Shall mean all surfaces with which the product may come in contact.

(3) *Non-Product Contact Surfaces*: Shall mean all other exposed surfaces.

C. *MATERIAL*

(1) All product contact surfaces shall be of 18-8 stainless steel with a carbon content of not more than 0.08 percent, or other equally corrosion resistant metal, that is non-toxic and non-absorbent, except that:

(a) Plastic materials may be used for screening media, screen frame assemblies, balls, gaskets, flexible connectors, and inspection port covers. These materials shall comply with the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Serial #2000".

(b) Rubber and rubber-like materials may be used for balls, gaskets, flexible connectors, and inspection port covers. These materials shall comply with the applicable provisions of the "3-A Sanitary Standards for Rubber and Rubber-Like Materials Used as Product Contact Surfaces in Dairy Equipment, Serial #1800".

(c) Cotton, linen, silk, or synthetic fibers may be used for screening surfaces. These materials shall be non-toxic, relatively insoluble, easily cleanable, and shall not impart a flavor to the product.

(d) Welded areas and the deposited weld material shall be substantially as corrosion resistant as the parent material.

(e) Solder, when used, shall have a tin content not less than 50%, and the remainder shall contain no more lead than is necessary under good manufacturing practices, and shall be corrosion resistant, cadmium free, non-absorbent, and shall not impart any toxic substance to the product under conditions of intended use.

(2) All non-product contact surfaces shall be of corrosion-resistant material or material that is rendered corrosion-resistant. If painted, the paint used shall adhere. All non-product contact surfaces shall be relatively non-absorbent, durable and cleanable. Parts removable for cleaning having both product contact and non-product contact surfaces shall not be painted.

D. *FABRICATION*

(1) All product contact surfaces except the screen surfaces shall be equivalent to a number 4 mill finish or 120 grit properly applied, or a number 2B mill finish on stainless steel sheets, free of imperfections such as chips, flakes, or pits. All joints shall be smooth and flush. All permanent joints in metallic product contact surfaces shall be welded. All welded areas of product contact surfaces shall be at least as smooth as the adjoining surfaces. Solder may be used to smoothly fill the joints where the screen is attached to the frame.

(2) All appurtenances having product contact surfaces shall be easily removable for cleaning or shall be readily cleanable in place.

(3) All product contact surfaces shall be easily accessible and readily cleanable, either when

in an assembled position or when removed. Removable parts shall be readily demountable.

(4) All internal angles of 135° or less on product contact surfaces shall have minimum radii of 1/8 inch, except as provided in D. (5).

(5) Gaskets shall be removable or continuously bonded so as to be smooth and easily cleanable. Gasket retaining grooves for removable gaskets shall be no deeper than their width. The minimum radius of any internal angle in a gasket retaining groove shall be not less than 1/8 inch, except that a 3/32 inch radius is permissable where a standard 1/4 inch O-Ring is to be used.

Grooves in gaskets shall be no deeper than their width and the minimum radius of any internal angle shall be not less than 1/8 inch unless the gasket is readily reversible for cleaning.

(6) All openings in the cover shall have raised rims and flanges of at least 3/8 inch.

(7) All openings in the cover not continuously in use, shall be provided with removable covers designed to prevent foreign material from entering the product zone.

(8) The sifter shall be constructed so as to provide for prompt continuous removal of rejected material.

(9) Woven stainless steel wire may be used for screening surfaces.

(10) Non-product contact surfaces to be painted shall be effectively prepared for painting.

(11) There shall be no exposed threads in product contact areas.

(12) All outside welded seams shall be smooth and waterproof. All mechanical joints shall be dust tight and splash proof.

(13) Legs, if used, shall be smooth with no exposed threads, and shall be of sufficient length to provide a clearance between the lowest fixed point of the machine and the floor of no less than 6 inches. If legs are hollow tube stock, they shall be effectively sealed. When legs are not used the base shall be designed to permit sealing to the mounting surface.

APPENDIX A

For the general guidance of sifter manufacturers and the dry milk industry, the following screen size openings may be considered as recommended openings to result in satisfactory screening of the listed dry milk products:

Product	Sieve Designation (From ASTM 223.1)	Maximum Sieve Opening mm.	inches (approx.)
Nonfat dry milk	#25	0.707	.027
Dry whole & dry buttermilk	#16	1.19	.045

It is recognized that larger screen size openings may be necessary for sifting certain special dry milk products (such as "instant" products) and for desired classification of products into different particle sizes.

Openings referred to above are based on general experience as to what constitutes satisfactory screening to remove product lumps or potential product contaminants, and also on ability of most currently used sifters to successfully sift dry milk products through such size openings without excessive loss of fine powder into the "reject material" outlet. (Other factors also affect such loss, such as percent of "open area" in screen used, uneven flow rates to the sifter, ratio of screening surface area to drier capacity, amount and kind of mechanical energy applied to the screening surface, sifter design and construction, and nature of dry milk product being sifted.)

Screen openings dimensions may be obtained by any desired combination of wire thickness and number of wires per inch. For instance, if the screening surface is made of stainless steel woven wire, the .027 inch opening might be obtained by using 24 x 24 mesh market grade screen cloth made of wire .014 inch thick (about 45% open area) or by using 30 x 30 bolting cloth screen made of wire .0065 inch (about 65% open area) or by many other mesh-wire thickness combinations. These combinations allow a wide choice to obtain desired balance between screen strength and percent open area. If materials other than stainless steel are used to construct the screening surface, similar combinations may be employed to achieve desired opening size.

REFERENCES

1. Goldberg, S. A. and Walter, W. When you specify sieves include screen opening size. Chemical Engineering, February 9, 1959.

2. Sieves for Testing Purposes — ASTM 223.1 — 1961.

APPENDIX B
RECOMMENDATIONS FOR CLEANING DRY MILK SIFTERS

I. *DAILY CLEANING PROGRAM* — The procedures set forth below should be followed as a daily cleaning program.

1. Completely dismantle and thoroughly vacuum or dry brush clean all product contact surfaces of the dry milk sifter. Reassemble as soon as finished and make every effort to keep all parts dry.
2. Check sifter screen(s) for broken or displaced wires (threads) and for other openings around the frame of the screen, which might permit the passage of unsifted product. Other parts

of the sifter, including ball trays and balls, if used, should also be inspected for condition. Any necessary repair or replacement should be made as soon as possible.

3. Flexible rubber or cloth socks at the inlet and outlets of the sifter should be thoroughly cleaned daily, following the procedures as recommended for the sifter. At this time socks should be closely examined for holes, cracks or other damage. (To facilitate removal for cleaning, use of easily removable fastening devices are recommended.)
4. Thoroughly vacuum or dry brush clean all external parts of the sifter, including the sifter frame and drive mechanism.

II. *WEEKLY CLEANING PROGRAM* — The procedures set forth below should be followed at weekly intervals.

1. Completely dismantle as in I. above, remove all loose dry milk, then rinse all parts with clear water and follow by a thorough hand brushing of all parts using a general purpose dairy cleaner. Rinse thoroughly to remove all evidence of cleaning solution or soil. It is recommended that hot water (170° F or above) be used for rinsing in order to sanitize the equipment and to aid the subsequent drying. Allow all parts to air dry completely prior to reassembly.

   The wet wash should be done more frequently if necessary and should be done after each use if the sifter is not being used on a daily basis.

   After cleaning, drying and reassembly the powder outlet should be protected against recontamination.

III. *GENERAL RECOMMENDATIONS*

1. Vacuum cleaning is preferred to brush cleaning or cleaning with air under pressure as it decreases the dust drift problem to other areas of the plant.
2. Brushes or vaccum cleaner fittings used for cleaning product contact surfaces should not be used for cleaning non-product contact surfaces or for other uses which might result in contamination. Such brushes and special fittings should be stored in an enclosed cabinet when not in use. (For protection and housekeeping considerations, such cabinets preferably should be of non-wood construction and should have open mesh metal shelving.)

These standards shall become effective July 9, 1965.

FLI/FDA 8th ANNUAL EDUCATIONAL CONFERENCE AND FLI SYMPOSIUM ON FOOD STANDARDS

More than 700 interested individuals representing industry, government and educational groups attended a two day conference and symposium in Washington, D. C. on November 30 and December 1, 1964. The theme of the meeting was the expanding consumer interest in better food standards and the need for development of a closer cooperation and understanding between the food and drug industry and the regulatory agencies.

The Eighth Annual Educational Conference on November 30 was sponsored jointly by the Federal Food and Drug Administration and the Food Law Institute. In the keynote address George P. Larrick, Commissioner of Food and Drugs, gave a brief review of the objectives and accomplishments of previous conferences and stressed the importance of the FDA workshop programs with industry and the many consumer education programs which are essential in voluntary compliance. Commissioner Larrick stated that it is FDA's purpose to prevent rather than punish violations but there are gaps between intention and accomplishment in this area. Fortunately steps are being taken by both Industry and Government to obtain compliance with regulations.

In his response Franklin M. Depew, President of the Food Law Institute, outlined the program of the 1965 conference which was designed to bring together responsible people to review various problems and situations and to develop avenues of working together toward a common goal. Mr. Depew emphasized the importance of promoting a better understanding of the nation's food and drug laws and of encouraging a program of voluntary compliance with these standards. He expressed the hope that guidelines resulting from the conference would establish a new era of Industry FDA cooperation.

Voluntary Compliance and Self Regulation

Shelby T. Grey, FDA, discussed compliance with present laws and stated that FDA is concerned with the development and utilization of all available education material which will lead to obtaining the objective of voluntary compliance. Most manufacturers today have the scientific knowledge, the equipment, and the desire to comply with regulations

voluntarily. The consumer has (1) the right to safety in products consumed, (2) the right to be informed, (3) the right to choose and (4) the right to be heard. To meet these rights FDA's extensive programs in consumer education are being expanded.

Dr. Richard L. Hall, McCormick and Company, Inc., asserted that there is a sincere desire within the industry to cooperate with government agencies and examples include the research and education training program of the National Canners Association, the 3A Sanitary Standards in the milk industry, the baking industry equipment standards, the Georgia food service programs, the FEMA food additive reports and the AOAC vanilla standard methods. Self-regulation in the food industry is a necessity and, although some government inspection is needed to be most effective, it should be at a minimum. Close cooperation between FDA and industry can develop a voluntary program of self-inspection and regulation.

Utilization of Cooperative Research

The program provided for discussion of various aspects of the general topic, "Science Promotes Voluntary Compliance". Dr. Oral L. Kline of FDA, reviewed the scientific developments and research of FDA in the areas of pesticide methodology, instrumentation, such as infra-red and x-ray flouresence, and toxin investigations. The scientific staff for basic research has been increased, programs of training have been developed and FDA continues to maintain a policy of education and development and release of information.

Dr. Austin Smith, President, Pharmaceutical Manufacturers Association, stressed the fact that voluntary compliance is the only practical way to meet regulations. There is a great need for facts which can be obtained only by consulting committees on plant sanitation, plastics, color, capsules and many other areas. The search for facts continues as science provides the yardsticks for measurement in regulations. Dr. Robert M. Schaffner, Libby, McNeil and Libby, noted the scientific advances made by industry research, especially in the areas of sanitation and processing. He commented on the importance of the Food Chemical Codex, the first bound edition of which will be available in 1966. Food standards should be more flexible, especially with optional ingredients. Finally, industry and government must educate the consumer—with education there is no reason for food fadism.

Workshop Discussions

Five afternoon panel workshops covered: Food Sanitation and Quality Control; Additives and Pesticides; New and Investigational Drugs; Drug Labeling and Promotion; and Consumer Education—What the Public Wants.

In the Sanitation and Quality Control Workshop Franklin D. Clark, FDA, explained the inspection procedures followed by FDA inspectors, pointing out the items of importance in an inspection which are: sanitation, raw material storage, processing, fate of rejected raw material, lists of recent shipment invoices, review with management as to recommendations, and report of findings. Charles H. Brokaw, The Coco-Cola Company, urged a speed up in communications with FDA. Prompt and meaningful replies are needed. Container fill is also a problem and a clarification of terms is needed especially with respect to a reasonable tolerance definition. Improved and adequate training of FDA inspectors is encouraged and industry workshops could be of great value in this training. Karl F. Lang, H. J. Heinz Company, emphasized that adequate information and education are valuable tools in the desired relationship between industry and FDA. He stated that good sanitation and quality control are mandatory in good business and are not practiced just for the FDA inspector.

FLI Symposium on Standards

The second part of the two day program was the Food Law Institute Symposium on December 1 on "The Legal Basis and Regulatory Use of Food Standards". It was sponsored jointly by the Food Law Institute, Inc., the Graduate School of Public Law of George Washington University and the Food Protection Committee of the Food and Nutrition board, National Research Council, National Academy of Sciences.

Alan H. Kaplan of George Washington University, discussed the development of food and drug standards over the years and pointed out that, whereas earlier standards were designed to regulate foods from the point of view of economic adulteration and fill of container, later standards have become more concerned with purity and safety. Although any interested person may offer a food standard, most standards are proposed by Food and Drug with amendments submitted by industry. The main purpose of standards is to promote reasonableness, honesty and fair dealing to the interest of the consumer. Changes are being made to improve the present procedures followed by FDA in setting standards, particularly in relation to public hearings and the requirements for the hearing examiner. The method of presentation of evidence is also being clarified and the food standard making procedure should be improved by the ideas and suggestions presently being considered.

Mr. Eugene H. Holeman, Tennessee Department of Agriculture, reviewed the role of the states in

establishing food standards and pointed out that there are many standard-making bodies producing hundreds of standards for foods which are serving a good purpose. However, uniformity of standards is sorely needed. Mr. Holeman mentioned the present bread standards and the orange juice standards where there are 10 FDA and 6 USDA standards. He also urged better exchange of information between various federal agencies and recommended the establishment of a joint committee from regulatory agencies to study the clarification of food standards.

George M. Burditt of Chadwell, Keck, Kayser, Ruggles and McLaren, suggested more practical use of the regulatory power to establish food standards. Among his recommendations for improvement in procedures were the limiting of standards to basic essentials, designating optional ingredients by generic terms, liberalizing standards, revising temporary permit procedure, expanding informal conferences, avoiding standards which impede technical development, and promoting specific standards for dietary foods.

Protecting the Consumer's Interest

An afternoon panel was devoted to the topic, "Do FDA's Present Food Standards and Standard Making Policies Best Serve the Consumer?" Malcolm R. Stephens, FDA, pointed out the necessity for standards and stated that FDA promulgates standards in the interest of both the consumer and industry. The consumer needs and wants protection and Industry naturally desires more freedom in standards, especially in the area of optional ingredients. FDA believes both these objectives are possible. Dr. Oral Lee Kline, FDA, discussed the scientific aspects of food standards and stated that safety of foods and ingredients must be considered and evaluated by all methods available. Improved methods of detection of contaminants and adulterants as well as establishment of objective, reproducible measurements of quality are always needed. New techniques and new tools make this approach more promising. Specifically, standards of fill require study and revision and the proper point of measurement needs to be determined, that is, whether after processing, after shipping, or in the hands of the consumer.

H. Thomas Austern, of Covington and Burling, and a member of the Lawyers Advisory Committee of FLI, indictated that food standards have been neglected when compared with other activities of FDA. He suggested that improvements in activity regarding food standards are possible in a number of areas. New standards are needed for dietary foods, fabricated foods, and imitation foods but there must be a justified need for every standard. Periodic updating of standards is desirable but flexibility is essential and manufacturing standards should be avoided. Improved standards by use of standard methods of analysis are essential but should be based on sample surveys and statistical analysis of data. Standards that cannot be enforced are legal ghosts and all standards to be of value must be enforcible.

The symposium concluded on the general note that there is definitely a better understanding of standard-making problems which should result in more practical standards in the future and in appropriate revisions of present standards through cooperative action of FDA and industry.

ASSOCIATION AFFAIRS

IAMFES, INC. COMMITTEES—1965

PROFESSIONAL AND EDUCATIONAL DEVELOPMENT COMMITTEE

Gilbert L. Kelso, *Chairman,* Chief, Field Training Unit, Community Services Training Section, CDC, PHS, Atlanta, Georgia.

Harold S. Adams, Professor, Department of Public Health, Indiana University, Medical Center, Indianapolis 7, Indiana.

E. M. Causey, Jr., South Carolina State Department of Health, Columbia, South Carolina.

Carroll E. Despain, State Sanitarian Supervisor, Engineering and Sanitation Division, Idaho Department of Health, Boise, Idaho.

John Patillo, Richmond City Health Department, Richmond 34, Virginia.

Richard E. Stedman, Senior Milk Sanitarian, Division of Public Health Engineering, Iowa State Department of Health, Des Moines, Iowa.

Raymond Summerlin, Director, Food Division, Georgia Department of Agriculture, Atlanta, Georgia.

Darold W. Taylor, Sanitarian Director, Sanitarian Liaison Officer, Office of the Surgeon General, PHS, Washington, D. C.

J. E. Watt, D.V.M., D.V.P.H., Supervisor, Environmental Sanitation, The Local Board of Health, City of Oshawa, Ontario, Canada.

COMMITTEE ON FROZEN FOOD SANITATION

Frank E. Fisher, *Chairman, Director,* Division of Food and Drugs, Indiana State Board of Health, 1330 West Michigan Street, Indianapolis, Indiana 46207.

A. C. Leggatt, Department of Dairy Science, Ontario Agricultural College, Guelph, Ontario, Canada.

Eaton E. Smith, Food Division, Department of Consumer Protection, State Office Building, Hartford, Connecticut.

G. L. Hays, Bacteriological Group, American Can Company, Central Division, 11th Avenue and St. Charles Road, Maywood, Illinois.

H. P. Schmidt, Assistant Director, National Association of Frozen Food Packers, 919 18th Street, N.W., Washington, D. C.

NOMINATIONS FOR OFFICERS OF IAMFES, INC.–1965-1966

FOR SECOND VICE-PRESIDENT AND SECRETARY-TREASURER

DAVID C. CLEVELAND
For Second Vice-President

Education and Training:

Dave received a B.S. degree in 1940 from Southeastern State College in Durant, Oklahoma, and obtained a M.P.H. from the University of Oklahoma in 1953.

In 1945 he attended a School for Sanitation Officers at Vanderbilt University, Nashville, Tennessee.

Employment and Experience Record:

After eleven (11) years service as a teacher and administrator in the public schools of Southeastern Oklahoma, he was employed as a Sanitarian by the Oklahoma State Department of Health in March 1943, and assigned to a district unit as a General Sanitarian. In 1950 Dave left local health work and served as a Milk Sanitation Survey Officer with the Oklahoma State Department of Health.

In April of 1954, he was employed by the City of Oklahoma City as Director of the Bureau of Dairy Control.

In 1957, he was employed as Director of Sanitation (Milk, Food, and General) for the Oklahoma City-County Health Department. Since that time, activities of the division have been expanded, and he is presently Director of the Division of Environmental Health of the Oklahoma City-County Health Department.

His experience in Public Health totals 21 years.

Affiliations with Organizations:

Dave has been a member of International since 1944. He is now and has been for several years, a member of the 3A Standards Committee, and is beginning a second term as a trustee of the 3A Symbols Council. He has served on the Membership Committee of International.

In 1953, he served as President of the Oklahoma Association of Milk and Food Sanitarians. That year, through the efforts of the Association, the legislature enacted the Oklahoma Law for Registration of Professional Sanitarians. Through the years, he has served on various committees of the State Sanitarians Organization. He is presently a member of the Legislature Committee of the Oklahoma Society for Registered Professional Sanitarians. He is also a member of the Oklahoma Public Health Association, and has served on a number of committees in that organization. He is also a member of the Oklahoma Chapter of the American Society for Public Administrators.

Dave is married, has three sons, two of whom are married, and the third just completed a six months training period in the Marines, and will enter college January 1965.

He is a member of the Baptist Church, and active in its program.

SAMUEL O. NOLES
For Second Vice-President

Sam, as he is commonly known by his associates, was born in Mt. Ida, Arkansas, January 8, 1912. He was reared on a farm in this community and graduated from the Mt. Ida High School. After completion of junior college at Magnolia, Arkansas, he spent a brief period in the oil fields of Texas; then four years in the U. S. Army, Veterinary Corps, in

the quality control of meat and dairy products for the armed forces.

After being released from the U. S. Army, Sam started working with the local health department in Gainesville, Florida. He attended the University of Florida, from which he graduated from the College of Agriculture with a major in Dairy Science in June, 1948. He continued working with the local health department in Gainesville until July 31, 1949, at which time he accepted a position with the State Board of Health as Milk Consultant.

September 1, 1951, Sam was granted an educational leave of absence for the purpose of securing a master's degree in Public Health. This was completed June 16, 1952, at the University of Minnesota.

He returned to the Florida State Board of Health and has continued working as Milk Consultant for this agency to the present time.

Sam has been a member of the International since his release from the army in 1945. A great deal of this time he has been an officer in the state affiliate as director, vice president, and president. He has been a member of the 3-A Sanitary Standards Committee of the International since 1955. He has taken an active part in the IMS program and is at present a member of the board of directors of this organization for the eastern seaboard, and has also served on various committees. Sam has been a registered sanitarian in the state of Florida since this state secured legislation requiring registration of sanitarians. He has been certified by the Public Health Service as a State Rating Officer for use of dairy products for interstate purposes.

Sam is married and has two children; his home and official headquarters are located in Jacksonville, Florida.

SECRETARY-TREASURER

KARL K. JONES
For Secretary-Treasurer

Karl K. Jones, Public Health Sanitarian, is Chief of the Retail Food Section of the Division of Food and Drugs, Indiana State Board of Health. Mr. Jones attended public schools in Indiana and Indiana University where he received a B.S.P.H. in 1950 with an option in Sanitary Science.

Mr. Jones has been in public health work for 15 years, beginning as a regional sanitarian in the Southwestern area of Indiana. He then served as the State Retail Survey Officer from 1952 to 1957 at which time he was appointed to his present position of Chief of the Retail Food Section.

For a number of years, Mr. Jones has been active in professional and technical organizations. He is a member of the International Association of Milk, Food. and Environmental Sanitarians, Inc., Charter member of the Indiana Association of Sanitarians, a member of the American Public Health Association and the Indiana Public Health Association. He is also a member of the Indiana State Board of Registration for Professional Sanitarians and has been active for several years in developing information and standards for sanitarians; and in 1958, a paper by Mr. Jones on the "Current Status of Sanitarian Registration Legislation in the United States" was published in the Journal of Milk and Food Technology.

Mr. Jones is married and lives in Indianapolis, Indiana.

NOMINATING COMMITTEE

A. E. Parker, Chairman	James Boyd
Kelley Saunders	Dick Whitehead
Richard March	Frank Kelley
Ben Luce	

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.

VIRGINIA ASSOCIATION OF SANITARIANS

Nineteenth Annual Meeting
Roanoke, Virginia
November 5-6, 1964

(*Secretary*, G. S. Kennedy, 6000 Crestwood Ave., Richmond 26, Virginia.)

The National Labeling Program, Past, Present and Future—*H. L. Thomasson*

Panel: The Pesticide Residue Control Program in Virginia—*Maurice B. Rowe, A. Lee Turner, M. W. Jefferson, Boyd L. Samuel*
Recent Developments in Control of Food Borne Sickness—*Robert Stevens*
The Development of Sevin with Emphasis on Control of Pests of Interest to Sanitarians—*Thomas F. Fricke*
What's New In Environmental Health—*James Jones*
Five Ways to Improve Your Environmental Programs—*Mrs. B. P. Chappell*
New Development for Bacteriological Examination of Milk and Milk Products—*Dr. C. K. Johns*
The Revised Milk Ordinance & Code, USPHS 1964 Recommendations—*George Hanson*
Pest Control Aspects of Food Plant Sanitation—*A. J. Kirby*
Human Relations—*P. J. Caron*

KANSAS ASSOCIATION OF PUBLIC HEALTH SANITARIANS

Thirty-fifth Annual Meeting
Wichita, Kansas
November 4-6, 1964

(*Secretary*, Frank L. Kelley, 1216 Ohio St., Lawrence, Kansas.)

The Importance of the Public Health Program—*Frederick K. Erickson*
Panel: Adult Care Homes—*Lucille Cook, Josephine Beam, Don Cross*
How the New PHS Restaurant Code is Working—*Harold E. Thompson, Jr.*
The Use of Training by Sanitarians—*John Wettig*
The Environmental Sanitation School—*Lindon J. Murphy*
How Has Sanitation at Resorts Been Improved—*Charles V. Wright*
Second Revision of the Pasteurized Milk Ordinance—*Harold E. Thompson, Jr.*
Brucellosis and Tuberculosis—*Roy S. Pyles*
Brucellosis and Tuberculoses Changes in the 1964 Pasteurized Milk Ordinance—*D. Manley*
How the Sanitarian Can Work With the Veterinarians in Kansas for Better Public Health—*Ralph L. Barrett*
A Survey of Kansas Lagoons—*Howard Duncan*

CONNECTICUT ASSOCIATION OF DAIRY AND FOOD SANITARIANS, INC.

Thirty-ninth Annual Meeting
Northford, Connecticut
January 20, 1965

(*Secretary*, Richard M. Parry, Tunnel Road, R. R. No. 1, Vernon, Connecticut.)

The Modified Whiteside Test—*Harry C. Temple*
Sediment Testing of Milk in Farm Bulk Tanks—*C. L. Weir*
The Vacuum Breaker—*L. F. Bender*
Panel: Shellfish Sanitation—*Thedore Willerford, Michael Rossetti, Edward P. Wong*
Panel: The Handling of Distressed Food and Drugs—*Herbert Plank, Eaton Smith, Francis Moakley*
What the Quality Consumer Expects in Foods—*Marion Arnold*
Industry Responsibility in Maintaining High Quality—*Donald Race*

CENTRAL ONTARIO SANITARIANS HONOR TWO OF ITS MEMBERS

The Central Ontario Milk Sanitarians, at its annual meeting on January 27, gave recognition to two of its well-known members for their service to the Association and for their contributions to the food industry.

The Association's able secretary, Tom Dickison, was selected as 1965 Sanitarian of the Year and the award was presented by J. L. Baker, Dairy Commissioner for the Province of Ontario. Tom is well known in Canada for his outstanding work in farm sanitation and quality control in milk production for his employer of 20 years, The Borden Company, Limited. Tom works out of the Toronto office but covers the Provinces of Ontario and Quebec in his wide travels.

Tom Dickison receives Sanitarian of the Year award plaque from Commissioner J. L. Baker.

The first Honorary Life Membership in the Ontario Association was awarded to Dr. C. K. Johns of Ottawa, Canada and the presentation was made by Dr. J. E. Watt, President of the Association. "C. K.", as he is known internationally, retired a little more than a year ago from his position as head of the Dairy Section, Food Research Institute, Canada Department of Agriculture, an organization he served for many years. He is now active as Consultant for Lazarus Laboratories, a division of West Chemical Products, Inc.

Dr. Johns has long been active in milk sanitation and is the author of many technical articles. He is a past president of IAMFES and among his many honors holds the IAMFES Citation Award (1954) and also enjoys an Honorary Life Membership (1964) in the International Association.

Other features at the Central Ontario meeting included an address by Mr. F. R. Roughley, Director of the Ontario Department of Health Laboratory,

Dr. C. K. Johns holds Honorary Life Membership award.

who outlined the methods initiated and adopted to develop successfully their Viscosity Gel Test of Milk Gel Index (M.G.I.), as they call it. Dr. Henry Atherton, University of Vermont, discussed problems encountered with old bulk tanks. These problems referred as much to the care the tank had been receiving as to the actual age of the tank. Copies of these papers are available.

Dr. A. N. Myhr, Ontario Agricultural College, gave an up-to-date report on the progress of the Provincial Cream and Butter Improvement Programme. The very size and complexity of this project made it a most interesting subject and, Dr. Myhr, who is heading this up, was well qualified to discuss it in detail.

An innovation for a Central Ontario meeting was an open forum comparable to the question and answer session at the International program in Toronto in 1963. Dr. David Arnott, Ontario Agricultural College, very capably handled the informal meeting, "fielding" any and all questions and directing them to others in the audience who were considered capable of answering them. This audience participation program was very valuable and, of course, gave the speakers on the formal program another workout.

Mr. H. L. "Red" Thomasson, Executive Secretary of IAMFES, was an honored guest at the annual meeting. The banquet was graced by Ontario's Dairy Princess, Miss Elizabeth Crawford, who was introduced by Mr. Jack C. Palmer. President-Elect, Herman Cauthers, presented retiring President Watt with an inscribed gavel as a token of the Association's esteem and appreciation.

ANNUAL MEETING WASHINGTON MILK SANITARIANS ASSOCIATION

The annual state meeting of the Washington Milk Sanitarians Association will be held in the fourth floor auditorium of the Public Safety Building in Seattle, Washington on April 7, 1965. This will be an all day meeting with a program, committee reports, election of officers and an evening dinner with a speaker, to be held at the Norselander Restaurant.

NEWS AND EVENTS

1965 INTERSTATE MILK SHIPMENTS CONFERENCE

The Brown Hotel at Louisville, Kentucky, will be the setting for the 10th National Conference on Interstate Milk Shipments, May 10-13, 1965. More than 400 representatives of public health and agricultural agencies, the dairy industry and others concerned in interstate milk shipments are expected.

Park Livingston, Dean Foods Company, Rockford, Illinois, chairman of the 1965 Conference, said that the meeting would be the largest held to date and commented: "The Conference is a voluntary organization which meets biennially to work out cooperative procedures to facilitate the inter-state shipment and sale of milk of high sanitary quality. New and modified agreements to provide greater mutual confidence on the part of shipping and receiving areas will be attempted at the 1965 meeting."

The voluntary Cooperative State-Public Health Service Program for Certification of Interstate Milk Shippers, first established in 1950, provides Federal agencies, States, communities, and the dairy industry with reliable and meaningful information on the sanitary quality of milk and milk products procured from areas beyond the jurisdiction of local agencies. The Interstate Milk Shippers List, published four times a year by the U. S. Public Health Service now lists more than 1100 interstate milk shipping organizations in 46 States and the District of Columbia, and shows the sanitation compliance ratings of their milk and milk products as certified by State Milk sanitation rating officers.

The PHS List goes to 2200 milk sanitation authorities and to industry officials. The entire program covers the milk production from 150,000 dairy farms and a total of over 12 billion pounds of Grade A milk shipped interstate annually.

Donald Race of the Dairymen's League Cooperative Association, Inc., of New York, program chairman of the 1965 Conference, said: "Basic agreements reached at earlier conferences will be reviewed in the task force committees, and changes will be voted upon by the general assembly. Among subjects scheduled for general consideration are: adoption of the new Pasteurized Milk Ordinance 1965 Recommendations of the Public Health Service; mastitis detection and control; official industry inspection; bulk milk sampling; interstate reciprocity agreements; and non-biological contaminants in milk and milk products. The interstate shipper certification program has improved the sanitary quality of milk being shipped in interstate commerce; it has stimulated a high degree of uniformity in the application of sanitary standards; it has improved milk laboratory control methodology; and it has eliminated the need for costly and wasteful duplicated inspections."

Representatives of regulatory agencies and industry will present other specific problems to be assigned to committees for consideration. Suggested changes in existing basic agreements will be presented at the opening session only for consideration by the entire group.

Shelby Johnson, Director, Food and Drug Division, Kentucky State Department of Health, Frankfort, is chairman of the local arrangements committee.

NEW NATIONAL RESTAURANT ASSOCIATION BOOKLET

A new booklet for its members entitled "A Food Protection Message for Food Service Operators" has been issued by the National Restaurant Association. The commendable purpose of the booklet is to motivate restaurant operators to maintain their food service at the highest level of safeness.

Typical but not authentic cases are selected as horrible examples of what happens when rules of good food sanitation and personnel hygiene are not fully observed. Food poisoning incidents are reviewed and the causes pointed out. The ultimate cost of such experiences in the form of loss of customers, loss of employee effectiveness through illness, and potential premium costs from claims, legal action and even permanent closing of business are emphasized.

The booklet is intended to be helpful to inexperienced operators and others who might become careless and is another service of the Association in its continuing efforts to improve the protection and handling of food.

Copies of the booklet may be obtained at a price of 25c from the Educational Materials Center, National Restaurant Association, 1530 N. Lake Shore Drive, Chicago, Illinois. 60610.

NEW OFFICERS FOR NATIONAL MASTITIS COUNCIL

At its 1965 annual meeting in Chicago on February 19, the National Mastitis Council elected Dr. H. G. Hodges of the De Laval Separator Company as it new president. Other officers for 1965 are Mr. D. E. Hirsch of the American Farm Bureau Federation, Vice-President; Dr. J. C. Flake of the Evaporated Milk Association and IAMFES representative, Secretary; and Mr. M. G. Van Buskirk of the Illinois Dairy Products Association, Treasurer.

Dr. R. W. Metzger, Dairymen's League Cooperative Association, Past President, was commended for his outstanding services and will receive a suitable plaque later. Mr. G. W. Willits who, as Executive Secretary, has been directly responsible for much of the Council's activities was drafted to serve for another year.

A statement of policy regarding endorsements and use of NMC material in advertisements was read and approved at the meeting. The statement is as follows:

> The NMC does not and will not endorse, directly or indirectly, any individual program for reducing the incidence of mastitis. The NMC does not endorse or approve any treatment for mastitis. The NMC does not approve or disapprove any equipment, or adjustments or installations of equipment used for handling of milking cows, or handling milk.
>
> The NMC is a forum for discussing these matters and hopes to accomplish much through the wide dissemination of information and the stimulation of activity that will result in a reduction of mastitis in the nation's dairy herd. It is the policy of the NMC to discourage the quotation or citation of the NMC and its publications in commercial advertising or promotions.
>
> The NMC Board of Directors is particularly concerned over quotations or citations that do not give the full thought of the piece cited. For example, the statement has been made that certain equipment will comply with the "functional recommendations" of the NMC. This is in error in that the NMC has not issued "functional recommendations" as such. While its publication "Current Concepts of Bovine Mastitis" discusses in detail what is known and believed about milking equipment, the statement in question is in error, both in assuming that the NMC has made specific recommendations to follow in installing such equipment, and that the limited number of recommendations cited are fully compatible with and represent all of the findings of NMC publications.
>
> It shall be the policy of the NMC that such quotations and citations be discouraged, and that the officers of the NMC be instructed to execute this policy, striving at all times not to discourage effective work for the reduction of the incidence of mastitis.

AMERICAN DAIRY ASSOCIATION ANNUAL MEETING

Dairymen representing all states except Hawaii will attend the American Dairy Association's 25th annual meeting at Chicago, March 22-24, 1965. This organization long has represented the American dairy farmer in the promotion of consumption of milk and products and improvement of the market position of the industry.

Featured at the annual meeting will be the premier showing of ADA's new motion picture produced in cooperation with the U. S. Olympic Committee. This new film replaces an earlier version produced four years ago and since seen by some 80 to 90 million viewers.

The Association conducts a large non-brand consumer advertizing program promoting milk and milk products. It also engages in a continuing market research, product development and research program as well as merchandising and public relations promotion.

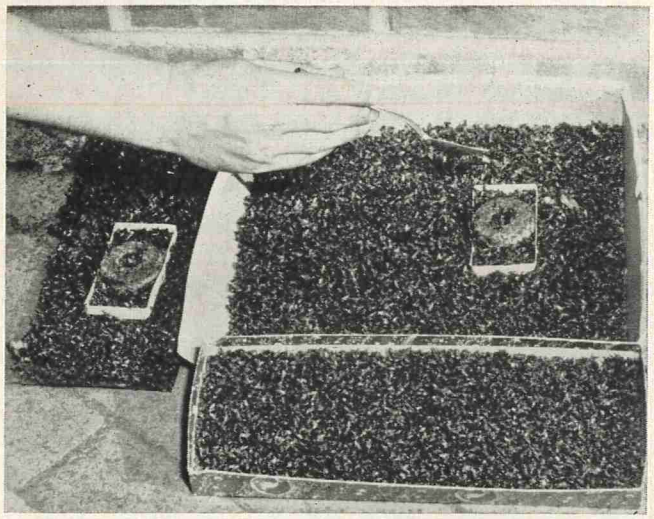
HOSPITAL AND NURSING HOME TRAINING COURSE

Howard University College of Medicine will offer a one-week training course in Environmental Health and Safety in Hospitals and Nursing Homes, April 26-30, 1965, in Washington, D. C.

The program is designed to present the most recent developments in prevention and control of health and safety hazards and will include: recent trends and developments in medical care and implications for environmental controls; legal aspects of hospitals and nursing homes; training and utilization of personnel; housekeeping and maintenance; patient accident causes and their control. Housekeeping and

maintenance topics will cover waste handling, laundry practices, food service operations, radiation, fires and explosion hazards, ventilation and illumination, and air sampling techniques.

Registration is open to health department personnel and others concerned with hospital and nursing home operations. Tuition is $110 but certain traineeships and per diem stipends are available for professional health workers. For further information address: Mr. Bailus Walker, Jr., Director of Short-term Training, Dept. of Preventive Medicine and Public Health, Howard University, Washington, D. C.



NEW LONG LIFE FLY KILLER

A new fly killer has been invented called the Cossman Fly Cake. The fly killer is in solid form, retains its killing power for months and contains ingredients which attracts flies.

The product is particularly useful in areas where sprays should not be used. Above is a photograph of the results obtained by the use of two fly cakes. More information may be obtained on this product by writing: Cossman and Levine, Inc., 7660 Melrose Ave., Los Angeles, Calif. 90046.

IFT TO CELEBRATE ITS SILVER ANNIVERSARY

The Institute of Food Technologists will hold its 25th annual meeting at Kansas City, Missouri on May 16-20. The theme of this Silver Anniversary program will be "Ideas and Technology for Changing Food Habits".

About two hundred technical papers will be presented. Many of the discussions can be expected to influence the creation and production of foods of the future—even some foods which may not reach the supermarket shelves until 1975 and after. Scheduled symposia will cover: preferences and prejudices

limiting proper selection, adequate nutrition and industry development of foods; impact of low-calorie foods on the food industry and on public nutrition; progress in international food laws; radiation preservation of foods; new product development; antinutritional factors in foods and their elimination; and quality control.

The entire program will be devoted to the science and engineering of production, processing, packaging, distribution, preparation and utilization of foods. An attendance in excess of 3000 food professionals is expected. Some 185 exhibits will present information on equipment, supplies and services to the food industry.

INSTITUTE OF ENVIRONMENTAL SERVICES 1965 MEETING

The Institute of Environmental Services has scheduled its 1965 Technical Meeting and Equipment Exposition at the Sherman House in Chicago, Illinois, April 21-23, 1965. Opportunities for exchange of technical and educational material covering a wide range of applications will bring outstanding leaders in the environmental industry together to stimulate creative research and development.

Fields of discussion include earth, space and marine environments; acoustical technology; radiation and heat transfer; shock and acceleration technology; human factors and other aspects of manned space programs; nuclear radiation; standards and calibration; and various educational program and laboratory techniques.

For further information on the program and meeting, address the Institute of Environmental Sciences, 34 South Main Street, Mt. Prospect, Illinois.

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

POSITIONS AVAILABLE

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SANITARIAN — Excellent opportunity for professionally trained sanitarian. Two years' experience in environmental health work and college graduate or combination of experience and formal training for total of six years. Experience in enforcing housing codes desirable. Good fringe benefits. Applications available at Civil Service Commission, City Hall, Waterbury, Connecticut.

WATER RESOURCES AND POLLUTION CONTROL CONFERENCE

The 14th Southern Water Resources and Pollution Control Conference will be held on April 14, 15 and 16, 1965 at the University of North Carolina, Chapel Hill.

On April 14 and 15 the program will cover evolving techniques and methodology for optimizing water utilization and waste control. A new feature of the program, Research Day, will take place on April 16. Water resource and pollution control research will be reviewed.

Information on the complete program is available from Prof. Charles M. Weiss, Box 899, Chapel Hill, No. Carolina.

BETTER TOOLS FOR FOOD DETECTIVES

Advancing knowledge and understanding of both the molecular structure and the physical and chemical properties of proteins has been greatly aided by refinements in technique designed to separate and identify macromolecular species in this class. Thus the "fingerprints" of many native proteins have been classified and characterized.

Forensic chemists and food technologists are taking a new and careful look at some of these developments. Consumers would like to—and have every right to—believe what's on the label. In the field of meats and meat-foods, fish and fish products, especially, it is usually impossible to be sure of the "pedigree" by inspection even under the microscope, or by tasting, much less by reading the label.

But chemists have long known that proteins are highly characteristic of the species from which they come. The muscle proteins from beef, sheep, pork, and poultry each have their own fingerprints. The same is true of different species of fish. Under certain circumstances, the species from which a sample of meat came can be identified.

Often, a combination of techniques must be used. Classical histological and histochemical tests still have their place along with newer immunological, serological, and electrophoretic methods. For example, gel (disc) electrophoresis has recently been exploited in distinguishing between fish such as flounder, pollock, haddock, and cod. Horsemeat or pork can also be differentiated from beef.

There are still problems which remain to be solved. When different proteins are finely ground and mixed, the results of the tests may become somewhat less definite. A big "catch" is that cooked products lose their normal identifying characteristics, especially in the electrophoretic methods.

Reprinted from FOOD AND DRUG RESEARCH, February, 1965.

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