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**Pages 199-201**

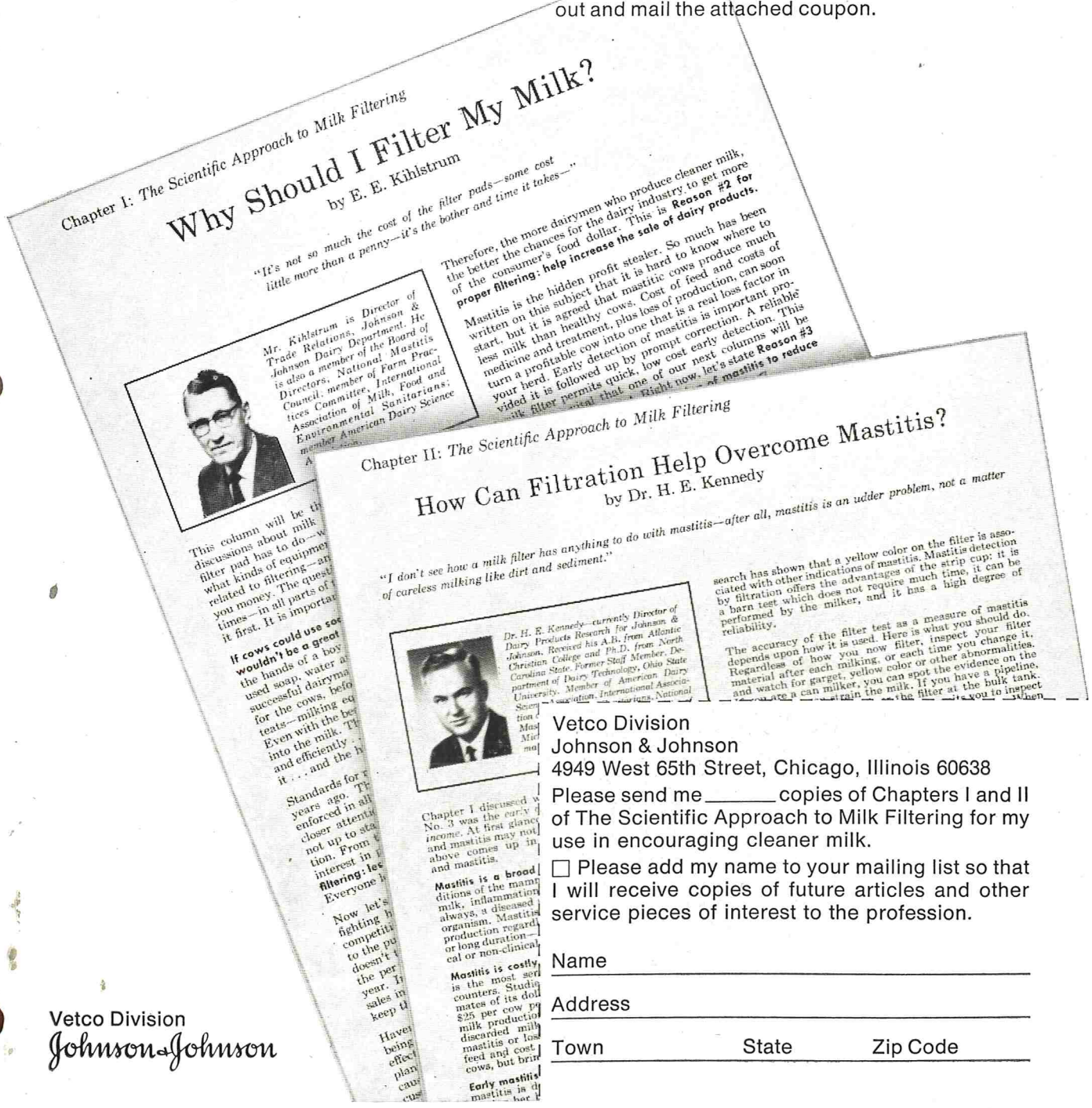
*Official Publication*

International Association of Milk, Food and Environmental Sanitarians, Inc.

## from Johnson & Johnson

# an educational contribution toward the production of cleaner milk

as a step toward our mutual goal of cleaner milk, Johnson & Johnson is presenting to the dairy farmer a series of educational articles under the general heading The Scientific Approach to Milk Filtering. These articles are intended to provide simple, practical answers to everyday questions concerned with the production of better milk, and to help educate the dairy farmer to the need for and value of proper milk filtration. If you are interested in obtaining the first two articles, already in print in leading dairy farmer journals, simply fill out and mail the attached coupon.



Chapter I: *The Scientific Approach to Milk Filtering*

Why Should I Filter My Milk?

by E. E. Kihlstrum

*"It's not so much the cost of the filter pads—some cost little more than a penny—it's the bother and time it takes—"*

*Mr. Kihlstrum is Director of Trade Relations, Johnson & Johnson Dairy Department. He is also a member of the Board of Directors, National Mastitis Council, member of Farm Practices Committee, International Association of Milk, Food and Environmental Sanitarians; member American Dairy Science*

Therefore, the more dairymen who produce cleaner milk, the better the chances for the dairy industry to get more of the consumer's food dollar. This is **Reason #2 for proper filtering: help increase the sale of dairy products.**

Mastitis is the hidden profit stealer. So much has been written on this subject that it is hard to know where to start, but it is agreed that mastitic cows produce much less milk than healthy cows. Cost of feed and costs of medicine and treatment, plus loss of production, can soon turn a profitable cow into one that is a real loss factor in your herd. Early detection of mastitis is important provided it is followed up by prompt correction. A reliable milk filter permits quick, low cost early detection. This is crucial that one of our next columns will be **Reason #3 of mastitis to reduce**

Chapter II: *The Scientific Approach to Milk Filtering*

How Can Filtration Help Overcome Mastitis?

by Dr. H. E. Kennedy

*"I don't see how a milk filter has anything to do with mastitis—after all, mastitis is an udder problem, not a matter of careless milking like dirt and sediment."*

*Dr. H. E. Kennedy—currently Director of Dairy Products Research for Johnson & Johnson. Received his A.B. from Atlantic Christian College and Ph.D. from North Carolina State. Former Staff Member, Department of Dairy Technology, Ohio State University. Member of American Dairy Science Association, International Association of Milk, Food and Environmental Sanitarians, National*

search has shown that a yellow color on the filter is associated with other indications of mastitis. Mastitis detection by filtration offers the advantages of the strip cup: it is a barn test which does not require much time, it can be performed by the milker, and it has a high degree of reliability.

The accuracy of the filter test as a measure of mastitis depends upon how it is used. Here is what you should do. Regardless of how you now filter, inspect your filter material after each milking, or each time you change it, and watch for garget, yellow color or other abnormalities. and watch for garget, yellow color or other abnormalities. and watch for garget, you can spot the evidence on the ...are a can milker, you can spot the evidence on the ...rain the milk. If you have a pipeline, ...the filter at the bulk tank. ...you to inspect ...when

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# VARIATIONS IN BACTERIAL COUNT IN COMMERCIAL CORN FREEZING[1]

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and

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*Western Regional Research Laboratory,[2] Albany, California*

SUMMARY

High bacterial counts arose from washers, from conveyor belts which were inadequately cleaned or disinfected, from the distributor at the entrance to the freezing tunnel, and, generally, from points where corn accumulated on guides, reels, or other equipment along the processing line. Accumulation of corn even at one point can contaminate the rest of the line and raise the count on the final product to more than a million/g. In plant chlorinated water, continuous rinsing of conveyor belts with chlorinated water, and split blanching with the second blanch as close to the freezer as possible lowered count. Continuous attention to the cleanliness of the line is essential.

The presence and behavior of microorganisms in frozen foods have been under investigation for almost as long as there has been a frozen foods industry. In recent years the application of bacteriological standards has often been suggested. Already there are some maximum bacterial tolerances. In 1954 the Canadian Department of Agriculture adopted a statute setting the maximum plate count for frozen vegetables at 100,000/g but has not actively enforced the law. Recently Massachusetts has adopted laws requiring that plate counts shall not exceed 50,000/g in precooked frozen foods sold there. Several industrial users of frozen foods are now buying with a maximum plate count in their specifications *(3)*.

The present paper describes the effect of various unit processes on the bacterial population of corn as it passes through the production line in preparation for freezing. Numerous line samples were collected from a number of cooperating plants in Oregon and Washington. The data presented here are based on total counts of aerobic bacteria on these samples. The number of *Escherichia coli*, staphylococci, or human pathogens would be of greater public health significance. The total count, however, is more readily determined, is included in all of the standards for vegetables, *(3)* and is indicative of the care with which the product has been handled. This report is confined to the effect of processing conditions on the total viable aerobic count.

## LITERATURE REVIEW

Counts of more than 100,000/g have frequently been reported on frozen corn. For example four reports cover the range of 65,000 to 5,000,000/g *(6, 11, 12, 14)*. Of 29 samples from 6 processing plants, only 2 samples were under 100,000/g *(6)*. It is also evident from the data presented below that high counts are extremely common on corn.

Washing only partly removes the microflora present on corn when it enters the plant. Pederson *(8)* reported that washing removed 69% of the bacteria present on corn after husking. Washing removed 90% of the microflora of unblanched peas *(2, 13)*. Hucker et al. *(4)*, however, reported an increase in count at the washer. From cut corn, one cleaner removed about 90% of the bacteria *(11)*, but in another plant a cleaner increased the count *(4)*.

Corn may enter the plant with a relatively high count, but blanching reduced the count by 97% *(8, 12)* or by 99.98% or more *(4, 14)*, and resulted in counts of 1,000/g or less in the corn leaving the blancher. In some processing lines the product cannot readily be sampled at this point. Samples taken after the corn has fallen onto a belt or flume may show higher counts because of recontamination *(11,* data on peas*)*. Blanching similarily reduces microbial flora in other vegetables *(5, 10,* and numerous others*)*.

Since few of the original microflora survive blanching, the problem of reducing the final counts on frozen corn becomes one of proper handling of the product after it leaves the blancher. Sanitation after blanching may be difficult because blanching makes vegetables more subject to bacterial spoilage *(5, 8)* and because of the adhesive properties of the corn juice which covers the product and equipment surfaces *(11)*. As will be discussed below, this causes accumulation of corn and debris which can harbor enormous microbial populations.

Belts have been reported to cause large increases in count during processing of vegetables *(2, 4, 8, 13, 14, 15)*. Splittstoesser et al. *(10, 11)* and Splittstoesser *(9)* reported that one belt, slightly worn, caused a 100- to 200-fold increase in count on beans and peas although newer belts used similarly had only a moderate effect. Scrubbing the belt did not improve the situation, and they concluded that the belt contained many minute cracks or holes that harbored rapidly growing bacteria. Installation of continuous sprays of chlorinated water greatly reduced belt contamination of green beans but not of peas or corn. Belt contamination was much heavier when the belt was only lightly loaded (with peas), because all of the product touched the belt. Counts fluctuated widely with variations in product flow.

Pederson *(8)* found 400,000 bacteria/g in residue around

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

[2]Laboratories of the Western Utilization Research and Development Division, Agricultural Research Service, U. S. Department of Agriculture.

the corn cutter. This exceeded the count on the uncut corn by over 20-fold, and was presumed to be the source of contamination. Splittstoesser et al. *(11)* suggested that corn cutters may create an aerosol of contaminated corn juice.

Other reported sources of contamination of vegetables include a filler elevator and filler *(10)* when cleaning was ineffective, recirculated or static cooling or flume water, or cooling water which spatters onto contaminated surfaces from which it drains into the product *(14, 15)*, wooden guides, boxes, and elevator cleats *(14, 15)* and worker's hands *(6, 14)*. Jones and Ferguson suggested that workers may increase the contamination by rubbing the product into the contaminated inspection belt. They also suggested that the inspection belt should precede the blancher, and Hucker et al. *(4)* stated that the final count on peas may be high if the blancher is far removed from the end of the processing line.

## EXPERIMENTAL METHODS

During the three years covered by this report, we visited 20 corn freezing plants, observed their operations, and took samples from various points along the line. We noted such items as the arrangement of processing equipment, plant housekeeping, and anything else which might affect the bacterial content of the frozen product. Sampling stations normally included the place where the corn was leaving each unit of equipment such as blancher, cooling flume, and dewatering reels or shakers.

All plants had the same basic procedure. The corn was cut from the cob, its enzymes were inactivated by heat, it was freed of chaff and silk, inspected, and then frozen. Nevertheless, each of the 20 cooperating plants had its own sequence of operations. The greatest difference in procedure was in blanching: The corn was completely blanched on the cob before cutting; or it was partially blanched on the cob to "set the milk," and the blanch was completed after cutting; or it was cut and subsequently blanched. There were differences also in the point at which the chaff was removed from the cut corn and in the type of washer or cleaners used to remove it. Some plants washed the corn immediately after cutting and prior to the second blanch, while others washed after the final blanch. Four different makes of flotation cleaners were in use. Flumes, pipe lines, and conveyor belts varied according to needs of each plant. Finally, some froze corn loose on belts in freezing tunnels, some in bulk on trays, and some by packaging the corn and freezing in the package.

*Sampling.*

As corn passed over each sampling station, 6 or 8 oz was allowed to fall into a clean, waxed retail frozen vegetable carton. Where drop filling was impossible, the samples were placed in the box with an alcohol-flamed spoon. The carton was immediately closed, coded, and frozen by direct contact with dry ice. The frozen samples remained on dry ice until they could be transferred to -10 F storage in the laboratory. During the 1959 season one sample was analyzed in the Albany, California laboratory and a duplicate in the laboratory at Puyallup. During 1960 and 1961 single samples were analyzed at Puyallup.

*Analysis.*

Microorganisms were counted according to Recommended Methods for Microbiological Examination of Foods (American Public Health Association, 1958). Fifty g of frozen sample was transferred aseptically to a sterile aluminum blender cup, and blended 2 min with 450 g of sterile tap water at high speed with a Waring Blendor. After standing 2 min to allow the foam to subside, the blender cup was shaken to resuspend particles that had settled out. Decimal dilutions for plating were made from the blended material. The dilution blanks were sterile 0.1% peptone. Plating was in duplicate on Plate Count Agar, Difco. After 72 ± 3 hr incubation at 32 C, the plates were counted under 12 power magnification, using a counter as described by Michener et al. *(7)*. This is higher magnification than is found in the usual colony counter, and is extremely helpful in counting low dilution plates containing corn particles which could be mistaken for colonies.

The APHA procedure gives a higher count than is obtained by shaking the sample in a measured sterile water blank containing glass beads and making the necessary dilutions from the resulting suspension. The shake method is useful in a freezing plant laboratory because it requires less equipment.

Lower temperature incubation would enumerate psychrophilic microorganisms which do not develop at 32 C, but high counts on frozen vegetables result principally from growth of mesophilic organisms on the production line between the blancher and the freezer.

## RESULTS AND DISCUSSION

Table 1 presents the finished product counts of corn samples from 20 plants. In the table the plants have been grouped according to processing methods.

When single blanching on the cob is used, the bacterial population cannot be reduced by heat after the cutting operation. Hence, more scrupulous attention to plant sanitation is needed. Common sense tells us that using a split blanch process with the second blanch as close to the freezer as possible

TABLE 1. BACTERIAL COUNTS OF FINISHED FROZEN CORN (FINISHED PRODUCT COUNT x $10^3$/G)

| Plant | 1959 | 1960 | 1961 | Comments |
|---|---|---|---|---|
| | | | | A. Blanching on the cob |
| 1 | 1,700 | 350 | — | Solution in washer unchanged 9-12 hr at time of sampling (1959). Temperature of solution 86 F. |
| 2 | 91 | 34 | — | Similar to plant 1, but with more frequent change of solution in washer, cooler water, and in-plant chlorination. |
| 3 | 2,800 | — | 310 | Large pickup of bacteria from washer, unsanitary belts, 1959. Improved sanitation, in-plant chorination, 1961. |
| 4 | 2,800 | 420 | 170 | More efficient use of in-plant chlorination and continuous belt sprays in 1960, 1961. Line changed to eliminate some trouble spots. |
| 5 | — | — | 1,700 | Very little attention given to sanitation between daily clean-up periods. Belts very dirty. |
| 6 | — | — | 530 | Storage bin, inspection belt in poor condition, freezing on wooden trays. |
| 7 | — | — | 140 | Sharp angles in chutes, etc., entrap corn. Paddle distributor to freezing belt difficult to clean. |

| | | | | |
|---|---|---|---|---|
| B. Split blanch, cleaning before second blanch, belt freeze. | | | | |
| 8 | 1 | 8.8 | 12 | Continuous cleanup, in-plant chlorination, refrigerated water in fluming, etc. |
| 9a[a] | 77 | 28 | 36 | Continuous rinsing of belts, in-plant chlorination, good policing of plant. |
| 10 | 2,400 | 2,200 | — | Out-of-the-way distributor to freezing belt difficult to clean. Counts low before the distributor. |
| C. Split blanch, cleaning, and inspection after second blanch, belt freeze. | | | | |
| 9b[a] | 120 | 130 | — | Some contamination in washer and distributor to freezing belt. |
| 11 | 680 | 790 | 260 | Main sources of contamination, long conveyor belt, stagnant end of vibrating conveyor. |
| 12 | 310 | — | 480 | Count built up in froth flotation washer, subsequent conveyor belts, air cleaner. |
| 13 | — | 53 | 240 | Counts picked up in air cleaner, inspection belt, distributor in pre-freeze room. |
| 14 | — | — | 730 | Washer, belts, distributor to freezing belts were contamination sources. |
| 15 | 420 | — | 580 | Washer principal source of contamination. Set-up for in-plant chlorination, unused at time of sampling 1961. |
| D. Split blanch, cleaning after second blanch; tray of package freeze. | | | | |
| 16 | — | 12,000 | — | Inadequate cooling, traying on wooden frame trays, freezing in sharp room at 11 F with trays inadequately spaced for good heat transfer. |
| 17 | 580 | 370 | 12 | Filler, bowl, chief sources of contamination in 1959, 1960, tray freezing 1961. Very careful attention given to sanitation of whole plant in 1961. |
| 18 | 510 | 60 | 130 | Washer was principal source of buildup in 1959, traying in 1961. |
| E. Cutting, washing, inspecting corn before blanching; belt freeze. | | | | |
| 20 | 120 | 90 | — | Dewatering shaker, distributor to shaker leading to freezer were buildup sources, but no post-blanch counts were over 150 x $10^3$. |

[a]Plant 9 was operating two lines, 9a where corn was cleaned after second blanch, 9b where second blanch followed cleaning or washing corn.

should give a better opportunity for low-count products. However, this is not enough. Plant number 10 used the split blanch, but neglect of the distributor used to spread corn evenly on the freezing belt gave this plant a poor showing.

Troublesome locations in the lines are discussed below to indicate some of the points at which high-count samples were obtained.

Corn cutters are difficult to keep in good sanitary condition. Counts on corn leaving the cutters ranged from 1000 to 8,600,000/g, with only 6 of 31 samples falling below 100,000/g.

TABLE 2. BACTERIAL COUNTS OF CORN ON EQUIPMENT IN FREEZING LINES

| Sources of material | Number of samples | Counts in millions/g | |
|---|---|---|---|
| Belt guides (Fig. 2) | 9 | 2.3 to 88 | 8.3 |
| Feed pipes, etc., to washers (Fig. 1) | 5 | 0.9 to 17 | 4.3 |
| Distributors at entrance to freezing tunnel | 10 | 0.2 to 620 | 12.0 |
| Others (hoppers, sumps, dewatering devices, etc.) | 11 | 1.6 to 230 | 20.0 |

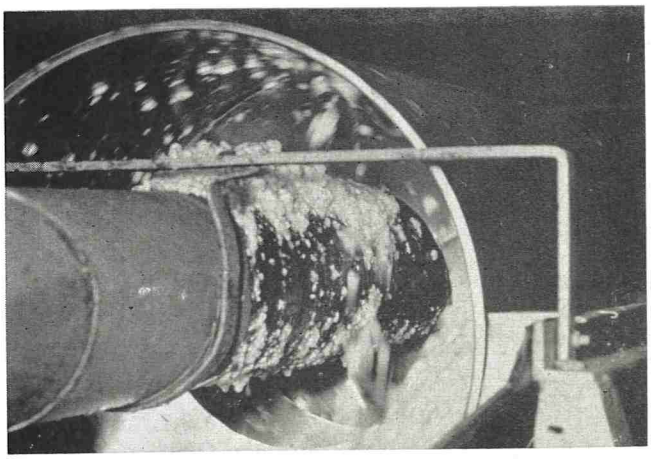

Figure 1. Accumulated corn on feed pipe bringing corn into froth flotation cleaner. Most of this accumulation could be prevented by substitution of a section of open flume for the pipe.

The corn is cleaned by removing loose pericarp and other chaff through froth flotation. Substantial suspensions of corn starch in the cleaner improves frothing. Solutions were only changed infrequently in some washers so that the resulting accumulation of starch would remove chaff more efficiently. Plate counts on solutions from such washers were as high as 10 million g.

Of the 23 pairs of samples taken immediately before and immediately after the flotation cleaning operation, seven showed decreases in count varying from 9 to 92%. No change was noted on one pair, and 15 pairs showed increases ranging from 2- to 22,000-fold. In the case of the extremely large build-up, the corn had a very low count when entering the cleaner. Fortunately, several of the extreme cases were found in plants where blanching after cleaning nullified this particular preblanch build-up, which

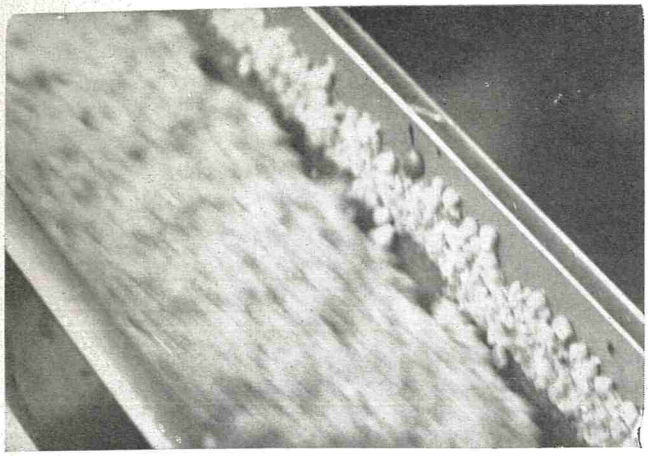

Figure 2. The plate count of the corn accumulated on this conveyor belt guide was several million/g.

would, however, be detected if a direct count were made on the product.

Corn accumulated on the feed pipe leading into froth flotation washers in several plants. These accumulations were observed sliding off the pipe into the washer (Figure 1). The corn which had accumulated on the pipe was removed and plated; it had a count of 17 million/g.

On 50 of 63 conveyor belts, the count rose as the corn passed over the belt. On over half of these 50 belts, the count no more than doubled, but there were some belts on which the count increased by more than 50-fold. Several of these many-fold increases were in locations immediately following the blancher where the count was small, but increases exceeded 100,000/g in some instances.

Accumulation of corn adherent to the processing equipment, as mentioned for the flotation washers, has also been observed in numerous other locations. Samples of these accumulations often contained enormous bacterial populations (Table 2 and Figures 2 and 3). These accumulations can fall back into the main stream of the processing line and contaminate not only the product but all succeeding equipment in the line.

The distributors at the entrance to freezing tunnels were sources of contamination in several plants. The corn usually dropped from distributors through a port in the floor of the room onto the belt in the freezing tunnel below. These distributors are usually located away from the rest of the line and may be hard to get to. They are difficult to clean, since cleaning water can easily run into the freezing tunnel. Neglect at this point nullified all the care in the rest of plant 10. A water-tight door over the freezing tunnel entrance to be closed during clean up periods, would permit thorough washing of the distributor without letting water into the freezing tunnel.

The count in blanched corn changes little during the first 2 hr it is held at room temperature, but on further holding it increases rapidly. Plate counts of blanched corn at room temperature (ca. 75 F) increased by 28%, 600%, and 1500% after 2, 4, and 6 hr (unpublished data, Wolford, 1940). The count on blanched cob corn rises even faster *(8)*.

Since normally less than 20 min passes between blanching and tunnel freezing, there is little chance for microorganisms to build up as the corn is being processed. Package freezing is not as fast, but under normal operating conditions the product temperature will drop below that at which rapid bacterial growth can occur in less than 2 hr. However, bacteria can grow in partial loads of packaged corn left out of the freezer during shut-down periods, such as lunch hours, rest breaks, and changes of shift.

Continuous cleaning of returning belts by spraying with chlorinated water, as shown in Figure 4, was used in plants 8 and 9 during all three years (Table 1, b) and in other plants in 1960 and 1961. Installation of belt sprays and other sanitation noticeably improved plant 4. Vaughn and Stadtman *(14)* and

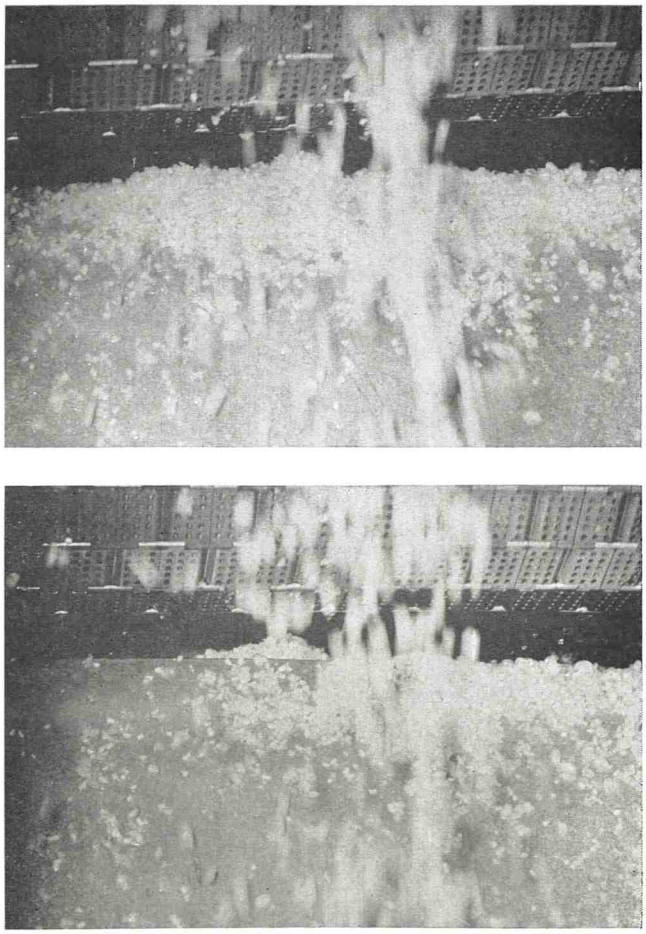

Figure 3. The stainless steel chute at end of a conveyor belt. Upper—Corn accumulated on upper end of chute. Lower—same spot after part of the accumulation had broken loose and dropped down the chute.

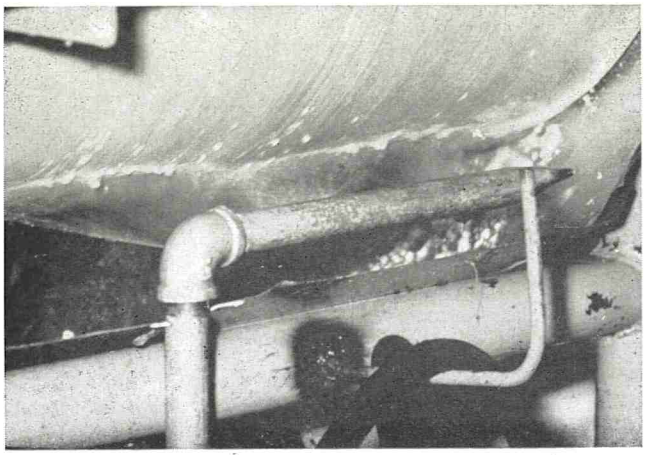

Figure 4. Continuous cleaning of conveyor belts.

Splittstoesser et al. *(10)* discuss this method of controlling belt contamination.

Analysis of duplicate samples in two laboratories yielded some interesting results. In 66 of the 135 comparisons, the ratio of the higher count to the lower was 1.5 or less. This ratio was between 1.5 and 2 in 37 pairs, between 2 and 4 in 15 pairs, and above 4 in 17 pairs. Counts from one of the laboratories were not consistently higher than from the other. Michener et al. *(7)* reported variations of 10- to 50-fold between replicate samples of frozen peas.

Observations made while collecting samples may explain in part why such large variations in count exist. Corn particles were observed adhering to belt guides, hoppers, washers, and other equipment in the line. Entrapment in eddies in flumes and accumulations on the feed pipes to washers also were noted. Should some of this material fall into the product stream and be included in a 50-g sample used for plating, the count obtained may be much higher than the count of the bulk of the product. If an 11-g sample were taken, as is prescribed in the shake method recommended by some industrial buyers, a single kernel of this material would have a proportionally greater effect. Variations in count may also result, as shown by Splittstoesser et al. *(11)*, from variations in the product flow rate.

The increases found as corn passes over different parts of the line must therefore be considered as coming from contact with contaminated equipment or from entrapped product which, after a period of accumulation, may break loose and return to the main flow of product as it travels along the line (Figures 2 and 3) contaminating not only the final product but subsequent portions of the line.

In general, packers are becoming aware of the problems of microbial contamination. Several plants lowered their plate counts substantially during years we visited them. Some have demonstrated that it is possible to pack corn with a microbial count of less than 50,000/g. Whether a standard at this level is too restrictive may be debatable, as a single oversight in sanitation can send the counts far above this.

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# SOME OBSERVATIONS ON THE BACTERIAL QUALITY OF INSTANT NONFAT DRY MILK IN CONSUMER PACKAGES[1]

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Summary

Samples of instant nonfat dry milk in consumer-size packages were collected over a period of 12 months for bacteriological analysis. Highest average bacterial count was obtained at 30 C. The average bacterial count of all 72 samples was 1900 per g. Counts ranged from 18,000 to less than 300 per g. Statistical analysis of the data indicated that higher total counts might have been obtained using a plate incubation temperature below 30 C. Of 1350 isolates obtained from the samples, 13.5% were gram-positive cocci. The remainder of the organisms were gram-positive rods. There was a tendency for samples having higher bacterial counts to have a higher proportion of cocci.

Considerable work has been done regarding bacterial quality of whole and nonfat roller and spray-dried milk, but no investigations have been reported concerning the quality of instant nonfat dry milk.

Supplee and Ashbaugh *(15)* stated that bacterial counts per g of powder are usually due to recontamination after drying. It was reported further that the number of organisms surviving drying remained quite constant regardless of the number present in milk prior to drying provided the liquid milk had a normal flora. They reported also that bacteria in milk powder died rapidly during storage. Additionally, large numbers of bacteria in dry milk did not alter the keeping quality of the powder if the moisture content was low enough to be commercially acceptable.

## Literature Review

Macy *(10)* determined bacterial counts of 31 spray-dried and 13 roller-processed powders and reported that counts of the spray process powder ranged from 4,400 to 5,500,000 per g, and for roller process powders the range was from 40 to 7,900 per g with the majority of the samples showing counts below 500 per g. High storage temperatures and prolonged storage periods were effective in reducing the bacterial counts.

Nichols *(12)* reported an average plate count of 4,363,000 per g of powder on 400 samples of spray-dried milk from 8 powder plants. A positive presumptive coliform test was obtained from 10% of the samples, but some of the positive results were due to anaerobic sporeformers. The yeast and mold counts were negligible.

Crossley and Johnson *(3)* showed lack of relationship between counts of raw milk and powder by comparing spray-dried milk from two plants. The wide disparity in raw milk counts (825,000 versus 37,000,000) was not reflected in the plate counts of the powders produced by the two plants. The bacterial count of the powder from the plant receiving a high grade raw milk, averaged 198,100 per g and that of the plant receiving a low grade raw milk averaged 57,790 per g of powder. Acid-forming thermoduric cocci accounted for the bulk of the flora of spray-dried milk powder. The bacteriological quality of powders was found to depend ultimately on the numbers and species of the organisms which survived pasteurization but the hot-air drying process resulted in considerable destruction of bacteria. The mean plate count for the winter period (October through March) was 50,110 compared to a mean of 61,420 for the summer period, with the range in the counts being much wider during the summer months. After three months storage, the mean count was only 25.9% of the original mean count. *Streptococcus durans* tended to die fairly rapidly and usually was not found in large numbers in powders after storage for three months. *Streptococcus thermophilus* survived for longer periods of time, but micrococci appeared to survive more readily than did any of the streptococci. As the storage time was lengthened aerobic spore-forming bacilli tended to predominate.

Mattick, Hiscox and Crossley *(11)* observed that poor cleaning and management gave significantly higher counts in the finished product. When a 30 C incubation temperature was used, microbacteria (*Corynebacterium*) predominated.

Higginbottom *(5)* found that at an incubation temperature of 37 C, less than 5% of the counts of the roller-dried products were above 100,000 per g, but that 70 to 85% of the counts of the spray-dried products exceeded this figure. At a plate incubation temperature of 55 C, less than 15% of the roller-dried products exceeded 10,000 per g while 45 to 55% of the spray process samples did exceed this number. Marked differences among the plate counts of samples derived from various plants were noted. The sifting and bagging of roller processed powder resulted in an increase in count of approximately 55% when plates were incubated at either 55 C or 37 C. The counts obtained at the 37 C incubation temperatures on roller-dried milk averaged about three times those at the 55 C temperature. With the spray-dried products the counts at 37 C were many times higher than those at 55 C.

Higginbottom *(6)* found that after storage of samples there was a decrease in the number of bacteria that would grow at 37 C but there was no decrease in those that would grow at 55 C.

After examining 315 samples of spray-processed powder Crossley *(2)* found that 70% yielded plate counts below 20,000 per g of powder. For drying operations not exceeding eight hours duration, 86% of all counts were below 20,000 per g; 81% below 10,000 per g and 20% below 1000 per g. High

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counts resulted from bacterial growth in the evaporator and in the atomizer feed tank.

Findlay, Higginbottom and Smith *(4)* showed that bacterial counts of spray powders were low when preheating temperatures of 200 and 190 F were used. When 185 F was used, counts were only slightly higher but preheating temperatures of 170 and 160 F resulted in powders of relatively high bacteria counts.

Higginbottom *(7)* reported that during the period 1937 through 1943 there was an improvement in bacteriological quality of spray process milk powder. For eight plants the geometric mean for the years 1937-38 was 446,700 at 37 C and 8,710 at 55 C incubation versus 3800 (37 C) and 460 (55 C) for the year 1943.

Higginbottom *(8)* found a poor correlation beween reduction time and plate count at 30 or 37 C. Higginbottom *(9)* noted that at high atmospheric humidities (80-100%) a rapid reduction in numbers of bacteria was followed by rapid growth of bacteria, and by overgrowth by molds. At relative humidities below 80% the number of surviving bacteria increased with decreasing humidity to maximum survival at about 10% relative humidity. The number of bacteria surviving then tended to fall again as the relative humidity approached zero. Maximum survival at 5-15% relative humidity was confirmed using pure cultures of *Streptococcus* and *Micrococcus*.

Olson and Nielsen *(13)*, using sterile equipment, showed that recombined milk could be stored at 45 or 50 F for 72 hr with no changes in flavor although there were significant increases in bacterial counts.

## EXPERIMENTAL METHODS

Six commercial brands of instant nonfat dry milk in consumer-size packages were obtained monthly from the Gainesville market for 12 consecutive months, a total of 72 samples.

Plate counts, coliform counts and yeast and mold counts were obtained following the methods outlined in Standard Methods for the Examination of Dairy Products *(1)*. Four incubation temperatures (30, 32, 37 and 55 C) were used to obtain the plate counts and all plates were incubated for three days. Milk protein hydrolysate agar (Baltimore Biological Laboratories) was used to pour the plates. Poured violet red bile agar (Baltimore Biological Laboratories) was used to determine the coliform counts and the plates were incubated at 32 C for 18-24 hr. The yeast and mold counts were obtained using the methods outlined in Standard Mehods for the Examination of Dairy Products *(1)* except that the plates were incubated at 30 C for five days.

After the counting was completed, plates which exhibited well distributed colonies and which were not overcrowded were selected for use in picking colonies. Five adjacent colonies from each sample at each incubator temperature were transferred to litmus milk. The isolates were purified using standard diluting and plating procedures.

A Gram stain of each purified isolate was examined under the microscope to determine the morphology of the organisms comprising the flora of the powder. The isolates then were stored at -26 C in litmus milk and held for further classification and identification.

## RESULTS AND DISCUSSION

The average plate counts obtained for the 72 samples examined are presented in Table 1. Both the arithmetic and logarithmic averages are presented.

TABLE 1. AVERAGE COUNTS OBTAINED AT SELECTED INCUBATION TEMPERATURES

| Incubation temp. | Sample | A | B | C | D | E | F | Average of all counts[a] |
|---|---|---|---|---|---|---|---|---|
| 30 C | Arith. | 2000 | 1500 | 1900 | 2200 | 2400 | 1200 | 1900 |
| | Log.[b] | 1600[c] | 1100 | 1700 | 1100 | 1500 | 1100 | 1300 |
| 32 C | Arith. | 1700 | 1900 | 1500 | 1200 | 1900 | 1600 | 1600 |
| | Log. | 1300 | 1300 | 1400 | 950 | 1400 | 1300 | 1300 |
| 37 C | Arith. | 1300 | 1000 | 1700 | 1100 | 1900 | 1400 | 1400 |
| | Log. | 1100 | 930 | 1500 | 930 | 1300 | 1100 | 1100 |
| 55 C | Arith. | 2100 | 2400 | 1200 | 1000 | 1400 | 1900 | 1700 |
| | Log. | 1100 | 1000 | 920 | 860 | 1000 | 1100 | 990 |

[a]Averages of all counts may not agree with an average of the figures in the corresponding row due to rounding errors.

[b]Figures in the logarithm rows are antilogs of the average logarithm.

[c]Figures in the body of the table are averages of 12 values and represent the average count for the year during which samples were collected.

The logarithmic averaging method reduces the effect of occasional high counts. The highest arithmetic average count and also the highest logarithmic count of all samples were obtained using a 30 C incubation temperature. Counts ranged from 18,000 per g for sample B in January to several counts of less than 300 per g. The counts observed on samples obtained during the winter months tended to be higher than those for samples taken during the summer months. The data are summarized in Table 2. The counts are probably affected by the month in which the powder was produced and also by the length of the storage period. Since the production date of the samples studied was not known, it would be erroneous to attempt to relate bacterial count to time of sampling the consumer packages of instant nonfat dry milk.

In Table 3 the results of the analysis of variance are presented. A logarithmic transformation of the data was used in an attempt to overcome non-normality of the original data. In determining the appropriate error term to use to test the significance of the different effects, it was assumed that the sample effects were random and the incubation temperature effects were fixed. Since, as previously explained, the month effects have no clear cut meaning in this experiment, the sum of squares due to month was removed from the error sum of squares in an attempt to increase the sensitivity of the analysis. The dif-

TABLE 2. EFFECT OF SAMPLING MONTH ON BACTERIAL COUNTS AND ON TYPE OF ISOLATE

| Month | Average Count[a] | % of isolates cocci |
|---|---|---|
| November | 1600 | 12.6 |
| December | 2900 | 26.6 |
| January | 1700 | 18.0 |
| February | 2000 | 33.3 |
| March | 2500 | 26.7 |
| April | 2000 | 22.2 |
| May | 1300 | 2.2 |
| June | 900 | 8.9 |
| July | 1300 | 7.8 |
| August | 1000 | 11.2 |
| September | 1000 | 17.5 |
| October | 1300 | 26.3 |

[a]The average count for the six samples at three incubation temperatures (30, 32 and 37 C)

TABLE 3. ANALYSIS OF VARIANCE

| Source | df | SS | MS | F |
|---|---|---|---|---|
| Blocks | 11 | 3.66702 | | |
| Samples | 5 | .67980 | .13596 | 1.38 |
| Temperatures | 3 | .71905 | | |
| Linear | 1 | .64767 | .64767 | 17.31[a] |
| Other | 2 | .07138 | .03569 | |
| Samples X Temp. | 15 | .56124 | .03741 | |
| Error | 253 | 24.87479 | .09831 | |
| Total | 287 | 30.50190 | | |

[a] ($P < 0.01$)

ferences between the means of the six samples studied were not significant. Fitting a straight line to the data explained most of the variation associated with the incubation temperature effects. The slope was negative indicating that higher counts might be obtained using incubation temperatures below 30 C. The interaction between samples and incubation temperature was not significant.

In the examination of all 72 samples only one coliform colony was found using the violet red bile agar presumptive test. The yeast and mold count averaged less than one per g of powder with the highest count being 12 per g in one sample.

By picking five adjacent colonies from one plate from each sample at each of the four incubation temperatures, 1350 isolates were obtained. Of these isolates, only 13.5% were gram-positive cocci. The remainder of the organisms were gram-positive rods. The number of gram-positive cocci isolated was much less than that reported in the literature. This may be explained by the fact that the samples in this study were examined after having gone through normal market channels. This may have involved considerable storage time. Crossley and Johnson *(3)* reported that as the storage time lengethened, the number of cocci in the powder sample decreased and that aerobic spore forming bacilli tended to predominate.

There appeared to be an association between the percentage of cocci isolated and the average total bacterial count for a given month (Table 2). The correlation coefficient between percent cocci isolated and average total bacterial count on individual samples incubated at the three lower incubation temperatures (30, 32 and 37 C) was found to be 0.299. Although this is a low correlation coefficient, it was significantly greater than zero ($p > .95$). It appears that there is a tendency for samples having higher bacterial counts to also have a higher proportion of cocci present.

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# HOSPITAL AND REST HOME SANITATION[1]

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Hospital hygiene or sanitation cuts across all departmental barriers, since its influence is felt throughout the hospital and is not restricted to any given area. A well organized plan to provide effective sanitary control will include the areas of central services, waste disposal, food service, water and plumbing, ventilation and air, laundry, housekeeping, laboratory, aseptic technique, and rodent and vermin control.

This program must be developed to operate efficiently under normal community conditions, and to function effectively during disaster. In the event that normal facilities may be greatly overloaded, needs must be anticipated and emergency procedures established in advance.

In a hospital which operates at an approximate 500 bed capacity, there will be a population five times this great, due to the staff and hospital employees and approximately two visitors per patient per day, or a total of 4000 individuals creating a markedly overcrowded situation. It is well established that patients entering a hospital as a group are generally much more susceptible to infection than are healthy individuals.

When it is realized that every individual, from a few minutes after birth until death, is a carrier of and often infected with various types of organisms, it is easily understood why a grouping of individuals in any crowded area will most probably develop an infectious condition or communicable disease. It should be indicated that infection means the introduction of organisms into a wound or that the organisms have become residents in a particular individual. This may result in sepsis, an acute communicable disease, or a carrier state. Sepsis is concerned with those instances in which the introduction of pathogenic bacteria has produced a suppurating wound or clinical condition.

After an infection occurs, whether or not a pathological condition will develop depends upon three things: the virulence of the infecting organism, the size of the dose, and the resistance of the host. These three factors initially are dependent upon a fourth; there must be a mechanism of transfer of the pathogenic bacteria or organism to the host. It is not possible in this short time to cover all the facets of hospital sanitation; therefore, I shall attempt to point out several specific areas and identify the problems related to them. Control of the sanitary situation will require the utilization of the entire field of epidemiology and could well be called "hospital epidemiology" for the sake of the work related directly to the hospital. But in fact, it amounts to being community sanitation, since the community is also definitely involved.

We must recognize that various strains of bacteria, as well as occasional other organisms, are brought into the hospital each time a new patient is admitted. It is our desire to prevent, if humanly possible, the transfer within the hospital of an infection from one individual to another and to prevent also the transfer of a hospital infection to an individual in the community.

## FACTORS AFFECTING POTENTIAL CONTAMINATION

It is therefore necessary to have adequate and effective control of all activities in the hospital such as surgical procedures, ward care, isolation units, maternity and obstetrical areas, housekeeping sanitation, food service, and all others. Susceptibility to infection among surgical patients is dependent upon such factors as the duration of surgery, the length of the incision, the listing of surgery, whether it is clean or contaminated, and the body area or system involved. Other factors are techniques, the number of personnel, their movement, and the general sanitation of the surgery, to mention a few. A wound infection rate will depend most certainly upon how effectively control is maintained over these various

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factors which may contribute to the introduction of bacteria into the wound.

In general, surgery patients, when there is no known contamination or in which the incision will not require opening of a contaminated area, may be considered clean. Others are recognized as contaminated or dirty at the time of admission to the hospital. Medical patients in general may be more often infected with larger numbers of organisms. This is particularly true in dermatology wards where large areas of the skin are involved and are therefore more susceptible, as well as having a larger area into which infection may be introduced.

In the maternity ward there have been many instances of infections occurring in mothers and infants. It has been amply demonstrated that the staphylococcus phage type 80/81 has been acquired by infants while in the hospital and the infection, having then been transmitted to the mother primarily through nursing, has later produced a breast abcess, thereby introducing into the community an essentially hospital type infection.

It has also been shown that when this occurs in the home, quite frequently the entire family will develop staphylococcus infections over a period of time from which the identical organism can be recovered. Although staphylococcus infection is the most common type in hospitals, and one about which most research is being done, the effective control of this situation should result in a decrease of cross infections of other types.

It is unfortunate that we do not know more about the resistance of the host and have some definite mechanism of determining this resistance, since it would contribute markedly in our effort to solve the problem of cross infections. It is, of course, obvious that in such diseases as poliomyelitis, smallpox, diphtheria, and several others, effective immunity can be produced by artificial means and those individuals who are adequately protected do not present a problem insofar as contracting these diseases is concerned. It is important, therefore, that all staff personnel and employee groups be vaccinated against the important communicable diseases and that a satisfactory level of immunity be permanently maintained.

The food service including the purchase of supplies, preparation and serving of food, cleaning and disposal of waste, presents a problem in the dissemination of disease, particularly those of the gastroenteric type, although by no means limited to these. Since many foods are contaminated in nature and the processing before serving may not be adequate to destroy the organisms, this poses a tremendous task in community as well as hospital sanitation.

The collection of laundry, the cleaning of walls, floors, and equipment all contribute to the possibility of transfer of pathogenic organisms which may result in development of a severe infection. "No stronger condemnation of any hospital or ward could be pronounced than the simple fact that any zymotic disease has originated in it, or that such diseases have attacked other patients than those brought in with them." So said Florence Nightingale 105 years ago. Hospital infections and sanitation are not new subjects.

## EFFECTIVE CONTROL MEASURES

In order to control the problem presented to a hospital, it is imperative that an infection committee be established which has broad responsibilities and areas in which to work. It should have sufficient authority and technical staff to provide the information necessary to develop an adequate program that will result in decreasing the cross infections to a minimum, as well as provide bacteriological surveillance of each contributing activity. Control procedures should be established so as not to require volumes of useless work, but be concentrated in those areas in such a manner as to reasonably be expected to produce the desired results.

In operating room practice as an example, a specific program of procedures should be established in an attempt to make a surgery like an "oasis in the desert" and should embrace the following:

1. Recognition of the importance of contact contamination which will reduce markedly the transfer of infection from patients, personnel, equipment, and supplies. Evidence indicates that persons, not things, are the most important as a factor in transmission.
2. Establishment and maintainance of strict and aseptic techniques by all persons.
3. The exclusion of all personnel with established staphylococcus infections from the operating room and intensive care areas.
4. Exclusion from the operating room of all unnecessary visitors and persons inadequately trained in aseptic technique.
5. The control and management of carriers known to harbor the same strains of staphylococci that are present in the hospital infections.
6. Constant testing of methods of sterilization, removal of street clothing and donning of proper operating room attire before entering the operating room, utilization of efficient masks, adequate preoperative scrubbing, proper preparation and draping of the operative area, carrying out of precautionary and cleaning measures between cases, reintroduction of adequate and realistic isolation techniques, constant revision and study of dressing techniques to minimize cross infection, and avoidance of indiscriminate use of antibiotics and the false sense of security created by their use.

7. In general, prophylatic use of antibiotics in surgical patients as substitutes or short cuts for well established surgical principles in technique should be discouraged. Although the development of antibiotics and chemotheraputic agents has been a tremendous step forward, it resulted undoubtedly in a major breakdown of our isolation techniques and housekeeping procedures.

Although the above procedures have been suggested primarily for the total care of surgical patients, these basic principles of sanitation are equally applicable in all areas of the hospital, but will require special adaptations to the particular service for which they are intended.

### ENVIROMENTAL FACTORS

Among all the physical facilities included in the building which may contribute to hospital contamination, the floor is the largest horizon surface to accumulate settling bacteria and cannot be ignored. Floor cultures are excellent indicators of the bacteriological types of infection and can reflect qualitatively and quantitatively the bacteriology of a room's occupants. They also act as an index of the infectivity of the environment. Patients with infection continually shed microbes into their environment and in turn these may be transported by droplet nuclei, droplets, or dust particles to other areas. The size of the particles will determine the rate at which settling occurs. The larger ones of 100 microns in diameter and more will settle immediately, those 2 to 10 microns in diameter will not settle to any appreciable extent, those of intermediate size will settle at various rates and this rate can be determined and bacterial counts and identification made.

The activities of the patient and the personnel will also affect the number of bacteria-laden particles in the air. High concentrations of bacteria are directly related to, and increased by, bed making, dry mopping, and activity of the patient and personnel. Be cause bacteria accumulates on the floor, the method of floor care is a major factor in determining the fate of the bacteria-laden debris, and unless these organisms are destroyed at frequent intervals, floor counts will reach astronomical proportions while air counts are concurrently increased.

### FLOOR CLEANING AND DISINFECTING

The ordinary clean mop and clean pail of solution are effective for a period of time, but rapidly progress to the point of being a dispersal mechanism for bacteria. When the pail is emptied and cleaned, the mop serves as a mechanism of transfer of bacteria to the clean solution, making the samples of the solution uncountable, particularly if the mop is stored for several days. Cultures of a sterile mop, pail, and soapy water immediately after replacing the mop following its use on a floor and at the end of a week end storage in a janitor's closet, were 230 per milliliter and 19 x $10^4$ per milliliter respectively.

When the operating room floor, after each use, is mopped with a 3″ string mop wet with a fresh solution of germicidal detergent, much better results are obtained. The mop is rinsed thoroughly in running water, is discarded after each use, and is sent to the laundry at the end of each day. A sanitary floor is essential to control air-borne contamination. Facilities must be provided for disinfection of the floor in the anteroom and sub-sterilization room adjacent to the operating room, since asepsis is as important here as is the instrument sterilizer.

At the end of the days schedule all furniture should be removed from the room or across the room so that the entire floor is accessible for cleaning. Trash and debris must be removed with a water trap or cyclone separator type of vacuum cleaner. A sufficient quantity of acceptable germicidal solution is made up. The actual type of germicide is less important than the manner in which it is used, provided it is an effective one. Overhead lights, furniture, sloping areas, shelves, molding, etc. are wiped with a clean cloth which has been wrung out of the detergent solution. The center of the floor area is flooded and washed first with obviously soiled spots being solubilized as necessary. The remainder of the floor is then flooded and scrubbed in a specific pattern. The moist slurry is picked up by a wet vacuum cleaner, starting at the door so that the hose and other parts of the equipment never become contaminated. The wet vacuum has the additional advantage of removing all contaminated material from small cracks, abrasions, and defects in the floor.

This same technique should be used daily in the nurseries, isolation units, obstetrical wards, and for terminal disinfection in patient care areas. Periodic bacteriologic monitoring must be done by taking samples from the floor and other areas after cleaning has been completed. Bacterial counts under 5 per cubic centimeters are possible in operating rooms and under 10 per cubic centimeters on ward floors.

Volume air counts do not increase during vacuum cleaning with properly designed and well maintained machines. This method has been shown to be effective in removing bacterially contaminated dusts and aerosols and should be used to replace all dry dusting and sweeping.

Floor waxes containing germicides have been found not to be more effective than ordinary wax over a long period of time. The only advantage is that the germicide will prevent contamination of the wax while it is being stored. In some instances, floor wax has been a source of contamination to the floors

after they have been cleaned. An effective, although less extensive type of operation is necessary for all the floors in the hospital, including the kitchen, halls, stairwells, and other service areas.

### CONTROL OF AIR-BORNE INFECTION

Because of the great expense and the uncertainty of the value, intensive study should be given elaborate ventilating systems before they are installed. The two prime objectives of mechanical ventilation are to remove as quickly as possible high concentrations of bacteria from specific areas, and to prevent cross infection between wards or potentially contaminated rooms and areas. Contruction problems are frequently compounded by the age and size of the hospital and use of natural ventilation.

Since air currents are important in the dissemination of disease, it is accepted procedure to have fresh, clean, filtered, bacteria-free air delivered to the operating room and kept under positive pressure so that by no means could air-borne contamination enter the surgery from another area. Proper organization of procedures initiated to eliminate entirely, or to reduce to an absolute minimum, movement in and out of the surgery of any personnel except those specifically required for the surgical procedure, must be enforced. One hospital was able to reduce the trips in and out of one operating room from fifty to two during a surgical procedure. In an isolation unit where highly infectious disease is being treated, the air pressure should be maintained on the negative side so that no possibility of infection could be transferred by air currents from the isolation unit to the remainder of the hospital by opening and closing of doors.

Each problem must be studied from all angles and in relation to other areas and activities in the hospital and those procedures instituted which do the job and fit into the general over-all sanitation control. Complete bacteriologic control with epidemiologic follow-up must be continually carried on in order to meet changing conditions and to be assured that the specific work being done in hospital sanitation is effective in producing results.

A hygienic environment results in disappearance of hospital strains of bacteria, a decrease in cross infections, and a shift of the bacteriology of the carrier toward a benign type of organism.

### REST HOMES AND CONVALESCENT FACILITIES

Environmental sanitation in rest homes, convalescent hospitals, and old peoples homes where groups of individuals with increased susceptibility to infection are cared for in limited quarters creates similar problems, although not as acute as occurs in the hospital. It is nevertheless a very important one and requires adequate attention.

There is less likelihood of securing adequately trained and properly supervised individuals to perform the necessary tasks, and thus it may become important for the health agencies to exercise a certain amount of control through legislation, education, consultation, and periodic investigations. Often much more drastic action, even to the extent of closing certain facilities must be taken.

The nursing home accreditation plan which has been developed will provide a marked impetus to the improvement of nursing home care. Although this is on a voluntary basis, it should tend to raise the general level of sanitation and care. Inferior rest homes will of necessity raise their levels of sanitation and care in an attempt to meet the competition of the accredited homes.

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# EVALUATION OF FOOD-SERVICE SANITATION PROGRAMS[1]

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One of the major problems confronting health departments today is the problem of program evaluation. Evaluating a program means, simply, determining how good a job has been done. It is a process of judging the worth of an enterprise according to some definite set of values.

Evaluation is an essential part of program administration and administrators of food-service sanitation programs who neglect it risk program decay. Its chief purpose is to point the way to progress. It enables us to make our work more effective—it provides a means to test our goals, our methods and our procedures against needs and accomplishments, and to change them in the light of our findings. It provides a sound basis for future planning and aids in obtaining needed supportive facilities and equipment, in promoting necessary budget support and, where necessary, in upgrading the qualifications of program personnel.

One form of evaluation is going on all the time. The public, as well as the public health agencies, either consciously or subconsciously, are continuously making judgments about the worth of the food-service sanitation program. They either are making complaints about it or are paying it compliments. We need to be sensitive to these "judgments." It is true that occasionally the public is not properly informed, has "an axe to grind" or has a complaint based on some reason other than the reason given. Nevertheless, experience has indicated that more often than not their complaints or comments are worthy of investigation.

In recognition of the importance of systematic evaluation in the development and maintenance of effective food protection programs, the Public Health Service has developed a tentative "Procedure for Evaluating Food Service Sanitation Programs."[2] It is widely accepted that, to be effective, a procedure must be based on a specific standard. It is through measuring deviations from a known standard that progress or regression in a program can be determined. The Procedure under discussion is based on the 1962 "Food Service Sanitation Ordinance and Code" which is a recognized national standard relating to food-service establishments.

The new Procedure is significantly different from the previous Public Health Service eating and drinking establishment rating methods, as will be shown in the following discussion. Greater emphasis was placed on the administrative aspects of the food-service sanitation program in the 1962 "Food Service Sanitation Ordinance and Code," so in the evaluation Procedure it is necessary that the criteria established take into account this important program aspect. In this connection, a more objective evaluation of administrative considerations may be achieved through the use of questionnaire type forms and through suggested items included in the Procedure, which will provide a basis for determination of program quality under each item.

The "Procedure for Evaluating Food Service Sanitation Programs" is broken down into two parts—Food-Service Establishment Data and Program Operations Data. Since both of these parts are very essential to a good operating program, they will be considered in more detail in this discussion.

Under this Procedure, the Food-Service Establishment Data is collected through the inspection of a statistically representative number of a community's food-service establishments. The sample is selected at random from the total number of establishments in the community. The establishments selected are inspected and the significant deviations from the sanitary requirements contained in the 1962 "Food Service Sanitation Ordinance and Code" are noted on the inspection sheet. These deviations are subsequently tabulated on a master sheet, the demerit scores determined, an average demerit score is calculated, and from the graph which will be included in the Procedure, a numerical score is recorded.

Other than a more specific and complete breakdown of sanitation requirements on the inspection sheet and the use of demerit scores, the field procedure for this part of the evaluation does not vary too much from previous survey procedures recommended by the Public Health Service.

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

[2]A copy of the new "Procedure for Evaluating Food Service Sanitation Programs, First Edition, (Tentative)" is available from the office of the Milk and Food Branch, Public Health Service, Washington, D. C.

### GUIDE LINES FOR EVALUATING CREDITS

However, the part in regard to Program Operations Data is a much newer concept. As many of you will recall, the administrative aspects in previous rating methods consisted of sixteen broad items with points assigned, under the title of "Enforcement Methods." There were not, however, any written instructions or guide lines established as to how to make a judgment in awarding of the point credits under each individual item. This is not the case under the new Procedure.

The Program Operations Data is broken down into several subparts. They include: Interpretation of Requirements, Administrative Procedures, Staff Training, Industry Training, Public Information, Program Support, Plan Review, Supportive Facilities and Measures, and Food-Service Establishments Outside the Jurisdiction of the Health Authority. Credit points are assigned to each subpart.

In the first subpart, Interpretation of Requirements, previous inspection records of the establishments surveyed in the evaluation will be reviewed to determine if violations are being consistently and accurately reported. Each significant violation should be recorded on the inspection sheet each time it occurs. The concept of significant violations will be discussed with the person accompanying the survey officer to determine if he is in agreement with the interpretation of the violations that were noted on the survey.

The second subpart, Administrative Procedures, takes into account the health authorities' procedures, including administrative or enforcement actions, to secure compliance with the 1962 "Food Service Sanitation Ordinance and Code." The last two inspection reports on those establishments in the sample are retrieved from the health department records and are reviewed for completeness of information, neatness, legibility and orderliness. Unless the inspection report is complete and legible, the restaurant operator has no way of knowing what he must do in order to comply with the sanitation requirements.

The dates on these two inspection sheets are also noted. The Ordinance and Code states that there must be at least one official inspection each six months. This is a minimum. Most health jurisdictions will find that a greater frequency of inspections will be desirable to achieve satisfactory compliance. It will also be determined from the records what action, if any, the health authority is initiating for successive violations of the same item of sanitation, or for violations that need prompt action — those where a serious health hazard may be involved if the deficiency is not corrected.

Staff Training is the third subpart. Continuous training of all food sanitation personnel is necessary to develop and maintain staff competencies. The food industry is undergoing a "product explosion in that roughly 80% of the convenience foods now available were not on the market some 15 years ago. The sanitarians must keep themselves knowledgeable in these new products, new processes, and new equipment. Staff training can be accomplished through short courses, seminars, professional meetings, staff meetings, conferences, joint inspections with trained personnel, viewing training films and through self-education activities. Textbooks, reference materials, trade and professional journals should be readily available for staff use.

Experience has shown that if food-service employees understand why they are to do certain things, why foods should be refrigerated, why utensils and dishes should be cleaned and sanitized, they are more likely to do it in the correct manner. This type of reasoning is behind the fourth subpart, Industry Training. The health authority has the obligation to point out the public health responsibilities of industry personnel and cooperate with them in solving problems, but should not assume responsibility for the training of food-service employees. It should, however, assist management in training the employees. The attitude of management has a great bearing on the effectiveness of the sanitation practiced in the establishment — even on the attitude his employees have toward correct sanitation practices. In evaluation of this subpart, the health authorities' efforts to assist industry through formal or informal training, instructions during inspections, distribution of printed or written information, and assisting in the training of food-service personnel will be checked.

### PROGRAM SUPPORT

Public Information, the fifth subpart, is an important phase of health department operations. Unless the public is aware of the needs, goals, and values of food sanitation, how can they be expected to give public understanding or the program the support necessary to achieve a high level of food protection? Under the proposed Procedure, the survey officer will review the methods utilized by the health authorities in dissemination of information, such as releases to radio, television, press and talks to civic, fraternal and professional organizations. The releases, for example, could take the form of health department activities in food sanitation, warnings on types of food to be avoided on picnics, new ideas in food sanitation, or the reasons for certain requirements. These releases, of course, should not be a "one-shot" affair, but should be on a regular, continuing basis. Only in this manner of keeping the public adequately informed can a health department

hope to secure support either in adopting correct sanitation viewpoints or in budgetary considerations.

The sixth subpart, Program Support, is probably the most difficult area in which to arrive at a judgment. This area is concerned with the priority being given the food sanitation program in relation to the other programs for which the sanitarian is usually responsible, and the adequacy of the budget to meet the program needs. Included in this component would be, among other things, provision of an adequate number of competent program personnel, sufficient funds for all necessary travel, materials, printing, books and journals, technical equipment and other essentials to program operations. The analysis of measures being used to develop and maintain a suitable level of program support should be considered, including budget requests and utilization of personnel.

"Built-in sanitation" is one of the newer concepts of an efficient, well operated restaurant. In the seventh subpart, Plan Review, this is taken into consideration. To insure compliance with sanitary requirements, to prevent any misunderstanding by the operator as to what is required, and to prevent errors which might result in additional cost to the operator, the health authority should require the submission of properly prepared plans and specifications for all new or extensively remodeled establishments before such work is begun. These plans should be reviewed and approved by the health authority. Credit will be given this item according to the extent to which plans are being required and reviewed.

In the subpart on Supportive Facilities and Measures, it is recognized that a food-service sanitation program may be effectively administered by well qualified personnel, yet may not have the equipment necessary to do the job or the facilities necessary to adequately implement the program. Adequate planning must be undertaken, in advance, to handle both routine and emergency services. In the evaluation of this portion of the data, the survey officer will note if a laboratory is available within a reasonable distance, which has the capability of performing microbiological analyses to identify the genera of the several microorganisms important to food sanitation, and qualitative analysis for chemical contaminants and adulterants. Whether the laboratory is used by the health agency also will be checked.

There should be a plan, known to the entire staff, in regard to the investigation and reporting of foodborne illness. For instance, the secretary in the health department receives a call stating that a number of persons are ill shortly after having a meal at "X" establishment. Does she know the individuals who must be contacted to get the investigation underway immediately? What about the procedure for the actual investigation — is there a prepared kit for collecting samples, who interviews the persons exposed to the possible illness, how are the samples collected, where are the collected samples sent, how are they sent, and how long will it take the samples to arrive and bacteriological or chemical tests conducted? By reviewing the files and by asking questions it will be determined how previous foodborne disease outbreaks were handled and if they were reported to the next higher administrative level.

It has been surprising to learn that quite a number of health authorities either do not have or do not use such basic equipment as indicating and maximum registering thermometers, chemical test kits, light meters, water pressure gauges, inspection forms, flashlights and other items of field equipment that are essential to making a thorough inspection of a food-service facility. This particular problem will be taken into account during the evaluation.

The last subpart under the Program Operations Data of the Evaluation Procedure relates to an emerging problem, that of Food Service Establishments Outside the Jurisdiction of the Health Authority. While twenty years ago most potentially hazardous foods were produced at the site of consumption or at least in the same city of general area, during the past few years the preparation of food supplies at a central point for shipment to distant areas has grown tremendously. It is not unusual for a dairy or bakery to be located in one State, which serves restaurants in two or three surrounding States. Time or finances would not permit the routine inspection of these facilities by each health authority which is being served by those businesses, nor should this be necessary. However, the health authority should assure himself that any food being received from any food-service establishments not under his routine inspection (1) operates under regulations substantially equivalent to those in the Ordinance and Code, (2) is under routine official supervision, and (3) that the sanitation practiced in those establishments is at least equal to that of the community receiving the products. During the evaluation of this subpart, the survey officer will discuss the procedures that have been established by the health authorities to permit acceptance of reports from responsible authorities in other areas where such food-service establishments are located.

## MEASUREMENT OF PROGRAM QUALITY

Through the use of the questionnairs and guide lines in the Procedure, a credit point total has been established for each of the nine subparts discussed. The total credits awarded will be added, and this value will be reported as the Program Operations Data Numerical Score.

There are now two scores—the Food-Service Establishment Average Demerit Score and the Program Operations Numerical Score. The scores by themselves have only limited meaning, but are an index to the quality of the total food-service sanitation program. As an index, they are useful in identifying a range of program quality. Although each of the scores will be reported as whole numbers, they will be identified as a Sanitation Level and an Administrative Level. The score ranges for the various levels will be clearly identified in the Evaluation Procedure.

As with any investigation, inspection, or evaluation, the work accomplished or the things that should be accomplished, must be brought together into a written report. This report should clearly identify the community or jurisdiction evaluated, the official agency responsible for the program, the Numerical Scores and Program Level achieved, and the program characteristics which contributed to achieving the scores and level, as well as those components which need strengthening. In this connection, specificity must be the rule rather than the exception. The program deficiencies must be clearly identified and recommendations for correction of these deficiencies should be presented in a constructive manner so the responsible administrative officials may use them for program improvement.

Report writing is not a simple or easy task, but it is probably the real key as to how effectively the results and recommendations determined in the evaluation will be implemented. For this reason, each evaluation report must be an "individual report." It cannot be a "form" where numbers and statistics are merely entered. Stereotyping should be avoided if the report is to be effective.

It cannot be emphasized too strongly the care that should be exercised in conducting an evaluation and in summarizing the results. You would be amazed at the mathematical errors—those of simple addition and subtraction—that "creep into" the reports. Carelessness on just one or two items can detract greatly from the effectiveness of the report.

At this point it might be well to discuss briefly the type of person who should make such program evaluations. In order to use these new criteria in an acceptable maner, it is important that the survey officer be a well qualified professional sanitarian, engineer, veterinarian, or other environmental health specialist who has demonstrated a high proficiency in food-service sanitation activities. Naturally, he should have a detailed knowledge of the 1962 "Food Service Sanitation Ordinance and Code" since this entire Procedure is based on that document. He should have a thorough understanding of program administration, and a basic knowledge of the epidemiology of foodborne diseases. His qualifications also should include a demonstrated ability to analyze factual information, to use such information to arrive at logical conclusions, and the ability to translate these conclusions into practical, constructive recommendations.

Since the same criteria will be used in each evaluation, it is necessary that interpretations of that criteria are uniform and consistent. To aid in developing this uniformity, all survey officers should be standardized and certified in the use of standard evaluation methods. The Public Health Service, through its Regional Milk and Food Consultants, will offer a food-service sanitation survey officer standardization and certification program.

In conclusion, the past few minutes have been spent in discussing the need for evaluation and in pointing out many of the areas included in the Public Health Service recommended "Procedure for Evaluating Food Service Sanitation Programs." The qualifications of the person who is to do such an evaluation also have been emphasized.

Although many months of careful thought and consideration, as well as the best thinking of the States have gone into this document, the Public Health Service has not purported that it has suddenly arrived at a foolproof, absolute solution to the problem of evaluation. It is believed, however, that certain areas have been incorporated into the criteria that are essential to a good food-service sanitation program, and that by use of the questionnaires, specific questions to be answered, and specific guide lines, a more objective evaluation will result.

Evaluation should not be thought of as an end in itself. It is really just the beginning. Through efficient use of evaluation, we can plan and operate better food-service programs.

# ASSOCIATION AFFAIRS

## PROGRAM

### FIFTY-CESOND ANNUAL MEETING

### INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS, INC.

In Cooperation With

### CONNECTICUT ASSOCIATION OF DAIRY AND FOOD SANITARIANS, INC.

**September 13-16, 1965**

**Hotel America** — **Hartford, Connecticut**

### REGISTRATION

**Monday, September 13—1:00 P.M.-5:00 P.M.**
**Tuesday, September 14—8:00 A.M.-6:00 P.M.**

**Registration Fee $5.00**
**Ladies' Registration $5.00**

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### SUNDAY, SEPTEMBER 12, 1965

10:30 a.m.—Executive Board Meeting, President's Suite

12:00 noon—Lunch

1:30 p.m.—Executive Board Meeting, President's Suite

6:00 p.m.—Dinner

8:00 p.m.—Executive Board Meeting, President's Suite

### MONDAY, SEPTEMBER 13, 1965

1:00 p.m.-5:00 p.m.—Registration, Convention Lobby

#### SPECIAL MEETINGS

8:00 a.m.-12:00 Noon—Executive Board, President's Suite

1. Report on Local Arrangements
2. Report of Executive Secretary
3. Report on Sanitarians Joint Council

12:00 Noon—Lunch

1:30-5:00 p.m.—Executive Board, President's Suite

1. Report of Journal Management Committee
2. Regular Agenda