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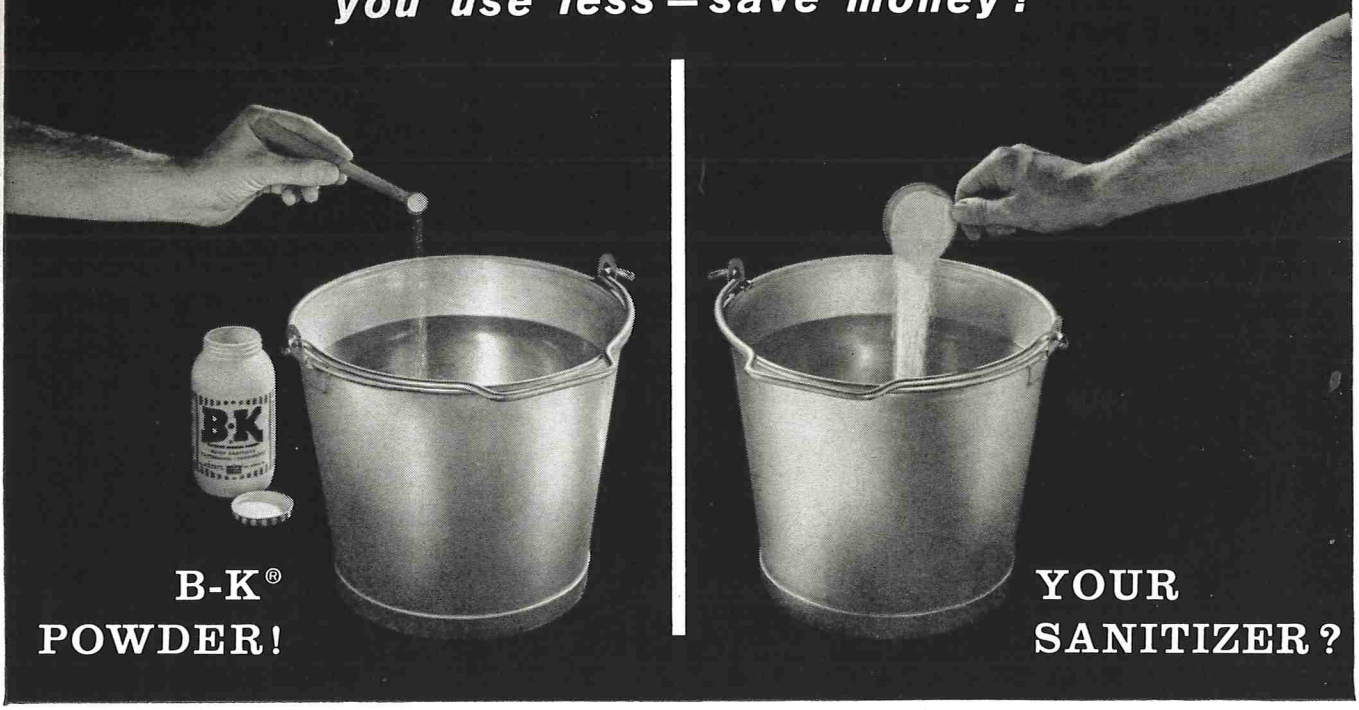

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Manuscripts: Correspondence regarding manuscripts and other reading material should be addressed to J. C. Olson, Jr., Associate Editor, Dept. Dairy Industry, University of Minn., St. Paul, Minn.

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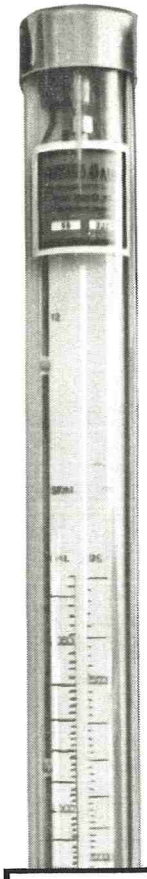

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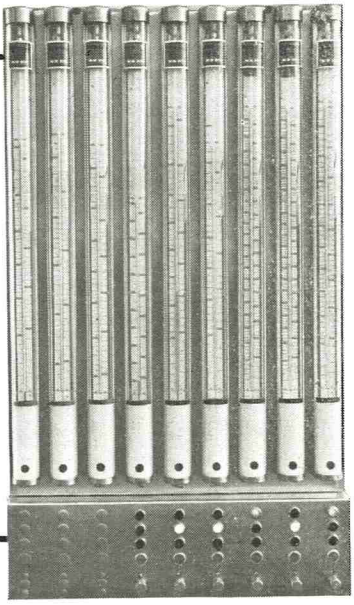

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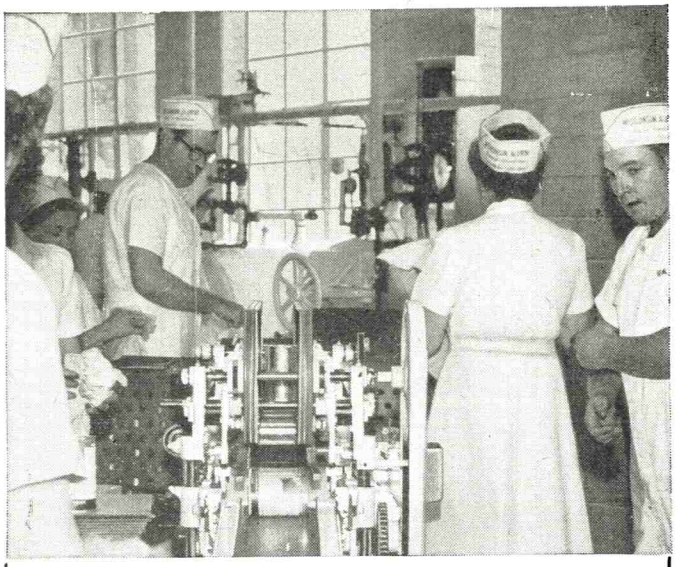

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EDITORIAL

Good Can Come From Group Action

An editorial in the November 1961 issue of *The American Milk Review,* called attention to the recent creation of a *Dairy Industry Board.* Its basic purpose will be to coordinate and direct activities of mutual concern to the member associations. Member associations in this case, mean the several segments of the whole industry such as milk, ice cream, cheese, etc.

Such a step is a commendable one. The studies, research and deliberations of this Board should bring into play the capabilities of the entire industry. Such unified thought and action on common problems will undoubtedly be both productive and valuable.

This action by the several interests in the dairy industry recalls a similar action taken in 1956 when the *Sanitarian's Joint Council* was formed. The feeling had been expressed by many that the several organizations having sanitarian members would do well to meet periodically and discuss common problems. This is precisely what is done by the *Sanitarian's Joint Council.*

Today there are four organizations having varying degrees of interest in the sanitarian. First, there is The Engineering and Sanitation Section of *The American Public Health Association.* This section has a membership of about fourteen hundred. How many are sanitarians is not precisely known. However, the group is of fair size.

Then there is The *National Association of Sanitarians* with a membership of about two thousand.

Another organization having headquarters in Oklahoma has a membership of about three hundred. This is the *National Society of Professional Sanitarians.* Another is *The Institute of Sanitation Management* with a varied membership, but a goodly number of its members practice in the environmental sanitation field largely in industry and commerce.

Finally, there is our own *Association,* having a membership of over four thousand with it origin dating back to 1911.

One might ask, "Why so many organizations with closely allied interests?" To answere this question, one should go back to origins. Of all the groups mentioned, The American Public Health Association is the oldest. Its genesis was in 1872. In those days, the control of the common communicable diseases and the control of epidemics was most urgent. Today the APHA has a membership of about thirteen thousand, embracing every public health discipline. Its program covers a very wide range of interests including the behavioral sciences, mental health, radiological health, epidemiology and environmental health, to name a few. With such diverse interest, it has become the recognized national association where all facets of public health are given an audience.

In the case of our own Association, it had its origin in the milk and dairy control field. In 1911, the safety of milk and dairy products was the consuming interest of those of our founders who needed to help one another through group action. Over the years our interests have broadened and so have the interests of our membership. This is as it should be. It identifies us as an Association that recognizes the broad areas of environmental problems with which we must deal.

The National Association of Sanitarians, came into being about 1945. It originated in California where sanitarians working in generalized programs felt a need for banding together. The NAS has grown both in numbers and effectiveness and has affiliated chapters in twenty-seven states.

The National Society of Professional Sanitarians, had its origin in 1956 at which time its Constitution was adopted. It emphasizes professionalism based upon a college degree and legal registration as a part of its membership requirements.

The Institute of Sanitation Management, has heavy representation among persons charged with building maintenance and sanitation, yet numbers among its members men engaged in food production and processing.

To combine all of these organizations into one would appear to be difficult. With their divergent interests it probably would not be feasible. However, through all there is a common bond of interest. And that common interest is improvement of professional standards which go hand in hand with productivity and improved effectiveness in environmental sanitation.

Like the *Dairy Industry Board,* we feel the Sanitarian's Joint Council is utilizing the idea of group action. In the final analysis individual action is highly important but group action would appear to expedite matters with resulting benefit to all.

H. S. Adams
Indianapolis, Indiana

Opinions expressed in this Editorial are those of the author and are not necessarily those of this Association.

THE MICROBIOLOGY OF SOME SELF-SERVICE, PACKAGED, LUNCHEON MEATS [2]

W. A. MILLER

Department of Bacteriology, Kansas State University
Manhattan, Kansas

(Received for publication August 20, 1961)

Microbiological examinations were made on 181 packages of sliced luncheon meats which were collected over a period of 21 months. Packages were obtained from 3 stores. Samples from 26 packages developed defects (sour, yeasty or musty, and sliminess) after storage for 3 to 7 days at 3° to 7.5° C; most of these originated from only one of the three stores.

Microbial counts on several spoiled samples, especially pickle loaf and macaroni-cheese loaf exceeded 2 billion/sq. inch.

There are a variety of sliced, packaged, self-service luncheon meats available in retail markets where they are stored at temperatures above 0° C. If such meats carry certain psychrophilic microorganisms, abnormal odors and/or flavors may develop under certain conditions, especially after the consumer purchases and stores such products at varying refrigerator temperatures and for varying time intervals.

Adame, Post, and Bliss *(1)* studied the bacteriology of commercially prepared, wrapped "wet" and "dry" type sandwiches. The staphyloccus count (using selective media) on some of the "dry" type sandwiches (including ham and salami) was greater than the standard plate count. No coagulase positive strains were recovered. However, they indicated that food poisoning types might be able to multiply under the same conditions, i.e., at ambient air temperatures (23° - 30°C) for 17-20 hours prior to sale.

Allen and Foster *(2)* studied the deterioration of vacuum-packed sliced processed meats during refrigerated storage. They suggested that meat packers cannot control types of organisms in their products, but that numbers can be controlled by good plant sanitation. If the microbial count is excessive, then storage life may be shortened.

Alford and Elliot *(3)* postulated that bacteria growing on food products stored at low temperatures may not cause fat deterioration so long as the food is held near 0°C; however, short periods at higher temperatures could cause fat lipolysis by the enzyme formed at the lower temperature.

Alm, Ericksen, and Molin *(4)* reported that some sliced processed meat products retained a higher quality in cold storage when vacuum-packed than when sealed at atmospheric pressure. They concluded that shelf-life in vacuum packages is prolonged when the initial bacterial count is low.

American Meat Institute Foundation *(5)* reported that adequately processed cured meats are subject to recontamination on the surface during handling, slicing, and packaging. Micrococci, yeasts, lactobacilli, microbacteria, and other lactic acid bacteria may be present.

Brown, Vinton, and Gross *(6)* reported that heat resistant cocci in processed canned ham multiplied slowly at refrigerator temperatures. They reported that multiplication of cocci in meat may act as a safety measure against growth of undesirable organisms.

Deibel, Niven, and Wilson *(7)* studied microbiological and related aspects of some fermented sausages and reported bacterial counts ranging from 4 million to 48 million per g in salami samples from various establishments. Lactobacilli comprised the predominant flora.

Miller *(8)* investigated the microbial flora of self-service, package, square slices of cooked ham and found a range of fewer than 1,000 to 52 million microorganisms per sq inch of surface area (initial count). Samples from 28 of 113 packages stored for 4 to 7 days at 4° to 11°C were sour. The dominating organism from the sour samples belonged to genus *Microbacterium*.

EXPERIMENTAL PROCEDURE

Four types of self-service, packaged luncheon meats (balogna, pickle loaf, cooked salami, and macaroni-cheese) were purchased at approximately weekly intervals over a period of 21 months from 3 of several stores doing a large volume of business in Riley County, Kansas. Within 15 minutes after purchase the packages were placed at 3° to 4°C and initial microbiological analyses were made on an outside slice from each package within 4 hours.

Five portions from at least 3 slices of each package were re-wrapped in "saran wrap". One of the 5 portions was placed at 3° to 4° C; one at 7° to 7.5°C; and one at 10° to 11°C. After 3 to 4 days one sample from each of the 3 temperature ranges was removed and analyzed. The remaining samples

[1]Contribution No. 378, Department of Bacteriology, Kansas Agricultural Experiment Station, Manhattan.

TABLE 1—MICROBIAL POPULATIONS OF PACKAGED SLICED LUNCHEON MEATS SOON AFTER PURCHASE, AND AFTER STORING AT 3° TO 11°C FOR 3 TO 7 DAYS (STORE I)

Type of product	Number of packages	Approximate numbers of microorganisms per sq inch of surface area					Total packages having an obvious abnormal odor, or showing sliminess
		Initial counts	Time and temperature of storage (portions of opened packages)				
			3 to 4 days at:		7 days at:		
			3° to 4°C	7° to 7.5°C	10° to 11°C	3° to 4°C	7° to 7.5°C
Bologna	22	<1T to 9M Md = 3½T	<1T to 5M Md. = 20T	<1T to 5.5M Md. = 310T	<1T to 12M Md. = 1.7M	<1T to 4M Md. = 84T	<1T to 120M Md. = 5.5M	0
Pickle Loaf	16	<1T to 14M Md = 12T	<1T to 14M Md. = 45T	<1T to 20M Md. = 111T	<1T to 200M Md. = 1M	<1T to 600M Md. = 575T	3T to 700M Md. = 46M	3
Cooked Salami	16	<1T to 1.6M Md = 3T	<1T to 8M Md. = 18T	3T to 85M Md. = 126T	<1T to 200M Md. = 1.1M	<1T to 150M Md. = 40T	6T to 300M Md. = 2.8M	1

T = thousand, M = million, B = billion, Md. = median

stored at 3° to 4°C and 7° to 7.5°C were held 7 days before analysis.

Procedures were essentially the same as those previously employed by Miller (7), except that eugonagar was used as a medium instead of tryptone-glucose-yeast extract agar. Plates were incubated at approximately 23°C.

RESULTS AND DISCUSSION

Microbial counts on packages of meat at time of purchase.

Initial counts made within 4 hours after purchase on balogna, pickle loaf, and cooked salami (Table 1) from Store I, revealed medians of 3,500, 12,000, and 3,000 microorganisms per sq inch, respectively.

In 3 similar products (Table 2) from Store II, listed in the same order, the median counts were 56,000, <1,000, and 1.1 million; 2 additional products (Store II), i. e., macaroni-cheese, and vacuum sealed macaroni-cheese showed medians of 32,000 and <1,000, respectively.

Median counts on 4 products (Table 3) from Store III were <1,000, 61,500, 240,000, and 176,000 on balogna, pickle loaf, cooked salami, and macaroni-cheese, respectively.

Maximum initial counts were 14 million on pickle loaf from Store I, 19 million on nonvacuum sealed macaroni-cheese from Store II, and 65 million on pickle loaf from Store III. Microbial counts and condition of samples stored 3 to 4 days and 7 days at various temperatures follow:

Store I: Three of 16 samples of pickle loaf exhibited abnormal odors and sliminess in 7 days at 7° to 7.5°C. The maximum count at this time was 700 million per square inch and the median 46 million. Samples from one of 16 packages of salami were slimy and sour in 7 days at 3° to 4°C and at 7° to 7.5°C; the counts were approximately 200 million on the slimy samples. Nothing abnormal in odor or appearance was detected among 22 samples of balogna. The maximum count was 120 million, and the highest median 5.5 million (Table 1).

Store II: Of a total of 21 packages of macaroni-cheese loaf, samples from 3 packages were found to have a definite musty odor in 7 days at 7° to 7.5°C. Counts on these samples were approximately 200 million per square inch.

The maximum counts for balogna, pickle loaf (vacuum-sealed), and salami (vacuum-sealed) were 70 million, 21 million, and 60 million, respectively. There was no obvious spoilage or sliminess in samples from 40 packages of these products (Table 2).

Store III: Samples from 4 of 20 packages of balogna were sour and slimy in 7 days at 7° to 7.5°C. Microbial counts on these 4 samples were 275 million to 400 million; the median of the 20 samples for the same time and temperature was 4.7 million.

Of 14 packages of pickle loaf, samples from 6

packages had a sour (and/or yeasty) odor, and were slimy in 7 days at 7° to 7.5°C; additional samples from 3 of the same 6 packages were sour and slimy in 7 days at 3° to 4°C. Other samples from 1 of the 6 packages were slimy and had an "off" odor in 4 days at 3° to 4°C, and in 4 days at 7° to 7.5°C. Microbial counts on 3 of the 6 samples were more than 2 billion per sq inch in 7 days at 3° to 4°C.

Samples from 3 of 12 packages of salami exhibited obvious "off" odors and, in addition, 1 of the 3 samples was slimy; counts on the abnormal samples were 100 million, 200 million, and 260 million in 7 days at 7° to 7.5°C.

Of a total of 20 packages of macaroni-cheese loaf, samples from 6 packages were sour or otherwise obviously abnormal in odor and appearance in 7 days at 7° to 7.5°C; other samples from 4 of the same 6 packages were spoiled in 7 days at 3° to 4°C. (Table 3). Counts on the 6 samples were 600 million to more than 2.5 billion per sq inch at 7° to 7.5°C. The median of 20 samples held 7 days at 7° to 7.5°C was 450 million.

NATURE OF THE MICROBIAL FLORA

Several genera of microorganisms were cultured from the luncheon meats. Among the organisms found were catalase negative streptococci, and lactobacilli. Yeasts, micrococci, and microbacteria were commonly present. Pinpoint colonies were frequently observed in considerable numbers on plates. Pseudomonads were observed infrequently.

Straka and Stokes *(9)* isolated 17 representative psychrophilic bacterial cultures and 1 yeast from materials collected at antarctica. The optimum growth temperatures for 16 of these psychrophiles were 20°C or above, and the maximum growth temperatures of 15 cultures were between 28° and 35°C.

TABLE 2—MICROBIAL POPULATIONS OF PACKAGED SLICED LUNCHEON MEATS SOON AFTER PURCHASE, AND AFTER STORING AT 3° TO 11°C FOR 3 TO 7 DAYS (STORE II)

Type of product	Number of packages	Approximate numbers of microorganisms per sq inch of surface area					Total packages having an obvious abnormal odor and/or showing sliminess
		Initial counts	Time and temperature of storage (portions of opened packages)				
			3 to 4 days at:			7 days at:	
			3° to 4°C	7° to 7.5°C	10° to 11°C	3° to 4°C	7° to 7.5°C
Bologna	18	<1T to 9M Md. = 56T	<1T to 10M Md. = 300T	<1T to 13M Md. = 360T	<1T to 18M Md. = 5.5M	<1T to 11M Md. = 1M	22T to 70M Md. = 11M	0
Macaroni & Cheese	10	<1T to 19M Md. = 32T	26T to 70M Md. = 770T	2T to 60M Md. = 1.8M	—	22T to 144M Md. = 1.3M	30T to 220M Md. = 2.4M	2
Macaroni & Cheese[a]	11	<1T to 300T Md. = <1T	<1T to 1M Md. = 3T	<1T to 55M Md. = 15T	3T to 90M Md. = 20T	6T to 70M Md. = 10T	5T to 200M Md. = 90T	1
Pickle Loaf[a]	12	<1T to 180T Md. = <1T	<1T to 4M Md. = <1T	<1T to 4.5M Md. = <1T	<1T to 5M Md. = <1T	<1T to 7.5M Md. = <1T	<1T to 21M Md. = 400T	0
Cooked Salami[a]	10	9T to 6.5M Md. = 1.1M	<1T to 16M Md. = 2.3M	21T to 14M Md. = 2.2M	38T to 25M Md. = 3.7M	5T to 33M Md. = 3.0M	60T to 60M Md. = 3.8M	0

[a]vacuum sealed

TABLE 3—MICROBIAL POPULATIONS OF PACKAGED SLICED LUNCHEON MEATS SOON AFTER PURCHASE, AND AFTER STORING AT 3° TO 11°C FOR 3 TO 7 DAYS (STORE III)

Type of product	Number of packages	Approximate numbers of microorganisms per sq inch of surface area					Total packages having an obvious abnormal odor, and/or showing sliminess
		Initial counts	Time and temperature of storage (portions of opened packages)				
			3 to 4 days at:			7 days at:	
			3° to 4°C	7° to 7.5°C	10° to 11°C	3° to 4°C	7° to 7.5°C
Bologna	20	<1T to 350T Md. = <1T	<1T to 1M Md. = 4.5T	<1T to 40M Md. = 14.5T	<1T to 80M Md. = 120T	<1T to 60M Md. = 91.5T	<1T to 400M Md. = 4.7M	4
Pickle Loaf	14	<1T to 65M Md. = 61.5T	<1T to 700M Md. = 1.7M	100T to <2B Md. = 5.5M	650T to >2B Md. = 27.5M	12T to >2B Md. = 11M	1.1M to >2B Md. = 240M	6
Cooked Salami	12	<1T to 9M Md. = 240T	<1T to 16M Md. = 1M	7T to 17M Md. = 1.1M	8 to 30M Md. = 9M	<1T to 80M Md. = 6M	1T to 260M Md. = 16.5M	3
Macaroni & Cheese	20	<1T to 19M Md. = 176T	<1T to 350M Md. = 6.8M	2T to 300M Md. = 25M	12T to 1B Md. = 132M	<1T to 2B Md. = 55M	2T to >2B Md. = 450M	6

These findings strengthen our convictions for choosing an incubation temperature of 23°C for plates, so as to culture most psychrophilic organisms and many mesophiles.

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BACTERICIDAL ASPECTS OF HIGH TEMPERATURE PASTEURIZATION OF ICE CREAM MIX[1]

MARVIN L. SPECK

Department of Food Science and Processing
N. C. State College, Raleigh

The primary purpose of a pasteurization process is to add assurance that a food is free from pathogenic microorganisms. Although opportunities may exist for contamination of the product after pasteurization, it is much more difficult to control the microbiological flora of the raw product. The varied possibilities for contamination of the raw product have made pasteurization processes essential. As one examines the development of pasteurization procedures, it becomes obvious that the basic concepts used in establishing requirements for milk pasteurization have also been involved in the standards established for ice cream mix. Since *M. tuberculosis* was found to be the most heat resistant pathogen likely to be carried by raw milk, the destruction of this microorganism has been most important in the development of official pasteurization standards. North and Park *(8)* found the following exposures sufficient to destroy *M. tuberculosis* in milk: 140°F for 10 min; 142°F for 10 min; 145°F for 6 min; 150°F for 2 min; and 160°F for 20 (or less) sec. They concluded that 142°F for a 30 min holding period was quite ample for the destruction of *M. tuberculosis* in milk.

The limitations on pasteurization treatments have been governed somewhat by economic considerations. Dahlberg *(1)* presented data showing the relationship between heat treatments necessary to destroy *M. tuberculosis* and those which caused impairment of cream volume; this latter property was considered to be of prime economic importance by milk processors. Cream volume impairment began at 142°F for 53 min, 145°F for 24 min, and 160°F for 20 sec. Thus, the treatment necessary for destruction of pathogens did not endanger cream volume particularly at lower temperatures. It was noted, however, that a comfortable time margin did not exist between these two conditions at 160°F.

We see, therefore, that milk pasteurization standards have been somewhat the result of a compromise between conditions required for bacterial destruction and those which could impair certain properties of milk. In more recent years, however, two other factors have had an effect on pasteurization standards for milk. One has been the homogenization of pasteurized milk which has reduced the economic value of cream volume (as has also the use of opaque packages). The second factor has been the discovery that *Coxiella burnetti,* the cause of Q fever, is a microorganism possessing heat-resistance somewhat in excess of *M. tuberculosis.* As a result of extensive research, the low temperature, holding (LTH) method of pasteurization standard has been raised to 145°F for 30 min; whereas, the high-temperature, short-time (HTST) standard of 161°F for 15 sec was found to be adequate. In raising the LTH temperature to 145°F little or no opposition was voiced from industry since cream line no longer is considered to be of importance.

The pasteurization of ice cream mix has the same main purpose as the pasteurization of milk, viz., the destruction of any pathogens which might be present in the product. Oldenbusch *et al. (10)* reported that *M. tuberculosis* in ice cream mix was destroyed at 145°F in 6 min. Other pathogens were destroyed by less heating. Official action was then given to recognize 143°F for 30 min as adequate pasteurization for ice cream mix. However, Fabian and Coulter *(2)* found that a 30-min hold at 155°F seemed necessary to free ice cream mix from coliform bacteria. Myers and Sorensen *(8)* studied this problem carefully using a heat-resistant strain of *E. coli.* They found 150°F for 30 min to be adequate, but recommended 155°F for 30 min as a margin of safety to insure destruction of *E. coli* in ice cream mix. This recommendation appeared to be consistent with heat treatments which would give mix the properties of good whipping and quicker freezing.

In view of these considerations, a pasteurization standard of 155°F for 30 min was reasonable from the processing standpoint, and it was much more than adequate for the destruction of pathogenic bacteria. The first Frozen Desserts Ordinance and Code recommended by the U. S. Public Health Service, therefore, suggested the pasteurization standard of 155°F for 30 min, although it did provide also "that nothing in this definition shall be construed as disbarring any other process which has been demonstrated to be equally as efficient". During the past 20 years, studies have been designed to ascertain other processes which are "equally as efficient" as 155°F for 30 min.

The experimental work involved in determining equivalent pasteurization exposures for ice cream

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mix posed certain problems which should be considered. The first decision concerned the most appropriate test cultures which could be used. The use of pathogens appeared unwise for several reasons: *(a)* the difficulty in determining what constituted typical heat resistance among cultures of *M. tuberculosis; (b)* the use of pathogens in plant experiments seemed to be an unnecessary hazard; and *(c)* since 155°F for 30 min was a far greater heat treatment than necessary to kill the most heat resistant pathogen, it would not be possible to determine equivalent heat treatments by the use of pathogens.

Consequently, the search for suitable non-pathogenic test-cultures was begun. A culture giving 100% kill at 155°F for 30 min did not seem most appropriate since, even if such a culture were found, it would be difficult to measure accurately the exact time giving complete kill. As a result, attention was turned to the use of cultures which would survive the standard pasteurization treatment in reasonable numbers. Then, various experimental time and temperature combinations could be determined which would give the same percent kill as the standard treatment. Various bacteria, usually micrococci, fulfill these requirements and have been used extensively in establishing HTST pasteurization treatments.

Another important aspect of ice cream mix pasteurization concerns the constituents in ice cream mix which are not present in milk. Consideration should be directed toward the probable effect of these on heat resistance of bacteria contained in mix.

The content of milk fat in a medium has been shown to be of only minor importance in the heat resistance of contained microorganisms. Thus, Hening and Dahlberg *(5)* showed that 40% cream required only about 1°F more than did milk at a given holding time for the destruction of *E. coli.* Sanders and Sager *(11)* noted that 20% and 40% cream required a temperature only 0.7°F higher than milk for the inactivation of phosphatase. These and similar studies have given assurance that pasteurization standards for milk are adequate for pasteurization of cream.

Variations in protein content between milk and ice cream mix are not known to have any measurable effect on heat resistance of bacteria.

The sugar content of ice cream mix can be expected to have the greatest influence on increased heat resistance of bacteria. Fay *(3)* pointed out clearly the effects of various sugars in hypertonic solutions on heat resistance of bacteria and thermal inactivation of certain enzymes. Lactose content seemed to have no effect. However, sucrose and glucose markedly increased heat resistance of bacteria. Confirmatory evidence for these effects have been noted by Sanders and Sager *(11)* for phosphatase inactivation in various milk products, by Speck and Lucas *(14)* for pasteurization of chocolate milk, and by Grosche, Lucas and Speck *(4)* in the pasteurization requirements of 3: 1 condensed whole milk.

With the foregoing considerations in mind, let us consider briefly the results of some research that was designed to determine pasteurization exposures in the HTST range which would provide bactericidal activity equivalent to 155°F for 30 min. The work to be described was conducted in our laboratories and described in more detail in a previous publication. *(13).*

Mixes were used which were typical in composition of those used for ice milk, regular ice cream mix, and premium mixes. In order to obtain representative mixes, 6 were tested. An analysis of the data indicated that mix composition had no significant effect on bacterial destruction. In view of their similar content of sugar (14 - 17%), and the fact that the variations in fat (4-18%) should have no effect, these results were not unexpected.

Laboratory pasteurization studies were conducted using 2 heat-resistant non-sporeforming bacteria as test cultures, viz., *Micrococcus sp.* (no. MS 102) and *Microbacterium sp* (no. 342-S-1). These were exposed to temperatures of 175°, 180°, 185° and 190°F for varying periods of times. In each experiment a control was pasteurized at 155°F for 30 min. The data obtained indicated that bacterial destruction equivalent to 155°F for 30 min was obtained by the following:

Temperature	*Microbacterium sp.* (No. 342-S-1)	*Micrococcus sp.* (No. MS 102)
175°F	16.0 ± 0.3 sec.	19.9 ± 0.7 sec.
180°F	11.0 ± 0.2 sec.	11.4 ± 0.2 sec.
185°F	6.4 ± 0.05 sec.	7.1 ± 0.05 sec.
190°F	.25 ± 0.01 sec.	0.94 ± 0.03 sec.

These data indicated only a slight difference in the resistance of the 2 cultures. The results showed that the tentative standard of 175°F for 25 sec, which had been permitted since 1948, is more than adequate.

In order to test the data obtained in the laboratory under practical operating conditions, some experiments were conducted with plant equipment. Mix was prepared containing the following: fat 12%; milk-solids-not-fat 10%; stabilizer 0.35%; and cane sugar 15%. The culture MS 102 was inoculated into the mix 10 min before pasteurization.

The first series of the plant experiments was performed with the Vacreator[2]. The mix was pasteur-

ized with first chamber temperatures of 185°F, 190°F, 195°F, 200°F, and 205°F. A control portion of the mix was pasteurized at 155°F for 30 min. By linear interpolation using logarithms of per cent survival it was determined that a first chamber temperature of 191.5°F would give destruction of the test culture equal to that of 155°F for 30 min. This temperature compared closely to the first chamber temperature of 194°F proposed by Tracy *et al. (15)* who also has been studying the Vacreator as a pasteurizer for ice cream mix. Furthermore, these workers calculated that the mix in the first chamber was held at the pasteurizing temperature for 0.75 sec. Assuming that the same holding time existed in our unit, the exposure of 191.5°F for 0.75 sec compared closely with the laboratory data where 190°F for 0.94 ± 0.03 sec was found to be equivalent to 155°F for 30 min.

In a second series of plant experiments inoculated mix, as used for the Vacreator, was pasteurized by a Stevac[3] pasteurizer. The holding tube had been adjusted to give a holding time of 25 sec. Then the mix was pasteurized for the 25-sec holding time at 165°, 170°, 175°, 180°, 185° and 190°F. A portion of the mix was pasteurized at 155°F for 30 min to serve as a control. The equivalent Stevac temperature was calculated as for the Vacreator. The experiments showed that a temperature of 172.2 ± 0.48°F for 25 sec was equivalent to 155°F for 30 min. These data agreed well with the laboratory phase where 175°F for 21.2 sec was found equivalent to 155°F for 30 min. Furthermore, this gave evidence for the adequacy of the tentatively approved standard of 175°F for 25 sec.

With this information available, the U. S. Public Health Service recommended approval of two new pasteurization treatments for ice cream mix. The tentative aspect of 175°F - 25 sec was removed and this exposure was fully approved; also approved was a first chamber temperature of 194°F in the Vacreator. It should be noted that both of these standards are above the heat treatment required for equivalence to 155°F for 30 min. Substantiating evidence for the greater equivalence of these new standards was shown in the work of Tobias *et al. (16)*. These workers, using the Roswell heater to pasteurize ice cream mix, reported that bacterial destruction equivalent to 155°F for 30 min was obtained at 181.3°F in 3.8 sec at 187.2°F in 0.8 sec. Similar confirmatory work was reported by John *et al. (6)* who reported that a first chamber temperature of 194°F in the Vacreator was more bactericidal than 150°F for 30 min in the pasteurization of ice cream mix.

The safety of the new pasteurization exposures, as established by the use of test culture MS 102, should be considered. In ice cream mix, milk phosphatase is inactivated at 155°F in only 5 min *(11)*. The same exposure killed *M. freudenreichii* Ms 66 in ice cream mix *(12)*. Both the phosphatase and micrococcus are more heat resistant than the heat resistant pathogen, *M. tuberculosis*. Therefore, the pasteurization standard of 155°F for 30 min has at least a 6-fold margin of safety in time. Other pasteurization standards, which are equivalent in lethality to 155°F for 30 min have comparable margins of safety. Since the new standards (175°F - 25 sec. for HTST and 194°F for the Vacreator) exceed 155°F for 30 min in lethality, they *a priori* have more than the 6-fold margin of safety.

The safety of the new pasteurization standards can be examined from another approach. If a semi-logarithmic plot is made of equivalent pasteurization treatments, *viz.*, 155°F - 30 min (vat) 172.6°F - 25 sec (Ste-Vac) and 191.5°F - 0.75 sec (Vacreator), essentially a straight line is obtained. Time-temperature relationships represented by this graph are, therefore, equivalent to one another. This line has a z value of approximately 10.8. Kells and Lear *(7)* reported that 3 strains of *M. tuberculosis* var. *bovis* in milk had z values from 8.6 to 9.4. These values are much lower than the z value of 12.6 which had been calculated for *M. tuberculosis* in cream from earlier work that was not done with the precision permitted by modern techniques. There is, therefore, no evidence that the destruction of pathogens in ice cream mix would require time-temperature combinations above those represented by the line originating at 155°F for 30 min and having a z value of 10.8. Information presently available would indicate that this line represents the many possible combinations of time and temperature that would have adequate safety for the pasteurization of ice cream mix. As temperatures in the ultra-high range are selected, this graph can be extrapolated to determine the time required at such temperatures. It is indeed conceivable that the attainment of physico-chemical properties in the mix may demand heating at a temperature beyond the time required for the desired level of bacterial destruction in the UHT range. This, however, should not be the basis on which pasteurization standards would be adopted for public health purposes.

[2]Manufactured by the Cherry-Burrell Corp., Cedar Rapids, Iowa.

[3]Manufactured by the Chester-Jensen Co., Chester, Pa.

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ENVIRONMENTAL HEALTH—PAST, PRESENT AND FUTURE[1]

ROBERT J. ANDERSON[2]

Public Health Service, Bureau of State Services
U. S. Department of Health Education, and Welfare
Washington 25, D. C.

I recall old-timers referring to "the good old days." I am sure they were not reflecting so much on the hard work, long hours, horse and buggy, and primitive tools of the yesteryears, but were harkening back to the leisurely pace, the wide open spaces, a less troubled life and lack of tensions. Today our environment seems not to permit this.

Man has always had to come to terms with his environment. Ancient medicine declared that Man was part of Nature; that a harmonious relationship to Nature produced health; and that disharmony produced disease.

Thus, the ancient Hebrews had a standing rule to the effect that a permanent threshing floor, a place for depositing carcasses, or a tannery should be set up a minimum of so many feet beyond the city wall —and to the East—presumably to guard the population from harmful dusts and offensive odors. The Egyptians recognized the need to drain swampland, burn refuse in big dumps, and filter water for drinking, in order to reduce the diseases prevalent at that time. Hippocrates, the Father of Medicine, wrote a book titled *Airs, Waters, and Places.* In it, he urged the physician to study the patient's background—climate, water supply, vegetation, and other matters—to get an idea of what may have affected the patient's condition. Some 500 years ago in England, in the reign of Edward the First, the first Sanitation Act was passed forbidding the pollution of rivers, ditches, and open spaces.

Beginning with the 17th century, and continuing through the 18th and 19th centuries, Man's inquiring and ingenious mind slowly but surely freed him from utter dependence upon, and subjection to, the raw forces of nature, and he became better equipped to deal with the problems of his environment. As the population grew, and industry increased in many countries, town and villages became crowded slum cities with devastating epidemics of communicable disease. Environmental health measures like water supply treatment, sewage treatment, heat processing and refrigeration of perishable foods, garbage and refuse collection, and insect and rodent control were started then. Also, at the end of the 19th century, bacteria were revealed, and provided a scientific basis for the control of communicable diseases to which most of our public health effort has been devoted during the past 50 years.

What about the environmental health problems of

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[2]Assistant Surgeon General, Deputy Chief, Bureau of State Services.

today? Since 1850 we have fashioned ourselves a new world. We produce more than *three times* as much in a 40-hour week as we did in a 70-hour week a century ago. By the year 2000, just 40 years away, this country will be able to produce as much in one 7-hour day as is now produced in a 40-hour week!

The Radio Corporation of America, which is primarily engaged in electronics, recently exceeded one billion dollars in annual sales volume for two successive years. However, the most extraordinary fact about this statistic is that 80 percent of this volume was in products and services that did not exist, or were not on the market, in 1946. In the fields of chemistry and pharmacology, more than 150,000 preparations are now in use, of which 90 percent did not exist 25 years ago, and 75 percent of which did not exist 10 years ago.

Is it strange then that we have created a whole new set of environmental hazards whose threat to our health is just now being recognized? Our advancements in technology have resulted in vast quantities of contaminants being introduced into the environment. The total effect of these new forces on the health and life expectancy of Man is not yet fully understood, but there is evidence that some of these may be responsible for some of our most serious impairments. As our industrial civilization progresses, more and different contaminants will be produced and will be introduced into the air, water and food on which we depend for life itself unless we take corrective measures. Let me illustrate with a few examples.

The automobile has in many ways completely reshaped our way of living, but currently some 70 million autos are exhausting sulfur di- and trioxides and the olefins, into the air we breathe.

Today, we have plastic, synthetic fiber, antibiotic, herbicide, rocket and detergent industries. These spew new types of wastes into our streams and into the air—wastes with toxicities yet to be determined. The water used in the manufacture of one pound of a particular antibiotic is 3,000 or 3,500 gallons. This indicates a total volume of wastes for antibiotic processes alone from 30 to 35 million gallons per day. These requirements result from cooling water, floor and equipment washings, and fermentation, purification, and recovery processes.

The development of nuclear energy for peaceful purposes has brought us many isotopes for industrial research and for medical diagnosis and therapy. Today, there are some 6,000 licensed users of radioisotopes. Of these, 1,800 are industrial firms. More than 2,500 licensees using radioisotopes are in medical research, diagnosis, and therapy. About half of these are physicians in private practice, and hundreds of thousands of patients are currently treated yearly with radioisotopes in diagnosis and therapy. I don't have to remind this audience of the tremendous savings to industry resulting from radioisotopes used as tracers and gauges, or of their tremendous diagnostic and therapeutic value. However, with such developments has come the problem of disposing of large amounts of radioactive wastes; and this is on top of other radiation hazards, such as, fallout from weapons testing.

Another example is the imposing array of chemicals used in the production of foods. About 100 years ago, a farmer produced enough food in this country to sustain five other people. By 1900, his productivity had risen to feed eight additional persons. Today, he can feed 24 other people—a fivefold productivity increase in 100 years! A major factor has been the development and use of a host of pesticides, herbicides, fertilizers, and other chemicals to control pests and crop diseases and to increase per acre yield. Some of these products, which are highly toxic, may be taken up by the plants; may lodge on the food itself; may be transmitted to animals which are used for food; may find their way into milk; or may be washed from the soil into water courses. We frankly don't know enough about the acute or chronic and cumulative effect on Man of many of these products or of the additives now used in foods. This must be determined.

Moreover, in the next 20 years, most of the population, 3 of every 4 of us, will be concentrated in metropolitan areas. Environmental sanitation will have to be maintained and extended in the face of this development to protect against communicable and enteric diseases. Already, among the environmental health problems of urbanization are sufficient and clean water, unpolluted air, better sanitation measures for foods, more recreational facilities, and better housing.

Occupational health problems, to which we have been devoting attention for many years, will increase as our industrial civilization progresses. We know that emotional and psychological problems add to, compound, and may even originate organic disorders which may appear as the result of the work environment. Hence, we can anticipate that some of the workers subject to new manufacturing processes and wastes will be more susceptible to heart disease, peptic ulcers, and vascular disturbances. The effects of rocket and missile propellants are brand new to practitioners of industrial medicine. Yet today, more than half of the industrial plants in the country do not have even a rudimentary type of industrial health program.

The incidence of accidents rises in a machine

world. New skills, new speeds, and new ways of doing things always involve mishap. Accidents in the home and on the highways are rising to alarming proportions.

The Public Health Service is concerned with the threats posed by all of these environmental health hazards, and has developed operating programs in the fields of air pollution, radiological health, water pollution, and accident prevention. We have bolstered our activities and are expanding our research effort in the areas of milk and food sanitation, and occupational health. Pilot studies on metropolitan planning for environmental health needs have recently been initiated. We have sought the advice of scientists, and of industrial and economic experts in developing and reforming these programs.

We seek the ability to shape our environment and to control it, and to prevent certain deleterious conditions from developing. The Public Health Service is currently regrouping its skilled staff and techniques to strengthen its efforts to control or eliminate the major health hazards originating in today's environment.

I wish to identify certain approaches we believe will be helpful in this work.

First, we will use all the skills—engineers, physicians, and add many others—oceanographers, meteorologists, aquatic biologists, microbiologists electron microscopists, to name a few.

Second, we will keep in mind the theory of the multiple etiology of disease. As Rene Dubos has indicated: "Unquestionably the doctrine of specific etiology has been the most constructive force in medical research for almost a century. . . . In reality, however, search for *the* cause may be a hopeless pursuit because most disease states are the indirect result of a constellation of circumstances rather than the direct result of single determinant factors."

Third, we will recognize that biological effects are the summation of all exposures. For example, the effects of specific trace metals upon the human biological system require air pollution, water pollution, food, and occupational health studies, since Man may take in these metals in each of those ways.

Fourth, being a new endeavor, great emphasis will be given to environmental health research, even though, it is no doubt true, that considerable knowledge currently available is not being used to ameliorate many health hazards. The application of known data to the solution of environmental hazards raises questions to which there are no known answers yet.

Fifth, greater attention will be given to problems of standards, regulation and enforcement. Environmental health problems require collective action to preserve the collective welfare. By their very nature, the problems of air and water pollution, and radioactive contaminants, reach far beyond local boundaries and jurisdictions. Great populations are attacked and affected simultaneously by these hazards.

In our democracy, we acclaim self-regulation. The Federal role is that of leadership. In this pattern, the Public Health Service develops codes which guide industry and the States. The *Milk Ordinance and Code* is one such guide. Some of these codes work; some fall short. Many people would say that, from an economic point of view alone, State or regional control of a national problem creates serious competitive inequities. You in the milk industry have had experience with such inequities arising from different standards and different degrees of regulation by various States and municipalities. Would the control of specific environmental health problems nationally by means of a set of uniform common denominator standards and Federal regulation help? I raise these questions to point out our concern, lest carefully designed local or state regulations bearing health labels become the cover for competitive economic interests.

Health regulations require knowledge of the facts. Hence, principal emphasis, at least in terms of the Federal effort, must be placed on research to seek the answers to the problems of prevention and control raised by increasing pollution of the physical environment by newer types of contaminants.

The complexity of research needed in this area staggers the imagination. In many cases, we are dealing with very low concentrations of substances. For example, perhaps one or two parts per billion in water or air of some substance may be a killer if absorbed by an individual over a long period of time. The detection of these substances, the measurement of their effect on humans, and the practical problems of removal of these small quantities from water and air, present research problems of a new order of complexity and difficulty unlike most of those which have been resolved in the past. These problems are typified by low-level radiation hazards, occupational exposures, and by chemical additives to milk and food.

Viruses—a hang-over problem from communicable disease—are another example of a complex area of research to be undertaken in air, water and food. For example, the infectious hepatitis virus can filter through any mechanism or procedure we have yet devised for water treatment.

These problems make an integrated environmental research approach essential if we are to integrate the effect and its control. Man's intake is the sum of his water, air, and food exposure.

In this great research task, we must stimulate and support the work of other scientists and agencies in these fields. We have already made a start through the research grants mechanism which the Public Health Service administers. For your information, grants have been approved for the current year in the amount of $186,000 to support research studies at various institutions on problems of milk technology, milk microbiology, and milk sanitation administration. We hope that researchers in this field will make increased use of the research grants mechanism.

Speaking specifically to research needs in the milk field, we must also strengthen our intramural research effort. Our current effort is not commensurate with today's needs; let alone, future needs. With the resources available, we have undertaken studies on such milk sanitation problems as thermal inactivation of pathogens, radioactive and chemical contaminants, staphylococcal enterotoxin, and the development of new laboratory methodology and techniques. But even in these areas, this is a limited effort. We are aware that acceptance of new industry developments are being delayed for lack of knowledge as to their public health implications. To expand our research, we must have your support.

Research, of course, is the way we improve the future. For the present we must use the measures and techniques we already possess to control polluted air and water, radiation hazards, occupational disease, and milk and food contaminants.

You and I set our goals by what we call standards. We revise them when new information indicates. These standards may require capital investment, as well as public health practice; and capital investment, of necessity, must be a long-range expentiture. Standards cannot be changed every day at one's whim and fancy. Thus, we need facts and this means science.

I think you will agree that in the standards field we must go forward, using the tools at hand to do the job. We must use "what we know"—and we know much.

If we are to be successful, a strenuous and coordinated effort by all groups will be required. Industry bears a responsibility for prevention of many environmental pollutants, and for improvement of environmental conditions. Your industry will accept this responsibility, as the past record shows. I look forward to this kind of close industry-government cooperation.

The 3-A Sanitary Standards program is one example of close industry-government cooperation in the public's interest. The Dairy Industry Committee, the International Association of Milk and Food Sanitarians, and the Public Health Service have worked together for many years to improve the public's milk supply, not only through the 3-A Sanitary Standards program but by other joint endeavors as well. The dairy industry is to be commended for its leadership and foresight in these efforts, and for the spirit of cooperation which it has demonstrated.

COMPOSTING OF CITY REFUSE [1] [2]

WALLACE H. FULLER

Department of Agricultural Chemistry and Soils

University of Arizona, Tucson

Man's bad social habits are fast catching up with him. The disposal of solid municipal wastes, including sludge, refuse and industrial wastes has only recently been recognized as one of the most serious problems of community development. Not only is it serious from a sanitation standpoint but the volume is so great that man is almost faced with the problem of "wallowing in his own filth." This waste is overburdening antiquated disposal facilities. Whereas man has been progressing in technology, medicine and science, and has improved his standard of living at a fantastic rate, his progress in waste disposal has not been given the serious attention it requires if we are to survive in modern civilization. The problem has reached alarming proportions in recent years and extends beyond national boundaries.

All waste disposal should be integrated in such a manner as to require the participation of multidisciplined experts. We are at the threshold of an urgent problem that needs study and action lest it suddenly pass from the realm of urgency to desperation. Fortunately, a few have recognized the full impact of this problem on modern civilization and are making slow but sound progress toward a solution. For example, an "International Research Group on Refuse Disposal (IRGR) has made available certain publications of research involving refuse disposals *(12)*. These research reports and articles have served to focus attention on the problem of adequate disposal of community wastes. John S. Wiley, who has been assigned by the U. S. Public Health Service to the position of Research Director of the sanitary section of its Technical Development Laboratories at Savannah, Georgia, has developed a sound research program leading to a better understanding of the process involved in the composting of wastes. The introduction of a new periodical entitled "Compost Science" in the spring of 1960 further serves to center attention on the disposal of wastes. Papers presented in this journal have particularly emphasized scientific methods and procedures of waste disposal and the logic behind such methods as a proper step forward in the advancement of modern society. Such publications also have pointed out the benefits that can accrue to man in the salvaging of community refuse. A book by Dr. Gotaas entitled *Composting: Sanitary Disposal and Reclamation of Organic Wastes*, published by The World Health Organization *(4)* brings together in an excellent manner the more pertinent literature on composting.

Compost is one of the valuable resources available to man as a byproduct of municipal waste disposal. Compost materials have been dissipated along with our natural resources of water, timber and minerals by our modern civilization. Although this waste has been ignored in the United States and certain other countries, a realization of the advantages of composting city refuse is apparent in many foreign countries such as the Netherlands, where today nearly 30% of all city refuse is converted to compost and this quantity is increasing every year *(9)*.

It is not the purpose of this paper to present the technological aspects of city waste disposal, but rather to emphasize the great agricultural value of city compost. In short, this is an open challenge to agriculture, as well as to industry, to quit standing aloof, allowing potential organic fertilizers by millions of tons to be lost for soil building. Will the agricultural scientist continue to stand by and ignore this tremendous source of organic fertility, which is so seriously needed in our soils to maintain the organic matter? Will modern society continue to allow refuse to be dumped into water sources where it can cause pollution, or to be burned where it can cause air pollution, or to be piled unceremoniously in heaps to decay openly and breed flies, rats and other kinds of vermin?

The answer to these questions is obvious to the sanitary engineer and the scientist who has made careful study of the disposal problem.

Man cannot afford to wait until the exploding population has expanded communities to the extent that sanitary and healthful methods of city refuse disposal are no longer possible. *Now* is the time to face this problem while there is still adequate space and resources to provide suitable disposal facilities. *Now* is the time for agricultural scientists to apply scientific experience and knowledge to the practical problem of the use of refuse compost for improving the productivity of soil and establishment of better plant growth such that both the grower and the compost producer can profit. An outlet for the city

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[1] Contribution of the University of Arizona Agr. Expt. Sta. as Technical Paper No. 680.

[2] Presented at the 48th Annual Meeting of the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, Inc., at Des Moines, Iowa, August 14-17, 1961.

refuse compost must be found or it will accumulate to fantastic quantities. The agricultural industry cannot afford to allow this valuable source of organic matter to be wasted or used in any way except on the soil.

ADVANTAGES OF COMPOSTING

Composting of municipal refuse is generally considered by the researcher in the field of waste disposal as being technically feasible. Some of the advantages of composting municipal refuse are listed as follows:

1. Provides a new and more effective and sanitary method of refuse disposal.

2. Supplies a source of organic matter for maintaining and building seriously depleted supplies of humus in soil.

3. Reclaims certain valuable materials, such as, metals, glass, cardboard and rags.

GENERAL NATURE OF CITY REFUSE

Raw refuse from cities in the United States differs considerably from that in Europe where the practice of composting refuse is fairly well established. For example, there is much more paper, rags, metal and glass in the United States than in European refuse. The city refuse in the United States is highly cellulosic, mostly because of the great amount of paper it contains. Proteinaceous materials are low in proportion to cellulosic materials. Readily available carbohydrates are also proportionately lower in city refuse from the United States as compared with that of Europe. Most city refuse has a surprisingly low moisture content. Because of these basic differences in the raw refuse, the well-established composting processes in Europe, for example, require modification before they can be successfully employed in the United States. Certain modifications, however, can readily be made by competent engineers working together with biological scientists. The adaptation of the Dano Bio-Stabilizer as originally established in Europe to processing of refuse in the United States is a good example of this point *(3)*. It should be pointed out also that successful European methods are not directly applicable to the United States because of differences in psychology of the public health with respect to space, time, engineering, and need and use of composts.

In 1952 the University of California made analyses of a large amount of mixed refuse from Berkeley, California, as a result of compost studies *(11)*. The data in Table 1 show that this material had a large amount of salvageable material and a modest amount of compostable material, about 68% on a weight basis.

TABLE 1—AVERAGE COMPOSITION OF MIXED REFUSE FROM BERKELEY, CALIFORNIA[a]

Physical Composition		Chemical Composition	
Kind	Amount	Kind	Amount
	(%)		(%)
Tin cans	9.8	Moisture (as collected)	49.3
Bottles & broken glass	11.7	Ash (dry basis)	28.5
Rags	1.6	Carbon (dry basis)	35.7
Metals	0.9	Nitrogen (dry basis)	1.07
Non-compostable waste of no value	7.6	Phosphorus as P_2O_5 (dry basis)	1.16
Compostable material	68.4	Potassium as K_2O (dry basis)	0.83

[a]Taken from Univ. of Calif. Tech. Bull. 2. 1952. *(11)*.

MICROBIOLOGICAL ASPECTS OF COMPOSTING

Inoculation of refuse for composting has not proved necessary if the conditions favorable for composting are provided. Organic refuse is teeming with indigenous microorganisms that multiply rapidly when the proper factors are provided. Both mesophilic and thermophilic organisms play important roles. Bacteria, fungi, streptomycetes and algae are active in the compost process. There is some evidence that the fungi are the dominant organism under dry conditions, whereas bacteria dominate under wetter conditions of composting. The saprophytic bacteria and fungi are the most active. These outgrow and aid in the elimination of parasitic organisms. Thus nature has a way of purifying man's refuse. The final compost from most processes may be used without fear of diease organisms.

PHYSICAL ASPECTS OF COMPOSTING

According to Snell *(7)* proper grinding is the key to efficient composting. Grinding vastly increases the surface area exposed for microbial attack. This facilitates penetration and invasion of the organisms. Grinding also breaks down natural barriers such as the effect of lignin, which physically blocks the penetration of organisms to the more readily available carbon sources *(2)*. Oxygen can penetrate the organic wastes more readily when they are ground. Grinding or mechanical pulverizing also facilitates the mixing of different kinds of refuse. Acid or alkaline residues are thus neutralized and made more suitable for rapid attack. Another advantage of grinding is the mixing of organisms indigenous to different kinds of materials and spreading of organisms of greater population to areas of less popula-

tion. Less heat and moisture are lost during the process of composting as a result of grinding. Perhaps one of the most important advantages of grinding is the insurance of a more uniform product and a product that does not resemble the beginning refuse in an obvious way. Although grinding is very important in the production of a suitable compost, grinding, pulverizing or shredding will not substitute for the microbiological process essential for the production of good compost.

Temperature during composting is vitally important to the production of a suitable compost. Temperatures should be sufficiently high for a sufficient length of time, according to Snell *(8)*, to accomplish three objectives. *(a)* destroy pathogenic organisms, *(b)* destory weed and vegetable seeds, and *(c)* destory fly eggs and larvae. Gotaas *(4)* suggests that a temperature of about 60°C be maintained for about one hour to kill pathogens. Most seeds are killed if a temperature of about 50-55°C is maintained for a few days under moist conditions. Snell *(8)* cautions against prolonged high temperatures of 70-75°C for fear of slowing down some of the beneficial microbial activity and causing nitrogen to be lost.

CHEMICAL ASPECTS OF COMPOSTING

Composting is accomplished best under aerobic conditions. Excess of water can cause anaerobic conditions. Odors accumulate and often the process is slowed if the moisture exceeds about 70%. Fly breeding is held to a minimum by keeping the compost moist but not soggy. Control of a favorable hydrogen ion relationship in the compost also is accomplished better under aerobic than anaerobic conditions.

According to Toth *(10)* the average composition of some fertilizing constituants of garbage is as follows: ash 29%; nitrogen (N) 1.0%; phosphorus (P_2O_5) 1,2%; and potassium (K_2O) 0.8%. Composting would tend to increase these values due to the net loss in weight by CO_2 evolution as a result of microbial activity. There is a wide varation in the N, P_2O_2, and K_2O contents of city refuse. Some cities include home trash, trees, yard prunings, etc., in their garbage collections.

Generally, nitrogen content of refuse determines its rate of decomposition and subsequent compost production. Unless the nitrogen content is between 1.25 and 1.50% on a dry weight basis the lack of this element prohibits compost formation at a maximum rate. Moreover, compost of less than this level of nitrogen will cause nitrogen starvation in plants if applied to soils low in native nitrogen *(10)*.

For the most part, phosphorus and potash content of city refuse is sufficient to support maximum compost production if other factors are favorable.

GENERAL CHARACTERISTICS OF MUNICIPAL WASTE COMPOST

The chemical characteristics of city refuse compost varies widely depending upon the kind of material composted and the specific process employed. If the beginning material is high in protein or nitrogenous substances such as excreta, slaughterhouse wastes, sludge, etc., it will be higher in nitrogen than composts made from refuse containing home prunings, trees, shrubs, dirt and ash. According to Gotaas *(4, 5)* a wide range in composition has been reported by various authors for municipal compost, see Table 2.

TABLE 2—CHEMICAL COMPOSITION OF SOME REPRESENTATIVE MUNICIPAL COMPOSTS[a]

Substance	Percentage by Weight
Organic matter	25 -50
Carbon (as C)	8 -50
Nitrogen (as N)	0.4- 3.5
Phosphorus (as P_2O_5)	0.3- 3.5
Potassium (as K_2O)	0.5- 1.8
Ash	20 -65
Calcium (as CaO)	1.5- 7

[a]Taken from Gotaas *(4)*

McGauhey and Gottas *(6)* reported the characteristics of municipal garbage and refuse which contained considerable quantity of paper as having the following values: N about 1.4%; P_2O_5 about 1.1%; K_2O about 0.8%; carbon about 28%; and ash about 37%. Fuller, *et al. (1)* report that refuse high in paper processed by the Dano process had a composition of about 0.92% N; 0.57% P_2O_5 and a pH value of 7.1. Other samples taken from this same process, though not previously reported by our laboratory had nitrogen values ranging from 0.9 to 1.3% N and phosphate values ranging from 0.5 to 0.9% P_2O_5.

The pH of municipal compost prepared by aerobic process finally ends up at a value near neutral or slightly alkaline even though the initial pH value of the compostable material may range from 5.0 to 7.0.

The physical condition of the compost is greatly controlled by the initial grinding, shredding or pulverizing employed. Refuse composted in mechanical digesters can be ground finer than that composted in windrows. Thus, in general the final products will differ considerably in appearance depend-

ing on the process used. Fine grinding usually results in a product that less closely resembles the beginning refuse than coarse grinding or no grinding. Some processes grind after composting as well as before. This tends to make a more uniform product which is more readily accepted by the public.

The color of compost varies from a dark gray to a deep brown or deep gray-brown.

Most city compost contains some bits of metal, glass and hard materials that are not altered by the microbiological process involved in composting. These materials will appear in the final product, depending on the extent of removal by screening and other means, upon the termination of composting. Their importance is determined by their nuisance and aesthetic value as assessed by the user rather than their harmful effects in the soil.

AIMS FOR A GOOD COMPOST

Fertility value

Compost should contain at least 1.5 nitrogen on a dry weight basis to insure against the possibility of causing nitrogen starvation to plants when incorporated into soil. When the nitrogen content is below 1.5% the material decomposes slowly and nitrogen starvation may appear in plants grown on soil where the compost is applied. The use of commercial nitrogen either as an additive to the compost or to the soil will improve the effectiveness of the compost. Usually compost is sufficiently supplied with phosphorus, potash and micronutrients so these elements are not apt to be a factor in its use for plant production. Only if the phosphorus content of the compost falls below about 0.2% P will it be a factor in limiting plant growth. It should be kept in mind, however, that as decomposition proceeds all the plant nutrient elements are released gradually for use by plants. Only during the initial stages of decomposition may the microflora offer a problem of competition with the plant for nutrient elements.

Physical conditions

A good compost is relatively finely divided but also possesses certain granulation that occurs during the latter stages of formation. Compost that has been initially finely divided has less characteristics of the original refuse. Certain amount of granulation of the product is desirable to eliminate the unpleasantness of a dust product.

Moisture content

The final moisture content of compost is important for three main reasons: *(a)* ease of handling and transport to ultimate destination, *(b)* transportation costs, and *(c)* sound public acceptance. One of the most variable characteristics of compost is its moisture content. The moisture content of certain composts from bio-stabilizing or rotating drum processes, however, is surprisingly uniform. The final moisture content of windrowed compost will depend upon the local climatic condition, time of the year and public demand for the compost as well as the procedures employed. Perhaps a good figure at which to aim is 25% or lower. Establishment of this value for the final product, however, does not imply that maintenance of a favorable moisture content between 50-70% during the composting process need be jeopardized but that some means should be employed to get rid of the excess moisture before marketing.

Freedom from appearances of raw refuse

Regardless of who uses the compost, sales appeal is greatly affected by appearances of the original refuse. Identifiable pieces of metal, advertising labels, plastic or glass is not desirable. Even fine glass may present resistance to acceptance of city refuse compost.

Freedom from unpleasant odors

It is important to avoid sales resistance as a result of a product having unpleasant odors. Certain composting processes are not concerned with unpleasant odors because of their strict maintenance of aerobic conditions.

Agricultural value of compost from city refuse

The agricultural value of certain composts has been well established. On the European continent, for example, composts derived from rotted crop residues have been used for centuries. In Japan and China, composts of animal excreta are highly valued for use in food crop production. More recently, composts from municipal refuse have been in demand for soil building in Western Europe. Research on agricultural use of composts made from city refuse in the United States has received limited attention. This is due in part to the limited supply available since composting of city refuse in the United States is a relatively new industry and in part to the lack of awareness the agricultural scientist has for conservation of this natural resource.

The lack of formal research on compost from city refuse from the United States would not be serious except that there is no other compost material with which it can be compared. Certain chemical and physical properties of the final product differentiate it from that of the European continent. For this reason, Fuller, *et al. (1)* at the University of Arizona conducted crop tests on the efficient use of munici-

pal compost made by the Dano Process of Sacramento, California.

Municipal refuse compost made by the Dano Process was applied to two Arizona soils of agricultural importance and planted to two test crops, tomato and cotton, to study its effect on plant growth and nutrient uptake under greenhouse conditions. Comparisons were made with and without supplemental soluble nitrogen and phosphorus, alone and together.

The results showed that the compost stimulated growth of both crops whether added alone or together with supplemental nitrogen and/or phosphorus. There was an effective residual influence of the compost on a succeeding crop of cotton. Both crops, however, obtained nutrients directly from the compost. The value of this city refuse compost for enhancing plant growth and for supplying certain nutrients was well demonstrated.

There is a definite advantage in supplying additional soluble commercial nitrogen and phosphorus either to the compost directly or to the soil where composts from city refuse are used for growing crops. A wise combination of commercial fertilizer and compost application for obtaining maximum crop production is suggested.

Compost plays another important part in agricultural production in addition to enhancing plant growth and providing plant nutrients. This is related to the physical condition of the soil. Soil organic matter has long been advocated as playing a key role in the physical condition of the soil and thereby functions in the favorable control of water and air movements. Compost provides the necessary beginning point for maintenance of soil organic matter. Soil organic matter is formed during compost decomposition. Only by decomposition of the compost in soil can it benefit plants. Only by decomposition can biological products be formed to improve soil tilth and can nutrients such as nitrogen and phosphorus and micronutrients be released for use of higher plants. Maintenance of even small amounts of organic matter in soils is critical to a favorable agricultural economy.

Composting of city refuse must become a part of our social structure not only as a means of correcting a serious waste of one of our most valuable resources but to meet the coming demand for sanitary and pollution-free living in a period of high development of modern civilization.

Research at all levels of compost production as well as marketing is seriously needed to solve this refuse disposal problem if civilization is to avoid being blindly backed down the dead-end street of antiquated disposal methods.

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STUDIES ON THE DEPOSITION AND REMOVAL OF RADIOACTIVE SOIL[1]

I. J. Pflug, T. I. Hedrick, O. W. Kaufmann, R. A. Keppeler and C. G. Pheil

Departments of Food Science, Microbiology and Public Health, and Agricultural Engineering

The rate of deposition and removal of a radioactive milk soil from several surfaces have been studied. The nature of the surface exhibited a small but measurable effect on the rate of deposition of a radioactive milk soil on the surfaces tested. However, the surfaces showed no significant effect on the rate of soil removal. The build-up that took place on all surfaces due to repeated soilings without washing was not a simple additive accumulation of residue but appeared to be a selective deposit of a residue slowly laid down over a period of time and difficult to remove. As the accumulated residue increased, a point was reached beyond which there was no significant difference among surfaces in the rate of soil build-up. Subsequent washing removed only part of the soil and even repeated washings had little effect unless special heavy duty cleaning was applied.

The importance and problem of cleaning food equipment have been emphasized by the many studies reported in recent years. In general, these studies were concerned with cleaning materials and methods, bacteriological cleanability of various types of surfaces or the amount of soil remaining on these surfaces.

The objective of this investigation was to obtain data on the rate of soil build-up, and the rate of soil removal from surfaces under several test conditions.

Review of Literature

If a surface is free of all organic and inorganic residues, then it is necessarily free of microbiological contamination; however, a surface may be free of microbiological contamination and still be covered with organic or inorganic residues.

Kaufmann *et al. (9)* observed that there was no apparent bacteriological build-up accompanying a visual soil build-up on the walls of the experimental bulk tank after 12 soilings using water rinses with no detergent followed by chlorine sanitization; at the expiration of this time the surfaces complied with bacterial requirements as recommended by Standard Methods *(1)* at least 96% of the times tested. Holland *et al. (5)* in a study of in-place cleaning of sanitary equipment found no correlation between film deposits and bacterial counts. They found some of the lowest bacterial counts where heavy films were readily visible.

Radioactive tracer methods according to Harris *(4)* are the most sensitive measure of residues at the present time and are in general ten times as sensitive as the next best method. Cucci *(3)* used P^{32} in the form of phosphoric acid, which was mixed with milk, to study deposition of radioactive soil on rubber, glass and tygon tubing. Jennings *et al. (6)* in a preliminary experiment to their extensive project on circulation cleaning compared *in vivo* labeled milk, prepared by injecting a P^{32} solution into a cow, with *in vitro* P^{32} labeled milk, prepared by adding a radioactive phosphorous solution to homogenized milk, in their cleaning regimens and found no significant difference between *in vivo* and *in vitro* labeled milk. They concluded that the use of *in vitro* labeled milk was justified as an index of both organic and inorganic residues.

General Experimental Procedure

This study of radioactive soil deposition and removal consisted of four groups of experiments. All soiling and washings (except to clean plates before a test or replication) were carried out with all plates in the rack shown in Figure 1 so each plate would be subject to the same treatment.

Radioactive milk soil was prepared by mixing fresh pasteurized skim milk, obtained from the University Dairy Plant, with P^{32} as phosphoric acid and with formaldehyde added as a preservative[2]. The solution was thoroughly mixed in a lucite container which was placed in a small, top-opening refrigerator

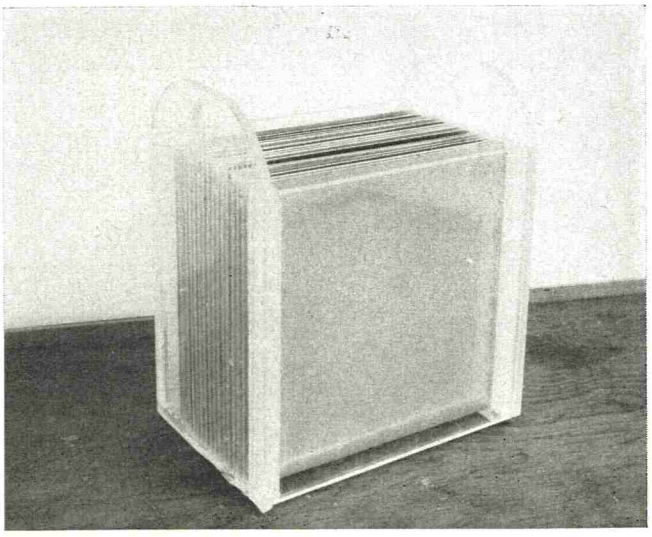

Figure 1. Rack with plates.

[1]Journal article No. 2857 from the Michigan Agricultural Experiment Station, East Lansing, Michigan.

TABLE 1—PROFILES[a] OF THE SURFACE FINISH OF THE 16 STAINLESS STEEL PLATES USED IN RADIOACTIVE TRACER STUDIES.

Stainless steel plate surface	Profile in microinches	
	Average	Range
2B	18.00	18[b]
3	22.75	22-24
4	18.25	18-19
7	15.75	14-17

[a]Measured using a Brush Surface Analyzer, Manufactured by the Brush Instruments Co., Cleveland 14, Ohio.
[b]All four plates had the same profile.

adjusted to maintain the radioactive milk soil at 36°F.

The plates were new at the beginning of these experiments and were cleaned initially by the same procedure used by Kaufmann *et al (8).*

The plates were soiled by submerging the rack of plates in the radioactive milk. (This dipping operation was carried out without removing the container of radioactive milk from the refrigerator.) The plates were allowed to remain in the radioactive milk solution for about 3 seconds; they were then removed, placed in a vertical position, allowed to drain, and dried prior to radioactive counting.

The dipping procedure used to soil the plates was constant throughout the experiment; however, drying times, temperatures and washing procedures varied among groups of tests.

Plates

Sixteen type 302 stainless steel plates, four of each of the four finishes (Nos: 2B, 3, 4 and 7) were used throughout this study. These 16 plates were produced by five different manufacturers; the four plates of one finish were from at least two manufacturers. The plates were 8 inches square and each plate was cut from a whole stainless steel sheet. The roughness of the finish (profile) was measured as the root mean square of the deviations of the peaks and valleys from the mean in micro-inches. A summary of the profiles of the 16 stainless steel plates is listed in Table 1. Four polished glass plates were included in the Group I and II studies for general interest purposes; the data for the glass plates are included in the results, however, a discussion of these data are beyond the scope of this study.

Radioactive counting

In general, the radioisotope technique outlined by Comar *(2)* was used. A Sugarman type Geiger-Miller disintegration counter with a Nuclear Instrument and Chemical Corporation, Model 161A scaling unit was used to count the radioactivity of the residue retained by the plates. The plates were placed in a jig, shown in Figure 2, with the head of the counter placed above the plate and a 1-minute count was made on each of four areas on the plate. The window of the counter had a weight per unit area of 1.4 mg per sq cm and was 2.8 cm in diameter.

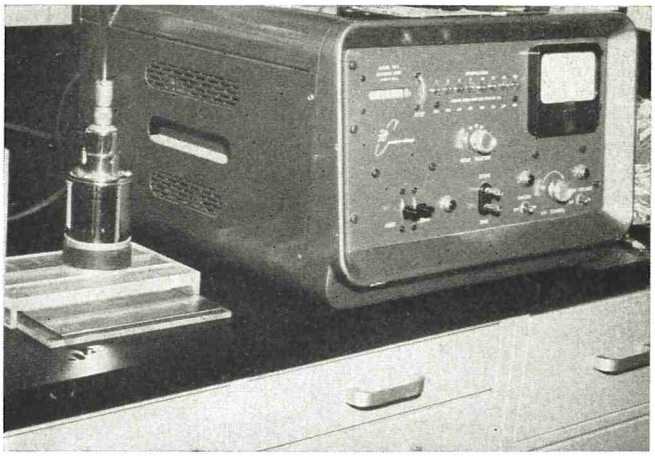

Figure 2. Jig for counting plates, counter and scaling unit.

A counting time of one minute was selected following the analysis of the counts of a standard C^{14} disk for 25 successive 1-minute periods. The counts showed a normal distribution with a mean of 480 counts per minute and a coefficient of variation of 0.042. A like test was done on one spot on a 2B plate and on a glass plate, both of which had been soiled with radioactive milk. The mean for the 2B plate was 1901 counts per minute, the coefficient of variation was 0.024; the mean for the glass plate was 1229 counts per minute, the coefficient of variation was 0.036.

Two 10-minute background radioactive counts were made each day the plates were counted, one before starting a series of countings and the other at the conclusion of the countings. They ranged from 19 to 23 counts per minute; the average was used as the correction for background count.

The counting system was standardized daily by counting a C^{14} source of known radioactivity. All counts were first corrected for background and this net count was then corrected for time decay back to the time of known radioactive level. Therefore, the results for the four Groups of tests can be compared after correcting the counts for differences in the initial amount of P^{32} and the volume of solution.

GROUP I STUDIES

Experimental

Group I was an accumulative soiling study followed by a repeated cleaning. The objective of the

[2] P^{32} was obtained from the Oak Ridge National Labtoratory, Oak Ridge, Tenn.

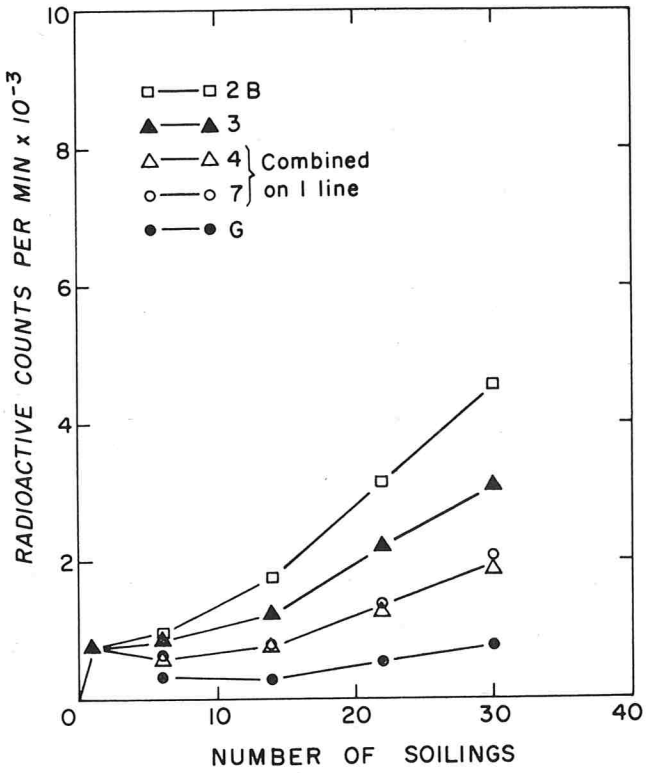

Figure 3. Results of Group I soiling test.

soiling study was to evaluate the effect of surface finish on the rate of soil build-up. The objective of the repetitive washing study was to evaluate the effect of the surface on the rate of soil removal.

The 16 type 302 stainless steel plates and four polished glass plates were tested using a radioactive soil made by mixing 1.0 ml of phosphoric acid solution containing 0.9 mc P^{32} and 7 ml formaldehyde with 6.5L of skim milk.

The plates were repeatedly dipped and dried without washing for a total of 30-dipping cycles. The plates were allowed to dry in a ventilated hood at room temperature (70°F) for at least 30 minutes between dippings.

The plates with the residue accumulated through 30 dippings were subjected to 10 washing cycles using the following procedure: the plates were soaked for 1 minute in 160°F water containing chlorinated alkaline detergent[3] (1 ounce per 5 gallons of water); then washed by lifting the plate holder containing the plates up and down five times as rapidly as possible. The plates were allowed to drain for approximately 1-minute, then rinsed by dipping three times in tap water at 120°F and then allowed to stand vertically and dry. The radioactivity of the residue remaining on the plate was counted after each washing cycle. The plates dried for at least an hour between washings.

Results

The counts after 6, 14, 22 and 30 dippings were subjected to an analysis of variance (10) which showed no difference among plates of the same finish after soiling or after washing. (P was greater than 0.25)[3]. The counts on the plates with the same finish were combined and these sums are shown in Figure 3 as a function of the number of dippings (The count for dipping number one is taken from Group III and IV studies and is the average corrected to the same initial radioactive level as Group I test.) An analysis of variance of the radioactive

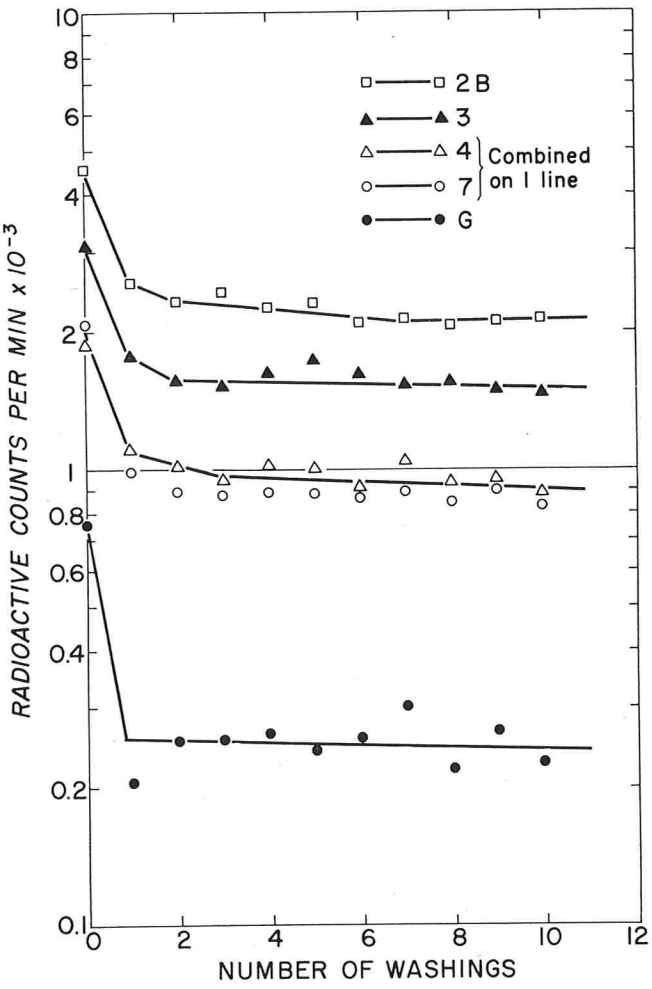

Figure 4. Results of Group I washing test.

counts after the 30 dippings suggested differences among finishes (P less than 0.005). Duncan's Multiple Range Test indicated that the three groupings are: 2B, 3; 4, 7; glass.

The results of the repetitive washing study are

[3]Klenzade Mfg. Co., Inc., Beloit, Wisconsin.

[3]P is the chance probability of occurrence on an F-value as large as or larger than that observed (see ref. 10)

shown graphically in Figure 4 where the sum of the counts on the four plates of the same finish are shown as a function of the number of washings. An analysis of variance of the percent reduction in radioactive count after washing showed no difference among stainless steel finishes (P was greater than 0.25).

GROUP II STUDIES

Experimental

Group II was an accumulative soiling study similar to Group I except: *(a)* the radioactivity of the soil was larger by a factor of 2.56 since 3.0 ml of phosphoric acid solution containing 2.3 mc P^{32} and 7 ml. formaldehyde were added to 6.5L of skim milk; *(b)* the number of dippings in radioactive soil was increased to 44 with radioactive counts being made after 5, 10, 15, 21, 27, 33, 39 and 44 dippings, and *(c)* the number of washing cycles was increased to 18.

Results

An analysis of variance of the radioactive counts after 5, 10, 15, 21 and 44 dippings showed no significant difference among plates with the same finish after soiling or after washing (p greater than 0.25). The counts on the plates having the same finish were combined and these sums as a function of the number of dippings are shown in Figure 5 (the count for dipping number one is taken from Group III and IV studies and is the average corrected to the same initial radioactive level as the Group II Tests).

The radioactive counts on the five surfaces appear to be different after 5 and 10 dippings but not different after 15, 21 and 44 dippings (for 5 and 10 dippings P is less than 0.005).

The results of the repetitive washing study are shown graphically in Figure 6 where the sum of the counts on the four plates having the same finish are shown as a function of the number of washings. An analysis of variance of the percent reduction in radioactive counts resulting from the 18 washings showed no difference among finishes (P greater than 0.25).

GROUP III STUDIES

Experimental

The Group III studies were designed to evaluate the soil deposition characteristics of a clean surface and the rate of soil removal from a one-time-soiled surface.

In this study, the 16 stainless steel plates were tested. The plates were arranged in the rack according to a series of random numbers. A different random order was used for each of the 10 replications. A single test consisted of a heavy duty wash-

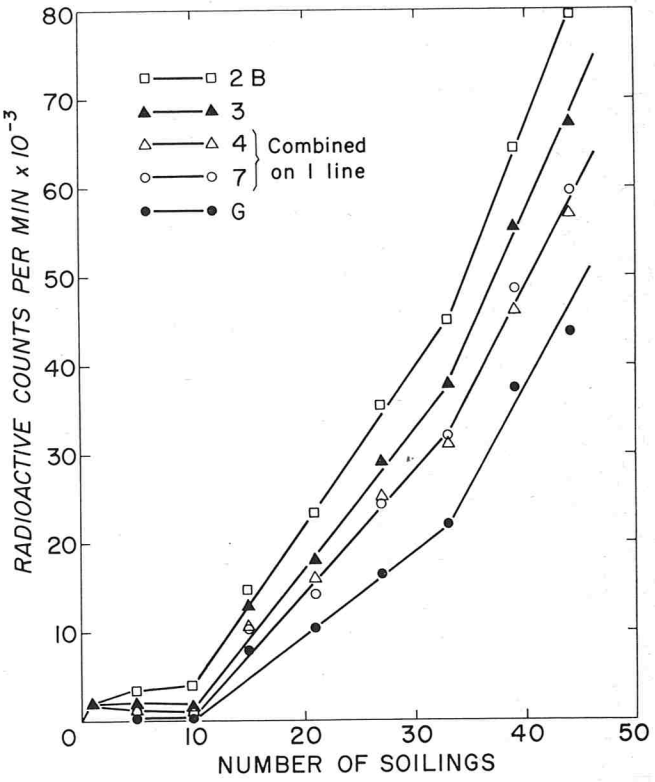

Figure 5. Results of Group II soiling test.

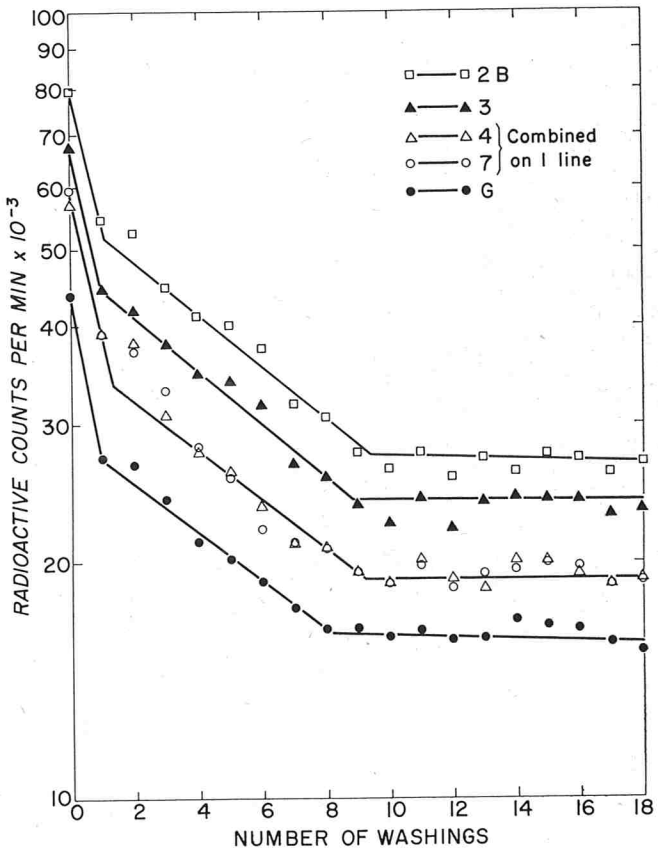

Figure 6. Results of Group II washing test.

ing to remove all soil (radioactive count at background level), dipping in radioactive soil, drying, radioactive counting of the residue, one controlled washing (described under Group I washing study), radioactive counting of the residue. The following procedure was used to clean the plates before starting each test: The plates were soaked overnight in a cleaning solution containing a chlorinated alkaline detergent at the rate of 2 oz per 5 gallons of hard water. The following morning they were scrubbed with a cellulose sponge and detergent and then rinsed in tap water followed by a distilled water rinse. The radioactive count of the clean plates was checked, after which the plates were assembled in the rack and dried prior to dipping in the radioactive milk soil. The radioactive milk solution was prepared by adding approximately 1 ml of phosphoric acid solution containing 10 mc P^{32} and 7 ml of formaldehyde to 7.8L of skim milk.

The drying and controlled washing procedure were the same as for Group I and II.

Results, washing study

The data from the controlled washings as percent reduction in radioactive counts were tested by an analysis of variance. There appears to be no difference among finishes ($P = 0.23$) or among plates of the same finish. The radioactive counts were reduced by an average of 97.6% in the one washing.

GROUP IV STUDIES

Experimental

The Group IV studies were identical with Group III studies except that a milder washing procedure was used which permitted more residue to remain on the plates. In this washing procedure the plates were dipped once, no soaking period, in 149°F water containing 1 oz alkaline detergent per five gallons of water, and immediately rinsed by dipping twice in 120°F water. The plates were dried in a hot-air oven (130-140°F) prior to being counted. After each soiling the plates were washed, dried, and counted three times.

Results, washing study

The reduced washing procedure in the Group IV studies left more soil on the plates than the Group III studies. Therefore, it was possible to subject the plates to three washing and counting cycles and still have counts that were measurably above background. The results indicated that there was no difference in the percent reduction in counts after washing; the P of the analysis of variance F was 0.20 for finishes and 0.25 for plates of the same finish. The average percent reduction in radioactive counts of the plates, by finishes, after each of the three washings are listed in Table 2.

Results, Group III and IV soiling study

The soiling procedures for Group III and Group IV were identical; therefore, in addition to analyzing each set of data it was possible to analyze the combined data. Data are summarized in Table 3.

TABLE 2—PERCENT REDUCTION OF RADIOACTIVE COUNT. GROUP IV STUDY AFTER FIRST, SECOND, AND THIRD WASHING.

Washing No.	Percent reduction of radioactive count of plate surfaces indicated:			
	2B	3	4	7
1	70.8[a]	71.9	71.5	72.8
2	74.2	75.4	74.6	76.1
3	75.2	76.6	76.5	77.5

[a]These values represent the average of 10 replications.

The Group III data indicated a difference in the radioactive count among finishes (P less than 0.005) also a difference among days, (P less than 0.005). To determine which plates were different the data for Nos. 2B and 3, also 4 and 7, were analyzed separately. Nos. 2B and 3 are not different, also 4 and 7 were not different (P less than 0.005 in both tests).

The Group IV data showed the same trend toward differences in the four finishes as the Group III data indicated; however, differences were smaller ($P = 0.15$).

TABLE 3—SUMMARY OF RADIOACTIVE COUNTS IN GROUP III AND IV STUDIES.

Stainless steel plate surface	Radioactive counts in thousands		
	Group III counts 10 dippings	Group IV counts 10 dippings	Groups III & IV combined, 20 dippings
2B	80[a]	91	171
3	79	87	166
4	65	100	165
7	67	83	150

[a]Sum of counts on the four plates of that finish.

Analysis of the combined data of the Group III and Group IV studies indicates differences among finishes. However, in the combined analysis a significant interaction, ($P = 0.005$) appeared. When the mean squire of this interaction was used to calculate F *(10)* instead of the error mean square, P increased from 0.020 to 0.100.

TABLE 4—RANKING OF FINISHES RELATIVE TO THE RADIOACTIVE COUNT, COMBINED GROUP III AND VI DATA.

Stainless steel plate surface	No. of times finish was:				
	First[a]	Second	Third	Fourth	Avg. score[b]
2B	4	10	3	3	45
3	7	4	5	4	46
4	6	4	5	5	49
7	3	2	7	8	60

[a]First indicates highest count.

[b]On the basis of 1 point for first, 2 points for second, etc.

A summary of the ranking of the plates on the basis of average radioactive count by finish for the 20 tests in Group III and IV are shown in Table 4.

DISCUSSION

The problem under investigation was soil deposition and soil removal from surfaces commonly used on food processing equipment. The results generally indicated that soiling and washing are not simple soil-additive or soil-removal phenomena.

Soiling and soil build-up

In the soil deposition studies a significant difference in radioactive count was found in the Group I studies and after 5, and 10 dippings in the Group II studies. In the Group II studies all five surfaces seemed to pick up soil at approximately the same rate after 10 dippings. The lines in the soiling graph, Figure 5, are approximately parallel over the 15 to 44 dip range. The data from Group I corrected for comparative purposes show similar trends, but for some unexplained reason the plates did not show as great an increase in radioactive count after 14 dippings as did Group II after 10 dippings. (Note: a correction must be made for difference in initial radiation of the radioactive milk soil before comparing Group I and II counts directly.) The fact that the plates were new at the time of the Group I studies may be the explanation for the difference.

These data suggest that build-up in the absence of washing takes place in three stages; initial soiling, concurrent soil removal and deposition with net soil level remaining approximately constant and finally concurrent soil removal and deposition with level of soil increasing uniformly. It seems probable that in the middle phase there is a selective build-up of the soil that clings most tenaciously to the surface. The data in Figure 5 seems to indicate that once the build-up stage is well established all surfaces add soil at the same constant rate.

In all cases where significant differences were observed the same relationship among surfaces existed in that finishes 2B and 3 tended to be similar as did finishes 4 and 7. Where ranking was employed the order of decreasing counts was usually 2B, 3, 4 and 7.

Soil Removal

In all studies there appeared to be no differences in the rate of radioactive soil removal (expressed as the percentage of soil present) either among finishes or among plates of the same finish. These results are in agreement with those reported by Kaufmann *et al. (8)* in their studies on the relative bacteriological cleanability of stainless steel finishes.

The rate of soil removal proved to be most interesting as shown in Figures 4 and 6. The first washing removed radioactive soil equivalent to the amount deposited in about the last 10 dippings. The effect of subsequent washing varied from Group I to Group II, in Group I washings 2 through 10 had practically no effect on soil removal.

The washing data was plotted as the logarithm of the radioactive counts vs washings, Figures 4 and 6, since the rate of removal of a soil is usually an exponential function of the number of washings. In Group II, Figure 6, there was an exponential reduction in radioactive counts with number of washings that extended approximately from wash 2 to 9 which were followed by the ineffective washings 10 through 18.

In the Group IV studies a reduced washing technique was used and the plates were washed and counted three times. Even though these plates were soiled only once the three washings did not produce an exponential radioactive count removal rate as was expected, but gave a pattern similar to Figure 4 and 6 where only the first wash was unquestionably effective. The fact that a rigorous cleaning procedure was necessary to reduce the radioactive count of a soiled plate to the background level is another indication that some of the soil adheres tightly to these surfaces.

Relative Behavior of Finishes

The differences in radioactive counts on plates with different finishes when dipped in a radioactive milk soil has been consistent throughout this study and these differences have been consistently small. The trend was for finishes Nos. 2B and 3 to behave similarly and finishes No. 4 and 7 to behave similarly. The overall trend was for the No. 2B finish to have the highest counts. In three out of the four groups of tests there were no measurable differences between the No. 4 and No. 7 finishes.

The differences in the behavior of the glass and steel surfaces evaluated is undoubtedly due to the nature of the surface in respect to chemical and physical characteristics, which determine the rate of residue deposit and build-up. The interaction between micro particles of soil (perhaps at the molecular level) and the surface of the metal (again, at the molecular level) will determine how tightly the soil is bound to the surface.

The differences observed in this study among stainless steel plates are due to the surface rather than the plate material since in the original selection of the 8 x 8 inch panels *(8)* each panel was cut from a different sheet and panels were obtained from several stainless steel manufacturers. If a basic ma-

terial or manufacturing technique was a factor there would have undoubtedly been differences among plates with the same finish.

Recent work by Jennings and Bourne *(7)* substantiates the belief that soil deposition and the adherence of soil to a surface is a very complicated physiochemical relation in which the nature of the surface has a role.

ACKNOWLEDGEMENT

The authors wish to acknowledge and thank Dr. R. C. Nicholas of the Food Science Department for his assistance in the preparation of this manuscript.

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NEWS AND EVENTS

RESUME OF THE SECOND NATIONAL CONGRESS ON ENVIRONMENTAL HEALTH

Three organizations sponsored the Second National Congress on Environmental Health which was held at Ann Arbor, Michigan, June 6, 7, and 8, 1961. These were, The University of Michigan, School of Public Health, The American Public Health Association and the National Sanitation Foundation. Some two hundred persons from the fields of public health, industry, commerce and education assembled to hear nationally known speakers discuss the many and varied aspects of the environment and its influence on man.

Carey P. McCord, M. D., of the University of Michigan, expressed the purpose and goal of the Conference in these words:

"The purpose of the Congress was to explore environmental resources and their value and usefulness for man in terms of needs for industry, government, and conservation - in keeping with health social and economic trends: to consider principles and methods of practice that will encourage a maximum development of our environmental resources for society.

The goal of the Congress was to explore and develop environmental concepts and principles, methodology, and practice that will encourage maximum health and the orderly development of our environment for the needs of society. Team work among those who participated in the Congress, seasoned by intelligent determination and rugged individualism, may contribute materially to the American way of life."

The key note address was given by Dr. Henry F. Vaughn, President of the National Sanitation Foundation. Certain of Dr. Vaughn's remarks pointed very succinctly to the fact that the facilities and the resources of many groups working together are essential for the shaping of man's life to give it the fullest benefits. His remarks, in part were as follows:

"The total environmental health program, to be implemented successfully, must embrace the resources and facilities not only of the official health agencies, but of the voluntary agencies, industry, labor, and the public at large, all utilized on a self-planned and self-integrated basis. The ultimate purpose in environmental health control is not merely the absence of a depth and breadth of filth; it is the fuller life to be had by all people, one in which all may benefit from the program, one in which we increasingly shape the environment for thriving, not merely surviving.

Man continually manipulates some factors in his environment to favor health conservation; the production of goods and services; and the satisfactions of his recreation, leisure, mental composure, and stability in a positive and fruitful way of life. A discordant environment is not conducive to one's internal peace. No one has an inherent right to do

as he wishes with his surroundings. Where water, air, and soil are used to serve production, health, economic and social needs, it seems desirable to return them to their former quality as near as is economically possible. Realistically, some sacrifices and compromises must be made so that society may obtain the goods and services it desires, but these sacrifices must not be inimical to health and the common good. Judgment is governed by social and economic benefits as well as health needs.

The American way of life depends upon a freedom of choice and a recognized liberty for the individual consistent with the public good. Free enterprise in industry is essential to the support of government to do what the individual cannot accomplish by himself. However, the individual engaged in production of goods and services who neglects the social, economic, health, and welfare trends leads us down the pathway of destruction and possible anarchy. Government is a citadel through which the dignity of man may be expressed. Understanding cooperation, activated by performance, between industry and government can resolve many pending health, social, and economic problems within the framework of current knowledge. This conference is designed to take a hard look at some of these problems. Discussion is essential, but we need something more; we must have action and maybe we can get it."

While it is not feasible here to summarize each of the fifteen separate papers presented before the Congress some of the more noteworthy thoughts and challenging statements will be summarized.

MAN VERSUS ENVIRONMENT - In this paper by Dr. Rene Dubos it was pointed out that man has to be viewed in response to his total environment, physical, biological and social. While the control of disease can come in large part from the control of environment, there are other factors that cannot be controlled so readily and perhaps not all. These include man's hereditary fabric, his biological cycles and his fundamental emotional responses, plus certain unpredicatable natural forces as the unpredicatable effects of technological civilization.

While man's efforts will continue to strive for comfort and for protection against threats to health, *excessive regulation might result in social stagnation.* A society that does not continue to grow through adventure and willingness to take chances is not likely to survive long in the modern world. Society must be willing to take the educated and calculated risks ship noting that some rather contradictory statements have been made with regard to chemical-physical adthat are inherent in a civilization where rapid technological advances are being made. While many technological innovations will bring threats to health, in practice it will prove well nigh impossible to evaluate all these potential dangers.

PHYSICAL ASPECTS OF ENVIRONMENT

Dr. Abel Wolman gave this paper and among the several salient points are the following:

Since man cannot live in a millenium where all problems of his domestic and industrial wastes are removed, he must be realistic because he cannot live in a sterile vacuum. Man gives no indication of being either willing or able to do so. His choice therefore, is to select as intelligently as possible those adjustments in his physical environment which will reduce disease and promote comfort.

Dr. Wolman then made a plea for sound leaderditives without comprehensive knowledge or valid proof of their effects upon man. He recommended a six point attack upon environmental health problems so approaches will remain intelligent and well founded.

1. A restatement of the essential characteristics of environmental problems with a careful separation of the known from the unknown.

2. An appraisal by competent groups of the real and apparent health aspects of the various factors with leadership in this from the American Public Health Association.

3. The initiation of an intensive effort toward the development of suitable methods of analysis of exotic chemicals.

4. The design of criteria of health and safety to obviate inconsistencies so these will not be frozen into laws and regulations difficult to remove at a later date when more accurate facts are available.

5. The assessment of toxicological effects of many substances finding their way into the environment. The assessment of these factors is invariably made on the basis of animal to man findings and it would be wise to make these interpretations and transfers through responsible group action, the APHA again being the agency best suited to such task.

6. The avodiance of false concepts without which there will be perpetuated the battle between propaganda, preconception and scientific verification. False concepts, no matter how assidously purused, are costly not only in money but in wasted manpower and resources. The weeding out of unreliable findings and consequent action is the function of scientific groups - a duty not consistently performed now.

Another interesting and enlightening paper was that presented to the Congress by U. S. Commissioner of Food and Drugs, Dr. George P. Larrick. This paper was under the title, *FOOD AND DRUGS.* Some of Dr. Larrick's remarks follow:

"We in government have an obligation to see that consumers get the pure food the laws says they should have. To help industry do its part we have a strong educational program designed to acquaint manufacturers with the requirements of the law. Where the educational effort proves inadequate, of course, we apply the formal sanctions of the law.

Under authority of the Pesticide Chemicals

Amendment of 1954, we establish safe tolerances for residues of pesticide chemicals that may legally remain on crops. Based upon toxicity and residue data, we have established safe levels for over 100 pesticide chemicals on more than 2,000 crops. However, these tolerances must be re-evaluated as new scientific evidence is developed which bears on them. We are constantly on the alert for new facts that may reveal inadequacies in the data originally considered.

Our scientists, in cooperation with the Department of Agriculture, have conducted some significant experiments to determine the fate of certain pesticide chemicals when fed to cows. They have shown that some of the chlorinated compounds accumulate in the meat and milk from even very minute levels in the feed; for others there are "threshold" levels in the feed below which residues do not deposit in the animal tissues. They have found that certain of the organic phosphates, such as parathion, are destroyed in the bovine metabolism and do not place residues in the meat or milk. This has been confirmed by experiments showing that the compounds are readily destroyed when added to bovine rumen fluid.

One of the most interesting developments of the frozen food industry - and perhaps an expected outgrowth, considering the eager acceptance of such convenience foods - has been the emergence of frozen precooked foods requiring the consumer to do little more than heat and serve complete meals from packages stored in a freezer. This has further shifted food perparation from the kitchen to the factory. It has simultaneously brought major problems of control to the manufacturer, the distributor, and the Food and Drug Administration.

There is little public information about the effect of varying processing techniques and sanitary conditions in the factory on the numbers and types of microorganisms in frozen precooked foods. Yet such data are essential to a sound evaluation of the adequacy and safety of manufacturing operations. To begin to accumulate basic data in this area, the Food and Drug Administration recently made a study of the frozen precooked foods indutsry, which covered a good cross-section of the products it now manufactures. We got a few answers. We found many questions for further study. Our inspections and recommendations resulted in a substantial voluntary improvements in a number of plants. In some instances, we brought regulatory action against firms operating under grossly unsanitary conditions."

Undoubtedly, the *Congress* shed new light on present and future concepts of man's enrionment. Whether the stated goal of the Congress, to explore and develop environmental principles, methodology and practice was accomplished, is an open question. As a matter of fact, the answer to this question can probably not be immediate. It is hoped that many who were present learned new facts about our living changing environment. It is hoped that they came away with the resolve that new methods, better techniques, improved understanding and team work are all necessary tools urgently needed for the task which is now upon us.

PUBLIC HEALTH SERVICE TO BUILD SHELLFISH RESEARCH CENTER

The Department of Health, Education, and Welfare has announced that the Public Health Service will build a shellfish sanitation research center adjacent to the University of Rhode Island's Marine Laboratory. The installation will employ approximately 25 scientists plus supporting staff. It will be located on the west shore of Narragansett Bay, six miles from the main campus of the University, at Kingston.

The announcement was made in conjunction with the offer to the Department of a gift of land from the University of five acres adjacent to its marine laboratory.

The Department said that several New England sites were considered and a number of places visited by Public Health Service engineers before the decision was made to accept the University's offer of land. The new center will be devoted to research and technical assistance in shellfish sanitation and will also be part of the Department's expanding activities in oceanographic research. Mutual benefits will accrue through the association of the shellfish center with the Marine Laboratory, which is part of the University's new graduate School of Oceanography. A pilot plant to make public health evaluation of shellfish purification methods will be incorporated in the center.

NEW BOOKS

McKinney, Ross E., Sc. D. Microbiology for Sanitary Engineers. ($12.50).

This book gives the sanitary engineer an understanding of fundamental microbiology and how it effects the work of the engineer. It is both a basic and an applied text with a definite division between the two areas so it can be used as a single unit or in two parts. The book includes a discussion of the various microorganisms of interest and a detailed coverage of the bio-chemistry of these microorganisms. This is the first attempt to tie the fundamentals

of microbiology to design and operation of sanitary engineering facilities; it is the first microbiology book written by an engineer for students in the sanitary engineering field. Professor McKinney is in the Civil Engineering Department, University of Kansas, Lawrence.

CALENDAR OF MEETINGS

1962

Jan. 17-20—North Carolina Dairy Products Association, Inc., Annual Convention, The Carolina Hotel, Pinehurst, North Carolina. Administrative Officer, John E. Johnson, P. O. Box 10506, Raleigh, North Carolina.

Jan. 21-23—Louisiana Dairy Products Association, Inc., Annual Convention, Royal Orleans Hotel, New Orleans, La. Administrative Officer, George F. White, P. O. Box 87, Homer, Louisiana.

Jan. 22-23—Virginia Dairy Products Association, Annual Convention, Hotel Roanoke, Roanoke, Virginia. Administrative Officer, C. L. Fleshman, P. O. Box 918, Lynchburg, Virginia.

Jan. 22-24—Ohio Dairy Products Association, 45th Annual Convention, Deshler Hilton Hotel, Columbus, Ohio. Administrative Officer, E. A. Graber, 5 East Long Street, Columbus 15, Ohio.

Jan. 22-31—Ice Cream Short Course, Dairy Department, University of Maryland, College Park, Maryland. Administrative Officer, W. S. Arbuckle, University of Maryland, College Park, Maryland.

Jan. 29-31—Alabama Dairy Products Association, Inc., Annual Convention, Grand Hotel, Point Clear, Alabama. Administrative Officer, Curtis H. Springer, 1207-8 First National Bank Building, Montgomery, Alabama.

Feb. 1—Evaporated Milk Association, bi-monthly meeting of the Industry, Builders Club, Chicago, Illinois. Administrative Officer. E. H. Parfitt, 228 North LaSalle Street, Chicago 1, Illinois.

Feb. 1—Ice Cream Conference, Student Union Building, College Park, Maryland. Administrative Officer, W. S. Arbuckle, University of Maryland, College Park, Maryland.

Feb. 4-7—National Dairy Council, 47th Annual Meeting, Bellevue Stratford Hotel, Philadelphia, Pennsylvania. Administrative Officer, Milton Hult, President, 111 North Canal Street, Chicago 6, Ill.

Feb. 7-9—Mississippi Dairy Products Assn., Annual Convention, The Buena Vista, Biloxi, Mississippi. Administrative Officer, F. H. Herzer, Box 356, State College, Mississippi.

Feb. 12—Oklahoma Dairy Products Institute, Board of Directors Meeting, Institute Office, Oklahoma City, Oklahoma. Administrative Officer, Dallas French, 129 N. W. 44th Street, Oklahoma City 18, Okla.

Feb. 13-14—Michigan Allied Dairy Assn., Convention, Hotel Pantlind, Grand Rapids, Michigan. Administrative Officer, Frank Koval, 3030 Vine Street, Lansing 12, Michigan.

Feb. 13-15—Oregon Dairy Industries, Annual Conference, Withycombe Hall, Corvallis, Oregon. Administrative Officer, J. O. Young, Oregon State University, Corvallis, Oregon.

Feb. 14-15—South Carolina Dairy Association, Inc., Convenvention—Annual Business Meeting, Hotel Wade Hampton, Columbia, South Carolina. Administrative Officer, W. L. Abernathy, Jr., P. O. Box 5, Chester, South Carolina.

Feb. 15—Dairy Products Improvement Institute, Inc., Annual Meeting, Hotel Governor Clinton, New York, New York. Administrative Officer, A. C. Dahlberg, 302 East State Street, Ithaca, New York.

Feb. 21-22—Missouri Ice Cream and Milk Institute and Dairy Institute of Kansas, Joint Annual Convention, Muehlebach Hotel, Kansas City, Missouri. Administrative Officer, W. H. E. Reid, Mo. Ice Cream and Milk Inst., 124 Eckles Hall, Columbia, Missouri.

Feb. 25-27—Dairy Products Institute of Texas, Inc., Annual Convention, Hotel Texas, Fort Worth, Texas. Administrative Officer, George M. Clarke, 1006 Perry-Brooks Building, Austin, Texas.

Feb. 27-28—Dairy Engineering Conference. Kellogg Center, Michigan State University, East Lansing, Michigan. Administrative Officer, Carl W. Hall, Dairy Eng. Conf., Continuing Education Service, Michigan State University, East Lansing, Michigan.

March 1-2—Minnesota Dairy Products Association, Annual Meeting & Convention, Radisson Hotel, Minneapolis, Minnesota. Administrative Officer, Floyd Thompson, 416 New York Building, St. Paul 1, Minnesota.

March 11-13—Dairy Products Association of Kentucky, Inc., Annual Meeting and Industrial Conference, Sheraton Hotel, Louisville, Kentucky. Administrative Officer, D. F. Conley, 2927 West Kentucky Street, Louisville 11, Kentucky.

March 12-14—ICMI Merchandising Council Spring Meeting, Boca Raton Hotel, Boca Raton, Florida. Administrative Officer, Robert H. North, 1105 Barr Building, Washington 6, D. C.

March 15-17—Pacific Dairy & Poultry Association, 38th Annual Convention, Biltmore Hotel, Los Angeles, California. Administrative Officer, Carl E. Nall, 1304 E. 7th Street, Los Angeles, California.

March 18-20—Tennessee Dairy Products Association, Annual Convention, Andrew Jackson Hotel, Nashville, Tennessee. Administrative Officer, B. V. Lawson, 1719 West End Building, Nashville 3, Tennessee.

March 20-22—American Dairy Association, Annual Meeting, Pick Congress Hotel (tentative hotel) Chicago, Illinois. Administrative Officer, M. J. Framberger, 20 N. Wacker Drive, Chicago, Illinois.

April 3-4—University of Nebraska, Annual Dairy Industry Conference, Nebraska Center for Continuing Education College of Agriculture Campus, Lincoln, Nebraska. Administrative Officer, T. A. Evans, 101 Dairy Building, Lincoln 3, Nebraska.

April 8-10—Indiana Dairy Products Association, Inc., Business and Social Meeting, French Lick-Sheraton Hotel, French Lick, Indiana. Administrative Officer, Ward K. Holm, 603 Union Title Building, Indianapolis 4, Indiana.

April 9-10—American Butter Institute, Inc., National Cheese Institute, Inc., Annual Meeting, LaSalle Hotel, Chicago, Illinois. Administrative Officer, E. W. Gaumnitz, 110 N. Franklin Street, Chicago 6, Illinois.

April 10-11—Iowa Milk and Ice Cream Mfgrs. Assns., Annual Convention, Hotel Savery, Des Moines, Iowa. Administrative Officer, John H. Brockway, 710 Fifth Avenue, Des Moines, Iowa.

April 11-13—Institute of Environmental Sciences, annual technical meeting and equipment exposition, Sheraton-Chicago Hotel, Chicago, Ill. Administrative Officer, J. P. Monroe, Lear, Inc., Grand Rapids, Michigan.

April 12-13—American Dry Milk Institute, Inc., National Meeting, Edgewater Beach Hotel, Chicago, Illinois. Administrative Officer, John Walsh, 221 North LaSalle Street, Chicago 1, Illinois.

April 26—Evaporated Milk Association, bi-monthly meeting of the Industry, Builders Club, Chicago, Illinois. Administrative Officer, E. H. Parfitt, 228 N. LaSalle Street, Chicago 1, Illinois.

Apr. 28-May 3—IAICM-ICMI Board of Directors Spring Meeting, Mountain Shadows, Scottsdale, Arizona. Administrative Officer, R. H. North, 1105 Barr Building, Washington 6, D. C.

Apr. 30-May 1-2—National Assn. of Dairy Equipment Mfgrs. Annual Spring Meeting, The Diplomat, Hollywood, Florida. Administrative Officer, John Marshall, 1012 Fourteenth St., N. W., Washington, D. C.

May 1-2—Pennsylvania Association of Milk Dealers, Annual Convention, Penn Harris Hotel, Harrisburg, Pennsylvania. Administrative Officer, Henry R. Geisinger, 303 Telegraph Building, Harrisburg, Pennsylvania.

May 9-10—National Dairy Council, Board of Directors Meeting, Sheraton-Chicago Hotel, Chicago, Illinois. Administrative Officer, Milton Hult, 111 North Canal Street, Chicago 6, Illinois.

May 9-10—New England Association of Ice Cream Manufacturers, Annual Convention, Sheraton Plaza, Boston, Mass. Administrative Officer, Malcolm D. MacLeod 70 Franklin Street, Worcester, Massachusetts.

May 21-23—Assn. of Ice Cream Mfgrs. of Pa., New Jersey & Delaware, Inc., Annual Meeting, Pocono Manor Inn, Pocono Manor, Pennsylvania. Administrative Officer, Peter F. Rossi, 405 Lexington Avenue, New York 17, N.Y.

June 6—The Holstein-Friesian Association of America, Annual Convention, Hotel Roanoke, Roanoke, Virginia. Administrative Officer, Robert H. Rumler, Brattleboro, Vermont.

June 10-15—VIII Congress of the Inter-American Assn. of Sanitary Engineering, Washington, D. C. Administrative Officer, Edmund G. Wagner, c/o Officer of Public Health, I.C.A., Washington 25, D.C.

June 17-21—The American Dairy Science Association, Annual Meeting, University of Maryland, College Park, Maryland. Administrative Officer, H. F. Judkins, 32 Ridgeway Circle, White Plains, New York.

June 17-21—National Association of Retail Grocers, Annual Convention, Auditorium, San Francisco, California. Administrative Officer, Marie Kiefer, 360 North Michigan Ave., Chicago 1, Illinois.

June 18-20—Grocery Manufacturers of America, Inc., Mid-Year Meeting, Greenbrier, White Sulphur Springs, West Virginia. Administrative Officer, Paul S. Willis, 205 E. 42nd Street, New York 17, N. Y.

June 18-21—National Dairy Council, Summer Conference, Sheraton-Chicago Hotel, Chicago, Illinois. Administrative Officer, Milton Hult, 111 North Canal Street, Chicago 6, Illinois.

June 28—Evaporated Milk Association, bi-monthly meeting of the Industry, Builders Club, Chicago, Illinois. Administrative Officer, E. H. Parfitt, 228 N. LaSalle Street, Chicago, Illinois.

August 5-8—West Virginia Dairy Products Association, Annual Meeting, Greenbrier Hotel, White Sulphur Springs, West Virginia. Administrative Officer, S. J. Weese, West Va. University Dairy, Morgantown, W. Va.

Sept. 12-13—National Dairy Council Board of Directors Meeting, Sheraton-Chicago Hotel, Chicago, Illinois. Administrative Officer, Milton Hult, 111 North Canal Street, Chicago 6, Illinois.

Sept. 17—Wisconsin Creameries Association, Annual Convention, Whiting Hotel, Stevens Point, Wisconsin. Administrative Officer, Oscar Christianson, 1 West Main Street, Madison, Wisconsin.

Sept. 18-20—American Dairy Association Board of Directors & State Managers Meeting, Olympic Hotel, Seattle, Washington. Administrative Officer. M. J. Framberger, 20 N. Wacker Drive, Chicago, Illinois.

Sept. 27—Evaporated Milk Association, bi-monthly meeting of the Industry, Builders Club, Chicago, Illinois. Administrative Officer, E. H. Parfitt, 228 N. LaSalle Street, Chicago 1, Illinois.

Oct. 2-3—Minnesota Creamery Operators' and Managers' Association, Annual Convention and Business Sessions, Hotel Lowry, St. Paul, Minnesota. Administrative Officer, Floyd Thompson, 416 New York Building, St. Paul 1, Minnesota.

Oct. 24-27—International Association of Milk and Food Sanitarians, Inc. Annual Meeting, Ben Franklin Hotel, Philadelphia, Pennsylvania. Administrative Officer, H. L. Thomasson, P. O. Box 437, Shelbyville, Indiana.

Oct. 29-Nov. 3—Dairy Exposition, Atlantic City, New Jersey. Administrative Officer, Joseph Cunningham, Dairy Industry Supply Association, 1145 - 19th St. N. W., Washington, D. C.

Nov. 12-14—Grocery Manufacturers of America, Inc., Annual Meeting, Waldorf Hotel, New York, New York. Administrative Officer, Paul S. Willis, 205 E. 42nd Street, New York 17, N. Y.

Dec. 6—Evaporated Milk Association, bi-monthly meeting of the Industry, Builders Club, Chicago, Illinois. Administrative Officer, E. H. Parfitt, 228 N. LaSalle Street, Chicago, Illinois.

1963

May 7-9—Pennsylvania Association of Milk Dealers, Annual Convention, Bedford Springs Hotel, Bedford, Pennsylvania. Administrative Officer, Harry R. Geisinger, 303 Telegraph Building, Harrisburg, Pennsylvania.

June 17-19—Grocery Manufacturers of America, Inc., Mid-Year Meeting, Greenbrier, White Sulphur Springs, W. Va. Administrative Officer, Paul S. Willis, 205 E. 42nd Street, New York 17, N. Y.

ANNOUNCEMENT

Short courses being offered at Michigan State University through the Cooperative Extension Service are scheduled as follows for 1962:

Quality Control and Analysis --Jan. 22-Feb. 2
Milk and Related Products ----Feb. 5-Feb. 16
Dairy Engineering ----------Feb.19-Mar 2

Persons interested in these courses should write to the Short Course Department at MSU, East Lansing, Michigan.

INDEX TO ADVERTISERS

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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.

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.

Central Ontario Milk Sanitarians Association

Oshawa, Ontario, Canada
November 29, 1961

(*Secretary*: Wm. D. McCorquodale, 409 Huron Street, Toronto, Ontario, Canada)

Laboratory Testing of Coliform Estimation on Pasteurized Milk Products - Gus Miller, Regional Lab. Dir., Dept. of Health, Peterborough.

Interest of Health Department on Coliform Count of Pasteurized Milk - Dr. Watt, Dept. of Health, Oshawa.

Tenth Annual Milk Sanitarians Short Course

Conducted By
Oregon State Department of Agriculture and Oregon State University

Corvallis, Oregon
November 28, 1961

(*Secretary*: Byron DeYoung, Jr., 2720 S. E. 6th, Portland)

What's New in Dairy Research - I. R. Jones, Prof. Dairy Husbandry; William E. Sandine, Prof. Bacteriology; E. A. Day, Prof. Dairy Technology, Oregon State Univ.

Producer Inspection Items 12 13 & 14 - Interpretation and Enforcement - Moderator: Art Blanding, Klenzade Products, Inc.
Wayne Gilbert, Portland Milk Inspection Service.
John Irving, Oregon Dept. of Agriculture.

Interstate Movement of Milk - Milton Held, U. S. Public Health Service.

Producer Inspection Items 8d & 9 - Interpretation and Enforcement - Moderator: Byron DeYoung Jr., Dairy Cooperative Ass'n.
Harry E. Killion, Portland Milk Inspection Service
Thomas Bailey, Oregon Dept. of Agriculture.

Dairy Substitutes - Moderator: K. E. Carl, Oregon Dept of Agriculture.
J. O. Young, Prof. Dairy Technology, Oregon State Univ.
Oscar Hagg, Dairy Marketing Specialist, Oregon State Univ.

Producer Inspection Items #5, 6b & 7 - Interpretation and Enforcement - Moderator: Calvin Keist, Dairy Dept., Safeway Stores, Inc.
Ben Masengil, Eugene Milk Inspection Service.
E. C. Holman, Oregon Department of Agriculture.

The Marginal Producer Problem - Moderator: Robert G. Mason, Exp. Station Editor, Oregon State Univ.
Vernon J. Damm, Ass't. Prof. Psychology, Oregon State Univ.
James Morgan, Oregon Dept. Agriculture.
W. W. Maltby, Oregon Dept. Agriculture.

Rocky Mountain Association of Milk & Food Sanitarians

Colorado State University, Fort Collins, Colorado
November 17, 1961

(*Secretary*: Frank Yatckoske, 3150 West 25th Ave., Denver 11, Colo.)

The Functions and Objectives of the National Mastitis Council - Harold J. Barnum, Chief, Milk Section, Denver Health & Hospitals.

What Can the Universities Do for the Food Sanitarian and the Food Industry - Dr. Sumner Morrison, Prof. of Microbiology, Colorado State Univ., Ft. Collins, Colo.

Industry's View on Food Technology Curricula - Robert J. McColloch, head, Agr'l. Research Chemistry, Univ. of Wyoming, Laramie, Wyoming.

1961-62 Objectives of the International Association of Milk & Food Sanitarians - Charles E. Walton, Pres. IAMFS, City Health Unit, Laramie, Wyoming.

Functions of Private and Public Laboratories and How Their Efforts Can Be Coordinated - Everett Cole, Biological Research Lab., Arvada, Colo.; Michael Purko, Dir., Chemical and Bacteriological Lab., Wyoming Dept. Agr., Laramie.

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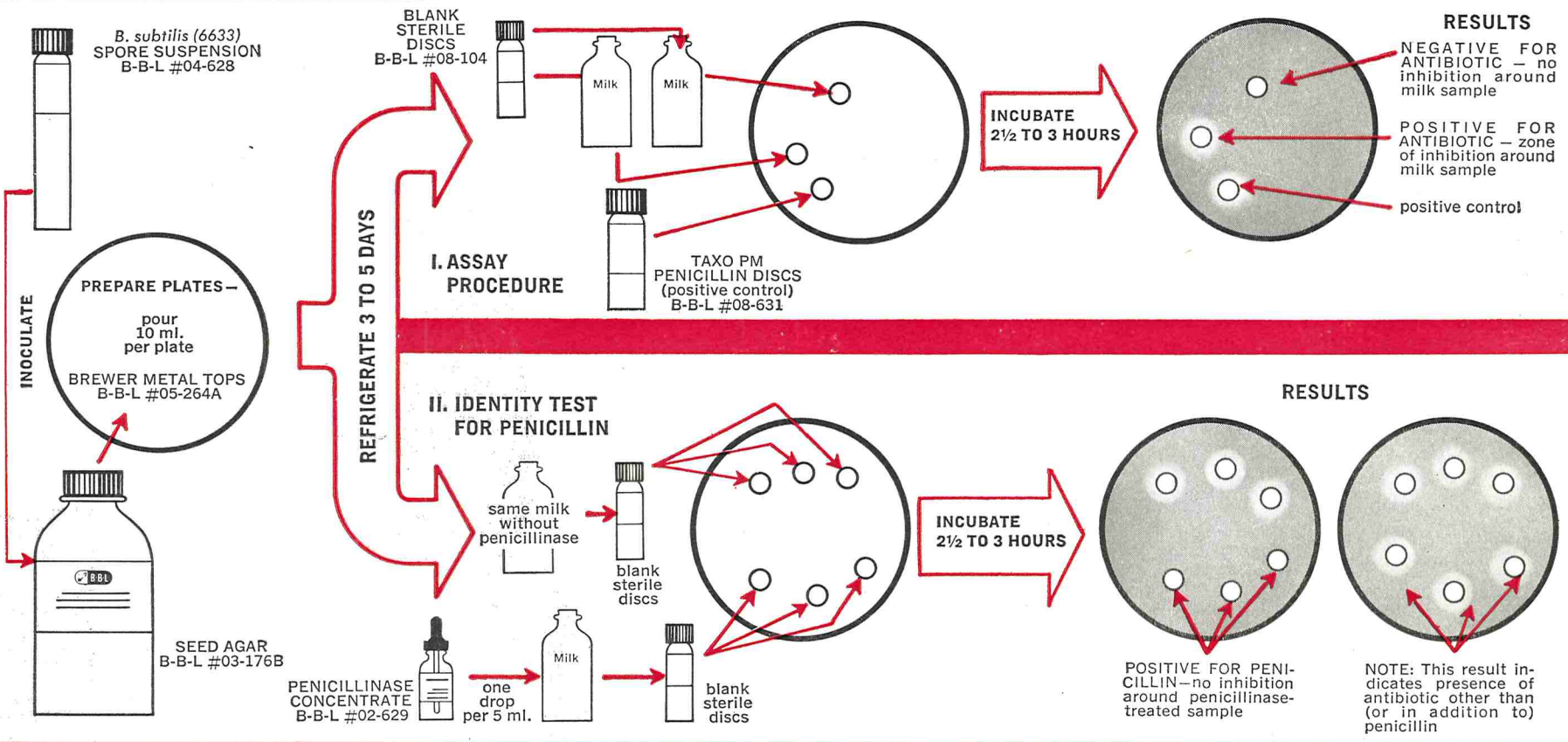
B·B·L techniCHART

DETECTION OF PENICILLIN IN MILK



The presence of antibiotics in milk following mastitis therapy in cows has created serious public health problems and caused technical difficulties within the dairy industry. A rapid, practical laboratory procedure to assist regulatory agencies and the dairy industry in solving these problems was described by Arret and Kirshbaum.* This procedure employs rapid growth of a sensitive strain of *B. subtilis* for assaying the presence of antibiotics in milk and for determining its identity with penicillin. Inhibition of growth by the presence of as little as 0.05 unit of penicillin per ml. of milk sample is detectable within 2½ hours.

In answer to many requests for information about the availability of B-B-L products for this simplified procedure, the B-B-L Development Laboratory has prepared this TECHNICHART. It graphically illustrates the basic procedure, showing the materials necessary—**all of which are available from B-B-L.** A complete brochure with detailed technique and product listing is available upon request.

*Arret, B., and Kirshbaum, A.: J. Milk and Food Technol. **22**:329, 1959.

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A WELL-READ SIGN
...with you in mind

Read by thousands of dairy farmers each year

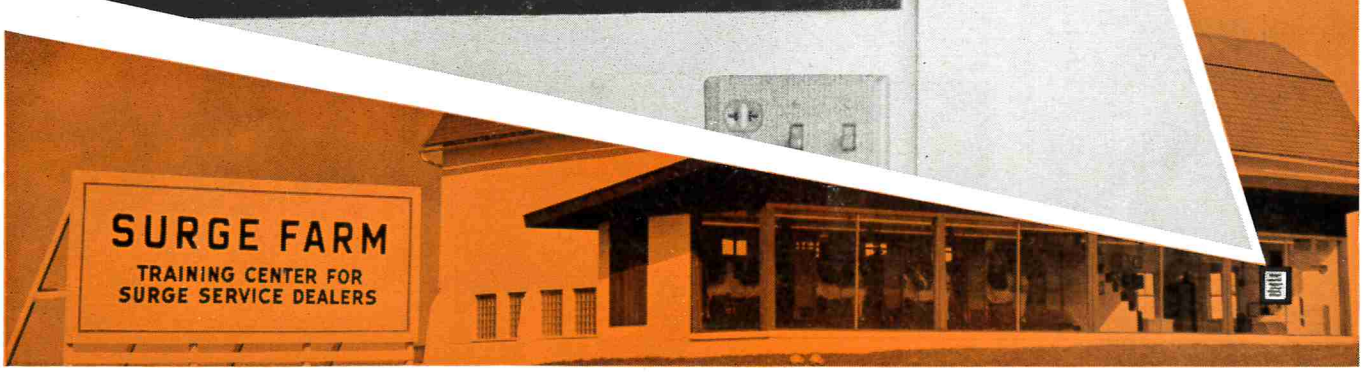
BEFORE YOU LEAVE, READ THIS –

NEVER BUILD A MILKING PARLOR OR INSTALL ANY KIND OF A PIPE LINE MILKER - (NO MATTER IF IT'S IN A PARLOR OR A STANCHION BARN) UNTIL YOU DO THESE THINGS —

1. DRAW A ROUGH SKETCH OF THE INSTALLATION YOU PROPOSE TO MAKE - YOUR SURGE SERVICE DEALER WILL BE GLAD TO HELP YOU -
2. SHOW THIS SKETCH TO
   - A. THE HEALTH DEPARTMENT WHO IS RESPONSIBLE FOR THE MILK SUPPLY FROM YOUR DAIRY FARM -
   - B. THE MILK PLANT FIELD MAN WHO REPRESENTS THE DAIRY THAT WILL PAY YOU FOR YOUR MILK EACH MONTH -

DOING THIS WILL SAVE MISUNDERSTANDING AND CONFUSION LATER ON - IT MAY SAVE YOU MONEY BY GETTING THINGS RIGHT THE FIRST TIME -

MANY TIMES GOOD SOUND IDEAS ARE DEVELOPED THAT ARE HELPFUL TO ALL CONCERNED BY COOPERATION OF THIS KIND



Each year, thousands of visiting dairymen are influenced by the above sign. It is prominently displayed in the Picture Window Parlor at the SURGE Training Center.

Many of these dairy farmers, who come here to learn the latest in good milking, are planning new construction or the installation of new milking equipment. And, *good sanitation practices* start right then and there. We urge every cow-milking man to work with his local health officials in the planning, construction and operation of his new milking plant.

Good sanitation is our mutual responsibility. We always welcome your suggestions.

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