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Editorial

The opinions and ideas expressed in papers and editorials are those of the respective authors. The expressions of the Association are completely recorded in the transactions.

Milk and Food Sanitation: One Field, One Organization

When the International Association of Milk Inspectors (now the International Association of Milk and Food Sanitarians, Inc.) was organized, for some years thereafter the development of milk and food sanitation was predominantly in the hands of health department officials. The formulation of standards, the adoption of effective regulatory procedure, the setting up of rules and regulations, the interpretation of compliance, and the solution of the many problems that arise in such work influenced the early workers to keep this Association restricted only to those sanitarians who were in official or governmental employ. This policy stimulated freedom of discussion among workers who were blazing trails in the (in)sanitary wilderness. Moreover, it assured every one interested that formulations of practises and interpretations of regulatory procedures were not motivated by commercial and other such considerations of personal gain. Inasmuch as the commercial interests had their own organizations, restricted exclusively to their own members, one felt that there was not any incentive to change this situation.

The work of the official agencies was so well done, as a whole, that milk and food sanitation-mindedness began to take hold of industry and public. As the years rolled by, we found that more sanitarians are engaged in this work by the industries than by official health agencies. Gradually, here a little, there a little, line upon line, precept upon precept, an imposing structure of sanitation consciousness has been seeking formulation and expression. This is now appearing in a developing literature of books and journals, college courses, and legal recognition. The subject has grown to proportions that extend far beyond the confines of the interests of only the official sanitarians.

Nowhere is this situation shown clearer than in the meetings of the International Association of Milk and Food Sanitarians, Inc. Look at the list of speakers—all were invited by the official program committee. Almost half the speakers are commercial men. Run down the list of contributors to the growing literature. A large proportion of them are not in official employ at all. And yet, who is there who questions their professional ability or technical competency or public interest or organizational integrity or sanitation idealism?

Some of our membership have feared that the admission of the non-official sanitarian into full, active membership in this Association would let down the bars, so to speak, to dominance by commercial interests which would divert the objectives of what this organization stands for. To this fear we reply that already many of our most active members, men who have spent many years of their lives in developing the subject of milk and food sanitation and the promotion of this organization, are now outside of official employ and yet are legally qualified, by the provision of our present constitution, to serve on any committee or to hold any office, including that of President. And yet, who fears their subversive influence? Of course, no one does.

There are three new factors that now influence the whole picture. First, the development of food technology. There was a time when an inspector who had a good sense of discernment, a keen nose, and an elementary (as now evaluated) knowledge of sanitation could do a good job of sanitary supervision. Those days are gone forever. Technology has thrust its complicated build-up of "know-how's" at us. We need all the association with kindred minds that we can get to keep up on the newer developments and to improve present practises and to meet the unknowns as they come. The men outside of official employ are in a better position to develop the technology of food sanitation than are the official men. The latter can only point out what should be done whereas the commercial men are the ones who actually do the work.

In the second place, we are finding that our greatest success in enforcing sanitation is to secure the cooperation of the people with whom we have to deal. This means education. Education enjoins contact. Contact promotes mutual understanding. The latter engenders cooperation. Cooperation insures team work. Thereby, the influence of official supervision is enormously extended because industrial sanitarians are carrying on the work in a hundred places when the official man is present in only one. We need these intimate associations with our non-official colleagues, so to speak, to help us do our official work, to develop the subject more highly, and to facilitate the educational process of disseminating the "know-why" as well as the "know-how."

And then there is the third factor. Milk technology societies are coming into being all over the country. The membership consists of the several local health department, federal government, and education men plus mostly the commercial men. The meetings are stimulating, and the group interest is stabilized and fostered. The personnel and the subjects are just what this Association represents and encourages and promotes. Attendance at meetings of this Association for the last twenty-five years fails to reveal any subversive tendency, actual or potential. Unless a spectator were acquainted with the employment of the speakers, he could not for the life of him tell who were the official men and who were not.

We are all milk and food sanitarians together. We are interested in protecting and in improving the public health, in producing clean, attractive, palatable food, and in taking pride in doing our jobs well. Such singleness of purpose produces strength. This strength then can engage in more development work, publish the JOURNAL monthly, and create a more effective professional solidarity. We are milk and food sanitarians first and always—after that, we are educators, supervisors, regulatory officials, industrialists. "All for one, one for all."

Association of milk and food sanitarians, let us reorganize and welcome into our fold fellow milk and food sanitarians who are just as anxious to see safe, clean products sold as we are. J. H. S.

(Note: Since writing the above editorial the Association and the Executive Board took action at the Annual Meeting, as discussed on page 377, toward broadening the membership base of the Association to afford membership status for industrial men equal to that of the regulatory and educational men.)

The Limitations of the Refractometer Readings of Milk Serums in Detecting Watered Milk

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Among the methods which are being used for detecting added water in milk are the refractometer determinations of the copper serum, acetic serum, and sour serum preparations of milk. These methods are recognized as official by the Association of Official Agricultural Chemists.

The use of the above methods, for student work during the past one and one-half years in this laboratory, failed to show added water until unusually large amounts had been added to samples of Jersey milk. Likewise, the comparative data published in 1921 by Hortvet (3) in connection with his cryoscopic method indicate that results obtained by means of the serum methods are not satisfactory for all milks.

In 1930 Elsdon and Stubbs (2) pointed out the following disadvantages of the sour serum method of preparing milk for refractometric determination; (a) milk cannot be examined when fresh and (b) the progress of souring cannot be controlled. These workers recommended souring the milk at a controlled temperature.

Recently Mitchell and Frary (5) made a study of the serum methods and stated, "It is believed that the lower limits for the immersion refractometer readings and for serum ash in the present Official Methods should be raised." Also that, "The cryoscopic method should be used to check the serum methods whenever added water is indicated."

Experimental Methods

In order to include the widest possible range of composition of normal milks produced by dairy cows, samples were collected over a period of 12 months, from both large and small herds and from certain individual cows of the Holstein and Jersey breeds.

Each sample was analyzed for percentage butterfat and total milk solids by the Mojonnier method. After dividing each sample into four parts, one serving as a control, calculated amounts of distilled water were added to the other three portions to constitute 5, 7, and 9 percent added water. Each of the four parts was then subdivided into fractions as needed for the various determinations.

The serums were prepared for analysis according to the methods outlined in *Methods of Analysis* of the Association of Official Agricultural Chemists (1). In addition, for the last 21 of the 36 samples analyzed, the sour serum method was modified, because of inconsistencies obtained by natural souring, to include addition of 1 percent buttermilk culture and incubation of the cultured samples at 70° F. until coagulation had taken place.

A Hortvet cryoscope was used for the freezing point determinations. The freezing point thermometer was calibrated by the recommended procedure (1) using pure sucrose obtained from the Bureau of Standards, Washington, D. C.

Experimental Results

Table 1 contains a summary of the results obtained in this study. It may be noted that there is a wide difference between the minimum and maximum refractometer values obtained on nor-

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mal milk regardless of the type of serum that was used in the analyses. This range of values is considerably larger than that reported by Mitchell and Frary (5) on 27 herd samples. When 9 percent water had been added to milk (Table 1), the maximum refractometer reading indicated no added water regardless of the method used in the preparation of the serum; however, in the case of the minimum values obtained on a sample containing 5 percent added water, the interpretations would have been "added water" for all except the copper serum method.

TABLE 1

EFFECTS OF ADDED WATER TO MILK ON THE REFRACTOMETER READINGS OF THE MILK SERUM AND ON THE FREEZING POINT OF THE MILK

Water (%)		Refractometer Values (Scale readings at 20° C.) Acetic Serum	Copper Serum	Sour Serum	Modified Sour Serum	Freezing Point (Degrees C)
None	Mean	42.15(25)	37.77(25)	42.20(23)	41.53(25)	—0.541(26)
	Max.	43.90	38.75	45.55	43.30	—0.562
	Min.	39.25	36.04	38.69	38.61	—0.529
5	Mean	40.49(12)	36.77(13)	40.13(11)	39.82(11)	—0.514(11)
	Max.	41.70	37.60	41.80	41.57	—0.538
	Min.	37.99	35.42	36.70	37.18	—0.492
7	Mean	39.82(17)	36.26(17)	39.44(16)	39.15(16)	—0.501(14)
	Max.	41.52	37.18	41.21	41.10	—0.512
	Min.	37.49	34.80	35.75	36.84	—0.487
9	Mean	39.27(9)	35.83(8)	38.71(6)	38.85(6)	—0.493(8)
	Max.	40.80	36.52	39.65	40.30	—0.501
	Min.	37.30	34.36	37.40	36.50	—0.485

The numbers in parentheses represent the number of samples analyzed.

It should be noted that the range of refractometer readings between minimum and maximum values of the sour serum method was narrowed considerably when the modified method of souring was used as compared with the natural souring method. However, the range was not narrowed to that of the acetic serum or to that of the copper serum.

The range of freezing point values (Table 1) is practically identical with the range reported by Stubbs and Elsdon (6) on 1,000 samples from individual cows and by Mitchell and Frary (5) on 27 samples of herd milk. (The latter reported values no doubt were intended to be negative numbers.) Although the maximum freezing point value showed no added water when 5 percent water had been added to the sample, the mean value indicated considerable added water.

Some of the data have been rearranged (Table 2) to show relationships between percentages butterfat, refractometer readings, and freezing point. A trend in increases of refractometer readings with increases in butterfat content of the milk will be noted. No such relationship exists between percentages butterfat and freezing point of the milk. The rearranged data of Stubbs and Elsdon (6) show no relationship between percentage solids-not-fat and freezing point.

DISCUSSION

A study of the foregoing data indicates that the usefulness of the refractometer in detecting watered milk has definite limitations. It would appear that raising the lower limits of the

TABLE 2

RELATIONSHIPS OF THE PERCENTAGES BUTTERFAT AND TOTAL MILK SOLIDS OF THE MILK TO THE REFRACTOMETER READINGS OF THE MILK SERUM AND TO THE FREEZING POINT OF THE MILK

Sample No.	Butterfat (%)	Total Milk Solids (%)	Refractometer Readings: Acetic Serum	Copper Serum	Modified Sour Serum	Freezing Point (Degrees C.)
26*	2.83	10.46	39.42	36.04	39.10	—0.550
25*	2.92	11.28	41.40	37.72	40.95	—0.551
29	3.16	10.73	39.25	36.29	38.61	—0.529
24*	3.23	11.45	40.38	36.70	39.68	—0.544
22	3.53	12.03	41.80	37.90	42.35	—0.540
28	3.56	11.82	40.68	37.10	39.65	—0.543
12*	3.59	12.19	42.20	37.75	41.20	—0.541
30	3.73	11.81	40.61	37.00	39.92	—0.531
33*	4.24	12.55	41.23	37.22	40.66	**
11	4.58	13.68	42.90	38.35	42.00	—0.538
10	4.75	13.69	41.10	37.50	41.50	—0.545
16	4.88	13.53	43.25	38.58	41.70	—0.550
13	4.93	14.14	43.55	38.75	43.30	—0.552
17	5.12	14.22	43.40	38.60	42.80	—0.530
27	5.56	14.61	43.13	38.15	41.77	—0.562
20	5.77	14.80	43.20	38.40	42.40	—0.534
34*	5.92	15.24	42.97	38.14	42.75	**
31	6.17	15.68	43.90	38.46	43.02	**

* Represents milk from individual cow.
** Freezing point not determined.

refractometer readings would make the methods more useful, but a careful analysis of these and other data (3, 5) indicate that raising the lower limits will not change these limitations.

It will be noted that the minimum acetic serum refractometer reading obtained (Table 1) is 39.25. Other low readings for the acetic serum (Table 2) are 39.42, 40.38, 40.61, and 40.68. The minimum value reported by Mitchell and Frary (5) is 40.3 and by Hortvet (3), it is 40.2. The present directions (1) for the acetic serum specify "A reading below 39 indicates added H_2O; between 39 and 40, the addition of H_2O is suspected." For the copper serum a minimum refractometer reading of 36.04 (Table 1) was obtained with other low values (Table 2) being 36.29 and 36.70. Other reported minimum values on the copper serum are 37.0 by Mitchell and Frary (5) and 36.3 by Hortvet (3). The directions for the copper serum method specify that a reading below 36 indicates added water. An injustice would be imposed on milks similar to the foregoing if they were to be subjected to a lower limit of 40 or 41 instead of 39 for the acetic serum method or to 37 or 38 instead of 36 for the copper serum method.

The maximum acetic serum reading obtained (Table 1) is 43.90 with other high readings being 43.55 and 43.40 (Table 2). Mitchell and Frary (5) reported a maximum of 44.1 and Hortvet (3) a maximum of 44.4. On the copper serum, the maximum reading obtained (Table 1) is 38.75 with other high readings being 38.60 and 38.58 (Table 2). Mitchell and Frary (5) reported a maximum of 39.2 and Hortvet (3) a maximum of 38.6. These data indicate that extensive watering of similar milks would be tolerated even if the acetic serum lower limit were raised to 40 or 41 and if the copper serum lower limit were raised to 37.

An alternative of establishing the lower limits appeared to have some merit, but this was readily discounted also. The thought was to establish lower limits suitable for different ranges in butterfat content. However, the addition of water to milk will lower the fat content as well as the refractometer reading, and the practice of skimming a portion of the cream from a can of milk and replacing it with water conceivably might cause the percentage butterfat and the refractometer reading to appear entirely normal if the foregoing expressed thoughts of lower limits based on ranges of percentages butterfat were operative as is easily conjectured by examining Table 2.

In order that results obtained by either of the serum methods be recognized as official, refractometer readings that are below the specified lower limits must be accompanied by values for the ash content of the serum. Since the process of ashing, together with other details, requires considerable time, skill, and equipment, the serum methods for detecting watered milk are not as practical as they first appeared to be. In this laboratory, freezing point determinations have been made, using the Hortvet cryoscope, in 8 to 10 minutes per determination after the necessary preliminary preparations had been made to assure a supply of cold ether for the cryoscope and cold samples of milk for succeeding determinations. The method requires very careful attention to details, and when so performed highly reliable and reproducible data are obtained. Macdonald (4) described a freezing point apparatus originally reported by Temple (7) and commented as follows: "The rate of cooling is quicker so that more samples may be tested in a given time, and it is cheaper to operate. The results obtained are the same as those given by the Hortvet apparatus, and the same technique is employed, so that it is very useful for those laboratories where large numbers of samples are examined."

SUMMARY AND CONCLUSIONS

Thirty-six samples of milk were collected and have been analyzed for percentages butterfat and total milk solids by the Mojonnier method, for refractometer readings of the acetic, copper, and sour serums with a dipping refractometer, and for freezing points with a Hortvet cryoscope. A modified sour serum method was compared with the natural souring procedure and was found to be an improvement.

It is concluded that the present lower limits for refractometer readings of milk serums permit extensive watering of some milk without detection, especially the high butterfat and total solids milks. Although raising of the lower limits would tend to correct such a condition for high solids milk, if raised sufficiently to have practical application, low solids milk would be subject to condemnation as watered when it is normal milk in every respect.

It would appear that the usefulness of the refractometer readings of milk serums to interpretations of watered samples is limited exclusively to the readings below the present lower limits. It should not be implied that any sample of milk does not contain added water if the readings are above the present lower limits; in such events other methods must be used to establish their status with respect to added water.

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Benzene Hexachloride Flavored Milk

From Feeding Potatoes Grown on Soils Treated with the Chemical[1]

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In the fall of 1947 reports were received that native potatoes purchased in stores had an undesirable odor when boiled or baked, and when eaten left a pronounced bitter taste which remained in the mouth for some time afterwards. The source of these potatoes was traced to fields that had been treated with hexachlorocyclohexane, commonly known as benzene hexachloride or 666, which had been applied to destroy wire worms at the rate of 5 pounds of wettable 50 percent concentrated benzene hexachloride per acre.

As these potatoes were unfit for human consumption, Professor Ralph W. Donaldson, Extension Professor of Agronomy, became interested in the possibility of using them for dairy cattle feed. A limited supply of the potatoes was procured, and in cooperation with the University of Massachusetts farm a feeding trial was conducted using one cow to determine whether the flavor would be transmitted to the milk.

Samples of milk from the cow were tested for flavor and odor before starting to feed about 20 pounds of potatoes daily to the cow for a period of 4 days. The milk was normal and free from any objectionable odors and flavors before feeding the potatoes, but on the first day after the potatoes were fed, a slight bitter taste could be detected. This flavor increased in intensity during the succeeding days of the feeding trial. At the end of the feeding trial no further samples were collected, thus no record was kept of how long the flavor persisted in the milk after the feeding of the potatoes was discontinued.

Some time later this question was raised and a second feeding trial was started on January 14, 1948. Again one cow was used in the experiment and about 20 pounds of the potatoes were fed per day. A pronounced bitter flavor was again detected in the milk after the potatoes were fed. The feeding of the potatoes was discontinued as of January 26 and sampling of the milk was continued until February 7, when the bitter flavor could no longer be detected and sampling was discontinued. The first noticeable decrease in flavor was noted five days after the feeding was discontinued, but 12 days elapsed before the milk seemed normal and did not leave a bitter taste in the mouth.

Possibilities of using chemical tests to detect benzene hexachloride were investigated but no specific test was found.

In March a dairy farmer from the central part of Massachusetts brought in samples of milk from each cow in his herd to check for flavor, as his milk dealer complained of an off-flavor in his milk supply. There were 30 samples, all of which had a typical bitter taste. There was a variation in intensity of bitter flavor between the samples, which may have been due to differences in amounts of milk produced. On questioning, the farmer said he had just finished feeding a carload of potatoes to his cows; thus there were no potatoes available for another feeding trial. The origin of the

[1] Contribution No. 683 of the Massachusetts Agricultural Experiment Station.

carload of potatoes was in the western part of the State. Although no specific data were available concerning the conditions under which the potatoes were grown, from the similarity between the flavor and that observed in the milk in previous feeding trials at the University farm, it seems likely that these potatoes had been grown on land treated with benzene hexachloride.

Another factor that ought to be studied is the question of whether sufficient amounts of the chemical will remain in the soil to flavor the potatoes the second year. However, a definite flavor was observed in the potatoes and the milk from cows fed the potatoes grown on the soil treated in the spring.

As far as is known, benzene hexachloride is not injurious to humans in the small amounts present in the potatoes, and as far as is known to the writer no harmful effects have been reported from consuming the potatoes or the milk obtained from cows fed the potatoes. However, the flavor in potatoes varies in intensity and frequently only persons with a keen sense of taste will detect it.

Benzene hexachloride is but one of many new chemicals offered to farmers to combat insects and pests, but this is the only one as yet that has come to our attention that seriously affects the flavor of potatoes and milk when they are fed to cows. Thorough investigation of all new chemicals used to spray or dust crops, or to treat soils on which crops are raised, should be made before they are released for widespread use.

The authors wish to acknowledge the cooperation and assistance of Matthew L. Blaisdell, Superintendent of the University Farm, for arranging for the feeding of the potatoes and taking the milk samples; and of Sumner R. Parker, State Director of P.M.A., for obtaining the potatoes for the feeding trials.

Sterilization of Dishes and Utensils in Eating Establishments*

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INTRODUCTION

FOR several years it has been generally accepted that disease producing agents may be transmitted through improperly sanitized dishes and food utensils. A human "carrier" with no disease symptoms may be equally as effective as a "case" infection in the contamination of dishes. Reports have been made of instances in which a healthy family became infected with colds after the visit of a dinner guest. Presumably the guest was a "carrier" and the dish sanitizing was inadequate. Transmission could have been by direct contact, handshaking, droplets, etc., as well as through inadequate dish sanitizing.

The term "sterilization" implies the complete killing or removing of all forms of microorganisms, including the more resistant spores as well as the ultramicroscopic viruses. Actually, under practical dishwashing conditions we frequently do not use bactericidal agents sufficiently strong to kill spores in the exposure period and under the conditions prevailing. For complete sterility, temperatures higher than boiling (under pressure) would be required, e.g. with the use of a pressure cooker or autoclave. However, spores generally are of relatively little sanitary significance on dishes since comparatively few of the common diseases are caused by organisms capable of spore formation. On the other hand, spores may be of considerable significance largely from the standpoint of food spoilage in utensils used for dairy and food industries, including bakeries. Rope formation in bread or high thermophilic count in milk may be a result of poor food utensil sanitation, resulting in survival of resistant spores. It would not seem likely that such pathogenic spore-forming bacteria as the anthrax or the botulism bacillus would generally need be considered in utensil sanitation of eating establishments. However, many of the filterable viruses are responsible for infection. Likewise the cysts of certain pathogenic protozoa may at times become a problem in food sanitation and possibly under unusual conditions in dish sanitation.

We are primarily concerned with making dishes safe for use and in this connection the word "sanitize" has been used. This does not imply the killing of all microorganisms but only those types which are likely to cause infection.

After food utensils have been properly cleaned in warm water employing a satisfactory detergent, and have been rinsed, we have at our disposal two commonly-used types of germicidal agents for sanitizing: (1) heat, and (2) chemicals. It is generally agreed that hot water is as satisfactory and as safe as any agent, however, the temperature must be high and the exposure period adequate. Hot water in sufficient supply is not always available or practical, hence we do have need for the chemical agents.

* Presented at the Sixth Annual Meeting of the Kansas Public Health Association, Topeka, Kansas, April 15-17, 1948.

HOT WATER AS A SANITIZING AGENT

A contaminated water may ordinarily be made safe but not necessarily sterile by simply bringing it to a boil and allowing it to cool. Slightly longer periods of high-temperature exposure might conceivably be necessary at high altitudes where boiling temperature is lower, especially if contamination is high. The U. S. Public Health Service Ordinance and Code Regulating Eating and Drinking Establishments (1943) (1) stipulates that utensils and equipment be immersed "for at least 2 minutes in clean, hot water at a temperature of at least 170° F., or for one-half minute in boiling water. Unless actual boiling water is used, an approved thermometer shall be available convenient to the vat. The pouring of scalding water over washed utensils shall not be accepted as satisfactory compliance." The U. S. Army Regulations (2) require a final dish rinse by immersion "in hot water for 30 seconds at 180° F., if the heat is controlled by an adequate thermostat or thermometer. If not, they will be immersed in boiling water for at least one minute and then removed and allowed to air-dry." Mallmann (3) et al. (1947) stated that for machine dishwashing "a 10-second rinse at 170° F. would appear to give us a practical standard with a good safety margin."

The use of hot water or heat for sanitizing dishes has many advantages. If the water is sufficiently hot for sanitizing purposes, the dishes and utensils air-dry quickly, requiring no toweling. The U. S. Public Health Service Code (1943) permits the use of drying cloths but recommends that wherever possible, utensils be allowed to drain dry without the use of drying cloths. The Army Regulations specifically state that dishes will be air-dried. The danger of towels becoming contaminated by hands and thus contaminating dishes is evident.

There are some limitations in the use of hot water. Some waters, when heated, do precipitate substances responsible for temporary hardness which may leave mineral deposits on dishes. Then too, many small eating establishments unfortunately are not equipped with satisfactory equipment for maintaining an adequate supply for hot water rinsing. Temporary eating establishments at fairs, carnivals, etc., also face this problem.

Where dishwashing machines are employed and an adequate supply of sufficiently hot water is available, it is essential that the holding period be sufficiently long in order to insure adequate heating of the utensil surface. In hand dishwashing the final rinse should be made by complete immersion of all utensils by means of a dipping basket (e.g. metal) for the stipulated time. Wood linings in the metal baskets help prevent streaking of dishes. Care must be exercised to prevent the trapping of air under utensils, thus preventing contact of the hot water with the surface of the utensils. All too frequently the rinse water is allowed to become cool and the hands, instead of the metal dipping basket, are used for immersion of utensils. A rinse water cool enough to permit hands to be immersed will not kill bacteria. The use of testing thermometers both by the dishwasher and the sanitary inspector is essential.

It was pointed out previously that different times and temperatures of utensil exposure have been recommended. Generally with a given contamination of utensils and other conditions constant, the higher the temperature of exposure, the shorter the time required. If the bacterial load of contamination is increased at a given temperature, the holding period will need be extended or, if the holding period cannot be extended, then the temperature of the immersion bath must be increased in order to result in the same sanitizing effect.

As newer research is completed we will undoubtedly gain more information relative to limits of safety in exposure periods at high temperatures. With heavily contaminated utensils, almost the full 2-minute exposure may be required at 170° F., whereas with lighter loads a shorter period of exposure will undoubtedly be feasible. Nevertheless, until we learn the limits, it would appear wise to maintain a good margin of safety, both by maintaining the temperature and by not reducing the exposure time. In this connection, the need for an adequate hot water supply or the use of booster sink heaters is evident.

Generally then, it is essential that utensils always be properly cleaned before sanitizing. Hot water (not less than 170° F.) for a period of two minutes is considered an excellent sanitizing agent for clean food utensils. Shorter periods of exposure at this temperature should be considered only after we have had the opportunity of testing under varied conditions, and data are available indicating these limits.

CHEMICALS AS SANITIZING AGENTS

Where hot water is not available, generally we have two possibilities of cold germicides in the chemical agents: (1) chlorine, and (2) quaternary ammonium compunds. A few other types of compounds have been proposed. Chemical agents as germicides function more rapidly as the temperature is increased, and the speed of reaction is augmented by increasing the germicide concentration.

Chlorine

Chlorine compounds vary considerably in their speed of reaction and germicidal efficiency. Hypochlorites are ordinarily faster in their action than chloramines (including chloramine T) (4, 5), however the latter are generally considered more stable in the presence of organic matter. pH influences the germicidal efficiency of hypochlorites tremendously (6), the hypochlorites becoming increasingly slower in their action as the alkalinity increases. The germicidal action of chlorine is apparently due to the hypochlorous acid formed and the quantity formed is a function of the pH. Alkaline hypochlorites would appear to require higher concentrations of available chlorine than neutral or acid hypochlorites, other things being equal.

The U. S. Public Health Service Ordinance and Code Regulating Eating and Drinking Establishments (1943) (1) stipulates that when hypochlorites are used, utensils should be immersed for at least 2 minutes in a lukewarm chlorine bath containing at least 50 p.p.m. available chlorine. The solution should be made up at a strength of 100 p.p.m. If chloramines are used, a concentration of equal bactericidal strength should be prepared. The relationship between hypochlorite and chloramine (or chloramine T) concentrations required for equal bactericidal strength is not well defined. Generally, however, since in the absence of organic matter, chloramines are slower in germicidal action than hypochlorites, higher concentrations would appear to be required for equal effect. Chloramines (7) generally are slower in their germicidal action than are the slower alkaline hypochlorites (6) but some exceptions have been noted and further study for clarification on this point is needed (8).

Chlorine compounds have been used as germicides for many years and a wealth of information is available regarding their germicidal efficiency. Some investigators (8) feel that hypochlorites should never be selected when the tuberculosis organism is to be killed, since this organism is known to be relatively resistant to chlorine. Certain viruses have been rather readily inactivated by chlorine, however only meager data are available on this subject. Also, limited data are available regarding the efficiency of chlorine against protozoan cysts. Generally these cysts resist chlorine concentrations many times as great as could be tolerated in drinking water. However, it would appear that by increasing the chlorine concentration to that used in food utensil sanitation, more favorable results should be obtained, especially if the exposure period is prolonged.

While chlorine compounds, when properly used, do have good germicidal action, they also have some limitations. They exhibit the property of combining with organic matter, forming products of lower germicidal efficiency than hypochlorite, or of no germicidal value at all. The need for complete removal of all organic matter by thoroughly rinsing, e.g. in the use of 3-compartment sinks, is evident. Chlorine solutions are often irritating to the skin of the hands of dishwashers, and it is frequently difficult to get dishwashers to use chlorine. Silver and silver-plated tableware may be darkened when treated with chlorine compounds. With utensil sanitizing there is gradual loss of chlorine by escaping as a gas, by being converted to chloride, or by combining with organic matter, in all cases resulting in reduction of the germicidal agent. The available chlorine residual should be checked periodically in order to ascertain the "life" of the germicide in terms of the number of utensils which may be sanitized before the solution needs to be renewed. A reasonably accurate measure of the effective germicidal residual (hypochlorous acid) of chlorine solutions under field conditions may be made by use of testing procedures such as the ortho-tolidine-arsenite method (9).

Quaternary Ammonium Compounds

Within the last few years quaternary ammonium compounds have been introduced as germicides. These compounds have been known for years by the chemist and have found use in the textile field. As early as 1890 they were reported to have germicidal properties, but the first record of their practical use as germicides appears to be about 1935 when Domagk (10), a German scientist, called attention to their high anti-bacterial activity. During the recent war and up to the present time the production of these compounds has increased greatly.

Quaternary ammonium compounds appear to have many desirable qualities when considered in terms of food-utensil sanitation. Among their desirable properties frequently publicized are: surface activity, relative freedom from toxicity, and freedom from skin irritation in concentrations used for hand dishwashing.

It is well established that certain substances do interfere with the germicidal action of quaternary ammonium compounds. These quaternary salts are cationic and are capable of being inactivated by anionic agents in proper proportion. Among these interfering substances are: soaps, anionic wetting agents, some detergents, certain types of organic matter, and substances in some types of waters. It is known that hardness (calcium, magnesium, etc.) is one factor in water but may well not be the only one which causes a reduction in germicidal efficiency of at least some quaternaries.

Quaternaries have been combined with detergents to attempt to produce combinations which will cleanse and sanitize in a single operation. The detergent added must be compatible with the quaternary. Non-ionic detergents have received considerable attention in this connection. The efficiency of a combined quaternary detergent in a single one-step operation remains to be proved. The germicidal efficiency of quaternaries generally is improved as the alkalinity is increased; however there is some evidence to indicate that with alkaline compounds, soaps will be formed in the presence of fat, resulting in at least partial inactivation of the quaternary (11). Until it has been proved that these combinations can cleanse and sanitize in a single operation in the presence of organic matter (food, milk, etc.), it would seem wise to first wash utensils, then rinse, and then immerse in the quaternary (e.g. as in a 3-compartment sink).

A number of detergents are incompatible with quaternary ammonium compounds (12). Hucker (13) has recently proposed a modified non-ionic detergent for combination with quaternaries which may prove to be of added value in cleaning and sanitizing in a single operation.

The use of brushes in connection with detergents and quaternaries has been reported to aid in the efficiency of these substances. Quaternaries have been used in connection with machine dishwashing (14) to substitute for the germicidal action of the hot water in case the water temperature drops, a condition which prevails more generally than is commonly believed.

Numerous chemical testing procedures have been developed for measuring the residual effective quaternary in the germicide rinse used in dish sanitizing. While a number of test kits have been developed for field inspection use, these generally measure the quaternary added, and it appears that as yet none is available for actually measuring the effective germicidal residual (15). Until such a testing procedure is perfected for field inspection use and we can determine the effective residual, we will be handicapped in our use of quaternary ammonium compounds.

SELECTION OF A SATISFACTORY GERMICIDE

There are numerous conflicting reports in the literature regarding the germicidal efficiency of quaternary ammonium compounds, and it becomes extremely difficult for those charged with sanitation control to select satisfactory germicides. In addition to this, our knowledge of these compounds is limited and we are still in the process of developing the most efficient methods for practical application of quaternaries in sanitation control.

The phenol coefficient (16) has been employed rather generally in estimating germicidal efficiencies of quaternaries, probably because this procedure has been used for years for regulatory purposes and to prevent gross fraud in the field of germicides. However, no direct method appears available for interpreting phenol coefficients in terms of practical application in food utensil sanitizing. A factor of 20 has been proposed for estimating effective concentrations (17) of phenolic-type compounds. Testing methods based on "use" concentrations, and "use" exposure periods under as nearly practical conditions as feasible are desirable, since the factors concerned are not necessarily "straight-line" functions and results with different concentrations, times, etc. cannot always be accurately predicted by extrapolation. Quantitative methods (18) involving the enumeration of bacteria surviving after definite exposure periods are more applicable.

The type of test organism makes a tremendous difference in the results of certain types of germicide tests using these compounds. Gram-positive bacteria such as *Staphylococcus aureus* are generally more susceptible to quaternaries than are Gram-negative types (e.g. coliform), yet many of the tests carried out have made use of rather susceptible organisms. In addition, the greater the number of test organisms added per milliliter of test solution, the longer will be the killing time. Yet many tests have been made using rather low numbers of bacteria. Some of the reported testing experiments have been carried out without the use of adequate inhibitors or neutralizers for the germicidal action of the quaternary, hence a new light may be thrown upon their efficiency when tests are repeated employing adequate inhibitors.

Generally all germicides become more efficient as the temperature is increased. An average value which one might expect to find for the temperature quotient (Q_{10}) would be about 2. This means that by decreasing the temperature 10 degrees Centigrade (18° F.), one might expect to double the killing time. The temperature at which a germicide is tested is of considerable significance.

In selecting a germicide for sanitizing food utensils, because of the wide variety in these compounds one should have available information as to how the germicide functions under conditions approaching practical application as nearly as possible. In order to insure an adequate margin of safety, all proposed germicides should be tested with a high number of test organisms comparable to the most highly contaminated utensils one might find under practical conditions, and at a temperature no higher than room temperature since under practical conditions the temperature is often this low. In addition, the water (15) used in the test should correspond to that to be employed under practical conditions. Other substances employed (detergents, etc.) and conditions should likewise approach practical application as nearly as possible. In this connection we have recently developed a laboratory procedure (18) for evaluating practical performance of quaternary ammonium compounds and other germicides proposed for sanitizing food utensils. Indications are that the killing time determined by this procedure will serve as an index to the exposure period necessary for sanitizing food utensils with a given germicide.

DISCUSSION

To check the efficiency of a germicide only by determining the bacterial count on sanitized utensils is not adequate. First of all, the bacterial "load" of contamination may be light and the proposed germicide may be doing little other than diluting or clumping bacteria so that the colony count is reduced (19). Secondly, the types of bacteria present may not be as resistant as others which may be encountered elsewhere under practical conditions. A germicide proposed for use should first have a good laboratory performance test (18) and then be given practical tests under actual "use" conditions by swabbing utensils (20). However, in the interpretation of results from practical tests, a germicide cannot be said to be satisfactory simply because it reduces the count to below the generally-used standard of 100 per utensil. The limit of "100 per utensil" should apply only to utensils which have been held for some time after sanitizing and have been exposed to air-borne contaminants, and should not apply to utensils as they are lifted from the germicide bath. Utensils coming from a germicide bath should be sterile, except for possibly an occasional resistant spore-forming organism which would probably be of no sanitary significance. This interpretation in connection with the evaluation of germicides in no way invalidates the use of the limit of "100 per utensil" for routine enforcement procedures.

A good germicide properly used will result in sanitized utensils which are practically sterile, while a poor germicide leaves utensils with either low (below 100), medium, or high bacterial counts, depending upon the initial contamination and other factors previously discussed. The importance of holding the bacterial count low in the wash water and thus decreasing the load of contamination is evident. The dishwasher may easily recontaminate adequately sanitized dishes simply by improper handling. Dishes properly sanitized may be held indefinitely if properly protected in storage, and would not necessarily need be resanitized immediately before use. However, long storage periods for food and dairy utensils would be unsatisfactory where large numbers of air-borne bacteria would increase the rate of spoilage or conceivably contribute toward food poisoning.

The use of the swab-rinse bacterial count technique (20) is extremely valuable for enforcing satisfactory dish sanitizing procedures. Care must be taken to employ adequate amounts of inhibitors either for chlorine or for quaternaries for protection of the surviving bacteria in transit to the laboratory. The chilling of swab vials is also essential to help prevent changes in bacterial population previous to plating.

CONCLUSIONS

In the sanitizing of food utensils the utensils should be first thoroughly cleaned with a good detergent (compatible with the germicide to be used), and then rinsed. Sanitizing may be accomplished with hot water (170° F. for 2 minutes in the case of manual methods) or with chemicals (chlorine or quaternary ammonium compounds).

Chemicals proposed for use as germicides should be thoroughly tested in the laboratory and then tested under practical "use" conditions in order to ascertain concentrations and time of exposure required. There is no satisfactory method available for interpreting phenol coefficients in terms of dishwashing efficiency; practical tests are of more value. A chemical germicide should not be considered satisfactory for use, however, simply because the bacterial count after sanitizing is below the limit of 100 per utensil. Some chlorine compounds are generally slow in their action (e.g. chloramines), hence higher concentrations must be employed for adequate sanitizing. Chlorine compounds have been used for many years and we have considerable factual information regarding their advantages and their limitations.

Quaternary ammonium compounds are relatively new. While they have many advantages they also have definite limitations, and undoubtedly we have not yet learned either all of the advantages or all of the limitations. Since these compounds are new in the field of germicides, they should be thoroughly tested before being put into practical use. The method of testing, including the type of test organism used, number of test organisms employed, type of water used, etc., is very important.

SUMMARY

Advantages and limitations of food utensil sanitizing (sterilizing) agents were discussed. Hot water, chlorine germicides, and quaternary ammonium compounds have been considered. It was pointed out that a new chemical germicide should be thoroughly and adequately tested before being employed under practical conditions. The type of test procedure (including the type of test organism, number of test organisms, type of water, etc.) is extremely important. Phenol coefficients do not give us information applicable to "use" conditions; a practical test approaching "use" conditions is more valuable, yet the swab-rinse bacterial count in itself does not give us adequate information. Reference was made to a recently-developed laboratory procedure (18) for evaluating practical performance of quaternary ammonium compounds and other germicides proposed for sanitizing food utensils.

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Paperboard and Paper Food Containers—An Analysis of Literature and Appraisal of Their Sanitary Condition

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SOME ten or twelve years ago the writer had the opportunity and privilege of studying various problems relating to manufacture and introduction of the paper milk container into a large eastern metropolitan area. Since that time this container has made a fine place for itself in the fluid milk industry. Among several problems which were raised by health officials and experts in the milk industry were the bacteriological condition of the paperboard from which the container was made and the bactericidal effects of the waterproofing process with hot paraffin on microorganisms contained therein. Owing to appearance in the literature since about 1938 of many articles and discussions, the general thesis of which has been that paper and paperboard are probably insanitary products for containing and wrapping perishable foods, the writer has spent the last year in searching for facts in the literature and analyzing results of experiments carried out in his own laboratory or in other laboratories in which he had a part either in an active way or in an advisory capacity. The following discussion is a result of this study. Attempt will be made to trace the origin of the renewed interest in microbiology of paper and paperboard, to bring out the facts on its sanitary condition and to discuss them carefully but fearlessly. This study was stimulated recently by appearance in our JOURNAL of an unsigned "Manual of Sanitation Standards for Certain Products of Paper, Paper Board and Molded Pulp" dated July 16, 1947.* This will be discussed later in this article.

* (Note: The author refers to the "Manual of Sanitation Standards for Certain Products of Paper, Paper Board or Molded Pulp", submitted by the Public Health Committee of the Paper Cup and Container Institute, Room 806, 1790 Broadway, New York 19, New York.)

* Published in this Journal, January-February, 1948, page 31.

EARLY DEVELOPMENTS

Interest in microbiology of paper and paperboard was renewed about 1938 with introduction of the paper milk container which has since proved itself to be a great contribution to distribution of fluid milk. From the very beginning it was shown to be superior bacteriologically to the container with which it has had to compete. Since these early observations have been confirmed, about the only factor that has prevented wider use of paper milk containers is inability of manufacturers to supply enough board and converters to make enough containers.

Paper has been used for many years and has contributed to cleaner foods. It has come into close contact with certain foods such as butter, ice cream, fluid milk (bottle caps), oysters, and many cereals have been distributed in paper over a long period of time without harming health. Why it should suddenly find itself under suspicion today may be difficult for some to understand.

When this new container for milk first appeared it was rightfully subjected to scrutiny by health officials and compared with the glass bottle which had made a good place for itself. Questions which were raised by these health officials convinced several manufacturers that it would be well to have investigations carried out in other laboratories than their own and preferably at an Agricultural Experiment Station where investigations of dairy and milk problems had been carried on over the years. Such a station was found in the New York Agricultural Experiment Station at Geneva, N. Y., where R. S. Breed had done much fine work in milk bacteriology and hygiene. The problem of whether the paper milk container met requirements of the sanitary code for milk of the New York State Health Department was a pressing one because this new venture in milk distribution had developed rapidly in New York City. The New York City Health Department had reported that approximately one-fourth of the fluid milk being distributed each day was in paper containers. One milk plant was distributing 250,000 such containers daily. Attempt had been made by the Baltimore City Health Department to formulate regulations to include the new package for fluid milk. Since little was known about it, these regulations made stipulations which were later found to be unnecessary. For instance, it was stated that if the container was waterproofed with paraffin, this should be done in the milk plant where it was filled with milk. Later it was found that paper milk containers which were waterproofed in the factory where they were made and shipped with adequate protection to the dairy plant were just as sanitary.

The interest in this new venture crystallized in two conferences at the New York Agricultural Experiment Station, the first on July 12, 1937 (Breed, 1937) and the second on May 2, 1938 (Breed, 1938) at which various problems especially those which seemed to be of sanitary significance were discussed, despite the fact that very little work had been done on which to base statements of fact. Previous to this time Dr. J. R. Sanborn became a member of the staff when several paper milk container makers subsidized investigations at the experiment station. Even at this early date recommendations were suggested which to the manufacturers who had spent several years study with the advice and help of food technologists, seemed premature and not based on adequate investigations. They knew that the new container was satisfactory and met the severe requirements of a container for the most protected food in America and that it was superior bacteriologically to the glass bottle. These "Paper Containers for Milk—Principles of Sanitation to be Observed in their Manufacture and Use," were simply statements of the obvious about raw materials, converter plants, manufacture of the containers, paraffining and shipping of the containers. The statements about paraffining, for instance, were without substance as to basic problems but stipulated that clean paraffin should be used and that the paraffin bath or tank should be clean and that new paraffin should not be mixed with a product which is unfit for use. Such paraffin was not defined. All this was far better appreciated by manufacturers. This early statement seems now to be an attempt to make a problem where there was none and by use of high sounding, stilted phrases to correct evils which were postulated to exist. One important item in the regulations was that paperboard from which these containers were made should not contain over 500 bacteria per gram. This will be discussed later in this article.

At the second conference on sanitation of paper milk containers at the same Agricultural Experiment Station on May 2, 1938 (Breed, 1938) a report of progress made during the year was made by several individuals, including the author. Critical examination of this report (Breed, 1938) today, reveals that little progress had been made beyond the fact that acceptability and distribution had increased and that between 500 and 1,000 examinations of samples of paperboard for bacterial content had been made at the station. A few amendments were made to the "Principles of Sanitation." It was reported that the station had been requested by about a dozen mills to undertake a preliminary inspection to determine how adequately they were prepared to meet the type of regulation that was suggested at the conference of May 2, 1938. These were apparently done before that date and the amended "Principles of Sanitation" could not have been used. Thus the quality of paperboard being used for the paper milk container was brought into the open. Paper and board for all perishable foods and later all paper and board to be used in the food industry were included. This brief discussion indicates how the whole question of satisfactory paper developed. From the year 1937, many publications were issued (from the N. Y. Agricultural Station) on the sanitary quality of paper used in the food industries.

The substance of most of these publications was that paper was a possible hazard to health, that paper mills were insanitary and that to prevent these conditions, strict microbiological control should be introduced—all this despite the fact that paper and paperboard had made great contributions to cleaner and safer foods without causing a single outbreak of disease. Strict microbiological control was not clearly defined but was probably assumed to be based on mill inspection and analysis of the paper itself to be sure that the bacterial content was kept below 500 bacteria per gram, the so-called "plate count standard" which had been proposed by the Agricultural Experiment Station. Few would object to such efforts even though they would make no contributions to the greater safety of the paper. Certain practices in mills have been known to be necessary to prevent economic loss due to defects in the final product. Such defects, however, were not the primary interest of those who wrote as indicated above.

CONSIDERATION OF STANDARDS

One of the first papers to be published (Sanborn, 1938) from the New York Agricultural Experiment Station was entitled "Proposed Standards for Paper Milk Containers." It was reported that an Institute had been established at the Experiment Station for "the purpose of securing fundamental information on the sanitary condition of paper for use in contact with perishable foods as milk and milk products, establish standards for this paper and its fabricated forms which will provide health laboratories with criteria for estimating sanitary quality in paper containers." No evidence was offered at that time that paper was not sanitary. Six items were mentioned as very important among which was mentioned pure process water and strict microbiological control at pulp and paper mills. This later idea if adopted would be the foundation of an extensive system of mill inspection presumably to be done in whole or in part by the new institute probably at the expense of the paper mills. This publication repeatedly pointed out evils which were said to exist in paper mills and contained statements such as "appreciable quantities of dirt and foreign matter may be introduced into new paper and board during manufacture," and after mentioning several possible kinds, their presence was associated with unhygienic and careless practices. These are, at best, careless general statements and cannot be applied to paper mills which were making board for the better food containers at that time. The author then went on to state that it is possible to grade paper products such as milk container board according to their bacterial content or the number of colonies developing on standard agar per gram of disintegrated stock. Here again the necessity of bacteriological control was recommended for an industry which has caused no trouble but has given a product responsible for much good. Having listed some of the evils which exist in paper mills and claiming that bad bacteriological condition of paper milk containers may be traced to bacteria in paperboard, even though the board is waterproofed with hot paraffin, let us see what the situation really was at that time by examining results of analyses given by Sanborn and Breed (1938) in a paper entitled "The Sanitation of Paper Milk Containers." It was stated that as soon as "a real study of the sanitary problems affecting the use of paper milk containers is started, it becomes evident that this is only a part of the larger problem of the sanitary use of paper wrappers and containers for all kinds of food." Now the entire field of wrapping foods in paper packages was brought into the picture—all paper and paperboard was under suspicion. In 1938, they reported that more than 70 percent of the containers showed counts of less than 5 colonies per container (not per ml. capacity). The other 30 per cent contained small numbers but occasionally a container would be encountered which yielded 500 colonies per container. The reasons were not clear but it was admitted that faulty technic might explain some of them. The important statement however was that the number of sterile containers is large. These authors then continue:

> "In other words, the number of bacteria added to a quart of milk from a paper container even where the number present in the container is relatively large is still so small that it would cause no detectable increase in the count per c.c. of milk. In fact, a container that yields a count of less than 5 colonies per container may be regarded as essentially sterile.
>
> Moreover, when the nature of the few bacteria present is determined it is found that they are common non-pathogenic, spore-bearing bacteria (*Bacillus subtilis, Bacillus cereus, Bacillus mesentericus,* etc.), saprophytic micrococci, sarcinae, and actinomyces, and some spores from wood fungi. All of these, with many other microorganisms are found in the pulp suspension as it is carried to the paper machine and over the hot drier rolls in the paper making process. The surviving organisms are all of very heat resistant types as the temperatures reached are much higher than those used in the pasteurization of milk. No pathogenic organisms could survive the temperatures used.
>
> For this reason, a determination of the number of living bacteria per gram of disintegrated board becomes a measure of the bacterial condition of the pulp. This record secured from the finished product even more accurately interprets conditions previous to the paper making processes than similar counts from pasteurized milk interpret the bacteriological condition of the raw milk."

Other investigators have reported this same situation. Tanner (1939) found over 90 percent of many containers to contain no viable bacteria. Of those which did, many yielded only one or two bacteria. In another group of 8000, 80 percent were sterile, the other 20 percent contained on an average 2 bacteria. If, as has been stated by Sanborn and Breed (1938) bad bacteriological conditions of paper milk containers may be traced to bacteria in the paperboard, this board is in quite good condition bacteriologically.

Results of 824 examinations of paperboard from which containers were made were summarized as follows: 5 percent were sterile, 30 percent yielded counts between 1–50, 26 between 51–100, 21 percent between 101–250, 10 between 251–500, and 8 between 501 and 1000, no samples showing greater numbers.

The results which Sanborn and Breed (1938) published show, as they stated, that the paper milk containers are capable of meeting severe sanitary standards, if indeed the word sanitary needs to be used. The so-called standard is an arbitrary count on the paperboard and from rinsing tests. Careful study of this publication reveals two facts, one that paper milk containers are much superior to glass milk bottles on the basis of results of rinse tests and the paperboard from which they are made contains very low numbers of harmless aerobic spore-bearing bacteria, and a desire on the part of the authors to make an issue of a doubtful sanitary problem in the paper-making industry. This early discussion which came from the so-called "Institute" at Geneva, N. Y. contains so many contradictory statements that it is difficult to know just what the real situation was at that time.

In 1937 Sanborn extended his statements which at first were made for paperboard to be made into paper containers to paper to be used for other foods, thus covering much of the whole field of packaging. He stated that the "manufacture of paper wraps and containers for perishable foods has revealed numerous unsolved problems in sanitary control." One problem mentioned was quality of water supply. Many paper mills were said not to be sufficiently concerned about this. Mills were then said to be too easily satisfied with temporary or makeshift measures, running risks of future operative difficulties and low quality paper, a warning which must have been greatly appreciated by technologists in an industry which has perhaps billions of dollars invested and where competition makes it necessary to observe every refinement of method and technic. It is pertinent to state that many mills have given much attention to quality of water and by use of good methods of treatment have been using good water. Other advice in the publication was elementary in light of the study which had been given the whole field by competent technologists before the introduction of the new package. From this time on came numerous publications with titles containing such phrases as "public health compliance", "sanitary condition of paper", "suitable paper wrappers", "microbiological control", "sanitary aspects", "proposed standards", "reasonable sanitary standards", "sanitary quality", and "sanitation of paper and products made from paper". Little or no recognition was given in any of these publications to reports of other investigators who were writing in this field and, in some cases, had different opinions. Only previous publications from the pen of Sanborn are mentioned. Publications by Rice (1930, 1932, 1938) all of which concerned bacterial content of milk containers and board were ignored as were those by Wheaton, Lueck and Tanner (1938), Tanner (1939) and Tanner, Wheaton, and Ball (1940).

The later publications from the "Institute" at the New York Agricultural Experiment Station at Geneva, N. Y. merely reiterated their former statements, only here and there giving new results and suggestions. For instance, Sanborn (1938) reported types of microorganisms from pulp and paper mills which persist in container board. Practically all were harmless spore forming species. Of 53 names which were listed only about eight were non-spore forming types, mainly micrococci, and they were harmless species which could easily have come from the respiratory tract of those who made the plates. Further space and time need not be spent with these later publications because they added little of anything that was new but merely continued to stress the fact that paper mills need microbiological control and that paperboard should conform to the "count standard" which had been proposed.

BACTERIAL COUNTS FOR CONTROLLING PAPERBOARD AND PAPER CONTAINERS

At the first Conference on Sanitation of Paper Milk Containers on July 12, 1937, at which a code, if it may be called that to save time, was proposed, it was stated, "Board prior to moistureproofing shall not at any time have a count exceeding 500 colonies per gram of disintegrated board." This count, according to Breed's (1937) report was arrived at because Sanborn in examining between 500 and 1000 samples of paperboard normally gave counts less than 500 per gram of disintegrated stock. When the primitive method then used for disintegration is studied as well as the fact that no information was given as to the source of samples or method of sampling and handling the samples, the question may be raised as to why such a number was suggested. Usually when such matters are settled for foods both good and bad samples are analyzed, a method of analysis adopted, and so-called referees asked to cooperate to work out difficulties and arrive at some reference point or "bench mark" from which to work in the future. This was not done in this case.

Report of the Second Conference held on May 2, 1938, at which amended "Principles of Sanitation" were proposed, contained the same statement about the "count standard" quoted above of not over 500 bacteria per gram. In a footnote it was stated that further research had indicated this to be a feasible and rather lenient standard. It was further stated that board for milk containers should not contain over 100 bacteria per gram where the milk contacted uncoated papers.

For completeness here, it should be stated that the committee of experts which prepared the Milk Ordinance and Code of the U. S. Public Health Service (Public Health Bulletin, No. 220, 1939) placed the tolerated count of paperboard for paper milk containers at 250 per gram. This new standard was secured by correspondence with Breed at the New York Agricultural Experiment Station. It later appeared in a "Sanitary Code" issued by that station under date of 1945. It is well to point out here that the count of 500 was reduced by about one-half before this by introduction of a new medium for counting bacteria in milk which gave about twice as many colonies as the old medium did. This medium was accepted for paper analysis by the Station mentioned above. To change the method which was used for arriving at a "standard count" without changing the count accordingly indicates an indifferent conception of the meaning of the original count standard. In later publications Sanborn repeated many times this "count standard" and also apparently believed that it should be applied to all paperboard used in the food industry. He apparently believed that it was of great significance because he used the term "public health standard" in a paper published in 1942.

In a Sanitary Code for the paper industry from the New York Agricultural Experiment Station, dated 1945, it was stated that paper and paperboard to be used in the manufacture of packing materials and containers for perishable foods shall contain not more than 250 colonies per gram of disintegrated paper or paperboard stock.

The attempt to introduce into paper making such a "plate count standard" probably resulted from such standards for other foods principally fluid milk where a plate count standard of not over 30,000 bacteria per ml. is generally accepted as standard. Perhaps, it was about the only method of impressing paper makers of the importance of suggestions and recommendations which were being given them. Fluid milk and paperboard are different products and do not necessarily react to the same methods and media. The technic and culture media which are used for milk were recommended for paper. Milk has a more heterogenous flora of bacteria while paperboard which has come through several very germicidal operations in its manufacture, has a restricted flora of aerobic spore-forming bacteria of no sanitary significance. It is very doubtful whether the presence of a few relatively low heat resistant types of bacteria in paperboard can have any relation to the method of manufacture. It is known, however, that such boards as chipboard, which are made from waste paper, would have a higher number of these bacteria which are devoid of sanitary significance. No need exists, however, for use of bacteriological plate counts to tell whether waste paper has been used. This is easily determined in other ways and we may even assume that most manufacturers are honest and use new pulp when they say they do.

Count standards are troublesome because of the fact that they are misused by some who are incompetent to judge their value. In milk control work, their greatest importance seems to be for use by militant members of women's clubs who are campaigning for something. More faith is placed in the reduction tests and sediment test than in plate counts. In the case of the count standard for paper the uninformed would believe that a paper board with 501 bacteria per gram would be insanitary while one with 499 per gram would be satisfactory. Bacterial counts are subject to so many variables that they do not have much value today. The type of bacterium is much more important than the number of miscellaneous types.

Accuracy and Significance of the Plate Count of Paper

Bacteriologists have had to recognize that plate counts are subject to great error. They have had widest use in the fluid milk industry where in the early days they probably had some significance because of insanitary methods of production. The count standards were high and variable in 1914, as high as 500,000 per milliliter in some cities and as low as 60,000 in other cities for the same grade of milk. Such variations indicate lack of any crystallized opinion on the value of a count standard. In the milk industry the count probably reflects some of the conditions under which the milk has been produced because by use of clean utensils and low temperatures the count may be kept low. Even here, however, the plate count does not reflect all that some believe it does. It does not reflect barn conditions because in two extensive investigations, it was found that the plate count of milk from cows maintained under dirty conditions was lower than the count of milk from cows maintained under conditions just the reverse. Lowering of permissible counts has done some good because it may have given cleaner milk in some cases. It is still true, however, that clean milk as is the case with other foods, is not necessarily safe milk.

What might be the value of significance of the plate count of paperboard? Fortunately, this has been answered by Breed and Sanborn (1941), the same individuals who proposed use of a count standard for paperboard of not over 500 bacteria per gram later reduced to 250 per gram. Their opinions on this question are significant in view of Breed's position in the milk bacteriology field and his work on methods of counting bacteria in milk and Sanborn's membership in the Technical Association of the Paper and Pulp Industry. The authors stated that plate counts for disintegrated paper are very inaccurate because they are subject to well-known sources of error and misinterpretation. Even refined methods do not reveal the exact number of bacteria present in a gram of paper or paperboard and it was said that we can only guess whether the results obtained in routine analytical work are accurate counts. If these statements are true and bacteriologists have been forced to recognize them for a long time, how can any plate count standard such as the one proposed for paperboard be used for judging the sanitary quality of paper? We may leave the problem by quoting from the article mentioned.

> "It is unfortunate that there is no method whereby the true accuracy of the counts obtained from paper products by this technic can be determined. Even the most painstaking research, using refined methods,

does not reveal the exact number of bacteria present in a gram of paper or paperboard, so that we can only guess whether the results obtained in routine analytical work are accurate counts."

These authors discussed methods which were used for determining the "count" of a sample of board and stated that the counts secured were too high. When is a count too high and who determines it?

In view of this statement one wonders how those who prepare and administer the Ordinance and Code Recommended by the United States Public Health Service, expect to use the count standard for paper. What does it mean when those who are responsible for it repudiate it and admit that plate counts of disintegrated paperboard are inaccurate and that with even the most refined methods and technics do not help? Such situations are appreciated by workers in the field of bacteriology who make counts and who know that they cannot be accurate as the term is thought of in analytical work.

PROPOSED CODES

Early in this discussion the two conferences on the sanitary condition of paper milk containers (Breed, 1937, 1938) were reviewed. At the first conference a report entitled "Paper Containers for Milk, Principles of Sanitation to be Observed in their Manufacture and Use" was proposed which was amended slightly at the second conference. At that time it seemed to the author that the recommendations were devoid of much substance and that an attempt was being made to create bacteriological problems where they did not exist and that some of the advice which was given to paper makers was quite primitive. Good business practise had indicated many of them for many years. To condemn the product of any industry without offering more evidence than assumptions to prove it, places applied science in a bad light. The science of bacteriology suffers today from attempts to make it do what it cannot do.

Efforts to formulate regulations for control of the paper industry were continued at the New York State Agricultural Experiment Station at Geneva, N. Y., an affiliate of Cornell University up to about 1946. One such report entitled, "A Sanitary Code containing Definitions and Interpretations for Guidance of Manufacturers of Paper Packaging Materials and Containers for Perishable Foods" was dated 1945. Much of the advice given was again the obvious with one important exception—the permissible number of bacteria in paperboard for perishable foods was not to exceed 250 bacteria per gram of disintegrated stock. This was really the second reduction in the count standard as described above. This new "count standard" means very little more than the old one and does not indicate in the least whether a paper is sanitary because all paper is sanitary paper if defined as one which has been produced in a clean mill and if it does not contain harmful substances, bacterial or otherwise. How widely this "Sanitary Code" was distributed the author has no way of knowing. It was, however, reviewed in the *American Journal of Public Health* **36** (1946), page 73, by Fuchs. The code, I have been informed, was prepared with the help of an advisory committee but how active a part they took, has not been revealed.

Naturally the paper making industry was a little disturbed in this new effort to introduce microbiological control in manufacture of their product. The need for it was never given other than in general assumptions. The need for promulgating it was questioned for the following reasons:

1. It would not contribute to improvement of public health.
2. It was not realistic in its consideration of the industry's problems.
3. It ignored the fact that for many

years paper had been employed in protection of foods and had never been responsible for impairment of health or spreading communicable disease. On the contrary paper has permitted improved sanitary practises, a situation which should not be overlooked.

The industry also believed that an exceedingly low bacterial count should not be used as a criterion of the sanitation of a paper mill or of the paper produced in it. The type of organism was rightly considered to be more important than numbers within reasonable limits. The industry did not seem to be opposed to preparation of whatever standards seemed to be desirable but believed they should be prepared by responsible parties who would give better reasons for their need than had been done in the immediate past.

The New York Agricultural Experiment Station at Geneva, N. Y., an affiliate of Cornell University, withdrew its support of the program, and Dr. J. R. Sanborn, who had apparently conducted the "Geneva Paper Container and Paperboard Investigatorships" then became affiliated with the Department of Plant Science at Syracuse University. Here he is continuing his work in this field for he has recently issued a "Manual of Sanitation Standards for Certain Products of Paper, Paper Board or Molded Pulp," under the imprint of Syracuse University. Thus was attempted control of a great industry transferred from one educational institution to another. The present status of this effort seems to be indicated in appearance of the "Manual" under the longer title just mentioned as an unsigned article dated July 16, 1947 in the January-February issue of our journal. This edition was to remain in effect until August 1, 1948, at which time it would be reviewed. Attention was called to the fact that Syracuse University was in position to test raw materials for manufacturers, to inspect their plants, and to inform health officials of the results.

Most of this last "Manual of Sanitation, etc.", is taken up with most general recommendations which any manufacturer would normally follow. The important item is VI Bacteriological Standards in which it is stated that paper and its products shall be free from coliform bacteria and shall conform to the requirements given in the Milk Ordinance and Code Recommended by the U. S. Public Health Service. This specifies that paperboard for making milk containers shall not contain more than 250 bacteria per gram of disintegrated paperboard. Note should be made of the fact that the new "Manual" did not contain this count standard itself, but placed the burden on the standard milk ordinance. One can understand this position in view of the repudiation and condemnation of the plate count of paper as an accurate entity by Breed and Sanborn (1941) as discussed above.

The stipulation that coliform bacteria shall be absent in paperboard and products made from it is redundant because these bacteria have never been found in the paper mill beyond the first treatment of the pulp. They have never been found in finished paper because they could not survive the various operations in making paper and are known to be destroyed on the drier rolls even when heavy suspensions of heat resistant strains were sprayed onto the web. This provision, then, is but an empty statement which by implication attempts to support the idea that paper is insanitary. Thousands of paper milk containers examined by the accepted rinse test have not yielded coliform bacteria.

WHAT IS SANITARY PAPER

Sanitary paper is paper which is free from pathogenic bacteria and other agents which might be deleterious to health. Even the lowest grades of paperboard are sanitary because only relatively heat resistant bacteria survive the processes used in making it. The fact that paperboard is made from waste paper does not necessarily mean that it is not sanitary. Waste paper is collected in many grades which are used for making different grades of paperboard. Only a portion requires cooking with chemicals at high temperatures; all, however, pass under the influence of heat of the drying rolls which has been shown to be very germicidal. All paper is sanitary as indicated by absence of coliform bacteria and presence of only a few harmless spore-bearing bacteria. It could not help but be sanitary because during manufacture it is subjected to operations in the paper mill which destroy microorganisms. Paper is protected from dirt after manufacture by wrapping.

Appearance of so many codes and manuals by agencies which had much less information about paper mills and their products, prompted preparation of a "Sanitary Practises and Procedures Applicable to the Pulp and Paper Industries" by "The Bacteriological Control Committee of the American Paper and Pulp Association, 1947." The document may be criticized as have been the "codes" mentioned above. The recommendations are simply those which progressive paper mills have used. A most significant point is that a "plate count standard" is not recommended. This is probably due to the fact that the paper industry technologists did not consider it useful or necessary, or it may have been that they had read Breed and Sanborn's (1941) discussion of the inaccuracies of the count of disintegrated paper. The Sanitary Practises and Procedures, etc., would undoubtedly contribute to better housekeeping and good-looking mills as would some of the early "codes".

One more point, but a significant one, is that non-spore-forming bacteria die rather quickly on paper. These are the types which cause communicable diseases. Prucha once used the term "selfpurification" for this phenomenon. While it is a somewhat unfortunate term because paper is pure, it probably does indicate what he had in mind. Paper and paperboard are not carelessly handled and allowed to become soiled and dirty. It is too fine a product and too costly to be spoiled in this manner.

The above discussion brings the problem up to date. It may be considered as a ten-year appraisal of work and statements on paper and paperboard to be used for packaging foods. The problem is not whether we should have the highest degree of sanitation, but to determine whether we have it now and how we may know we have it.

1. The recent clamor about sanitary paper and paperboard for perishable food products and other products is a tempest in a teapot.

2. Paper or paperboard are devoid of bacteria which have sanitary significance such as coliform bacteria. Pathogenic bacteria could not survive the operations used in making paper.

3. The only bacteria which are found in paper are harmless aerobic spore-forming species with slight heat resistance of the types which are widespread in nature.

4. Coliform bacteria are absent in paper and in paper milk containers.

5. A "plate count standard" for paperboard is a snare and delusion because it does not bear any relation to dirt in pulp and paper and does not indicate insanitary methods.

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The Toxicity of Certain Organic Acids to Yeast and Mold in the Presence of Fruit Juice-Syrup Mixtures *

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The local drug store has long since ceased to compound its own peculiarly flavored fruit syrups for soda fountain consumption. The famous "sarsaparilla delight" and other flavors of its ilk have gone the way of the horsecar and warming pan. Today the druggist has come to depend upon large supply houses for fruit syrups which he then dilutes and carbonates, and serves over the counter.

This change in procedure may have eliminated the bother of syrup compounding, but it has introduced the problem of spoilage in stored syrup. Fermentation by yeast and growth of mold are the most frequent sources of difficulty; Robertson (1) encountered only one case of spoilage by bacteria in 15 years of working with fountain syrups. Attacks by these microorganisms have been met by the use of either sodium benzoate, or a combination of sodium benzoate and citric acid. However, this has not been entirely satisfactory because sodium benzoate may introduce a change in flavor, and citric acid when used alone shows little preservative action.

Vinegar has long been used as a preserving agent, and is readily available at a low cost. It was thought that this common household preservative might offer a possible solution to the problem of fruit syrup spoilage. It has been used on similar occasions in the past, Chenoweth (2) having mentioned the use of vinegar in fruit juices in a drink called shrubs.

Several studies have established the reason for the higher toxicity of organic acids over mineral acids in solutions of equivalent concentration. Kiesel (3) found that aliphatic acids, such as acetic, were more toxic toward fungi than mineral acids, such as hydrochloric, sulfuric, and phosphoric. Acetic acid, CH_3COOH, is the principal acid in vinegar. Reichel (4) demonstrated that acetic acid had a marked harmful effect upon the development of *Penicillium* and showed that it was more toxic to this mold than the mineral acids. Kirby, Atkins, and Frey (5) found that, at a pH of 3.5, acetic acid was inhibitory to *Aspergillus niger,* whereas tartaric, phosphoric, lactic, and citric acids, and calcium acid phosphate had no effect. They also concluded that the toxicity of acetic acid was due to the undissociated acid molecule, rather than the acetate or hydrogen ions. In itself pH is not effective as a preservative. Thom (6) found that a slightly acid pH was more favorable for mold growth than neutrality or alkalinity. Molds did not exhibit a well-defined growth optimum with respect to pH but grew equally well over a wide range, according to Johnson (7). Levine and Fellers (8) stated that the toxicity of acetic acid could not be attributed to its pH value alone.

The preserving action of sodium benzoate is due to the undissociated benzoic acid, and not to the sodium or hydrogen ions, according to Cruess (9). Smith (10) reported that while sodium benzoate is used in preserving fruit syrups, the preserving

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agent is the benzoic acid resulting from the reaction of the fruit acid with the sodium benzoate.

EXPERIMENTAL PROCEDURE

The object of this investigation was the study of the effectiveness of acetic acid as a preservative when combined with fruit juice-syrup mixtures. In addition acetic acid was compared with citric and lactic acids, and with sodium benzoate. The plan of study was as follows:

1. A comparison was made of the inhibiting properties of acetic, lactic, and citric acids in strawberry juice-syrup mixtures against a typical yeast and a typical mold.
2. A comparison was made of the inhibiting properties of acetic, lactic, and citric acids in raspberry juice-syrup mixtures against a typical yeast and a typical mold.
3. A study was made of the inhibiting properties of 0.1 percent sodium benzoate in combination with raspberry juice-syrup mixtures.

In this study a representative member of each of the groups of microorganisms causing spoilage in fruit syrups was used. *Saccharomyces cerevisiae* was chosen from the yeasts; *Aspergillus niger* was chosen from the molds.

Yeast Studies

Using aseptic technique, 9 ml. of syrup and 1 ml. of acid were mixed in a test tube. The acid was added in such concentration that the final mixture contained the desired percentage of acid. One half of this mixture was removed and examined for pH and soluble solids, with the aid of a Beckman pH Meter and Abbé Refractometer. The remaining 5 ml. were inoculated with 0.1 ml. of nutrient broth containing approximately 100,000 yeast cells, and the contents were well mixed.

The yeast inoculum was prepared from a fresh culture of *S. cerevisiae* grown on wort agar, then transferred on three successive days to fresh nutrient broth, and finally diluted so that the resulting broth contained 1,000,000 cells per ml.

The inoculated tubes were incubated for one week at 25° C. At the end of the incubation period, the tubes were plated at dilutions of 1:1,000 and 1:1,000,000 using wort agar. The tubes were also examined for pH and soluble solids. The plates were incubated at 32° C. for 48 hours and counted by means of a hand lens and a Frost plate counter. Doubtful colonies were checked by microscopic examination.

Mold Studies

A mixture of 49 ml. of syrup and 1 ml. of acid was placed in 250 ml. Erlenmeyer flasks for the mold studies. The acid was adjusted to bring about the final desired acid concentration. Sterile distilled water was used in the controls. Tests for pH and soluble solids were made on 5 ml. of the mixture. Inoculum consisted of 0.1 ml. of mold spore suspension prepared by scraping sporulated slants with a sterile needle under sterile distilled water.

The inoculated flasks were stored in the dark at 25° C. for one week. Disturbance of the flasks was avoided, since motion might give additional surface for mold growth. At the end of the incubation period the mold mats were separated from the spent syrup by washing on quantitative filter paper. The mats were carefully washed with hot water to remove adhering syrup, transferred to tared 50 ml. evaporating dishes, and dried to constant weight. Soluble solids and pH value were determined on the filtrate.

The fruit syrups were prepared from frozen fruit. The soluble solids were adjusted to 35 percent by the addition of sucrose. Total acidity, as citric, was determined by titration against standard alkali and was found to be 0.67

percent for strawberry, and 1.61 percent for raspberry. The syrup used in the mold determinations was previously filtered through quantitative filter paper lest cellular debris appear later as mold mat during the weighing.

EXPERIMENTAL RESULTS

Examination of Table 1 shows the inhibitory effect of the acids against *S. cerevisiae* in strawberry syrup. Acetic acid was the most effective, being inhibitory at a concentration of 0.33 percent; while 6.29 percent citric and 5.72 percent lactic acids were required to produce the same inhibitory effect. In Table 2 it is apparent that it was necessary to use 7.03 citric, and 6.25 percent lactic acids to produce an inhibitory effect, while it required only 0.33 percent acetic acid again. The percentages shown above were added acid. It should be remembered that the natural acidity of the syrups was 0.67 percent for strawberry, and 1.61 percent for raspberry as citric. The yeast grew better in the raspberry syrup than in the strawberry as can be seen by an examination of the controls.

Acetic acid was an even more effective inhibiting agent against mold than it was against yeast. Table 3 shows that only 0.19 percent acetic acid was required to prevent mold growth in strawberry syrup, while 4.58 percent lactic acid was required to prevent growth. It is interesting to note that citric in concentrations as high as 7.75 percent added acid was not effective in

TABLE 1

THE EFFECT OF DIFFERENT CONCENTRATIONS OF ORGANIC ACIDS UPON THE GROWTH OF *Saccharomyces cerevisiae* IN STRAWBERRY SYRUP *

Percent acid added	Initial pH	Final pH	Soluble Solids Initial	Soluble Solids Final	Average total plate count in millions per ml. after 48 hours
		Acetic Acid			
0.33	3.35	3.35	35	35	none
0.26	3.35	3.35	35	32	21
0.17	3.40	3.35	35	27	28
0.13	3.40	3.40	35	26	35
Control	3.45	3.25	35	28	37
		Citric Acid			
6.29	1.80	2.10	40	42	none
5.82	2.10	2.10	39	40	0.001
2.95	2.30	2.25	37	35	17
1.50	2.50	2.70	36	31	101
1.16	2.60	2.80	35	30	56
0.68	2.70	2.90	35	30	73
0.57	2.85	2.85	35	30	48
0.38	2.90	3.00	35	29	54
0.35	3.00	3.05	35	29	59
0.22	3.10	3.15	35	28	63
0.17	3.15	3.15	35	28	47
Control	3.35	3.35	35	27	50
		Lactic Acid			
5.72	2.35	2.35	37	39	none
2.50	2.55	2.60	36	37	17
1.30	2.80	2.75	36	32	34
1.00	2.80	2.85	36	30	34
0.64	2.95	2.95	36	30	105
0.51	3.00	3.10	36	29	50
0.30	3.15	3.10	35	28	69
Control	3.40	3.30	35	27	68

* Fruit juice-sugar syrup mixture, 35 percent soluble solids.

preventing mold growth. Acetic acid inhibited the growth of mold at an added concentration of 0.098 percent in raspberry syrup, while 4.58 percent lactic was needed. Again citric acid failed to inhibit in the highest concentration used, 7.75 percent. These results are shown in Table 4.

No growth was observed in either syrup when inoculated with mold or yeast when 0.1 percent sodium benzoate was present.

DISCUSSION

Acetic acid was more effective as a preservative against mold than it was against yeast. Only 0.19 percent added acetic acid was necessary to inhibit mold growth in both syrups, but 0.33 percent was required to prevent yeast growth in the syrups.

Citric acid showed the reverse effect; it was more effective against yeast than it was against mold. Yeast growth was prevented in both syrups by adding 6.29 percent citric acid, while the highest concentration of citric acid used against mold, 7.75 percent, failed to prevent growth. In both syrups a higher concentration of added lactic acid was needed to prevent yeast growth—6.25 percent, compared with 4.58 percent to prevent mold growth.

Acetic acid was much more toxic than either lactic or citric acids. Only 0.33 percent added acetic acid prevented both yeast and mold growth in

TABLE 2

THE EFFECT OF DIFFERENT CONCENTRATIONS OF ORGANIC ACIDS UPON THE GROWTH OF *Saccharomyces cerevisiae* IN RASPBERRY SYRUP *

Percent acid added	Initial pH	Final pH	Soluble Solids Initial	Soluble Solids Final	Average total plate count in millions per ml. after 48 hours
		Acetic Acid			
0.33	3.15	3.15	35	36	none
0.26	3.20	3.20	35	27	58
0.17	3.25	3.30	35	22	91
0.13	3.25	3.30	35	21	123
Control	3.30	3.35	35	19	117
		Citric Acid			
7.03	2.10	2.40	47	42	none
6.29	2.15	2.40	39	41	0.102
5.82	2.30	2.85	38	34	3.5
2.95	2.60	2.75	37	32	91
1.50	2.85	3.00	35	26	54
1.16	2.90	3.05	35	23	0
0.51	3.00	3.20	35	20	122
0.17	3.20	3.35	35	19	237
Control	3.25	3.30	35	21	350
		Lactic Acid			
6.25	2.45	2.50	38	40	none
5.24	2.40	2.60	38	40	0.0015
2.50	2.70	2.75	37	32	21
1.30	2.90	3.05	36	25	63
1.00	2.95	3.15	36	23	89
0.51	3.00	3.15	35	20	126
0.15	3.20	3.40	35	19	137
Control	3.20	3.45	35	20	93

Sodium Benzoate

No growth of *S. cerevisiae* was found in raspberry syrup containing 0.1 percent sodium benzoate.

* Fruit juice-sugar syrup mixture, 35 percent soluble solids.

TABLE 3

THE EFFECT OF DIFFERENT CONCENTRATIONS OF ORGANIC ACIDS UPON THE GROWTH OF *Aspergillus niger* IN STRAWBERRY SYRUP

Percent acid added	Initial pH	Final pH	Soluble Solids Initial	Soluble Solids Final	Weight of mold mat in mgs. after 7 days
		Acetic Acid			
0.43	3.30	3.40	37	40	none
0.19	3.40	3.45	37	39	none
0.098	3.45	3.25	37	37	153
Control	3.45	3.20	37	36	268
		Citric Acid			
7.75	1.80	2.15	38	37	361
5.17	1.95	2.20	38	32	352
1.29	2.65	2.70	37	32	440
Control	3.40	3.40	36	34	833
		Lactic Acid			
4.58	2.40	2.50	37	38	none
3.37	2.60	2.65	37	34	106
2.29	2.65	2.80	37	35	117
0.10	3.30	3.25	37	33	—

TABLE 4

THE EFFECT OF DIFFERENT CONCENTRATIONS OF ORGANIC ACIDS UPON THE GROWTH OF *Aspergillus niger* IN RASPBERRY SYRUP

Percent acid added	Initial pH	Final pH	Soluble Solids Initial	Soluble Solids Final	Weight of mat in mgs. after 7 days
		Acetic Acid			
0.43	3.15	3.05	37	38	none
0.098	3.20	3.10	37	38	none
Control	3.15	2.55	38	28	1,649
		Citric Acid			
7.75	1.95	2.00	38	37	602
5.17	2.15	2.20	37	35	1,832
1.29	2.75	2.40	36	33	2,233
0.10	3.00	2.50	35	32	2,544
Control	3.05	2.60	36	34	1,572
		Lactic Acid			
4.58	2.65	2.70	36	39	none
3.37	2.80	2.60	36	36	87
1.14	3.00	2.95	36	35	814
0.10	3.20	2.70	36	32	1,735
Control	3.25	2.60	36	33	2,064

Sodium Benzoate

No growth of *Aspergillus niger* was found in raspberry syrup containing 0.1 percent sodium benzoate.

both syrups; while as much as 6.25 percent added lactic acid was required to arrive at the same result, and citric acid in the highest concentration used, 7.25 percent, failed to inhibit mold growth.

As a practical check to the above results, raspberry syrup with 0.33 percent acetic acid added was exposed to room temperature in an open container under conditions which would be conducive to spoilage. Frequent periodic inspections were made and evaporated water was replaced. No spoilage was observed after three months exposure.

Carbonated beverages were prepared from raspberry and strawberry syrups acidified with 0.33 percent acetic acid, by adding three parts of carbonated water to one part syrup. A tasting panel was unable to detect any difference between these drinks and similar drinks prepared with unacidified syrups.

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A New Method for Fixing, Defatting and Staining Milk and Cream Films

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Since the use of the direct microscopic method for judging the bacterial quality of raw milk, pasteurized milk, and cream appears to be steadily increasing, it seems very desirable to bring about improvements in existing methods of defatting, fixing, and staining dried films of milk and cream.

Defatting and Fixing Technique

The standard procedure[1] specifies dipping the prepared slides in xylol for at least one minute to remove fat, after which they are drained and dried. In the next step they are fixed by immersing in 90 percent ethyl alcohol for one to two minutes, dried, and transferred to the staining bath. Since the films are usually overstained in the methylene blue it is necessary to decolorize them by again dipping in 90 percent ethyl alcohol. In preparing cream films, immersion in xylol and alcohol is repeated two or three times.

Alcohol as a Fixing Agent

The coagulating effect of alcohol upon certain kinds of milk is a well established fact. Hammer[2] found that about 11 percent of 177 samples of raw milk were positive to the alcohol test, and 42 percent of these contained less than 500,000 bacteria per milliliter. Some of the various factors considered responsible for coagulation are increased acidity due to bacterial growth, a bacterial rennin, colostrum milk and milk from advanced stages of lactation, milk from cows with mastitis, the amount and kind of salts present in milk, and feeding of silage. Alcohol used in making the alcohol test usually ranges from 68 to 75 percent. A larger number of positive tests are obtained with 90 to 95 percent alcohol.

In order to obtain optimum results and eliminate the coagulating effect of alcohol on dried films of milk and cream, it seems quite necessary to use a defatting and fixing agent that can be mixed in equal parts with milk and cream, without any perceptible coagulation or precipitation of the milk or cream used in the test even after standing for several minutes. A defatting and fixing agent of this type can be expected to have practically no effect on the dried films.

Chloroform-Alcohol Reagent

After testing various combinations of solvents it was found that a mixture of two parts chloroform and one part of 95 percent ethyl alcohol containing 0.057 percent gelatin, was compatible with milk and cream and failed to cause coagulation or precipitation with normal or abnormal types of milk and cream. The dried films were found to have a smooth, uniform surface, with a minimum of cracks, after immersion in this reagent for one to five minutes.

They also appeared to be more translucent and free from opacity than similar films treated with 90 percent alcohol.

Occasional films made from mastitis milk may absorb staining solution underneath the film. This causes a slight stretching of the film and after drying, more heavily stained ridges may be observed.

In a small series of tests made by mixing one part of milk with one part of 90 percent alcohol, it was found that 30 percent of the milk samples were strongly coagulated and the remainder had variable numbers of small or large flakes. In a similar series made by mixing one part of milk with one part of chloroform-alcohol reagent, no coagulation or flakiness was noted in any samples. In a similar series of tests made with cereal cream, coffee cream, whipping cream, and a few samples of vanilla ice cream mix, all samples were strongly coagulated by alcohol and none were found to coagulate and have flakes when mixed with chloroform-alcohol reagent.

Dried films of milk and cream *must be defatted and fixed* with chloroform-alcohol reagent prior to staining with polychrome methylene blue. Films treated with xylol and alcohol are loosened from the slide and may come off the slide in the polychrome methylene blue staining solution.

STAINING METHODS

Of the three stains presently used for staining dried films of milk and cream, carbol methylene blue [3] appears to be the most widely used. Since the ability to see bacteria in the stained film is largely dependent on whether the film is smooth, of uniform thickness, and comparatively free from ridges, folds, coagulated milk solids, cracks, etc., more satisfactory results with carbol methylene blue are obtained with films defatted and fixed with chloroform-alcohol reagent.

The Newman-Lampert stain [4], although convenient and simple to use, appears to have technical disadvantages associated with a disruption of the film in certain types of milk. These effects are also obtained by improper technique. The staining solution must be frequently changed because of the accumulation of milk fat.

The acid methylene blue stain recently proposed by Mallmann [5], if properly used, appears to give higher bacterial counts than can be obtained with carbol methylene blue. Since the stained background of the film is very light an orange filter is necessary. The acidity of the stain needs careful adjustment to keep the films from washing off.

A polychrome methylene blue stain for staining malaria parasites has recently been reported by Manwell.[6] This stain was found to have excellent staining properties for dried films of milk and cream. Since it has a differential staining effect, the background of milk solids being stained lightly and the bacteria deeply, this makes it unnecessary to decolorize the film after staining. The bacteria are permitted to retain the maximum amount of dye absorbed. Satisfactory results are obtained merely by removing the slide from the staining solution and allowing to drain and dry on end on bibulous paper. To obtain the best results it is preferable to rinse off the excess stain for one or two seconds in a beaker of cold tap water, not in a stream of running water. Warm water should not be used.

POLYCHROME METHYLENE BLUE STAIN

Many batches of polychrome methylene blue stain have been successfully prepared in this laboratory during the past year by using the directions of the original authors. In some cases, however, it has been necessary to use more than the stated 10 ml. amount of sodium hydroxide to bring about solution of the dye precipitate which is always obtained after heating and cooling.

The original authors [7] specify that the solution containing methylene blue, potassium dichromate, and sulphuric acid be heated for three hours in an autoclave at a pressure of 0 to 5 pounds. They further state that after heating "the solution turns blue which indicates almost complete polychroming. If the color remains greenish, further heating for another hour or so is required. If the temperature is allowed to rise above 110° C., the oxidation of the methylene blue may be carried too far and the solution will turn violet purple. When the solution has turned deep blue after 3 hours boiling, allow it to cool at room temperature. Then add 10 cc. of one percent potassium or sodium hydroxide solution, drop by drop, very gradually, while constantly shaking the flask".

It is evident that variable results may be obtained even when the directions are followed exactly. It seems entirely probable, from our results, that complete polychroming is obtained when the solution immediately after heating for the required period of time has either a blue or blue green color and after cooling forms a heavy blue precipitate. The supernatant fluid has practically no staining effect.

Although the original authors state that a temperature of 109° C. and 5 pounds pressure must not be exceeded, we have obtained consistently good results by using 15–17 pounds pressure for a minimum of 30 minutes. Twenty minutes were insufficient but a one hour period was satisfactory. If adequate heat and pressure are used for a sufficient length of time the reaction will be complete and the resultant color of the cooled mixture appears to be relatively unimportant.

Previous difficulties in preparing the stain have apparently been due to the variable ability to obtain solution of the dye precipitate with small or large amounts of a one percent solution of sodium hydroxide. Manwell and Fiegelson [8] have suggested two alternative methods for dissolving the precipitate, the one based upon solution of the filtered dye precipitate with a M/2 solution of Na_2HPO_4 and the other based on the use of an excess of one percent sodium hydroxide plus the addition of phosphate salts to buffer the pH at 8.0. Solutions of this type were found to be unsuitable for staining dried films of milk since the large amount of phosphate salts caused a marked distortion of the film.

We have observed that the dye precipitate will go into solution very rapidly with very small amounts of Na_2HPO_4 anhydrous, if sufficient heat is applied. The precipitated dye mixture or the filtered dye precipitate, will, in both instances, dissolve rapidly in a 0.1 percent solution of Na_2HPO_4 anhydrous, if the solution is heated to 90°–95° C. for 15 minutes with occasional stirring. The pH in both cases will be 7.0 to 7.2. It is not necessary to check the pH or use any additional buffering agents. This is believed to be the most desirable pH for staining dried films of milk and cream. We have found, however, that the pH has little effect upon the depth of staining of milk films as compared to the concentration of dye in the solution.

With 500 ml. batches the amount of dye precipitate was found to be approximately 0.55 gram. In the method as given by the original authors, about half of the dye precipitate was filtered off and discarded since it was presumed to be insoluble. In the method we are proposing all of the dye is utilized and the total amount of the staining solution is increased from 500 ml. to 1 liter with a dye content of approximately 0.05 percent.

FILTERS

The examination of large numbers of stained films with the microscope entails a certain amount of eye strain and fatigue. If the bacteria present are sharply contrasted with the background by the use of a suitable filter, the eye strain involved can be greatly reduced. A blue filter used alone may absorb the color of lightly stained bacteria to such an extent that they are no longer visible.

In connection with the examination of films stained with polychrome methylene blue, a number of different colored filters of various types were used to enhance the contrast between the bacteria and the background. The most satisfactory filter was found to be a Corning color filter #3780 Dark Lemon Yellow, 2″ × 2″. This is used with an ordinary blue filter by mounting it on a wooden or metal support in front of the microscope mirror. The B. & L. microscope lamp has a suitable attachment for two filters.

Since this filter shows relative transmissions in the green and blue part of the spectrum similar to the sensitivity of the human eye in that region, it provides a very restful background and sharply accentuates the outline of bacteria.

PREPARATION OF REAGENT AND STAIN

1. Chloroform-alcohol reagent.

Prepare a gelatin-in-alcohol solution by adding 6 ml. of an aqueous 1 percent Bacto-gelatin solution to 100 ml. of 95 percent ethyl alcohol. To one part of this stock solution add two parts of c.p. or reagent grade chloroform and then add ether to the amount of 5 to 10 percent of the total volume. The addition of ether may be omitted if only dried films of milk are to be defatted, but it is preferable to include ether in defatting films of cream and whipping cream. Mix and allow to stand overnight, then filter. Store in a screw cap bottle and it will keep indefinitely.

It is advisable to keep a 500 ml. stock solution of 1 percent gelatin in 95 percent alcohol and a 500 ml. stock solution of filtered chloroform-alcohol reagent. If the reagent in current use is kept in a widemouth screw cap bottle or jar it may be renewed as needed and replaced with fresh solution at least once each month.

2. Polychrome methylene blue staining solution. (Modified)

Methylene blue (Bacto)	0.5 gm.
Potassium dichromate C.P. 5 percent........	10 ml.
Sulphuric acid C.P. 1 percent	3 ml.
Disodium hydrogen phosphate C.P. anhydrous	1 gm.
Distilled water	990 ml.

Dissolve thoroughly 0.5 gram methylene blue in 490 ml. of water in a liter flask. Add 3 ml. of 1 percent sulphuric acid and mix well. Add 10 ml. of 5 percent potassium dichromate slowly with thorough mixing. A precipitate of methylene blue chromate is formed. Heat in an autoclave or pressure cooker at 15 pounds pressure for 30 minutes. The solution must be cooled to room temperature. Two alternate methods of dissolving the dye precipitate may be used.

1. Add 1 gm. Na_2HPO_4 anhydrous to the 500 ml. dye mixture and heat to 95° C. Add 400 ml. of distilled water and heat to 90°–95° C. for 15 minutes with occasional stirring. Cool to room temperature and dilute to 1 liter. Filter through rapid filter paper and solution is ready for immediate use.

2. Filter the dye precipitate. Wash the precipitate from the filter paper with 500 ml. of distilled water. Add 1 gram of Na_2HPO_4 anyhdrous. Heat to 90–95° C. Add 400 ml. of water and heat to 90–95° C. for 15 minutes. Cool and dilute to 1 liter, then filter. The stain can be used at once.

To obtain optimum results the staining solution in current use may be renewed as needed and replaced with fresh solution preferably each month or after 100 to 150 slides have passed through. The staining solution in storage bottles will keep for several years. A few tests made with gram positive and gram negative bacteria indicate that it does not support their growth and on the contrary has toxic properties.

If desired one or more 500 ml. batches may be prepared at one time, and after cooling the dye precipitate is filtered through rapid filter paper. After drying, the long needle-like crystals can be stored indefinitely in a tight container. Small or large amounts of staining solution can be prepared by weighing out 0.05 gram of dye and dissolving in 100 ml. of a 0.1 percent solution of Na_2HPO_4 anhydrous. The solution is heated to 95° C. for 15 minutes, cooled, and filtered.

If a pH of 8.0 is desired, the solution of dye precipitate should be carried out in a similar manner, substituting 0.3 percent of Na_2HPO_4 in place of 0.1 percent.

If a more intensely staining solution is desired, 0.1 gram of dye can be dissolved in a similar manner in 100 ml. of 0.3 percent Na_2HPO_4.

TECHNIQUE

Slides are defatted and fixed by placing in a screw-cap coplin staining jar * for one to two minutes. Remove and allow to drain and dry on end for 1 to 2 minutes. Place in a similar jar containing polychrome methylene blue for 45 to 60 seconds only. Remove, rinse in a beaker of preferably cold tap water one or two seconds, and allow to drain and thoroughly dry on end on blotting or bibulous paper. Rinsing in water may not be necessary if the slides are drained properly. After rinsing slides avoid forceful tapping on blotting paper to remove drops of water since the film may loosen from the slide.

For defatting and fixing cream or whipping cream films, immerse the slides in the chloroform-alcohol reagent for two minutes, remove and dry for two minutes. Replace in the chloroform-alcohol reagent for two minutes. Remove and dry on end for two minutes. Stain in the same manner as milk films. As with all stains the slides should be defatted and fixed immediately after drying and stained preferably within a few hours.

To obtain best results slides must be clean, free from scratches and oil, and preferably flamed. When loops are used to measure the milk, care should be taken to withdraw it from the milk in such a way as to obtain a similar amount each time. The amount of milk and thickness of film obtained with loops can be compared with other films prepared by using pipettes graduate in 0.01 ml. Care should be taken to avoid larger amounts than 0.01 ml.

If the reagent and staining solution are properly prepared, changed each month as advised, and the technique followed, no trouble will develop with films loosening from slides. This statement is based upon two years of close observation and the routine results obtained with over nine hundred stained slides with films of raw milk and over two hundred slides with films of pasteurized milk, cream, and whipping cream. Most of the slides contained ten films.

TECHNICAL ADVANTAGES

The chloroform-alcohol reagent and polychrome methylene blue staining solution can be easily prepared in large or small amounts since they are quite stable.

The operation is simplified since the defatting and fixing are combined in one step. The total time required is from three to six minutes.

The film is uniformly stained, decolorization after staining is eliminated, and bacteria present retain all of the dye. The uniform clarity of the film together with the absence of coagulated or granulated particles reduces to a minimum the necessity for continuous refocusing.

A primary advantage of the method lies in the fact that milk solids are not coagulated or granulated in the film prior to staining. This is an indispensable prerequisite to obtain best results.

* 9196-S, Arthur H. Thomas Co., Phila., Pa.

COMPARATIVE TESTS

Although a sufficient number of comparative tests using polychrome methylene blue and carbolated methylene blue were made to demonstrate to our satisfaction that the former stain reveals an appreciably larger number of bacteria than the latter stain the results are not included in this report. To insure impersonal objectivity factual evidence of this character should not be appraised by those having a direct interest. Comparative tests should include an examination of the film before and after staining to detect any alteration that would make the observation of stained bacteria more difficult.

Through the courtesy of Dr. F. L. Mickle, Director, State Department of Health Laboratory, Connecticut, the following comparative results may be of interest:

	Technician No. 1 102 Specimens	Technician No. 2 107 Specimens
PMB>CMB	85	89
PMB>PC	67	58
PMB<CMB	15	17
PMB<PC	30	46
PMB = CMB + or — 10,000	5	1
PMB = PC + or — 10,000	2	3
Log. Ave. PMB	470,000 per ml.	510,000 per ml.
Log Ave. CMB	280,000 " "	240,000 " "
Log Ave. PC 35° C.	450,000 " "	430,000 " "

PMB — Polychrome Methylene Blue
CMB — Carbolated " "
PC — Plate Count
> — Greater Than
< — Less Than

SUMMARY

Alcohol as a fixing agent for milk and cream films has certain disadvantages caused by its ability to coagulate an appreciable percentage of different raw milk specimens and practically 100 percent of all cream samples as well as ice cream mix.

Many different factors appear to be responsible for the flakiness and coagulation that result when equal parts of milk and alcohol are mixed together.

A chloroform-alcohol reagent was found to be compatible with milk and cream when mixed together in equal parts. Dried films of milk and cream when defatted and fixed with this reagent were smooth, homogeneous, and relatively free from cracks, ridges, folds, etc.

Three presently used staining methods are discussed and the advantages of a new polychrome methylene blue stain are described.

Difficulties previously involved in the preparation of polychrome methylene blue stain are discussed and the development of a simple and fast modified method is presented in some detail.

A description is given of a color filter that can be advantageously used in conjunction with either polychrome methylene blue or carbol methylene blue stains.

The preparation of a chloroform-alcohol reagent and polychrome methylene blue stain is outlined and also a new technique for defatting, fixing, and staining dried films of milk and cream.

The method is believed to have certain technical advantages. It has been used successfully for two years in the examination of over ten thousand specimens of milk and cream. It appears to be equally satisfactory for the examination of raw milk, pasteurized milk, coffee cream and whipping cream.

(Continued on page 364)

MILK and FOOD SANITATION

A Philosophy for Sanitarians*

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We shall begin our discussion of this assignment by considering how Webster defines the word philosophy. Among several uses, we find this one:

> The body of principles or general conceptions underlying a given branch of learning, or major discipline, a religious system, a human activity, or the like, and the application of it; as, the philosophy of history, Christianity, or of business.

In terms of every-day language, our inquiry might read, "What is a sanitarian, what does he do, and why does he do it?"

Development of Sanitation

The attention which is now being given to hygiene is one of the spectacular developments in present-day public health practise. After increasingly effective epidemiology had revealed the grosser etiological agents in the spread of disease and thus made possible their control, we discovered new factors that contributed to the well-being of mankind. One of these was the subject of environmental hygiene. Its importance does not lie so much in its demonstrated direct etiological influence in the public health as it does by an indirect effect.

This indirect effect is twofold in nature. First, there is the powerful force of cleanliness—a sort of negative health factor in that it minimizes the baneful effects of dirt, vermin, foul air, polluted water, contaminated food, and poor lighting. Second, by reducing the number of infecting microorganisms it seeks to make our environment attractive, to make our world a nicer, more comfortable, healthier place in which to live. This latter factor is largely an emotional matter, but powerful in its stimulus to encourage man to engage in outdoor healthful activity, to live in pleasant surroundings, to enjoy his increasing leisure, to live under conditions of decreased health hazards, to be free from irritating factors which militate against public decency and healthy living—sometimes called esthetic considerations but important nevertheless.

The personnel of a health unit who engage in this work are the sanitarians—formerly called inspectors. These are the men who used to constitute the political appointees, the "faithful" who were rewarded for getting out the vote by being given jobs. The marvel is that these men became earnest, faithful, devoted public servants who learned their duties the hard way. Gradually they lived down their humble (un)professional background, and rendered service which is the foundation on which much of our present utilization of sanitarians is built. In Canada, such health work still is done by sanitary inspectors, called in this country sanitarians.

Duties of Sanitarians

Sanitarians constitute the second largest group engaged in public health activities in official health departments. They are employed to carry out inspectional and educational duties, and to enforce laws in the field of environmental sanitation (1).

"Their work, more than that of any other group except public health nurses, brings them in close daily contact with the general public and consequently has great influence on the public's judgment of the entire depart-

* Presented at the in-service training course for sanitarians, University of Massachusetts, September 13–17, 1948.

ment." Under the guidance of more highly trained personnel the type and quality of sanitation service rendered by this group today bears but little resemblance to that of a decade or two ago (2). The men formerly had to use strong arm methods many a time; they had to call on the police for protection from physical violence; they were trail blazers in hacking a path of sanitation consciousness through the wilderness of public ignorance, apathy, and self interest.

These men, together with the nurses, constitute the health department in action. These men do what the health officer would do if he could be in a hundred places at the same time. They bring the principles of good public health practise right down to where the people live. It is they who must "sell" the idea of good health to the public. It is they who largely make or break good health administration. They get the kicks, the curses, the hard knocks, sometimes the thanks, occasionally the praise for their work.

The multiplicity of functions of a modern public health organization now touches all phases of community life, and must maintain this contact in the community where conditions of living continue to change in the direction of increasing this complexity. The field recognized as coming within the purview of this personnel has been well outlined by the Canadian Public Health Association (3).

Communicable disease
Food and food sanitation
Milk
Housing
Lighting
Nuisances
Plumbing and drainage
Public health organization, administration and legislation
Refuse
Sewerage and sewerage systems
Ventilation and heating
Vital statistics
Water

In this country the duties of sanitarians have been defined by the Committee on Professional Education of the American Public Health Association as follows (4):

1. Under the supervision of the health officer or public health engineer or other person designated by the health officer, the public health sanitarian carries out inspectional, educational, and investigational duties, and assists in the enforcement of the law in the field of environmental sanitation. His activities include assistance in the control of domestic water supply and sewage disposal; wastes disposal; swimming pools and recreational areas; dairies and milk-handling plants; manufacturing, processing, storage, handling and distribution of foods; housing; industrial sanitation; school sanitation, rodents and insects and nuisances. He also participates in the inspection of institutions and assists in the control and epidemiological investigations of communicable diseases.

2. As a member of the team composed of the health officer, public health engineer, and other members of the health department staff, his responsibilities relating to the list of duties above include the conducting of surveys and the analysis of information obtained thereby; the determination of sanitation problems, education of the public in regard to them, and development of programs for solving them; the evaluation of laws and regulations and the formulation of recommendations for necessary changes and additions; assistance with the organization of community groups interested in sanitation programs, and the promotion of sanitary practices through use of the various publicity media; study and research in the sciences and technics of public health for the increase of knowledge and a better understanding; and the administration of field and office work.

In brief, the above defines a wide field of inspection and supervision in general environmental hygiene practises, and also participation in the development and administration of new applications, education, and legislation. Obviously, such a program must be directed by personnel with high professional qualifications, often a sanitary engineer. The closer the sanitarian can approach to the education and experience necessary to execute such a program, the greater will be his value.

In industry the sanitarian has a secure place. He may never be labeled as such but his work locates him. He is responsible for the so called good housekeeping of the plant. Often his duties are broader than those of the public health sanitarian in that he administers the quality control program, both of raw materials as well as finished product, and is responsible for the sanitation of the plant. Industrial quality control includes such organoleptic factors as appearance, taste, appearance of package, color, constancy of composition, proper labeling, and other such practical measures. The sanitarian supervises vermin control, waste disposal, employee hygiene. He is the liaison officer between the company and the health department, often including in his portfolio the handling of customer complaints. The sanitarian in commercial employ is no longer a window-dressing luxury, a sort of necessary expense as prophylaxis against the punitive action of regulatory officials. He is needed on his own account because of awakened awareness in management of the need for the kind of service he renders, and for the demands of the public that safety and quality be guaranteed.

EDUCATIONAL REQUIREMENTS

An analysis of present educational requirements (5) of 138 positions listed by the merit system revealed the following average situation: approximately 33 percent of the positions required public health training courses at a college level (experience in substitution thereof accepted to only a limited extent).

Breaking down these positions into three grades, the requirements were as follows:

	Highest Grade	*Intermediate Grade*	*Lowest Grade*
Education (college)	4 years	3.8 years	2 years
Experience	5½ years	3.4 years	1.6 years
Special public health training courses in	6 out of 10 positions	15 out of 34 positions	24 out of 92 positions

The states of California, New Jersey, and New York have legal requirements which specify educational and experience standards for the employment of sanitarians by local health units.

On the basis of these findings in current practise, the Committee on Professional Education of the American Public Health Association recommends that the educational requirements for Assistant Sanitarian and Sanitarian be:

> The minimum qualification should be two years of college work with emphasis on biological and social sciences.
>
> The desirable qualification should be a basic educational preparation including the physical engineering, biological, and social sciences leading to a bachelor's degree from an acceptable institution.

The program of instruction for the bachelor's degree is recommended to be set up as follows:

The first two years:

Cultural courses such as:

English, mathematics, economics, geography, anthropology, social institutions, etc.

Sciences such as:

Mathematics, elementary bacteriology, physics, psychology, zoology or physiology, or general biology.

The second two years:

Advanced general bacteriology, medical entomology, and/or parasitology, and public health courses to include elementary public health, communicable disease control administration, health education.

Principles of environmental sanitation,

Epidemiology

Biometry

Principles and practices of water supply and sewage disposal

Control of production and distributon of milk and food

Salvatory procedures used in the maintenance of a sanitary environment

Personal qualities should consist of:

Initiative
Tact
Good judgment
Pleasing appearance
Good health
Good habits of personal hygiene
Enthusiasm for the work
Ability to deal with people
Industrious habits of working
Integrity

A small but increasing number of sanitarians with a bachelor's degree find such satisfaction in public health that they seek further academic training at the graduate level (6). Some go on in bacteriology, health education, medicine, veterinary medicine, and engineering.

A few accredited schools of public health will admit sanitarians with a bachelor degree for work toward a master degree, providing they were adequately grounded in the basic sciences and at least three years experience.

Accredited schools of public health are:

University of California School of Public Health.
Columbia University School of Public Health.
Harvard University School of Public Health.
The Johns Hopkins School of Hygiene and Public Health.
University of Michigan School of Public Health.
University of Minnesota School of Public Health.
University of North Carolina School of Public Health.
University of Toronto School of Hygiene.
Tulane University School of Medicine, Dept. of Public Health.
Yale University School of Medicine, Dept. of Public Health.

Industrial firms employing sanitarians (or quality control men) are not limited to the above schools but employ their men from many other institutions of learning. These schools have set up courses in food technology; this was a broad coverage of all aspects of food handling including many of the subjects included in the purview of the official public health sanitarian. Usually they go deeper into the question of production, quality control, and plant sanitation than do the schools that are accredited in public health. Both groups overlap over a broad area. My latest published list is as follows (7):

Brooklyn Polytechnic Institute.
Bucknell University.
College of the City of New York.
Illinois Institute of Technology.
Iowa State College.
Massachusetts Institute of Technology.
Michigan State College.
Ohio State College.
Oklahoma A. & M. College.
Oregon State College.
Pennsylvania State College.
Rutgers University.
Texas A. & M. College.
University of California.
University of Georgia.
University of Illinois.
University of Maryland.
University of Massachusetts.
University of Minnesota.
University of Missouri.
University of North Carolina.
University of Tennessee.
University of Washington.
University of Wisconsin.

My latest addition is the University of Denver. This institution is inaugurating courses for sanitarians at both college as well as junior college level. It is particularly designed to supplement the training of pre-medical and pre-veterinary men who have completed their preliminary training but who are unable to gain admittance to the medical schools.

Numerous articles in the JOURNAL OF MILK AND FOOD TECHNOLOGY describe in detail the work that sanitarians in the industries must perform or supervise.

PROFESSIONAL DEVELOPMENT

Inasmuch as the sanitarian is associated with physicians, engineers, nurses, chemists, bacteriologists, and other such professions, he is developing a feeling that he too should be given professional recognition. This is a commendable ambition when it is predicated on a sound basis of education, experience, and personal service. Unfortunately, this desire has been abused by some moves savoring of trade unionism. These serve to discredit the work of sanitarians in quarters where respect should be cultivated.

Professional people who have earned their position the hard way by years of extensive study and experience cannot be expected to sympathize with such attempted short cuts to barnstorm into the circle of professional recognition.

What is a profession? Webster says:

> The occupation, if not purelv commercial, mechanical, agricultural, or the like, to which one devotes oneself; a calling in which one professes to have acquired some special knowledge used by way either of instructing, guiding, or advising others or of serving them in some art; as the profession of arms, of teaching, of chemist.

Attainments in the above examples can be acquired only by long study in standard courses. So sanitarians must expect that in order to secure professional standing, they must expect that the world will demand an education that the academic world will accept. Personally I am confident that the sanitarian will attain this position because I am seeing this very thing work out in the field of food technology, and am observing similar processes in the case of the veterinarians and nurses. Subprofessional groups gradually acquire professional recognition as increasing qualification requirements exact more investment in education and experience. New professions are being created by the inauguration of new techniques and the development of new know-how's.

First of all, we sanitarians must agree on what we shall include in the curriculum that leads to this education. Obviously the field is so broad that no one man can be expected to be professionally competent in all—analogous to the situation in engineering, medicine, chemistry, and other such fields. It would seem that the engineers and the home economists have shown how we might go about this.

These professions have grouped their subjects into several broad classes. In the case of the engineers, we have the civil, electrical, mechanical, mining, chemical and other classifications—all based on a standard basic course, common for all. We can group all the listed duties of sanitarians into possibly four divisions, namely, industrial, health, water supply, and food, maybe another or so—all built on a common basic curriculum of the sciences and liberal arts.

It may be argued that such a setup, based on a four year academic curriculum, will lead to the same training as that of sanitary engineer or that of food technologist. In the former case, the curriculum will constitute the path of development—certainly not to engineering—and in the latter case I think that the adequately trained food sanitarian is indeed a food technologist. My reason for the latter statement is the result of years of experience in public health and industrial food control work. I have learned (and no doubt others have also) that education of the public and industry can be best done when the inspector (if you will) or the sanitarian (now) knows more about the product or operation that is under control than the plant operator does. This relationship is essential for leadership. The leader must be ahead of his crowd. He must be in a position whereby the industry and public heed what he says, not just because the exercise of the police power forces adherence but because the correctness and scope of his knowledge together with his pleasing personality, convinces them that they ought to do so and so in their own interest—and like it. The same principle prevails in industrial work: the plant sanitarian must know his plant process in order to secure the compliance of the plant operators.

The great changes that are taking place in our living and industrial conditions are bringing in new problems (and eliminating some old ones). This means that regulatory procedure must not be allowed to become static. The regulatory officer must grow with the times. He must modify his emphasis to meet the new situation, and not feel embarrassed because he does things differently today from what he did a few years ago. What is standard today may not be so tomorrow. This calls for seminars, refresher courses, reading the literature, attendance at meetings of professional associates. My old professor of physical chemistry used to say, "If you want to learn a subject, write a book on it." This drives you to the literature, and you will be surprised (I was) to find how much you don't know in fields that you thought your information was continuous.

Dale Carnegie is reported to have said, "A man rarely succeeds at anything unless he has fun doing it." Of course this means that the sanitarian succeeds in a large way only when he puts his whole heart and soul into his work (true of any occupation). Fortunately there seems to be something about public health work, whether official or industrial, that commands a man's allegiance to the cause. Sanitarians are the only group that I know of who are so interested in their work that many travel long distances to meetings, often at their own expense, holding three sessions a day—"hogs for work" as somebody has put it.

Sanitarians are by the very nature of their employment the employees who are directed by professional groups, particularly the health officer (physician) and the engineers. This keeps them at the lower salary levels. This in turn limits their efforts to improve their technical knowledge and to raise their professional status. But none have any excuse to hide behind this situation and use it for neglecting to grow in knowledge. "Knowledge is power." Journals, books, conferences, in service training courses, Social Security funds for special courses, all are available to the ambitious sanitarian.

There is another aspect of the work of the sanitarian about which nothing is usually said. This is its most important one, namely, the character of its service to the public. Disease is an insidious enemy. It attacks man like a snake in the grass—suddenly, unannounced, deadly. No wonder that early man attached a mysterious significance to it and associated it in some way with black magic. Even though modern man understands in a general sort of way that disease has definite, well-known causes, he himself is helpless in defending himself against it because he cannot recognize its approach. He is stricken before he knows that danger is near. The sanitarian is the defensive line. He possesses the know-how to attack conditions that engender diseases at their sources. He strikes before the enemy gets started. The enormous saving in life as shown by our declining death rate is the measure of what was done in the field mostly by him. One hundred years ago the death rate in the large American cities was approximately 30 deaths annually per 1,000 people (9) whereas today in the same cities the rate is approximately 10 per 1,000. Imagine what this means in lives saved! Moreover, the morbidity (illness) rate has declined too. Absenteeism from work means economic loss. A reduction in this is an economic gain. Add this to the productive value of the lives saved. A staggering sum is the economic value to the country that the work of the inspector contributes. Add to this the sorrows of bereavement that never occurred, the suffering that did not come, the misery that was prevented. Truly, the sanitarian is engaged in a useful, valuable, noble calling. This is tremendously rewarding in itself.

Sanitarians, your work is necessary. Demands for your services are increasing. New fields are opening up. Stability of your employment is assured. Therefore investment in your future is sound.

"He who knows not and knows not that he knows not is a fool: shun him.
He who knows not and knows that he knows not is simple: teach him.

He who knows and knows not that he knows is asleep: awaken him.
He who knows and knows that he knows is wise: follow him."

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LEEDER JOINS RUTGERS DAIRY STAFF

Dr. Joseph Gorden Leeder, until recently director of research for the Ramsey Laboratories at Cleveland, Ohio, has began his duties as associate professor of dairy manufacturing at the College of Agriculture, Rutgers University.

Dr. Leeder received his bachelor of science degree from Ohio State University. He was awarded his master of science degree by the University of Vermont in 1940, and his doctor of philosophy degree by Penn State in 1944.

While at Penn State Dr. Leeder collaborated with F. J. Doan in developing a method of preserving milk by concentration and freezing. Whole milk was concentrated in a vacuum pan, homogenizing it, then frozen in a continuous ice cream freezer. The milk later was reconstituted. The process has met some success in actual practise in this country and has been considered by the Australian government as a means of supplying milk to the outlying sections of Australia.

The Responsibilities of Restaurant Owners and Operators in Food-Handling Training*

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RESTAURANT sanitation is the composite of practices and conditions in food-handling establishments, which safeguard the health of the customer. There are four distinct elements that go into this composite. The first is the raw material that is purchased, that is the food. "Purses cannot be made from sows' ears." Raw milk, infected meat, filthy baked goods, adulterated canned goods, contaminated grain products, polluted water have no place in a healthful restaurant. Keep these things out of the buying list.

Second is the methods that are used. Equipment must be used for the purpose for which it was designed and in the manner described in order to guarantee satisfactory results. Every procedure must be done by the method that protects food and keeps it from becoming a conveyor of sickness and death.

The third element is the equipment that is available. It is true that extremely conscientious workers using very careful methods can accomplish some minor miracles with poor equipment, but for most restaurant workers good tools go a long way to make a good worker.

The fourth is the man who does the job. To do a job well a man must be well trained. An important part of the job of food handling is to keep that food safe for eating. For the food handler, his own health and his own personal hygiene habits are inseparably linked with his job know-how. In increasing number, food-handler training courses are being conducted under joint cooperative sponsorship by local health department and restaurant owner associations to teach the man who does the job how to do it the sanitary way.

The restaurant owners and operators of food-handling establishments have a very large stake in the success of food-handler training programs. With this stake goes certain responsibilities. Some of these may be undertaken before a food-handler course is formally opened, and others must be faced in the many weeks after the formal training course ends. There are two important ones which must be faced as beforehand responsibilities, and in one sense they are relatively easy for they involve only a mental effort without the expenditure of dollars and cents.

First, each owner and operator must convince himself that sanitation in his establishment is a business necessity. If he will think for but a moment, he will realize that sanitation is cheap insurance against the damages he would suffer should food-borne diseases occur among his patrons. As has been amply demonstrated by court decisions in the State of North Carolina and in other states, restaurant owners and operators are legally liable for sufferings caused by sickness and death from food-borne diseases. During the years from 1938 to 1944 there have been no less than 1,485 verified and completely investigated outbreaks of food-borne disease. We know that

* From an address to the Winston-Salem Restaurateurs Association, Winston-Salem, North Carolina.

there are many more which have escaped recording for an investigation requires the time and skill of the medical specialty of epidemiologists. These outbreaks caused 57,591 cases and 299 deaths. You may be sure that the court decisions and settlements of many of these cases cost operators hard-earned profits. Such losses could be directly measured, but the losses due to damaged reputations and reduced patronage are hidden losses which all will most certainly agree must have run very much higher than the direct cost of paying out claims.

Another measurable profit-taking cost, which can result from deficiency in restaurant sanitation, are court fines for violations of sanitary regulations. Public health organizations are extremely reluctant to resort to legal action in order to procure compliance with sanitary regulations which are designed to help people. Public health officials will use their legal power of enforcement only as a last desperate resort when an establishment is a self-evident hazard to the health of the people of the community, and the operator is beyond all possible hope of seeing health and sanitation as an asset to his business. Nonetheless it is helpful to our thinking to note that in the City of New York during an intensive effort to raise the level of restaurant sanitation there were no less than 3,182 court actions for violations of the sanitary code, which took $256,799 from the pockets of restaurant operators from June, 1946, to September, 1947. Surely sanitation is cheap insurance against the risks of damages that have been noted. No thinking business man goes without insurance against fire, theft, and property damage. No thinking restaurant operator can go without sanitation as insurance against the risk of a food-borne disease outbreak originating in his establishment.

When he realizes that sanitation can be made one of the strongest assets for promoting business, the restaurant operator will further be convinced that sanitation is a business necessity for his restaurant. During the last year North Carolinians and people throughout the United States have become acutely health conscious as a result of issues which have faced our legislatures and the expanding health education activities in our schools, on our radios, and in our newspapers. We are only at the start of a great era during which all of our people in every walk of life are going to be awakened, and equipped with knowledge as to what they must do in order to enjoy good health. In the past five years there has developed a new specialty among the professions of public health, that of the health educator whose entire training, whose entire job is to bring to all of the people the knowledge of how one gains and keeps health. It is up to restaurant operators to seize upon the opportunity to make customers of the health conscious people of their home area and to capture the transient and tourist trade.

The second beforehand responsibility is that restaurant operators must school themselves to expect their employees to know the sanitary techniques of food handling and to practise the proper personal hygiene as part of their job know-how. This basic know-how is as much a requirement for holding a job as knowledge of the technique of cooking, preparing, and serving. In fact, the sanitary technique and personal hygiene are so inter-wound with these methods that food handling and sanitary food handling are one and the same. The only good food handling is sanitary food handling. The operator and all of his supervisory staff must make it forcefully clear to all employees and particularly the new hires that the use of sanitary food handling technique and compliance with the rules of personal hygiene are things that the employer expects of them as naturally as it is expected of them to be punctual, respectful to their supervisor, and courteous to their patrons.

Another key part of building up

inherent attitudes toward sanitation throughout the staff is that you require the participation of all of your employees in food-handler training courses as a condition of employment. Restaurant operators share in the planning of these courses. They voice their opinions as to what should be included, when the meetings should be held, and where these should be held. In setting up these courses in cooperation with their health departments, they have already made an investment of time and energy. They must make this investment pay, and an obvious step toward making it pay is to have every one of their employees attend all of the sessions.

Intensive food-handler courses which are carried on cooperatively between restaurant owners and health departments may be likened to a honeymoon. There may be a festive occasion, such as an evening dinner of the sponsors that may be compared to the marriage ceremony itself. The joint sponsors gather to celebrate the uniting of the interests of restaurant owners and the interests of the public health organizations, to produce something very much better than they have ever had before. The formal training sessions are somewhat honeymoon-like as the participants work together in an atmosphere and under conditions which are very much different from those under which the newly resolved relationship will have to carry on through the many weeks and months which follow. Very much like the honeymooners, they will have a much better chance of realizing their hopes, if they confront some of the grave aftermath responsibilities which they must meet in order to make a success of the operation.

The health department must think of their aftermath responsibilities and alter their organization's plans and operations to meet their new contract. But more significant are two major aftermath responsibilities which fall on the restaurant owners and operators. First, they must continue to show an interest in the training course after it is completed by seeing that its teachings are applied. This requires that the principles taught be incorporated into the standard practises in their kitchens, dining rooms, and storage rooms, and into the personal hygiene habits of their employees. It also requires that they verify that the teachings and course presentations have been grasped by the restaurant workers. In conversations and meetings with their employees the restaurant operators will be able to determine what things are clear and what needs to be taught again. With such information they will have practical and important recommendations to make for inclusion in future food-handler training courses and conferences. Finally, this responsibility requires them to observe the methods used by their workers and to encourage, compliment, and compensate those who do it the sanitary way.

The second major aftermath responsibility is one which is very tangible for it relates to equipment and materials. Restaurateurs must equip their establishments with the essential facilities and materials required by their employees to practise their learning, and to do their jobs in the sanitary way. In their training, the restaurant workers learn a new role, a new way in which to carry on their jobs. It is up to management to set the stage so that they can perform their jobs in the new sanitary way.

This means that restaurant owners must provide at least the minimum of two of the four parts which comprise sanitation in food-handling establishments. It means that they will insist on food, the raw materials, from sources which have the highest sanitary standards. Any restaurateur who is uncertain of the standing of the suppliers and distributors which serve him should seek help from his health department. There information can be given from a list of approved sources for such products as milk, meat, and baked goods. To carry out this second responsibility you must also invest in health protection by providing the essentials of handwashing and toilet facilities, refrigeration, hot water, dishwashing set-ups, and equipment and utensils that are easily cleanable and in good repair.

It is clear that if the restaurant management is indifferent to these responsibilities for safe food and good equipment, the workers will conclude that management has little real interest in the sanitation of the establishment, the hygiene of their techniques in food handling and preparation, or in their personal hygiene habits. As our Spanish-speaking friends to the south say, management is "el que manda"—"he who commands." Commanding means more than merely ordering; it means leading and participating. These things must be done if the new marriage of resolve for better sanitation in the restaurants taken during food-handler courses is to be a productive marriage.

Looking back over these responsibilities, one safe and certain conclusion may be made. Sanitation costs money and requires work. So it is with all things, no good work is achieved without effort and the investment of time, energy and funds. In each individual restaurant today, there are certain things in which the restaurateur takes pride. Things which have won compliments and attracted customers. It may be interior decoration, lighting, attractive window displays. It may be tasty food or novel menus. All of these required money and work, but these are paying off. These are winning profits.

The biggest contribution that any restaurant owner or operator can make to guarantee the success of a food-handler school is his firm conviction that he must add sanitation to the profit-making items that will make this year the best business year that he has ever had. He must remember that his competitors are going to take up this opportunity. He must remember that an ever growing percentage of his customers are becoming more acutely health conscious, and are demanding that there be included in the price of the meal they eat in his restaurant, health insurance against food-borne diseases. That means safe foods, sanitary methods, clean and adequate equipment.

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New Books and Other Publications

Veterinary Bacteriology, by I. A. Merchant. Third edition. Published by The Iowa State College Press, Ames. 1946. viii + 683 pages, 136 figures. $7.00.

This revision not only brings the subject of veterinary bacteriology up to date but contains such new material as a chapter on antibiotic agents, one on the pleuropneumonia group, also on *Proteus ammoniae, Hemophilus bovis,* and *Clostridium sordellii.* It deals with practically all the kinds of bacteria that cause diseases in domestic animals, and in both man and animals, and some in man only. No pathogenic protozoa nor laboratory methods are included as they lie in fields that are covered by other publications. The illustrations are clear, the material well arranged for teaching and reference, and the typography and binding easily readable and durable.

Food Products, by Saul Blumenthal. Published by the Chemical Publishing Co., Inc., Brooklyn, N. Y. ix + 986 pages. 1947. $12.00.

This is a compilation of a large amount of material that is informative and useful for the food manufacturer, salesman, foreman, and laboratory man. It covers such basic food ingredients as the flavors, solvents, essences, colors, polishes, stabilizers, anti-oxidants, gums, and fruit acids; milk and its products; confectionery and cocoa, tea, and coffee; dessert powders and puddings; condiments; fish; dried foods; health foods; pastry and bakery products; fruits and vegetables, fresh, dried, and canned jellies and preserves; drying and freezing procedures; and practical information on plant sanitation and food control. The Appendix carries some useful tables on weights and measures of some common materials, conversion factors, glossary, and list of common abbreviations. The bibliography is somewhat sketchy.

Dairy Bacteriology, by B. W. Hammer. Published by John Wiley and Sons, Inc., N. Y. 3rd edition, 1948, 593 pages. $6.00.

In the ten years that have elapsed since the second edition of this well-known book was published, much new knowledge and some changing emphases have necessitated this revision, as for example, the quaternary detergents and fiber milk containers. The general arrangement of contents remains about the same. One hundred pages have been added in spite of condensation of text and economies in format, as for example, the collection of references in double volumes at the end of chapters instead of the footnotes. Some good new figures have been added and especially many references, as for example, an increase in those relating to cheese from 99 to 188, and butter, from 97 to 159.

The chapter on tests for controlling the quality of raw milk has been largely rewritten and expanded from 19 to 28 pages. There are new chapters in "Bacteriology of Filteration, Clarification, and Separation; an expansion of "Growth of Bacteria in Milk and Cream", "Milk Enzymes", "The Bacteriology of Milk Powder", "The Bacteriology of Lactic Acid Cultures", and especially "Bacteriology of Butter" and that of cheese, a reorganization of the material on pasteurization and the concentrated milks, and a new chapter in "Bacteriology of Dairy-Plant Water Supplies."

The publishers have greatly improved the readability of the text, the clearness of the cuts, the quality of the paper, and the appearance of the binding.

Standard Methods for the Examination of Dairy Products. 9th edition, 1948. Published by the American Public Health Association, New York, N. Y. 373 pages. $4.00.

"Standard Methods" has been entirely reorganized and rewritten. The increase in the number of pages is due to the incorporation of new material, in spite of economies in expression throughout the book. One of the great improvements of this edition is the assembling of discussion on the selection of tests and their interpretation in the first chapter, supported by nearly 300 references to the literature. This chapter is a classic in its handling of public health interpretation. The editors have further improved the book by organizing the products that are to be examined into separate chapters, with cross references to avoid duplication of descriptive analytical procedure. Another useful innovation is the inclusion of screening tests to sort samples quickly into quality groups without the time and expense necessary to subject each sample to the more involved official analysis. We wonder why the Report of the Committee on Assay of Foods was not placed in Chapter 1, and why this subject, together with that of the phosphatase tests, is not considered a "chemical method," and why the determination of vitamin C was not included. The index is more than doubled over that in the previous edition, now running to 21 pages. The typography and format are very good. This new edition represents a great amount of skillful reorganization, rewriting, and interpretation, and will certainly be an advance in our dairy products control literature.

Practical Emulsions, by H. Bennett, Technical Director, Glyco Products Co., Second edition, 568 pages. Chemical Publishing Co,. Brooklyn, N. Y. 1947. Price $8.50.

In the preface the author states that he has revised the first edition and has added material on the partial fatty acid esters of polyhydric alcohols with their application in bread, cakes, ice cream, and other food products. References on patents, formulae, and supporting papers date as late as 1945.

Part I deals with general information on types of emulsions agents for emulsifying, wetting, and dispersing; foams and frothing methods, formulation, and equipment; stability and then lists about 250 surface-active dispersing and wetting agents with their respective composition, then 601 emulsifying agents and 963 emulsions are listed with references.

Part II is a symposium of special papers by contributing authors on emulsifying agents and emulsions.

Part III gives emulsion formulas for agricultural sprays, cutting oils, emulsifying agents, bituminous emulsions, cleaners and soaps, cosmetics and drugs, defoamers, foods, gasoline, lacquers, leather treating agents, lubricants, medicinal products, paints, paper processing products, polishes, resin and rubber, textiles, waterproofing, waxes, miscellaneous, and dispersions.

Milk and Dairy Products, by Lincoln M. Lampert. 291 pages. 1947. 71 figures. Chemical Publishing Co., Brooklyn, N. Y.

The composition, food value, chemistry, bacteriology, and processing of milk and its products are given in clearly-presented non-technical language The text is well illustrated and elucidated with good photography and cuts and well-organized tabulations. A bibliography of 210 references supports the text, and an appended reading list of 22 titles is given for further reading. An appendix contains tables of useful dairy numerical data. Although intended for the general reader, there are some subjects briefly presented for the first time in an American general milk text, such as continuous buttermaking processes and the German ultra-violet light milk pasteurization process. The lay reader will find here something (a little) about every phase of the dairy industry in its production and processing.

Nutrition in Public Health, by Lucy H. Gillett. Published by W. B. Saunders Co., Philadelphia and London. 303 pages, with 33 illustrated. 1946. Price $2.75.

The opportunity, even the responsibility, of the public health nurse to educate her charges in the development of good food habits is facilitated by the use of this book. It is written in a pleasing, conversational style, well arranged, clear, definite, and practical. The first chapter presents the widespread influence of nutrition on the welfare of the community. Chapters II through IV review the nutrition essentials for various age groups. Chapter V suggests ways of protecting the health of the family through intelligent meal planning. Chapter VI should help in improving the food customs of various social and national groups. Chapter VII includes ways of protecting the nutrition of those who are on special diets. Chapter VIII discusses food and the family budget. Chapters IX and X show how to get the maximum food value out of available budgets.

The Chemical Composition of Foods, by R. A. McCance and E. M. Widdowoon. Second revised edition. Published by Chemical Publishing Co., Inc., Brooklyn, N. Y. 156 pages. 1947. $3.75.

This new edition covers new scientific developments and changes in the diet from 1942 to 1947. Some additional cooked dishes have been added in this new edition. Composition of foods is given per 100 grams and also composition per ounce, and covers only the edible portions. Some changes have been made in the calorific factors used. The table of ionizable (inorganic) iron is omitted as unnecessary. The form of the main tables and text remains the same.

Methods of Vitamin Assay, prepared and edited by the Association of Vitamin Chemists, Inc. Published for the Association by Interscience Publishers, Inc., New York. 1947. 189 pages. $3.50.

Here is a practical manual for the assay of vitamin A, carotene, thiamine, riboflavin, niacin, and ascorbic acid, using methods which have been tried out by the Association and found to give reasonably dependable results in the hands of "a laboratory technician with limited training in quantitative analysis". In each case a complete list of apparatus needed for the assays is included, together with useful references to the pertinent literature (for the convenience of the analyst who wants more detailed information). The first chapter on "Sampling for Vitamin Analyses", giving detailed information for sampling meat and other animal tissues, pharmaceuticals, cereals and feeds, fruits and vegetables, and blood and urine. Each chapter on the respective vitamin discusses the general chemistry, the methods available, their application, and the cited literature.

In the case of vitamins with which the members of the Association have had no practical experience, a list of references is given on methods available for the following: vitamins D, E, K, biotin, folic acid, p-aminobenzoic acid, inositol, choline, pantothenic acid, and pyridoxine.

The material is organized for the analyst to follow conveniently.

(Continued on page 379)

JOURNAL of MILK and FOOD TECHNOLOGY

(*including* MILK AND FOOD SANITATION)

Official Publication of the

International Association of Milk and Food Sanitarians

(Association Organized 1911)

The JOURNAL OF MILK AND FOOD TECHNOLOGY (including MILK AND FOOD SANITATION) is issued bimonthly beginning with the January number. Each volume comprises six numbers. Published by the International Association of Milk and Food Sanitarians at 374 Broadway, Albany 7, N. Y. Executive Office, 23 East Elm Avenue, Wollaston 70, Mass.

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Manuscripts: Correspondence regarding manuscripts and other reading material should be addressed to the Editor, J. H. Shrader, 374 Broadway, Albany 7, N. Y., or 23 East Elm Avenue, Wollaston 70, Mass.

Membership and Dues: Active membership in the Association is $3.00 per year, and Associate membership is $2.00 per year, including respectively all issues of the JOURNAL OF MILK AND FOOD TECHNOLOGY (including MILK AND FOOD SANITATION). All correspondence concerning membership in the INTERNATIONAL ASSOCIATION OF MILK AND FOOD SANITARIANS, including applications for membership, remittances for dues, failure to receive copies of the JOURNAL OF MILK AND FOOD TECHNOLOGY, and other such matters should be addressed to the Secretary of the Association, J. H. SHRADER, 374 BROADWAY, ALBANY 7, N. Y., OR 23 EAST ELM AVE., WOLLASTON 70, MASS.

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JOURNAL of MILK and FOOD TECHNOLOGY
As Their Official Organ

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Association News

Chicago Dairy Technology Society

The October meeting of the Chicago Dairy Technology Society was held the second Tuesday of the month, October 12, at the Furniture Mart, 666 Lake Shore Drive.

Professor Paul Lucas of Michigan State College spoke at the September meeting. He gave an interesting talk on "Controlling Body in Commercial Ice Cream." In his discussion, Professor Lucas brought out the difficulty of differentiating between Body and Texture in judging ice cream. They are so inter-related that he considers them together.

He stressed the need for continued "harping" on the food value of ice cream. Some of the industry's best boosters are school teachers. They realize the food value of ice cream. If their confidence is to be continued, this type of ice cream should be offered.

Professor Lucas showed the value of building up the milk Solids-not-Fat in ice cream to both the manufacturer and the consumer. He predicts this will be the new trend in ice cream.

H. P. SMITH
Recording Secretary

New Food Technology Course at Rutgers

The Food Technology Department at the New Jersey Agricultural Experiment Station, Rutgers University, held open house in October in its newly remodeled and equipped quarters.

The department is comparatively new at the State University, and was set up to conduct research and to do teaching in canning, freezing, dehydration, refrigeration and other food preservation and packing methods.

Dr. Walter A. Maclinn, head of the department, and his staff conducted visitors through laboratories and explained what research is expected to accomplish.

Dairy Technology Conference at University of Maryland November 30, December 1 and 2

The Fourth Annual Dairy Technology Conference will be held at the University of Maryland, November 30, December 1 and 2. Arrangements are being made for guest speakers who are authorities in the various fields of the dairy industry.

The conference will have a varied program of interest to milk and ice cream plant operators and technicians, to public health officials and to dairy fieldmen.

Thirty-Fifth Annual Meeting

PHILADELPHIA, PENNSYLVANIA, OCTOBER 21–23

REPORT OF SECRETARY FOR 1947–1948

THE Secretary's report for 1947–48 is a combined report embracing the activities of the Association from Oct. 1, 1947 to June 1, 1948, under Dr. J. H. Shrader, and from April 3, 1948, to Oct. 1, 1948, when your new Secretary was initiated into the many phases of the new job.

During the transition period when records, correspondence, and Secretary's functions were being transferred, there no doubt were many delays and errors of commission and omission in the handling of the Association business.

The first order of business for your new Secretary was a general study and orientation covering the responsibilities, duties, records, and functions in connection with the office of Secretary-Treasurer. An inventory and analysis of the active records and incoming mail revealed about ten basic categories or functions for which the Secretary-Treasurer is held responsible. These include (1) budget and expense, (2) committees, (3) constitution and by-laws, (4) convention, (5) executive board, (6) Journal of Milk and Food Technology, (7) memberships direct with the association, (8) memberships with the affiliated organizations, (9) 3A sanitary standards, and (10) secretary's and treasurer's accounts and reports.

Budget and expense as reported under the financial report of the Treasurer show that total receipts for 1947–48 were $8,419.15, of which $4,405.60 were for the payment of dues. Surplus receipts over the 1947 Convention expense in Milwaukee amounting to $45.15 were due largely to the registration fee of one dollar charged per person. This policy has made the Convention more or less self-supporting and lifted it out of the deficit column.

Committees, while operating largely under the direction of the President and respective chairmen, do call on the Secretary for reports and material in connection with their work. During the year the work of the Secretary has been with the Committees on Ordinances and Regulations, Professional Status of Sanitarians, and the Committee on Sanitary Procedures. The proposed model ordinance was sent to all active members of the Association, and over 160 sets of 3A Sanitary Standards were sent out in addition to those sent out to all state and municipal health officers and sanitarians throughout the United States.

Constitution and by-laws. By authority of action taken at the Milwaukee meeting, a proposed amendment was circulated among the active members of the Association for consideration at this meeting, providing for a President-Elect, in order to make it possible for the President-Elect or incoming President without embarrassment to plan his work in advance and to make his committee appointments promptly at the beginning of the year.

Convention. One of the major responsibilities of the Secretary is the planning and arranging for the annual convention. Without the complete assistance of the President W. D. Tiedeman on program and Mr. Wesley M. Holmes, chairman on local arrangements, it is doubtful if your Secretary could have handled the many details in connection with this 35th Annual Convention on four or five months planning.

Executive board. One meeting of the Executive Board was held in New York City in addition to the meetings held in Milwaukee on October 15, 1947, and Oct. 18, 1947.

Membership. During the year 1947–48, $3,120 was paid to the JOURNAL OF MILK AND FOOD TECHNOLOGY for each paid-up member of the Association. This does not reflect a true picture as clerical difficulties have beset your new

Secretary preventing an up to the minute report on paid-up dues. The service to the members has been foremost in the Secretary's mind. This consists chiefly of reporting all new members to the Editors of the *Journal of Milk and Food Technology* for inclusion on the mailing list, reporting changes of addresses, and reporting all members to be removed from the mailing list for non-payment of dues. Since membership is the lifeblood of this organization, the Secretary feels that regular receipt of the Journal is of paramount importance to sustain this membership. The establishment of a complete, accurate mailing list of all active and associate members is the ultimate aim of your Secretary by developing a closer liaison and working relationship with the affiliated organizations. These are located in Dubuque, Iowa, Florida, Iowa, Illinois, Michigan, Minnesota, New York, Oklahoma, Virginia, and Wisconsin. Three groups are now negotiating for affiliation with the INTERNATIONAL. The Association now has a total membership of 2,550 of which 2,207 are paid-up. Of this group 420 are active and 1,787 are associate members. Since most of the unpaid dues are among the members in the affiliated groups, the service to the members in these state asociations and dairy technology societies cannot be underestimated. Your new Secretary believes that our strength comes from a better working relationship with all members, whether they be active or associate. It is to this end that he will address himself in the months to come.

Respectfully submitted,
GEO. A WEST,
Secretary-Treasurer

ANNUAL REPORT OF THE TREASURER
1948

Receipts

Balance—Oct. 1, 1947		$3,936.06	
Annual Dues		4,405.60	
Convention and Registration Fees			
Receipts	$1,138.00		
Expense	1,092.85		
Net Gain		45.15	
Sale of 3A Sanitary Standards		14.25	
Collections and Miscellaneous		18.09	
TOTAL RECEIPTS			$8,419.15

Disbursements

Membership subscriptions to the JOURNAL OF MILK AND FOOD TECHNOLOGY: $1.00 per paid-up member to Sept. 30, 1948	$3,120.00	
Refund on over-paid dues	27.00	
Personal services (salaries)	1,089.98	
Contractual services (lawyers fees)	140.00	
Printing	728.68	
Postage and Mailing	258.24	
Office supplies and equipment	21.52	
Telephone and telegrams	9.97	
Travel	218.97	
Fidelity bonds	25.00	
Bank service charges—foreign check collections, and non-payment checks	43.61	
Registration (annual report)	1.00	
Petty cash	15.00	
TOTAL DISBURSEMENTS		$5,718.97

Summary

Total Receipts	$8,419.15
Total Disbursements	5,718.97
BALANCE September 30, 1948	$2,700.18

Summary of the Thirty-fifth Annual Business Meeting of the International Association of Milk and Food Sanitarians

PHILADELPHIA, PENNSYLVANIA

This annual meeting will be noted as one of our very successful ones. The papers brought forth discussion, much of which was quite extended and stimulating. Great emphasis was placed upon the need for the acquisition of facts instead of opinions as the basis for technological progress. The registration was almost 300. The banquet session was entertaining, full of clean fun, and a compliment to the generosity and good taste of the local industry. Mr. W. S. Holmes, secretary of the Philadelphia Dairy Council, was the efficient and genial chairman of the local committee.

Present membership is reported as follows:

Paid up membership:	2207
Members with unpaid dues:	343
Total	2550

At the business meeting presentations were made that the need to restrict our active membership exclusively to those who were engaged in governmental employ and regulatory supervision, as was considered necessitous in the early days of the Association, no longer prevail. It is plain that increasing emphasis on education of the industry on the developments of milk and food technology, and the inauguration of formal curricula in the training of food sanitarians have been operating to create a broader base for membership than have prevailed in the past. There is another organization that is restricted exclusively to governmental employees; it meets in sections in all parts of the country. Since regulatory needs are so well provided, some members have thought that the work of this Association would be improved if membership were broadened to include all persons, whether governmental, educational, or industrial. As a result of these deliberations the following motion was unanimously adopted:

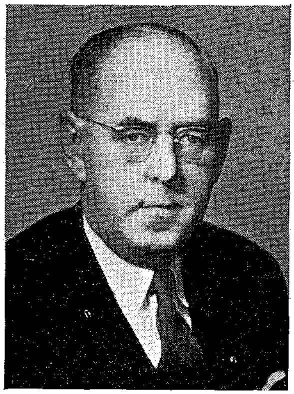
> The Executive Board of this Association is respectfully requested to consider ways and means of more effectively integrating our work and objectives with those of other milk and food sanitarians and technologists, both those who now have and also those who have no organic connection with this Association; and further that the said Board prepare a report of their findings and recommendations for circularization among our membership as soon as practicable by mail, and finally that necessary implementing amendments be drawn and circulated for action by mail vote for Constitutional action at our next annual meeting.

The new officers were as follows:

President: A. W. Fuchs, Washington, D. C.
First Vice-President: M. R. Fisher, St. Louis, Missouri.
Second Vice-President: K. G. Weckel, Madison, Wisconsin.
Third Vice-President: C. S. Leete, Albany, New York.
Secretary-Treasurer: G. A. West, Rochester Health Bureau, 44 Marshall St., Rochester, N. Y.
Auditors: C. E. Carl, Jefferson City, Mo.
W. H. Haskell, Beloit, Wis.

At the first meeting of the Executive Board after the annual business meeting, the board approved in principle the elimination of restrictions to the active membership so that amendments will be drawn that will provide for membership, regardless of their employment relationships.

R. B. Stoltz—1890-1948



Professor Robert Bear Stoltz passed away on October 2, 1948, and was buried on October 5. He was Chairman of the Department of Dairy Technology, University of Ohio, and an internationally known figure in dairy and Masonic circles.

Professor Stoltz had been associated with the University's College of Agriculture since his graduation there in 1912. He was made a full professor in 1923 and six years later was elevated to the chairmanship of the Department.

Professor Stoltz held important posts in a number of dairy associations and was outstanding in the Masonic Order. He had been secretary of the Ohio Swiss Cheese Association, the National Cheese Association, the Columbus Milk Distributors Association, and the American Dairy Science Association, heading the latter organization in 1934 and serving as its secretary-treasurer since 1936. He was a member of the Advisory Council of Sealtest, Inc. of the National Dairy Products Corporation.

He was a member of the Columbus Rotary Club, of the Ohio Post-War Program Commission, and was listed in Who's Who in America, Who's Who in American Education, and Men of Science. In 1937 he studied dairy conditions in New Zealand and Australia.

Professor Stoltz was a 33rd degree Mason, and was elected this year as Deputy General Grand Master of the General Grand Council, R. & S. M., of the United States; had served as Grand Master of the Grand Council, R. & S. M. of Ohio; was Past Master of University Lodge of Masons and for 14 years its secretary; a member of York Chapter, R. A. M.; York Council, R. & S. M.; Columbus Commandery; Scottish Rite; Aladdin Temple; Red Cross Constantine; Acacia Fraternity and Delta Theta Sigma and Gamma Sigma Delta, honorary fraternities.

Professor Stoltz was a native of Bradford, Ohio, was a member of First Community Church, and lived at 1971 Concord Road, Columbus, Ohio.

Surviving are his wife, Mrs. Marie Cassel Stoltz; a son, Philip Cassel Stoltz; and three daughters, Mrs. Bonnie Marie Downes, Mrs. Susan Ann George, and Mrs. Roberta Mary Miles.

New Members

ACTIVE

Walter R. Comer, Sr., 314 East Third St., Frederick, Md.

Walter N. Dashiell, U. S. Public Health Service Dist. 4, 1539 Jackson Ave., New Orleans, La.

John E. Lobb, 710 Oak St., Fargo, N. Dak.

Eugene Reeves, 510 Interstate Bldg. U. S. Public Health Service, Kansas City, Mo.

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Mr. Thomas D. Curran, 14901 Terry Avenue, Detroit 27, Michigan.

Mr. Francis J. D'Amour, 1512 E. Houghton Avenue, Houghton, Michigan.

Mr. Herbert J. Dunsmore, Battle Creek Health Dept., Battle Creek, Michigan.

Mr. Hugh F. Donnelly, St. Clair County Health Dept., 600 Park Street, Port Huron, Michigan.

Mr. Charles H. Edwards, Kalamazoo City-County Health Dept., City Hall, Kalamazoo, Michigan.

Mr. John R. Fleming, Van Buren County Health Dept., 226 East Michigan, Paw Paw, Michigan.

Mr. Herbert H. Hasson, c/o W. K. Kellogg Foundation, Battle Creek, Michigan.

Donald M. Kirschenbaum, 67 Wilson St., Brooklyn 11, N. Y.

Raymond LaFave, Alger-Schoolcraft, Manistique, Michigan.

Mr. Hugel A. Leonard, District Health Dept. No. 1, Courthouse, Lake City, Michigan.

Prof. P. S. Lucas, Dairy Department, Michigan State College, E. Lansing, Michigan.

Mr. Leo H. Rothe, Shiawassee County Health Dept., Courthouse, Corunna, Michigan.

Mr. John Sherbeck, Sanitarian, Bay City, Health Department, City Hall, Bay City, Michigan.

Mr. Cranston Wilcox, Branch County Health Dept., 35 Sprague Street, Coldwater, Michigan.

CHANGES OF ADDRESS

Mr. Ben Davies, Chippenham Wiltshire, London, England, to United Dairies Limited 34, Palace Court, Bayswater, London, W. 2, England.

Mr. Donald V. Fitzgerald, Box 164, Woodstock, Ill., to Box 301, Elgin, Ill.

Mr. Edmund C. Garthe, Chicago, Ill., Sanitary Eng. Div., U. S. Public Health Service, Washington 25, D. C.

Major Robert L. Hummer, A.P.O. 929 c/o Postmaster, San Francisco, California, to Surgeons Section, H Q Fifth Air Force, A.P.O. c/o Postmaster, San Francisco, Calif.

Mr. W. H. Krehl, 924 Huron Street, Jacksonville 5, Fla., to 420 N. W. 29th St., Miami 37, Fla.

Mr. M. M. Miller, 304 New Custom House, Denver 2, Colorado, also University of Denver, to 6600 E. 19th Ave., Denver 7, Colorado.

Mr. Robert Slingerland, R. D. Dundee, New York, to 207 E. Elm Street, Penn Yan, N. Y.

Mr. Robert S. Taggart, 144 Market Street, Amsterdam, N. Y., to 14 Girard Place, Maplewood, New Jersey.

Mr. Donald W. Taylor, 1644 Northgate Road, Baltimore 18, Md., to 15062 Winthrop Street, Detroit 27, Michigan.

Mr. J. J. Willingham, Mrs. Tucker's Foods, Inc., Sherman, Texas, to Same until January 1, 1949, after January 1, 1949 change to Dept. of Dairy Mfgrs., Texas Technological College, Lubbock, Texas.

Mr. Burr Willits, 106 N. 2nd Ave., Marshalltown, Iowa, to 207½ E. State St., Marshalltown, Iowa.

NEW BOOKS

(Continued from page 371)

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"Doctor Jones" Says—*

PAUL B. BROOKS, M.D.

A fellow, awhile ago, was telling me about some of this new air-conditioning business. If you wanted it warmer or cooler or wanted more ventilation or more or less humidity, all you had to do was turn a knob or something. And, you know, I was thinking: if we could regulate our mental attitudes like that we'd live longer, accomplish a lot more in life and do it easier.

There's no doubt but what a considerable part of our difficulties, our failures and the wear and tear on our systems—it's the result of fear that we won't be able to do the things we want to do or think we ought to. More or less unconsciously we build up obstacles that don't exist 'til we've created 'em.

Remember the little poem (I learned it when I was a boy) about the fellow: "Somebody said that it couldn't be done But he, with a chuckle, replied That maybe it couldn't but he'd not be one To say so 'til he tried"—and so on? My mother, when I was small, told me there was "no such word as 'can't'." Well, like some other things, I took it too literally. I found it, later, in the dictionary, so I concluded she must've been wrong. But the idea she was trying to convey—I recognize now: it's a word that's greatly overworked.

When we get some understanding of how our minds work and the part our imaginations play in our lives it's possible, if we've got the intelligence, backbone and perseverance, to cultivate healthy mental attitudes. It ain't as easy as just moving a switch or turning a knob but it can be done—up to a certain point. Anyway, it's worth trying and "I'll try" is a lot more stimulating slogan than "I can't."

If we can sift out the imaginary and unnecessary obstacles we'll be in better shape to deal with the unavoidable ones. Like the old fellow I heard of, down in the Ozarks. He was sitting on the porch, rocking due north and south. On the other end, in another rocking chair, his son, age forty, was rocking due east and west. Finally the old man spoke up: "Listen, Zeke, don't rock that-away," he said. "Turn your chair 'round. Rock with the grain and save your strength."

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* *Health News,* New York State Department of Health, Albany, N. Y., Dec. 22, 1947.

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Authors

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