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*Twenty-seventh Annual Meeting
Cleveland, Ohio, October 19-21, 1938
Headquarters, The Allerton*

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Official Publication of

INTERNATIONAL ASSOCIATION OF

MILK SANITARIANS

1

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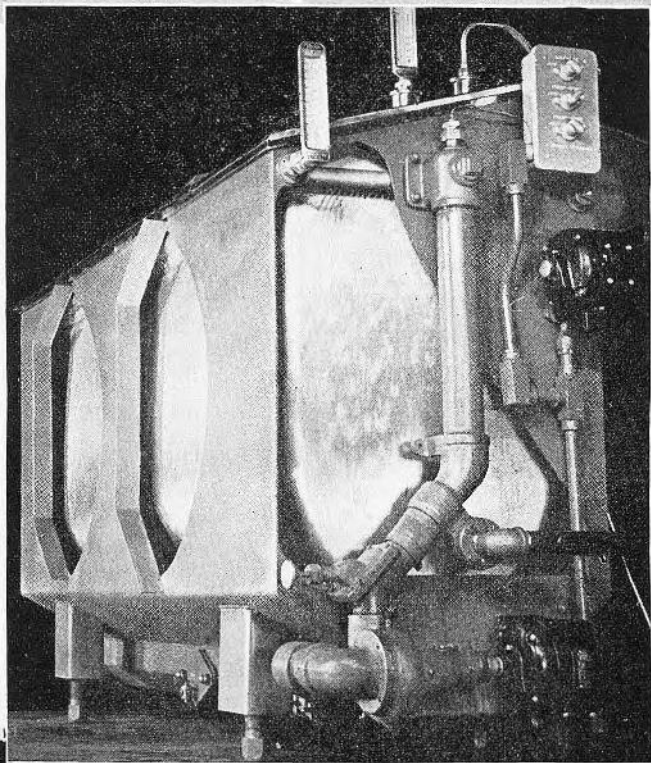
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JOURNAL OF MILK TECHNOLOGY
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The International Association of Milk Sanitarians

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March, 1938

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Editorial Section

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

The Journal as Official Organ of Local Associations

The Journal of Milk Technology came into being because the International Association of Milk Sanitarians had outgrown their annual year book. The latter had served well for twenty-five years but was inadequate for the present needs of the Association. A publication medium was necessary to keep the membership abreast of the new developments in dairy technology, to publish the papers in convenient form, to convey official notices of the officers, to maintain frequent contact throughout the year, and to foster Association loyalty and maintain interest. These objectives are being fulfilled by the Journal, judging from the letters we are receiving from our fellow sanitarians.

Some rather rapid recent developments have indicated that the local or area associations of milk inspectors (sanitarians) are recognizing similar needs. They feel that the papers presented at their annual meetings should be published, but they feel the need of a more frequent contact than their year book. The publication of a journal is a somewhat larger undertaking on which they hesitate to embark. A newly formed local (area) association which had not yet organized its publication program made overtures that this Journal serve as its official organ. As soon as two of the older and larger state associations heard of this idea, they expressed themselves as being interested in a similar relationship.

The management of the Journal outlined a plan whereby such a development could be realized and submitted it to the Executive Board of the International Association. The Board approved a plan that would be mutually beneficial to all local associations and the International Association. Local associations would maintain their independent status as now. The Journal would become their official organs. This would provide a medium for publication of the notices, programs, news items, and such papers as the local association secretaries would designate.

It is clear that such a development would be to the interest of all quality control officers, both official and commercial. At the option of the local associations their papers would be published either in their year books as now or in the Journal. Their programs of meetings would be published more widely than now and thereby foster local interest and develop some where none now exists. The publicity given these programs would enable secretaries to learn what are the most interesting and valuable papers given at other meetings, and thereby assist them in building up their own programs. The frequent contacts between the officers and membership would operate to maintain interest between the annual meetings.

Under the present conditions, only the larger states have the resources in personnel to support a state association. The difficulty of building good programs and the expense of publication deters the men in many of the smaller states from assuming the responsibility of forming a state association. The small membership and limited circulation would be insufficient to support a journal. Under such a plan as above outlined, these obstacles would be overcome because the Journal would publish programs, papers, and technological news which would effectively relieve the officers of their chief worries.

If this general plan were followed, any state that has 25 inspectors should form a state association for the following reasons: 1. it would accord to milk sanitarians everywhere professional privileges which are available now only to those in the larger states; 2. it would improve their local prestige; 3. it would publicize the work of milk quality control and engender interest where none now exists; 4. it would form a working nucleus which would serve as a rallying center to all local milk sanitarians and gain strength as they joined one by one; 5. it would make the local inspectors vocal and give them a voice in any public measure in which they are interested; 6. it would tend to strengthen their positions by reason of the combined influence of their fellow members; and 7. it would improve the work of all milk sanitarians by reason of the pooled knowledge.

NEXT ANNUAL MEETING

The Twenty-seventh Annual Meeting of the International Association of Milk Sanitarians will be held in Cleveland, Ohio, October 19, 20 and 21, 1938, with headquarters at The Allerton.

Plumbing Hazards in Pasteurization Plants

W. Scott Johnson, M. S.

*Chief Public Health Engineer, State Board of Health of Missouri,
Jefferson City, Mo.*

Notable progress has been made during the last ten years in the sanitary features of pasteurization plant and equipment design. However, the milk control official's motto must be "constant vigilance," and his objective, to improve continually the safeguards surrounding the quality of a public milk supply. The recently revised attitude of health officials toward the health significance of plumbing should be sufficient reason for the milk control officer to add additional items to the requirements of pasteurization plant sanitation. It is difficult to conceive of any location where greater potential health hazards might be introduced from defective plumbing than in a milk pasteurization plant. To appreciate fully the hazards of faulty plumbing in a pasteurization plant it is essential to discuss briefly the plumbing requirements of milk plant equipment and the hazards of faulty plumbing.

A modern milk plant is concerned with the processing of milk and milk products for the market. Pasteurized fluid milk and cream, butter milk, cultured milk, cheese, and ice cream constitute the principal end products. For the manufacture of these products various types of equipment are necessary, such as pasteurizers, coolers, holding vats, churns, condensers, refrigerators, compressors, brine tanks, bottle and can washers.

Large quantities of water are essential for washing, rinsing, cooling, the generation of steam for power, and sterilizing purposes. It is common practice to rinse equipment with water before milk or milk products are placed in contact with surfaces. Usually the initial cooling is accomplished with tap water and it is not uncommon for the shell or pipe wall separating this cooling medium from the

milk to develop leaks. Frequently a product such as butter is washed direct in tap water. Cooling water is used over and over with the aid of roof aerators which are exposed to aerial contamination. Condensers are often employed for cooling the refrigerating medium with tap water which is used repeatedly with the aid of aeration or discharged to waste through a solid connection to the sewer. Toilet facilities are provided to maintain satisfactory personal hygiene. Generally this equipment is connected directly to both the water and sewer system of the building.

Provision is made for the disposal of waste water from such plants by means of the usual system of sewer lines. The contents of these lines consist of the sewage from toilet rooms as well as large volumes of waste water from washing and rinsing machinery, floors, and other appurtenances. These sewers carry potentially infectious material and at times are probably overloaded to the extent of producing internal pressure.

Most pasteurization plants maintain a laboratory for control purposes. Many pieces of laboratory equipment such as aspirators, water baths, etc., are connected with the water or sewer system in such a manner as to constitute potential hazards.

From this brief description it should be apparent that the quality and quantity of the plant water supply are very important from the standpoint of the sanitary protection of the milk supply as well as effective operation. Likewise safe disposal of plant waste by means of the sewer system is essential to sanitation.

It is recognized that at least a partial vacuum may exist without warning in any water piping system due to a number of

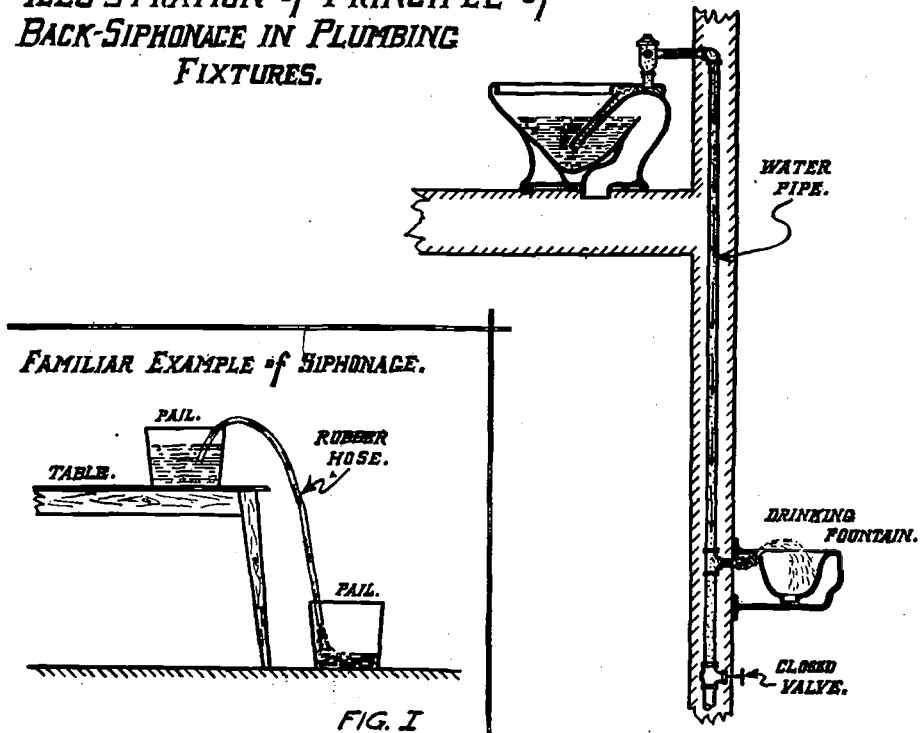
causes such as a heavy draft in a main due to a fire, or cutting off the water supply and draining lines for repairs. Such a vacuum has been shown for example to be capable of siphoning the contents of a flush valve type toilet bowl, in good working order, into the water supply line. See Figure 1. For a similar reason any potable water outlet that is submerged may be converted into a siphon and pull the liquid substance into the water supply pipes.

The usual method, if any, of protecting potable water lines directly connected to contaminated water or sewer lines against pressure on the non-potable water side from a pump or back pressure due to the temporary stoppage or surcharging in a sewer line has been by means of a check or manual valve. The ease and

frequency with which such valves are made ineffective by corrosion, stoppage by foreign substances, or even tampering by the careless or uninformed, render their protection very uncertain. It is a well known fact that building as well as street sewer lines do become clogged causing sewage to back up at times under considerable pressure. Further it should never be assumed that a sewer line, regardless of its construction, will not sooner or later leak due to excessive pressure, faulty joints, or corrosion.

In general, these faults of piping or plumbing systems are responsible, in a great variety of modifications, for most of the existing potential hazardous plumbing conditions. The public health reasons for keeping the contents of sewers from contact with food or a potable

ILLUSTRATION of PRINCIPLE of BACK-SIPHONAGE in PLUMBING FIXTURES.



water supply are too well understood by health officials as well as the public to require further discussion.

A recent survey of the plumbing and piping systems of six milk plants indicated a situation that was extremely complicated, especially in the large plants. The many types of equipment concerned, the frequent maze of pipes, and the various ways that this equipment was interconnected with water and sewer lines presented many difficulties in obtaining accurate information. To simplify and clarify the results of the survey, the defects found have been grouped into six general types according to the way in which the condition becomes a plumbing defect and potential health hazard. "Plumbing defect" is used in a broad sense to include faults in piping systems as well as equipment design. Figure II illustrates typical plumbing defects of the various types found in the six milk plants surveyed.

Type 1. Direct pipe or equipment connection between potable water supply and sewage or other contaminated water, with or without check or manual valve between, which through excessive back pressure or negative head, or both, might result in the contamination of the potable supply with sewage or polluted water. Example—Polluted water pump directly connected to potable water supply; condensers directly connected to potable water supply and also to sewer lines; drains or overflow from potable water tanks directly connected to sewer lines; mechanical refrigerating units directly connected to potable water supply and sewer lines.

Type 2. Potable water supply inlets submerged constantly or because of direct or indirect stoppage that, due to a negative head or vacuum in the potable water supply lines, might result in the contamination of the potable water supply with sewage or polluted water through back siphonage. Example—Constantly submerged inlets which are hazardous even when the fixtures are in good operating condition such as siphon jets in

water closets and urinal traps, laundry washing machines, processing tanks, water softeners, and stockwater basins. Inlets not ordinarily submerged beneath the surface of the fixture contents but which at times become submerged due to carelessness in filling or to stoppage of outlets, such as flushing rim openings in water closets, urinals, and slop sinks, lavatories, aspirators, utility room sinks, drinking fountains, bottle washers, loose hose, etc.

Type 3. Sewer lines located over pasteurizers or other milk processing equipment; floor drains located in refrigerators or other rooms where food is stored or processed and in rooms where ice is made or prepared for use.

Type 4. Water supply subject to aerial pollution. Example—Potable water supply tanks with open or loose tops or covers located on roof of building or other exposed location.

Type 5. Possible infection of persons through use. Example—Incorrectly designed drinking fountains which can be contaminated by user with possible hazard to subsequent users.

Type 6. Equipment designed to hold food during processing, surrounded by or containing pipes or jacket through which the water supply is circulated. Frequently this type of equipment is rinsed with tap water just previous to use. The danger from such connections and operation is predicated upon the water supply becoming contaminated due to other faulty plumbing and the development of breaks in the pipes or jacket so that contaminated water would leak into the food supply. Example—Certain types of milk pasteurizers, milk holding vats, milk coolers, and other equipment in which dairy products are heated or cooled or both.

Based on this grouping of plumbing defects, Table I indicates the number of plumbing defects in each milk plant.

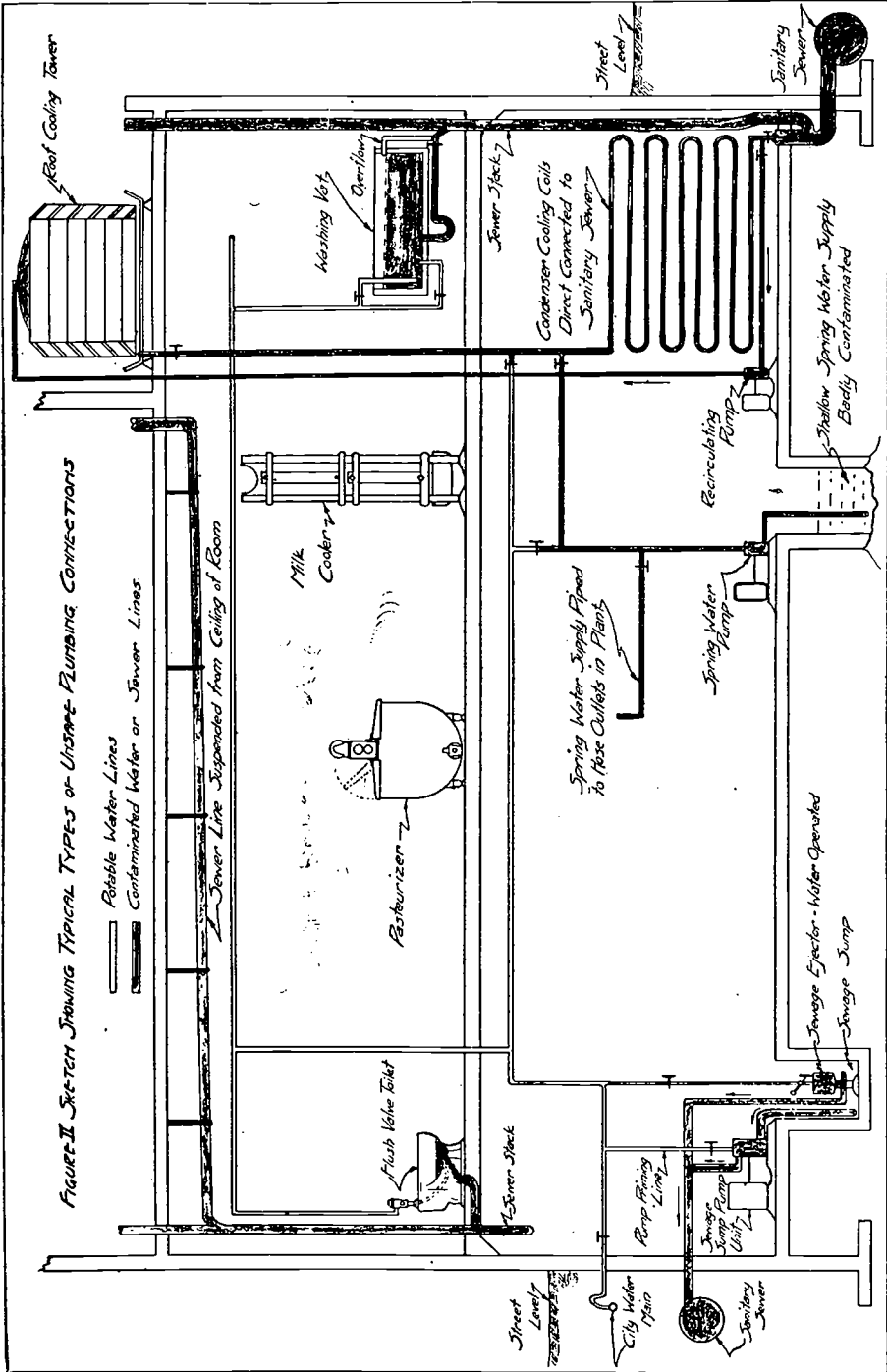


FIG. II

TABLE I
Number of Plumbing Defects in Each Milk Plant Surveyed, Classified According to Types
 Number of Plumbing Defects Found

Milk Plant	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Total
A	4	35	1	3	4	12	59
B	0	13	0	0	0	1	14
C	0	21	1	1	0	14	37
D	0	13	2	0	0	9	24
E	0	10	2	0	0	3	15
F	4	43	0	5	5	4	61
Total	8	135	6	9	9	43	210

TABLE II
Number of Plumbing Defects in Milk Plants Classified According to Type and Equipment Involved
 Number of Plumbing Defects Found

Equipment	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Total
Bottle Sterilizer	—	2	—	—	—	—	2
Bottle Washer	—	4	—	—	—	—	4
Brine Tank	—	2	—	—	—	—	2
Can Washer	—	5	—	—	—	—	5
Case Washer	—	2	—	—	—	—	2
Cheese Tank	—	—	—	—	—	2	2
Condenser	—	2	—	—	—	—	2
Culture Tank	—	6	—	—	—	5	11
Drinking Fountain..	—	5	—	—	9	—	14
Floor Drain	—	—	2	—	—	—	2
Flush Toilet	—	25	—	—	—	—	25
Hose	—	51	—	—	—	—	51
Laundry Washer	—	2	—	—	—	—	2
Milk Cooler	—	—	—	—	—	4	4
Milk Condenser	1	—	—	—	—	1	2
Milk Storage Tank ..	—	—	—	—	—	2	2
Pasteurizer	—	—	—	—	—	29	29
Potable Water Tank ..	—	—	—	7	—	—	7
Pump	5	—	—	—	—	—	5
Refrigerator	1	—	—	—	—	—	1
Roof Cooler.....	—	—	—	2	—	—	2
Sewer Pipe	1	—	4	—	—	—	5
Soaking Tank	—	1	—	—	—	—	1
Steam Cooker	—	4	—	—	—	—	4
Sterilizer	—	1	—	—	—	—	1
Wash Bowl	—	15	—	—	—	—	15
Wash Tank	—	7	—	—	—	—	7
Water Softener	—	1	—	—	—	—	1
Total	8	135	6	9	9	43	210

Table II indicates the extent to which equipment is involved in various types of plumbing defects.

In two instances samples of water collected from milk plants showed heavy contamination. In one case, an auxiliary spring water supply, cross-connected with the city water supply and also used for cooling and flushing purposes within the plant, showed contamination. In the second instance the water sample was taken from a supply line to a milk cooler.

The survey of milk plants showed the existence of 210 plumbing defects. There were 28 different kinds of milk plant equipment involved in the hazardous connections found. In 152 instances the plant water supply was subject to possible contamination. Forty-three pieces of equipment were found with water jackets or coils which in case of a leakage would allow the plant water supply to come into contact with the milk. In 137, or 65 percent, of the defects found, back siphonage and in some cases stoppage of outlets would be necessary to cause a hazard. Ten, or 4.8 percent, of the defects resulted from direct connections, that is, solid piping without a break existing between contaminated water or sewage and the potable water supply.

The results of this survey reveal a number of ways in which water supply, milk, or milk products in all the plants surveyed might be contaminated. If the water supply of the plant becomes contaminated with sewage because of one of the above reasons, there are many possibilities of this pollution coming in contact with milk due to leaks in coolers or pasteurizers. Whenever water is used in direct contact with milk products, such as butter or rinsing surfaces of milk equipment, the danger is obvious. There is also the ever present danger of this contaminated plant water supply back-flowing into the distribution system. Additional examples of a hazardous situation in milk plants is the location of sewage lines directly over equipment used to process milk products, and the dangers due to leakage from joints or corroded pipes.

Certain types of plumbing connections are more dangerous than others. Like-

wise the type and age of buildings, equipment, maintenance of equipment, and other factors, all have a bearing on the possibility of a health hazard occurring. Old plumbing, badly corroded and lacking many modern safeguards, as well as a poorly maintained piping system present great potential hazards. Besides defective plumbing, this survey indicates that milk plant equipment is improperly designed in many cases, and may be responsible for contamination of the water supply or milk products.

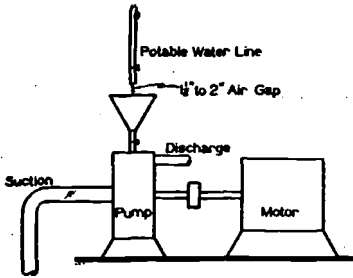
In general methods of eliminating these plumbing and equipment defects in milk plants do not present unusual difficulties, although some ingenuity and a thorough understanding of the hydraulics of plumbing is essential. In the construction of new plants the added expense of eliminating plumbing defects will be small. Likewise in the purchase of new equipment there should be no difficulty in specifying a design that will eliminate hazardous conditions. However, in the case of older plants and equipment, more difficulty and considerable expense are involved. Frequently the difficulty of finding all plumbing hazards in old plants is a major problem.

In the case of Type I or direct pipe or equipment connection between potable water and contaminated water or sewage, it is usually quite a simple matter to provide protection. Figure III indicates a scheme for introducing an air gap which precludes the possibility of contamination gaining entrance to the potable water lines.

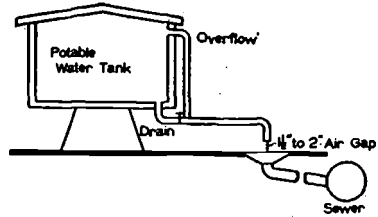
Type 2 defect when potable water supply inlets are submerged constantly or because of stoppage can usually be corrected without difficulty. Figure IV indicates methods for correcting the most common connections of this type so that there is no danger of contaminating the potable water supply.

Whenever a plant is located on more than one floor, the sewer lines serving the upper floors should be so located that they do not pass over or near any equipment used for processing purposes.

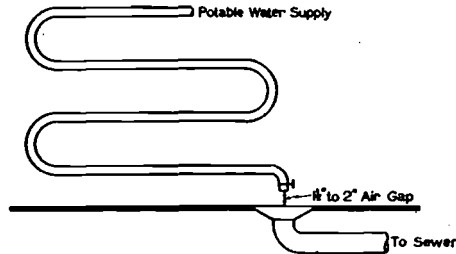
FIG. III



Satisfactory Method of Providing a Priming Line from Potable Water Supply to Pump

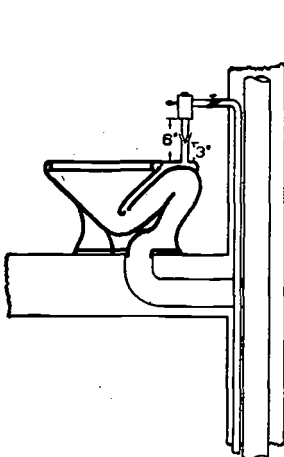


Satisfactory Air Gap Connection between Drain and Overflow of Potable Water Tank and Sewer

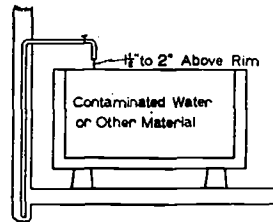


Satisfactory Open Gap Connection between Condenser or Cooler and Sewer

FIG. IV



Toilet and Flushometer Valve Equipped with Vacuum Breaker



Satisfactory Above Rim Potable Water Inlet to Wash Water Vat or Similar Equipment



Scheme for Keeping Hose Nozzle above Floor

It is recommended that the floor should drain to walls or supporting columns with inlets at these points to sewers which rise vertically from the basement to roof vent. In the floor construction, particular attention should be given to assuring water tight conditions.

When floor drains are installed in refrigerators where milk or milk products are stored, these drains should have a broken connection to the house sewer, as indicated in Figure V, to prevent the back flow of sewage into the refrigerator.

In the case of auxiliary water tanks on roofs they should have tight tops that keep out air borne contamination. Cooling towers should not be directly connected to the potable water supply.

To eliminate Type 5 defect all milk pasteurization plants should be equipped with angle jet drinking fountains designed in accordance with the standard set up by the A. P. H. A.

It is obviously not feasible to eliminate the use of water for cooling purposes in pipes or jackets surrounding milk or milk products. Likewise it would be difficult to assure that these pipes are absolutely leak proof at all times. However, if the potable plant water supply is protected against every possibility of contamination as previously discussed, it would appear that every reasonable precaution has been taken against the contamination of a milk or milk product from this source.

As an additional safeguard and protection in the design of a plumbing system for milk plants, careful consideration should be given to the hydraulic characteristics of water and sewer lines. In both cases loss of head should be reduced to a minimum and the size of pipe determined on the basis of maximum flow requirements. Properly designed sewer and water lines will greatly reduce the danger from excessive back pressure in the former and negative head or vacuum in the latter.

While it is not the function of this discussion to deal with the administrative problem presented by faulty plumbing, in conclusion the following brief suggestions are offered. Plans for new plants must be carefully checked and approved before the construction contract for building or equipment is let, and field checked after installation to assure compliance. The work is very definitely a function of the health department and should be under the supervision of a competent public health engineer. When the existing plumbing inspection department is not under the jurisdiction of the health department, close cooperation is essential. The health department should not delegate the responsibility for assuring safe plumbing in milk plants to any other department for the same reasons that the responsibility for proper milk pasteurizing and cooling equipment is not delegated to another agency.

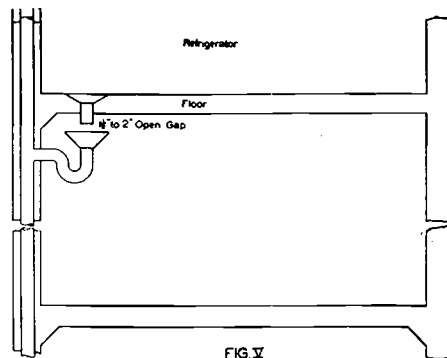


FIG. V

Satisfactory Method of Installing Refrigerator Drain

Observations on Problems Relating to the Paper Milk Bottle*

E. Wheaton, R. H. Lueck and F. W. Tanner

*Laboratories of Bacteriology of the American Can Co.,
Maywood, Ill., and the University of Illinois, Urbana.*

Willingness on the part of those concerned with production and distribution of milk and milk products to accept new ideas has kept this industry on a high plane. Few foods in America are handled under conditions which have been so greatly influenced by science as has milk. While this may be largely due to the inherent character of the product as well as to the fact that it may be an important factor in spread of communicable diseases, economic factors have also had an influence. During the early days of the milk industry practically all milk was sold in the bulk. While bulk or dip milk has not been entirely eliminated, health officers have done much to drive it from the market and to introduce the individual retail container filled and closed in the milk plant. To the present time this container has been made of glass and has many advantages. For obvious reasons, attempts have been made at regular intervals to substitute a one service container and it is with this problem that this symposium is concerned.

Several years ago saw the beginning of a trend in food distribution toward packaging in retail containers. Today, practically all foods are packaged before they reach the hands of the retailer, only a few being packaged by the retailer himself. All of these packages are used once and not returned. Fluid milk is about the only major food product which is distributed in returnable containers. The other dairy products such as cheese, butter and ice cream are distributed in one service cartons. One wonders why the one-trip container for fluid milk was not developed successfully before this.

It has so many advantages in its favor.

No attempt will be made in this discussion to review the history of the one-trip milk bottle. Some eight or ten have been proposed since 1920 and used to various extent under commercial conditions. With one or two exceptions, none have enjoyed wide use, and interest in the earlier ones practically disappeared. However, the recent introduction of new types of such bottles has revived much interest in them. Something over half a million quarts of milk are being distributed in paper milk bottles daily in the metropolitan New York area. This indicates that either something quite new has been introduced, or that the public has assumed a different attitude; we believe the former.

As evidence of the fact that something has been given to the public in the newer type square base single trip container which meets with popular approval, the following features are of interest. The elimination of home and dairy contact, thus preventing the possible transmission of communicable diseases, makes the fibre bottle a welcome addition to the single-trip container field. The ease with which the containers may be stored in the home refrigerator as well as in the dairy and on the delivery wagon, and the marked reduction in weight of handling have proven attractive features. Of importance to the users of this type of container is the compactness with which these bottles may be stacked, thus allowing the milk packages to remain cold longer due to the inability of air to circulate around them.

To the housewife the freedom from paying a deposit at retail stores has further enhanced the value of the fibre con-

* Read before International Association of Milk Sanitarians, October 13, 1937, Louisville, Ky.

tainer. Other features such as the neatness of the package, its easy destructibility after use, the elimination of dripping after pouring are all factors which have helped the new fibre milk bottle reach its present state of popularity.

To the dairies, the opportunity for attractive advertising on the bottle and the elimination of expensive cleaning and sterilizing equipment have proven attractive incentives for the use of the fibre bottle. The fibre container made by the American Can Company has a cap for closure integral with the bottle. The cap is sealed at the place of manufacture under conditions free from organisms. The container once closed remains in that condition until it reaches the filling machine at the dairy, and after filling is immediately sealed again. These operations are all completely mechanical, thus eliminating handling by human hands.

The health of consumers of dairy products has always been carefully guarded by health officers. Practically all of the larger health conservation agencies have divisions which are concerned only with milk. Consequently any new venture in this field is scrutinized closely to determine its effect on human health. However, consumer acceptance on a large scale in the New York Metropolitan district indicates beyond any reasonable doubt that the one-trip container for fluid milk has come to stay just as it has for several decades for other dairy products. The problem now seems to be mainly one of informing those who are interested in such containers about its present bacteriological condition and making it possible for them to examine the containers themselves. Our information today on the bottle under discussion results from several years work in our own laboratories, the laboratories of the Department of Bacteriology at the University of Illinois, and more recently those of the New York Experiment Station at Geneva. At the last mentioned institution the work is being carried out by Dr. J. R. Sanborn under the direction of Dr. R. S. Breed. More recently

Dr. P. S. Tracey and Dr. M. J. Prucha of the University of Illinois have also undertaken work on paper milk bottles.

This short discussion of some problems relating to manufacture and use of one-service milk bottles must indeed be somewhat fragmentary. We shall not attempt to review all of the results which have been secured over some four years of practical research. We shall, however, present some of our conclusions, leaving for other papers in scientific publications presentation of detailed results of experiments. While our work has been done with but one bottle, we believe in general our conclusions will apply to other bottles made in somewhat the same way. The conclusions which we have reached are based on over four years of investigation, during which time thousands of bottles have been rinsed to determine their bacteriological condition.

The paper board base from which the bottle under discussion is made, comes from pure virgin pulp. The base is not, as some believe, made from waste and scrap paper. Not one particle of such material is used. Anyone who is familiar with the methods of making paper will appreciate that few, if any bacteria, could endure the chemical and heat treatment to which it is subjected. The pulp is subjected to treatment with calcium acid sulfite or alkaline sodium sulfite at high temperatures, bleached with chlorine, and then passed to the rolls of the paper making machine. Here it is again subjected to temperatures which markedly reduce its bacterial content and in some cases probably sterilizes it. It is quite probable that in the near future, a sterile paper will be produced. Leaving the paper making machine, the board is rewound and cut for the bottle making machines. The rolls of paper are carefully wrapped and sealed for delivery to the bottle making plant.

At the bottle making machine the paper board is cut into the various parts required for the bottle; these are printed and the seams cemented with thermoplastic resins. The use of this type of cement avoids the use of adhesives that

might themselves be media for bacteria unless preservatives be employed. The bottle is then given its water-proofing treatment which consists of immersing in hot paraffin in such a manner that it is completely coated. It is then drained and cooled to set the paraffin. During this last step it is sealed under essentially sterile conditions and the seal is not broken until the bottle is on the filling machine in the dairy. Upon delivery from the cooling chamber the containers are placed in paper cartons which are tightly sealed thus rendering them dust-proof. In this condition the containers are delivered to the dairies either for immediate use or storage.

The paraffin serves several functions, among which it water-proofs the paper-board, contributes to rigidity of the bottle, improves the appearance, and assists in obtaining a sterile container. At the present time it is the best material to use for these and other reasons. Recent extensive observations have not revealed any alterations in the taste of the milk stored in the paraffined bottles. Every attempt has been made to use highest grade paraffin. At the present time the paraffin is being delivered from the refinery to the bottle making machines in the molten condition. This has made it necessary to secure special stainless steel tanks both for transporting the paraffin and holding it in the plant. The paraffin baths in the bottle making machines operate at a temperature of 82.2° C. (180° F.) to 85° C. (185° F.).

Originally it was felt that the paraffin when applied to the bottles at a high temperature 82.2° C.—87.7° C. (180° F. 190° F.) exerted a thermal-lethal effect on microorganisms thus insuring a sterile container. Subsequent investigations have indicated that this is not entirely true. It has been shown, however, that a marked reduction of bacteria is brought about by the application of this hot paraffin coating. In addition to some thermal-lethal effect, the decrease in bacterial flora brought about by the paraffination process is probably due also to a com-

ination of factors such as smothering, or burying of organisms in the solid paraffin, the lack of nutrient material and of oxygen.

For experimental purposes a laboratory paraffining unit was constructed with which the actual effect of this operation on bacteria in artificially inoculated paper-board was studied. The assembled-unparaffined containers were sprayed with pure cultures of various bacteria after which they were passed through the paraffin bath to be examined later for viable cells. Pure cultures of *Escherichia coli*, *Eberthella typhosa* and *Staphylococcus aureus* were used in cell concentrations greatly in excess of what would be expected under practical operating conditions. For example, the containers in certain of our experiments received 0.5 ml. of an *Escherichia coli* suspension containing 10,975,000 cells per ml. The average bacterial content of containers sprayed with *Staphylococcus aureus* was 55,237 cells per bottle before paraffining. Plates made from the rinse water of unparaffined bottles sprayed with *Escherichia coli* were uncountable. After paraffining, the average number of bacteria in 12 bottles sprayed with suspension *Staphylococcus aureus* was only 59 per bottle; seven of these bottles failed to yield any viable bacteria. After 96 hours of storage, 12 more bottles were rinsed but none showed viable bacteria. Results with *Escherichia coli* were similar. These results are typical of those secured in many experiments. They indicate a marked reduction of bacterial flora during paraffination and death of bacteria in or on the paraffin during storage.

To secure added information on the effect of storage on bacteria in the bottle, bottles were sprayed with concentrations of *Escherichia coli* of varying numbers: 830,000 per ml.; 12,550,000 per ml. and 22,250,000 per ml. Bottles received 0.5 ml. of these suspensions and were then paraffined. Rinse tests were made and the rinse water plated after the bottles had been stored for 96 hours. None of these bottles tested (144) showed pres-

ence of viable *Escherichia coli*. Similar work with *Staphylococcus aureus* showed this organism to be somewhat more resistant. A few bottles yielded viable cells after 96 hours but the number was always low—less than 5. It should be emphasized again that the number of viable bacteria used in these experiments were greatly in excess of those which are found in regular paper-board.

The behavior of microorganisms in the paraffin bath was also studied. Originally it was thought that the paraffin bath during continual operation might become heavily seeded with bacteria which would be taken up by the bottles passed through the bath later. To study this possibility heavily inoculated bottles and uninoculated bottles were passed alternately through the paraffin bath. Over 300 uninoculated bottles were used, none of which showed viable bacteria. This seems to indicate that even though all bacteria are not destroyed in the paraffin bath, they are greatly reduced in number. If by chance some containers harbored an abnormally large number of organisms at the time of passage through the paraffin, the possibility that bacterial free containers might pick up these organisms from the bath is rather remote.

Damaged paraffined containers were also studied because it was believed that such bottles might release viable organisms if they happened to be imbedded in the paraffin. In studying this phase, inoculated unparaffined containers were coated in the regular manner and then chilled. The containers were then damaged in such a manner as to cause the paraffin coating on the inside to become severely cracked. These bottles were then rinsed with sterile water and this cultured for the test organisms. No evidence could be secured to indicate that the bacteriological picture was influenced in any manner by the cracked paraffin.

The bottle with which we have worked is completely assembled in the bottle making plant. It is, therefore, different in this respect from some which are formed and paraffined in the dairy plant.

While the bottles are tightly sealed when they leave the manufacturing machine and packed in heavy paper cartons, experiments were carried out to determine whether they could become contaminated by the air about them in the carton. We sought to determine whether tightly sealed and opened bottles in damaged and undamaged cartons, would take in bacteria as the temperature varied with different storage temperatures. A large number of closed bottles as well as bottles with the closure cap removed were placed in the paper shipping cartons and allowed to stand overnight at 43.3° C. (110° F.). The following morning the cartons were transferred to a cold room in which the air had been sprayed with a test bacterium. Some of the cartons were purposely torn at the time of placing in the cold room. The organism was not found in commercially sealed bottles held in the damaged or undamaged cartons or in the opened bottles retained in the undamaged carton. The only instance where the organism was recovered was in a very small number of the open bottles held in a damaged carton.

During the past few months we have examined in one laboratory alone 4,933 containers to determine how many bacteria are being carried as well as to make observations on the types present. All of the bottles which we have examined are within the limits of bacteriological contamination suggested for the glass bottle i. e., not over one colony per ml. of bottle capacity. In practically all instances they also meet easily the requirements of the Baltimore city regulation of February, 1937, of less than 50 colonies per bottle.

Data from these examinations allow clear-cut conclusions. Fibre milk containers are now being supplied to dairies in a nearly sterile condition as determined by a rinse test method approved by several laboratories. Approximately eighty percent of fibre milk containers now being used yield no viable bacteria. Of the remaining 20 percent that do show colonies on plates made with rinse water,

over 90 percent give fewer than five colonies per bottle, the great majority showing but one colony per bottle. These counts are especially significant when it is realized that the Public Health Ordinance and Code (1935) states that bottles shall be so clean that they shall contribute not more than approximately 1,000 organisms to each quart of milk, or one bacteria or colony per ml. capacity.

The types of bacteria have been carefully observed. *Escherichia coli* has been consistently absent when determined by culturing 5 ml. of rinse water in lactose broth. Lactose fermenting organisms have never been found to be present. Bacterial types that have been found on the plates have been white staphylococci, yellow sarcina, spore-forming and non spore-forming rods. Rarely have molds been isolated. Consideration of the types of organisms that have been isolated, along with the fact that they are present in very few numbers in containers that have any viable microorganisms whatsoever, indicates that real progress has been made toward an ideal package for fluid milk. Further study should even improve the present situation.

Previous mention has been made to the use of the sterile rinse test which is the method described in Standard Methods of Milk Analysis (Sixth Edition p. 58). In our tests we have used the method outlined whereby the bottle is rinsed with 100 ml. of sterile water and two 1 ml. portions are then plated with plain agar. The number of colonies developing on each plate multiplied by 100 equals the estimated number of colonies per bottle.

Modifications of this method have been used whereby the bottle is rinsed with 10 ml. of sterile water and two one ml. and two one-tenth ml. portions have been plated on plain agar. Another technique involved the rinsing of the bottles with 10 ml. of water and the subsequent culturing of the total recoverable amount (9.5 ml.) on three plates. The use of plain broth and skim milk as a rinsing agent has been tried by Dr. Clark at Urbana and somewhat higher counts were secured in the few instances tried.

Fluid agar has been used to rinse the bottles after which the agar is left in the container and incubated in that condition. Considerable difficulty with spreaders was encountered by this method.

Our data indicate that at the present time the best method available and the method which gives the most uniform results is the one whereby the bottle is rinsed with 10 ml. and all the recoverable portion is plated. Perhaps in the near future an even more satisfactory method may be developed. A procedure involving the rinsing with twenty ml. of water and the culturing of 10 ml. of this might prove even better. This would permit the use of a larger amount of rinse water as well as the accurate plating of a designated amount.

It is apparent that the paper milk container as judged by the results presented by various laboratories is a good one for fluid milk. Distribution of milk in it makes it possible for this perishable food product to be merchandized under conditions which contribute much to cleanliness.

NEXT ANNUAL MEETING

The Twenty-seventh Annual Meeting of the International Association of Milk Sanitarians will be held in Cleveland, Ohio, October 19, 20 and 21, 1938, with headquarters at The Allerton.

The Use of Social Security Funds in Training Milk Inspectors*

C. E. Waller

Assistant Surgeon General, U. S. Public Health Service, Washington, D. C.

Mr. President: If you will permit me to do so, I shall depart somewhat from the subject specifically assigned to me in your program. I think I probably can best give you what I believe you wish to hear by outlining in a general way the operation of the public health program under Title VI of the Social Security Act, showing as I go along where milk sanitation and training for milk sanitarians fit into this program.

I think it might be well, also, before I discuss Title VI of the Social Security Act, to preface my remarks by a brief reference to the functions of the Public Health Service.

The oldest function of the Public Health Service is that of providing medical care to certain beneficiaries of the federal government, particularly seamen in the merchant marine, federal employees injured in line of duty, the personnel of the coast guard and veterans.

The Public Health Service had its origin in the first Marine Hospital, established at Norfolk, Virginia, in 1798. A great many people have wondered why the Public Health Service is a bureau in the Treasury Department. There you have the answer. When the first Marine Hospital was established for the benefit of American seamen, and the Marine Hospital Service was created, there were just three departments in the executive branch of the federal government. One of these was the Treasury Department which at that time had charge of everything pertaining to shipping and the merchant marine. Therefore, our service became a bureau in the Treasury Department and has remained there ever since.

Our second oldest function is that of preventing the introduction of disease from abroad into the United States. You are all familiar, no doubt, with our quarantine service maintained at all of the important ports of entry into the United States and with the physical and mental examinations made by the Service of all aliens who desire to be admitted to this country.

The third important function of the Public Health Service is that of preventing the interstate spread of disease. Originally the Domestic Quarantine Division had for its chief function the rendering of assistance to the states in the application of interstate quarantine measures. I think everyone here today realizes how futile it would be to try to prevent the interstate spread of disease through the application of quarantine measures under present conditions; so we discharge our functions in the prevention of the interstate spread of disease in other ways. I need do no more than refer, in passing, to our work on the certification of water supplies used on interstate carriers and the activities we carry on in cooperation with the several state authorities in protecting the consumers of shellfish.

One of the most important functions performed by the Public Health Service in helping to prevent the interstate spread of disease consists in research into the causes and methods of prevention of disease. The results of these researches are handed down to the local and state authorities for application.

The Public Health Service cooperates with the states also by giving special aid in the suppression of epidemics; by giving financial aid, as is now being done under the provisions of Title VI of the

*Read before the 26th Annual Meeting of the International Association of Milk Sanitarians, Louisville, Kentucky, October 11-13, 1937.

Social Security Act; by rendering expert consultation service to the state and local authorities through the state health departments; by conducting surveys of public health administration in states and local communities; and, lastly, by lending officers to aid in the organization of state and local health departments.

I should like particularly, at this point, to make it clear that the Public Health Service has no jurisdiction whatever over local health matters entirely within the states. You probably recall that the Constitution of the United States reserved to the states all powers not specifically delegated by the Constitution to the federal government. Control over local health matters wholly within the states was not among the powers delegated to the federal government by the Constitution. I also wish to emphasize the fact that it is not the aim of the Public Health Service, in carrying out this or any other program, to establish a huge federal machine which will have control over all state and local health work in this country. It is our purpose, on the other hand, to aid the state and local authorities in developing further their own organizations and programs. The last thing we wish to do is to break down the local sense of proprietorship and the sense of responsibility, among the local people, for support, financial and otherwise, of their own institutions.

Title VI of the Social Security Act is divided into three parts. Section 601 of the Act authorizes the Congress to appropriate not to exceed \$8,000,000 a year for grants-in-aid to the states for the purpose of assisting states, counties, health districts and other political subdivisions of the states in establishing and maintaining adequate public health services, including the training of personnel for state and local health work. Section 602 prescribes the procedure to be followed by the Surgeon General of the Public Health Service in allotting the funds to be given to the states for these purposes and in making the payments to the states from the allotments.

The third section, 603, authorizes the Congress to appropriate direct to the Public Health Service, for its own use, the sum of not to exceed \$2,000,000 a year for extending the research activities of the Service, and financing the expense involved in the administration of the grants-in-aid program.

It should be noted that these sections of the Act do not actually appropriate the funds. They merely authorize the Congress to make such appropriations, within the limits prescribed, as it may see fit to make from year to year.

It is conceived to be the aim, among other purposes, of Title VI of the Social Security Act, to stimulate a comprehensive nation-wide program of public health, financially and technically aided by the federal government but supported so far as possible, and administered, by the states and local communities. To this end the funds provided for allotment and payment to the states are available for (a) strengthening state and territorial health departments, or bureaus or divisions of such departments, and providing adequate facilities especially for promotion and guidance of district, county, and city health services; (b), through the state and territorial health departments, strengthening or aiding in the development of district, county, and city health services; (c), the training of personnel employed or to be employed in state and local health organizations.

Work to be done within the states under the Public Health Title of the Act is not performed directly by the Public Health Service but carried out by, and administered under the supervision of, the state and local health authorities under the authority of state and local laws and regulations, in the same manner as the regular activities of such authorities have been performed heretofore. All funds paid to the states become state funds just as if they had been appropriated by the state legislature. All persons employed on the work within the states and local communities are state or local employes, selected, appointed, and paid by the state or local authorities.

Responsibility for allotment of the annual appropriation for grants to the states is placed on the Surgeon General of the Public Health Service. In making the allotments to the states, however, the Surgeon General must take into account three major factors, namely: the relationship of the population of each state to the total population of the United States as a whole; financial need of certain states, or inability of certain states to meet their health problems without financial assistance; and special health problems imposing unusual burdens on certain states.

The second and third factors are applied as differentials. As examples of special health problems there may be cited the prevalence of bubonic plague in the Pacific Coast and Mountain States; the unusual prevalence of endemic typhus fever in Georgia and Alabama; and the large areas to be covered, and the sparse populations, of some of our northwestern and mountain states.

The weighting and application of these factors in the distribution of the funds are left to the discretion of the Surgeon General, subject to the approval of the Secretary of the Treasury. It should be noted particularly that the allotments must be made to the states and that the Public Health Service can not deal directly with local authorities either in the distribution of the funds or in the consideration of plans for the work. It is within the discretion of the state health authorities to ~~make such distribution of the federal allotments as they may consider advisable.~~ Therefore, communities interested in participating in the benefit of federal aid, must present their applications and plans to their respective state health departments.

The entire appropriation for aid to states each year must be allotted at the beginning of the federal fiscal year; however, the fact that an allotment has been made to each state does not mean that each state necessarily receives the full amount of its allotment. The state allotment is in the nature of a drawing account from which the state may receive payments as it presents plans and bud-

gets and meets other conditions with which it must comply before payments can be made.

Once funds have been allotted and paid to a state, they must be expended solely for the establishment and maintenance of health services and in accordance with plans presented by the health authority of such state and approved by the Surgeon General.

In the administration of the appropriation for aid to the states, as I have already pointed out, it is the aim of the Public Health Service not to establish Federal jurisdiction over health work within the states but to aid them in the development and expansion of their own state and local health services under their own laws and regulations, to the end that the public will continue to look to its own state and local health authorities for protection and guidance in local matters affecting the public health.

The selection of activities to be carried on within each state has been left largely to the state health departments. Each state health officer has the privilege of originating such plans as he may consider best for his state. While these plans must be submitted to the Public Health Service for approval before they become effective and before the payment of federal funds may be made, it has been the policy of the Public Health Service to give its approval to any plan that may be considered scientifically sound and ~~which gives promise of an adequate return on the investment.~~

The Public Health Service has particularly refrained from recommending a standard pattern of organization and administrative practice. On the other hand, it has encouraged the adoption of plans adapted to the particular needs of each state and encouraged experimentation with different methods of administrative practice. It is believed this policy will stimulate local initiative in the search for better methods of public health administration as the program moves along and will avoid the freezing of organization and administrative practice in a standard pattern which would not permit readjust-

ment to changing conditions and future concepts of the public health program.

Payments to the states are made quarterly in advance, in accordance with budgets submitted by the state health officers to the Surgeon General and approved by him. At least fifteen days prior to the beginning of each quarter, the state health officer makes a request for the quarterly payment. After the request has been determined to correspond with the approved budgets and the amount of money available, certification for payment is made by the Public Health Service to the Treasury Department. The checks are issued by the Treasury Department and mailed to the state official legally empowered to act as custodian of the funds.

As examples of specific purposes for which federal funds may be used by the state health authorities, the following may be mentioned: (A) State health departments: 1. Addition of technical and administrative personnel (and this includes personnel employed on milk sanitation); 2. The addition of special facilities for the control of syphilis, tuberculosis, cancer, malaria, and other diseases regarded as special health programs; 3. The addition of facilities for promotion of special activities in fields such as industrial hygiene, mental hygiene, public health nursing, milk sanitation, public health education, and nutrition; 4. The addition of public health laboratory facilities (including milk laboratory facilities); 5. Strengthening divisions of public health engineering in the promotion of environmental sanitation, including supervision of water supplies, sewage disposal, sanitary control of milk supplies, and mosquito control; 6. The purchase of serums and vaccines and drugs; 7. The purchase of other supplies and additional equipment.

(B) The programs of local health departments which will be developed or aided through the use of federal funds usually include the following activities: 1. Communicable disease control, including home visits to cases, immunization, and maintenance of diagnostic clinics; 2. Facilities for treatment of venereal dis-

eases; 3. Maternity service, including home visits to expectant mothers, maintenance of maternity clinics, and infant and pre-school health service, including maintenance of clinics for and on care of infants; 4. School hygiene, including inspection and examination of school children and dental health education; 5. Diagnostic laboratory service for communicable diseases; 6. Environmental sanitation, including protection of water supplies, sanitary control of milk supplies, sanitation of food handling establishments, and mosquito control; and 7. Public health education, including home conferences, public lectures, newspaper articles, moving pictures, literature, exhibits and instructions in schools.

The provision of medical care, other than that involved in immunization for prevention of communicable diseases and treatment of venereal diseases to render cases non-infectious, is not contemplated under the provisions of the Act, nor is any provision made for cash benefits to compensate individuals on account of illness or to provide medical services.

With respect to the training of personnel, portions of the allotments to the states have been set aside especially for the training of state and local public health workers. These funds may be used for paying tuition fees for instruction and for subsistence stipends for such personnel while in training. The individuals chosen for special training are selected by the state health authorities. As a rule the selection is limited to persons already employed on health department staffs or to individuals specifically chosen to fill existing or anticipated vacancies.

If any state health officer wishes to use any part of his allotment especially for the training of milk sanitarians, engineers, or any other members of his staff charged specifically with the duty of the protection of milk supplies, it is within his discretion to do so. The Public Health Service will approve budgets which contain items set up for paying living stipends and tuition for training milk sanitation personnel. The state

health officer may select the school where he wishes to send such students.

I wish to add, however, that this whole training program contemplates only post graduate instruction. It is not intended to serve simply as a means by which any individual who may desire assistance in obtaining a professional education may do so at the expense of the federal government. It is to train people who are already in service or prospective employees who have had under-graduate work but who must have additional special training.

To meet the urgent need for trained personnel for new work made possible in the states under the provision of the Social Security Act, it became necessary to consider the establishment of additional facilities for short intensive courses for health officers, nurses, and other personnel, to serve at least until the present emergency has passed. Certain schools to be used as regional training centers for giving short courses were designated by majority vote of the state health officers in the territory to be served. In the selection of these schools, special consideration was given to those already having a nucleus of facilities for public health instruction upon which to build. The additional amount necessary to equip the school to give the desired short courses has been, in each instance, set forth in budget form and included among the budgets of the State in which the school is located. It is highly desirable that public health workers eventually receive at least one year of special training. One year fellowships have been provided in most states for specially selected individuals in key positions.

The short courses, as now constituted, are based on either one semester or two semesters of intramural instruction. It is intended that those who take the initial courses shall return later for completion of the full year's work. It should be especially noted that although the training centers have been selected by the state health officers through the exercise of group choice, no officer is obligated to send his people under training to any

specific training center. He is at liberty to send them wherever he believes the most satisfactory training will be received.

Among the conditions laid down, not by law but by the Public Health Service, under which payments will be made to states, is a requirement that certain portions of the allotment to each state must be matched. A certain part of the allotment may be matched with what are called "old funds." These are funds that were being appropriated prior to January 1, 1935. Another portion must be matched with new funds appropriated since January 1, 1935.

To illustrate what a stimulating effect this matching requirement has had, seven and a half million dollars of new money have been appropriated for health work by the state and local authorities since January 1, 1935. The amount is at least that much, and we believe there is more that we do not know about.

This matching requirement does not necessarily mean that the federal contribution to each budget need be matched. The state must show that it is expending in a lump sum the amount required to match the "lump sum" allotted to the state by the Public Health Service; but after the "lump sum" matching requirement has been satisfied, it is within the discretion of the health officer to set up an individual project in which no matching whatever with local funds would be required, if he should see fit to do so. It is conceivable that a project might be operated entirely with federal funds. Once the matching requirement has been satisfied through the expenditure of state or local funds somewhere within the state, that is all that is required.

Under Section 603 of the Social Security Act, the Public Health Service has been able to effect a considerable expansion of its research activities. We have been able to undertake new work in pathology, pharmacology, chemistry, zoology, cancer research, child hygiene, cooperative studies with institutions and state and local health departments, industrial hygiene, leprosy, malaria, and milk sanitation.

The research projects in milk sanitation are all related to an attempt to reduce the amount of milk-borne disease. The studies relate to: 1. pasteurization and heat treatments, infection, temperature and time requirements; 2. chlorine and chlorine compounds in sterilizing milk containers and equipment; 3. tests of recent pasteurization equipment in order to assure state and city health authorities as to the efficiency of pasteurization equipment; 4. municipal milk control surveys relating to control in American cities; 5. advisory assistance to state health authorities on milk control programs.

To assist the states with their problems of organization and administration in carrying out their public health programs, we have set up five regional offices, in each of which we have a regional medical officer, and a regional nurse. Recently we have combined with that force our district engineering service—and in several of the districts some of

Mr. Frank's milk specialists. The whole program of cooperation with the states on problems of organization and administration is being coordinated and brought into one more or less integrated service. The regional consultants do not act as supervisors. They are there simply as aids. They go into the states only on the request of the state health authorities, or on request of the local authorities through the state health department.

In summary, I may point out that the funds are allotted and paid to the states through the state health departments. The Public Health Service can not deal directly with local communities in considering requests for financial aid or for the training of personnel. It is within the discretion of the state health officer to devote to milk sanitation and to the training of milk sanitation personnel any part of his allotment which he may consider proper in relation to other activities of the state and local health departments.

Nutritional Aspects of Milk*

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A group of milk sanitarians is naturally interested in the production of milk of high quality. A group of nutrition workers also would be interested in the production of milk of high quality. The term "high quality," however, would have a slightly different meaning for each group.

The term "quality milk," at least until rather recently, was applied to milk in the production and inspection of which the following points had been given consideration:

1. Health of the cows.
2. Health of the handlers(?)
3. State of the milk (raw or pasteurized).
4. Composition $\left\{ \begin{array}{l} \text{Fat} \\ \text{Solids not Fat} \end{array} \right.$
5. Keeping power $\left\{ \begin{array}{l} \text{Acidity} \\ \text{Bacteria} \end{array} \right. \left\{ \begin{array}{l} \text{total} \\ \text{harmful} \end{array} \right.$
6. Cleanness—sediment.
7. Flavor—taste and odor.

It will be noted that all the above points can be included under the general heading of "sanitary aspects". At this point the nutrition group raises the question, "What about the food value of the milk; should not another item 'Food value' be added to those comprising the sanitary aspects?" It is with this question that this paper will be particularly concerned because in the light of our newer knowledge of nutrition it is known that the value of milk as a food depends to a considerable degree on how the cows producing that milk were fed and how the milk was handled subsequent to its production.

All of you are familiar with the percentage chemical composition of average market milk: water 87.3, protein 3.5, fat 3.6, lactose 4.9, ash 0.7. In general it is almost impossible to change permanently the chemical composition of milk through feeding. The one notable exception to this concerns the element iodine. The iodine content of milk can be changed readily by varying the cow's intake of this element.

There is in milk another class of substances whose vital importance has within the last ten years been brought to the attention of all, namely the vitamins. All of the six generally recognized vitamins, A, B, C, D, E, and G, are found in milk. Fresh milk is a rather constant source of vitamin B, and E, but varies considerably with respect to its content of the other vitamins.

So little work has been done on the vitamin E content of milk that little can be said other than milk contains it and that 5 percent of butterfat in a diet will allow normal reproduction in an experimental animal.

Milk is but a fair source of vitamin B and all attempts to increase the amount in milk by feeding the cow have been unsuccessful.

Milk is an excellent source of vitamin G but the amount present can be varied by changing the nature of the roughage fed. Young, growing, pasture grass, for example, results in milk somewhat richer in vitamin G than that produced on more mature grasses.

VITAMIN C

Until recently most of the experimental evidence has shown that suitable changes in the cow's feed would result in measurable changes in the concentration of vitamin C in her milk. Workers at the

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Kansas Experiment Station have never agreed with this contention, having failed to find increased antiscorbutic potency in pasture milk over that found in winter milk. Using both the biological assay method and the new titration procedure, Riddell and coworkers at Kansas (1936) compared milk from cows receiving pasture with milk from cows receiving either silage or dry feed alone. The results of these experiments indicated that the rations studied had no significant influence on the vitamin C content of milk. Shortly after this there appeared an article by Rasmussen and coworkers at Penn State (1936) on the effect of breed and stage of lactation on the vitamin C content of cow's milk. This work showed that wide variations existed in the vitamin C content of milk from cows of the same breed and that these differences could be partially accounted for on the basis of stage of lactation. The vitamin C content of milk was found to be relatively high during the early stages of lactation, but decreased to a minimum after about two months, and then increased to a maximum in the later stage of lactation. The milk from Brown Swiss, Holsteins, Ayrshires, Jerseys, and Guernseys was studied. Brown Swiss milk had the highest ascorbic acid value and Holstein milk the lowest. At the American Dairy Science Association meeting last June the Kansas workers again showed that they were unable to increase the vitamin C content of milk when as much as 65 to 85 pounds of green rye were fed. The Vitamin C content of the urine increased fivefold, which is in keeping with a similar observation made at the Ohio Experiment Station when cows were fed large quantities of A. I. V. silage. In view of the most recent work on this question it would seem that milk varies considerably in vitamin C content and that breed and stage of lactation are at least as important as feed in determining the amount of this factor in milk. One important point brought out in this recent work is that fresh milk contains considerably more vitamin C than was credited to it in the early work.

Our problem in connection with this vitamin would seem to be with conserving the vitamin in the milk after it is produced rather than with trying to put more into milk only to have it dissipated by subsequent handling. In this connection it might be mentioned that high-temperature, short-time pasteurization has little, if any, effect on vitamin C, whereas long-time, low-temperature pasteurization may be quite destructive.

VITAMIN D

Indirect evidence that cow's milk is a poor source of vitamin D has long been available. This was based on the observation that infantile rickets was relatively prevalent and that it was more common in bottle-fed than in breast-fed babies. Biological tests for vitamin D in milk confirmed this observation. As was the case with all the other vitamins except vitamin E, studies were made soon after the discovery of vitamin D to determine what effect, if any, was exerted by the cow's feed on the amount of this factor in milk. One of the earliest observations made was that milk produced by cows on pasture contained more vitamin D than milk of cows that were barn-fed but it was not clearly demonstrated to what extent sunlight was responsible for this difference. Just a few months ago Bechdel and Hoppert of Michigan published a paper which contributes much to the fragmentary evidence that was previously available regarding the relative importance of ordinary feed and sunshine in determining the vitamin D potency of milk throughout the year. By assaying monthly milk fats from several sources over a period of two years it was found that milk may vary as much as 900 percent in antirachitic potency. Values ranging from 3.1 to 43.8 U.S.P. units per quart were observed. Highest values were obtained during July, August, or September, and lowest values during February. This variation could be closely correlated with the amount of available sunshine and led the authors to conclude that sunlight is the major factor contributing to the vitamin D content of milk.

Unequivocal verification of this contention just recently came from England.

The conclusion just cited applies to ordinary feeding operations when the usual roughages like hay, pasture, and silage are fed, but leaves unanswered the academic question as to whether or not the vitamin D content of milk can be increased by feeding.

As early as 1924 Lesne and Vagliano had succeeded in increasing the vitamin D content of milk by feeding cod-liver oil to cows. This was later confirmed by several groups of investigators who found at the same time that too much cod-liver oil depressed the fat percentage of the milk. Wachdel, in Germany, was the first to show that the vitamin D content of milk could be materially increased by feeding the cows irradiated yeast. Since then, other vitamin D concentrates have been fed, such as irradiated ergosterol and a concentrate (Vitex) prepared from cod-liver oil. Very recently it has been shown that by feeding two pounds daily of cacao shells the vitamin D content of winter milk could be brought up to that of summer milk. Of these methods, the feeding of irradiated yeast has been shown to be most economical. In addition to proving that vitamin D could be fed into milk, such a large amount of D needed to be fed before much change in the milk could be effected, that under ordinary feeding conditions sunshine is seen to be the principal factor in causing seasonal variations in the vitamin D content of milk.

In view of the available evidence, then, we can expect market milk to vary in vitamin D content throughout the season and to be a poor source of vitamin D even during the summer months. Owing to the efforts that have been made within recent years to point out the desirability, from a public health standpoint, of enriching milk with vitamin D to the extent that it becomes an anti-rachitic agent, it is well to be informed as to the status of this question from time to time. The use of sun-cured legume hay during the winter and turning the

cows out-of-doors as much as possible during the effective sunshine season will help to keep up the vitamin D content of milk, but for the production through feeding of what is now classified as "vitamin D" milk, irradiated yeast must be resorted to.

Milk is also being enriched with vitamin D by the direct addition of vitamin D concentrates and by irradiation with ultra-violet light. A discussion of this nutritional aspect of milk might well occupy the full time allotted to this paper. Suffice it to say at this time that in the opinion of nutrition workers, it is desirable to fortify milk with vitamin D and to point out that as far as the Council on Foods of the American Medical Association is concerned, approval of the fortification of foods with vitamin D will be restricted to milk.

This group is interested also in control measures. The newest control measure concerns the checking of commercial vitamin D milks. Our laboratories at the Ohio Experiment Station have for more than two years assayed periodically surprise samples of commercial vitamin D milks produced in the state of Ohio. The results have been gratifying. In very few instances have we found samples to be below standard, and on rechecking these have met the requirements. This new development in the production of milk with enhanced food value is progressing under what seems to be satisfactory control.

VITAMIN A

In speaking of the vitamin A potency of milk we are referring to the response obtained with rats in a properly conducted biological assay. In the case of milk, this response is due to two biologically active substances: (1) the precursor of vitamin A—carotene, or, more popularly, the colored form of vitamin A, and (2) true vitamin A, or the colorless form of vitamin A. This is important because the fat of milk, which is the biologically active fraction of milk, contains both the colored and colorless forms of

vitamin A, the amount of each present depending upon the feed and the breed of the cow. Thus, a deeply colored Guernsey butterfat does not necessarily contain more vitamin A activity than a less deeply colored fat from Holsteins if both breeds were fed alike because Guernseys secrete proportionately more of the colored form of vitamin A into their milk, whereas Holsteins secrete more of the colorless form. Both fats may have the same biological activity. Within the same breed, however, color of the fat is a rough index of its vitamin A activity.

It must be explained that in plants vitamin A exists in the colored form as carotene which is a yellow pigment. The depth of yellow color in butterfat depends, therefore, upon the amount of this yellow pigment consumed by the cow and upon the extent to which she transfers carotene into the colorless form. The vitamin A response obtained from plants can be accounted for on the basis of the amount of carotene present. Since carotene can be determined chemically, there is thus afforded a means of determining the vitamin A potency of plants by a chemical method. The significance of this lies in the fact that the effect of any particular feed on the vitamin A and yellow color of milk can be predicted with reasonable accuracy on the basis of a chemical determination.

All research work on the problem has shown that as the vitamin A intake of the cow increases, the vitamin A content of her milk increases up to a certain maximum. So uniformly consistent have been the results in this field that it seems unnecessary to review the early literature. This early work soon showed that milk varied considerably in vitamin A potency, the most striking change being observed to occur when the cows were placed on or removed from pasture. Recent work in this field has been concerned primarily with developing systems of handling crops that will make available for winter feeding material which will at least prevent the large drop in vitamin A potency that occurs after the pasture season ends.

To refer to each of the researches of very recent years would consume considerable time so we will concern ourselves with a summary of the results with natural crops and then spend a little time on special treatments. Green crops, such as grass, alfalfa, clover, and soybeans, have been found to be outstanding sources of carotene, the consumption of which by cows results in milk rich in yellow color and high in vitamin A potency. The great loss of carotene which has been shown to occur in the methods usually used in preparing crops for winter feeding has led to a search for methods of conserving carotene. Grass silage and artificially dried hay have given striking results in this respect. More recently attention has been directed to the ensiling of leafy crops like soybeans, alfalfa, and alfalfa-clover mixtures. By adding molasses or mineral acids to crops such as these when they are put into the silo, carotene is preserved to a high degree and it is possible by feeding these silages during the winter months to maintain the yellow color of milk at a high level.

There are several reasons for being concerned about preserving the carotene normally present in green crops. In the first place it has been shown that cows have a high requirement for vitamin A and that when an excess of the body requirements is not fed this is reflected in a lowering of the vitamin A content of the milk. This occurs during the winter when the vitamin A intake, due to the feeding of dry roughage, is materially reduced. In the second place, young calves have a high requirement for vitamin A and it has been shown that disease and mortality in young calves increase when their dams are fed roughage low in carotene. Thirdly, the vitamin A intake of humans decreases during the winter months due to a decrease in the supply of fresh vegetables and due to the drop in the vitamin A content of milk. A fourth reason involves milk sales. Every milk dealer has complaints during the winter because of lack of color in the milk. Should it be possible to prevent

this, milk sales might be maintained and even stimulated.

It is hoped that by this time you have become more familiar with the newer concept of "quality milk" which combines the sanitarian's and the nutritionist's viewpoints. As sanitarians, can you accept this broader concept of quality milk, and if so, can you incorporate it in your guardianship of the nation's most vital food? When it is realized that a cow may be free from contagious disease

and still produce, because of poor feeding and management, milk of lower nutritive value, I think you can. By encouraging whenever possible the adoption of feeding programs of proved value, and by keeping abreast of developments in handling and processing milk after it is produced so as to preserve or enhance its nutritive value, you will be having a part in the production of not only a pathologically safe milk but a nutritionally sound milk.

Abstract of Third Annual Report of the Committee on Milk Control of the Canadian Public Health Association.— *Canadian Public Health Journal*, September, 1937.

Milk-borne epidemics in Canada between 1906 and 1935 are listed. Typhoid fever was responsible for 6,612 out of 7,935 cases and for 681 of 688 deaths. The Montreal epidemic of 1927 was responsible for the bulk of these.

A survey of the extent of pasteurization in cities of over 20,000 population is reported. Information concerning the percentage of cows tested for tuberculosis and contagious abortion is included in the table. A further table shows the approximate number of dairy cows in each province and an estimate of the percentage tested for these two diseases.

Licensing of milk distributors under the new regulations in Ontario is dependent upon a favorable report by the Provincial Department as to the type of plant and equipment, method of processing and qualifications of the operator.

Studies of the present standard methods for laboratory examination of milk and of the phosphatase test have been carried on under the direction of the Committee in three laboratories.

C. K. JOHNS.

The Accuracy of the Direct Microscopic (Breed) Count of Bacteria and Leucocytes.— *N. J. Strynadka and H. R. Thornton. J. Dairy Science*. 20, 685-692 (1937).

With a view to determining the accuracy of the Breed count for milks containing few bacteria, counts were compared on from 60 to 2,000 fields per smear of aseptically drawn samples of middle-milk. Replicate smears were also prepared from 8 samples. The authors concluded that counts on 60 fields were seldom reasonably representative of the sample even when the bacterial content was rather high for such milks. The examination of even 1,000 fields sometimes gave misleading results. Consequently, as milk improvement is effected the usefulness of this test decreases unless more fields are examined than seems possible in routine work. The number of fields examined should always be indicated in reporting Breed counts unless the bacterial content is high.

When applied to the determination of leucocyte content, the Breed method showed reasonable accuracy. Differences observed between replicate 60 field counts were attributed to uneven distribution of cells in the smear.

C. K. JOHNS.

Report of Committee on Methods of Improving Milk Supplies in Small Communities*

Leslie C. Frank, *Chairman*

Last year's report of this committee brought out the following facts:

(1) That *local* milk control is carried out by only one in five municipalities in the 1,000 to 10,000 population group. There are approximately 5,500 such municipalities, and only 852 of the 5,500 communities in this population group were reported as having milk ordinances. This figure included milk ordinances of all kinds, good and bad, complete and fragmentary.

(2) That on the average the state milk control staffs are not adequate to cope with the problem of milk control in all small communities in the state, would in fact have to be increased four or five-fold before state control could possibly be adequate.

(3) That an average of only 38.6 percent of the milk sold in communities of the 1,000 to 10,000 population group is pasteurized.

It has further developed from the studies of the Public Health Service, as

indicated in Table 1, that 66 percent of all milk-borne outbreaks of disease which were reported to the Public Health Service during the past decade took place in communities of less than 10,000 population.

The inevitable conclusion from these facts is that we cannot possibly hope to reduce materially the annual toll of milk-borne outbreaks in the United States until we have solved the very important problem of how to introduce adequate milk control in urban communities of less than 10,000 population.

It may be worthwhile, therefore, to inquire more closely into the reasons why milk control is so conspicuously lacking in this lower population bracket. Among the reasons may be cited the following:

(a) Smaller communities are much less likely to have full-time city or town health departments than are the larger communities and therefore much less likely to be provided with an adequate milk control staff. A number of

TABLE I
Number of Outbreaks by Population Groups

Year	Under 1,000	1,000 to 10,000	Over 10,000	All Population Groups
1927	5	20	11	36
1928	12	22	12	46
1929	5	18	28	51
1930	8	22	18	48
1931	1	20	13	34
1932	9	14	10	33
1933	13	15	14	42
1934	7	22	13	42
1935	17	16	11	44
1936	16	17	14	47
Total Outbreaks	93	186	144	423
Percent	22	44	34	

*Presented before the 26th Annual Meeting of the International Association of Milk Sanitarians, Louisville, Kentucky, October 11-13, 1937.

the smaller communities which have no health departments do nevertheless employ milk inspectors, but they constitute so small a percentage of the total communities that this fact need not be seriously considered in a general analysis of the problem. The important thing is that milk control has tended to come into being very little faster than the establishment of full-time local health departments.

(b) The county or district health departments have only recently begun to recognize that milk control should form an essential part of their general public health programs. Such "area" health departments have been increasing in number rapidly during the past decade. Many of the towns in a state are too small to afford a full-time health department and the area of most states is too large to permit an efficient centralized state control of all of the minutia of public health (even if it were possible to secure the enormously augmented state appropriations which would be required). Therefore the conviction is rapidly growing that there must be established some intermediate area of public health organization which can be held responsible for the details of public health work within such area.

The area plan of milk control has been progressing rapidly during the past decade. However, while exact figures are lacking general observation supports the statement that except in certain areas in the south and other limited portions of the United States, where the development of the United States Public Health Service Milk Ordinance and the development of county health departments have proceeded simultaneously, such local "area" health departments have in general not tended to include milk control as part of their milk control programs.

(c) Few state health departments have as yet an adequate and sufficiently trained staff of milk sanitarians charged with the task of promoting adequate milk control by the city, county, and district health departments of the state. Therefore, the necessity for a sound milk

sanitation program has not as yet been adequately brought home to many of these local health departments.

(d) In many sections the county or district health departments are not empowered to pass milk ordinances for the entire area and must therefore resort to the adoption of a local milk ordinance in each individual town in the area. This naturally retards progress. Furthermore even the expense of publication of a complete milk ordinance seems prohibitive to many of these small communities and deters them from adopting a milk ordinance.

(e) Many of the county or district health departments would have to increase their personnel in order to add effective milk control to their present public health program. Appropriations for such increased personnel are often not available.

(f) There is a real shortage of adequately trained local milk inspectors. In order to undertake milk control it is frequently necessary for local public health authorities to employ a relatively untrained man and then hope to secure training for him from some source. Here again the need for adequately trained personnel in the state health department comes into play. Until all state health departments are in position to give such training to local health personnel quickly and effectively many county and district health authorities will be reluctant to undertake a milk program.

(g) The Committee believes that in some states retardation of active local public health control has been the result of a divided state authority in matters of milk control. The Committee considers that the division of authority between the state health department and some other state department is unwise and that the public health control of milk supplies should be vested exclusively in one department.

The reasons why so large a percentage of small communities do not now enjoy milk control may therefore be summed up approximately as follows:

(1) The individual communities themselves are too small to afford independent full-time health departments.

(2) The county or district health departments, which are intended to provide public health work for such local communities, have not awakened to the need, or are not authorized to pass legislation and must therefore resort to the cumbersome and expensive procedure of having the ordinance passed in each small community within the area. Often they have insufficient funds, or cannot easily secure adequately trained milk inspectors.

(3) Many state health departments are not empowered to undertake direct state control and have not undertaken a program to promote the establishment of adequate control on a county or district basis.

The remedy for this situation is not simple, but your Committee believes the following points should be stressed:

(1) All states which have not already done so should attempt to secure the passage of state legislation which will either

(a) empower the state milk sanitation authority to pass state regulations on milk sanitation which will be enforceable by county or district health departments, or

(b) empower county or district boards of health to pass milk sanitation regulations.

In either case the county or district boards of health should be authorized to enforce the regulations in all communities in the area except those which prefer to exercise their own direct control and which demonstrate within a reasonable period of time, to the satisfaction of the state, that they are able to exercise effective milk control.

(2) All state milk sanitation authorities, unless they are prepared to undertake direct and complete milk control in

all small communities which do not undertake effective control for themselves, should set up an adequate milk sanitation staff empowered to carry out the following duties:

(a) Promote the approval and enforcement of the state milk regulations by the county or district health departments, or, in the absence of such regulations, promote the adoption of adequate, uniform local milk regulations by the county or district health departments, or by the individual towns;

(b) Help secure and train local inspectors for the municipal, county, or district health departments;

(c) Make periodic investigations of the enforcement of the milk regulations in each municipal, county or district milkshed;

(d) Assist the local departments in solving special technical problems for which expert technical assistance is needed.

(3) All state health departments should make maximum use of the privileges offered by the Social Security Act in promoting the establishment of adequate local budgets for milk control.

(4) To supplement item (2) (b) all state milk sanitation authorities should promote the establishment of milk sanitation seminars or training courses at which local inspectors will be able to secure intensive training in the details of milk sanitation.

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Report of Committee on Dairy Farm Methods

F. D. Holford, *Chairman*

Presented at 26th Annual Meeting of the International Association of Milk Sanitarians, Louisville, Kentucky, October 11-13, 1937

In a report submitted by the Committee on Dairy Farm Methods for the year 1936, the general fundamentals essential for the production of a safe, clean milk were discussed. However, this year we will elaborate on a few topics which we feel are of extreme value, namely, "The Sediment in Milk," "Mastitis in Dairy Cows" and "The Sterilization of Dairy Utensils on the Farms."

SEDIMENT

Formerly, sediments were taken from a pint of milk out of a forty-quart can which had been thoroughly agitated. The next step was to take sediments from the last three or four quarts in the bottom of the can at the time of dumping. At the present time, the suction type sediment tester has been developed which removes the sediment from the bottom of the can before contents are emptied. In many cases apparently clean milk as indicated by the earlier methods of sampling might today show considerable sediment. Although the solution of this problem is primarily one that rests entirely with the dairymen, dairy control officials must recognize that they can and should cooperate with and advise the producers on methods which, from experience, appear to be the best procedure of preventing dirt from getting into milk.

Sediment comes from different sources but experience proves that most of it comes from the udder of the cow. Foreign matter gets on the udder while the cow is lying on a soiled bed located either within or outside of the stable; also, by the cow walking through dirty barnyards or swampy land. Hair on the udders and flanks should be kept short at all times even though this may necessitate more than one clipping during the year. Washing of the udders and flanks before milking may be a requisite procedure on many farms. When cows are allowed to walk through muddy barnyards or

swampy land, they bring into the stable a certain amount of dirt on their legs and feet which dries and drops on the cow beds. Cow beds should be kept clean. Whenever possible, clean bedding free from dust should be used.

No doubt some sediment finds its way into milk cans after they have been washed at the factory. Cans should not be allowed to sit along dusty roads or in a dirty atmosphere. Sediment will also work its way into an empty can even though covered. The change of temperature inside of a closed can will vary with the change in atmospheric temperature. As the volume of air within the can changes, due to temperature, there is a certain amount of air going in or out of the can. If there is a decrease in volume of air in the closed can it will bring about more or less suction. As the air in the can decreases in volume, one can readily see that the quality of air surrounding the can would have a bearing on the amount of sediment within the can. For this reason it is necessary to store cans in as clean an atmosphere as possible.

Milk cans should not be transported in dirty trucks. Whether full or empty they should be properly covered with canvas. It is a poor practice for truck drivers to walk over the top of milk cans. In the summer time with more dust prevalent, it is a good practice to cover milk cans with wet blankets under the canvas covering. This will not only help to keep out dust and dirt but will also help to keep the milk cool while in transit. An insulated truck is an ideal way to transport milk from dairy to plant.

It is true that morning's milk contains more sediment than the night's milk. No doubt this is due to the fact that cows are not cleaned in the morning before milking and, in some instances, to neglect on the part of the dairyman while rushing to get the milk to the factory on time.

Acceptable filter cloths or cotton discs should be used in strainers. Filter pads should be changed often during the process of milking and used only once. It is advisable not to use one strainer pad for more than three cans. Fine sediment will work through the best filter pads. There has been much discussion on the quality of filter cloths. A cloth with an abundant nap gives the greatest efficiency. From a dairyman's standpoint the problem should not be one of straining but one where extra effort must be applied to keep all foreign matter out of milk during production and handling. What the public must have is clean milk not "cleaned milk." True, the use of some means of removing the foreign matter from milk as soon as possible has distinct merit.

Finely woven cloths with a heavy nap have a tendency to retard the straining. It is well to call attention to the necessity of allowing the milk to filter normally through the pad. Shaking or bumping the strainer may cause holes in the pad. (This refers particularly to cotton pads.) Straining of milk on the farm should always be accomplished by the use of some type of single-service straining pad, as this will eliminate the questionable washing of strainer material. In some cases

where a metal disc strainer is used, it is advisable to dampen the disc with clean water and then place it on top pad in the box, which will enable the proper placing and centering of pad in the strainer—a very important operation.

It may be impractical to secure milk entirely free from sediment, but with proper methods employed at the source of production it can be reduced to a minimum.

MASTITIS

Mastitis has been called the worst enemy of the dairy industry. It goes without saying that the first and most important factor in the production of clean, safe milk is the health of the animals producing the milk. As a disease problem, mastitis has been given particular attention due to its frequent relationship between disease and human infection as observed in septic sore throat and also because it is one of the greatest problems of the dairyman where both usefulness of the animals and the amount and quality of milk is involved. Its esthetic aspect suggests that the milk from infected udders should not be used for human consumption. It has been shown by different investigators that the comparison of normal milk with mastitis milk is as follows:

Properties	Changes in Mastitis Milk	
	Increase	Decrease
Water	X	---
Fat	---	X
Solids not fat	---	X
Casein	---	X
Albumin Globulin	X	---
Milk Sugar	---	X
Lecithin as per cent of fat	X	---
Ash	---	X
Chlorides	X	---
Sodium as Na ₂ O	X	---
Calcium as CaO	---	X
Potassium as K ₂ O	X	X
Titrateable Acidity	---	X
Acidity (pH)	Above 6.9	Below 6.4
Rennet Coagulation (Time)	X	---
Catalase	X	---
Body Cells	X	---
Bacteria	X	---
Pathogenic Streptococci	X	---
Viscosity	---	X
Cream Layer	---	X
Quantity	---	X

Milk from cows suffering with mastitis will frequently have a distinctly altered physical appearance. Milk having either a flaky, stringy or watery appearance, a dark or abnormal color, or a distinct salty taste, should be excluded from use.

The tests commonly used for the detection of mastitis may be classified in two groups—field tests and laboratory tests. From the standpoint of this report, we are most interested in field or barn tests. Qualified veterinarians can be of much assistance in educating the dairymen as to precautions to be taken in the preservation of the health of their herds. The strip cup test for mastitis is one wherein the first few streams of fore-milk are passed through either a fine wire mesh or a dark strainer cloth into a separate vessel. This test can be applied by any dairyman and will detect probably 25 percent of the mastitis cases, especially those having discolored or flaky milk. The bromthymol blue test is an alkalinity test and can be used by any careful dairyman who has been properly instructed as to the reading of the reactions. The milk from normal cows in the first and last stages of lactation might give a slight reaction to this test. It is possible by the aid of the microscope to check cows in the first stages of mastitis and, in some cases, before any physical symptoms appear. However, the microscope may fail to reveal long chains of streptococci in milk from a cow with advanced stages of the disease. In most of these cases the physical examination by an experienced veterinarian leaves no doubt as to the actual condition.

A simple method for detecting mastitis and streptococci in milk is put out by the United States Department of Agriculture—Circular No. 400, August, 1936, by R. P. Hotis—and is known as the Hotis test. The method consists in adding 0.5 cc. of sterile 0.5 per cent aqueous solution of brom-cresol-purple to 9.5 cc. of milk carefully collected directly from the animal. After the sample is mixed it is incubated for 24 hours at 37.5° C. and

the results are observed. The characteristic change in the color of the sample after incubation, together with the occurrence of flakes or balls of growth, indicates the presence of *S. agalactiae*. Examination of 753 samples of milk by the Hotis test and the blood agar method shows the two tests to be in perfect agreement for 715, or 95 percent, of the samples. This figure may be considered an accurate measure of the accuracy of the Hotis test if the results indicated by the blood agar plate are assumed to be 100 percent.

Early recognition of mastitis is necessary both for treatment and prevention. Badly infected cows should be immediately segregated and their milk kept from the supply. Cows in infected herds should be stanchioned according to their classifications and milked accordingly.

Strip cups should be used before milking each cow. Hands of milkers should be clean and dry during the milking process. When the milker comes in contact with a case of mastitis, his hands should be thoroughly washed and disinfected before handling the next cow. The veterinarian making physical examinations of dairy herds should follow the same procedure. Cow beds should be clean, dry, and when bedding is used, great care should be exercised as to the quality. Lime or superphosphate should be used daily on the walks behind the cows. All stalls where cows with mastitis have been stabled should be thoroughly cleaned and disinfected before another cow is allowed the privilege of the stall.

In the construction of stables, the cow stalls should be of sufficient size so that the cows can lie as well as stand in complete comfort. Partitions should be placed between the cows so as to prevent injury to udders and teats. Infection takes place more readily after milking process and it is good practice to dip the teats in a non-irritant disinfecting solution after milking. All additions to herds should be examined by a qualified veterinarian before entering the herd. Injury may result in an infection.

Large producers are more susceptible to mastitis infection. Dirty milking machine tubes and teat dilators also pave the way for this disease. Clean milking machines and proper adjustment should be stressed in the prevention of mastitis. Careless milkers are also factors. Improper drying off is a common causative factor. Mastitis in first-calf heifers may be due to their being sucked while quartered with other calves. This may cause enough secretion to bring about a marked development in the udder, and then when the calves are separated the milk contained in the udders may become infected. Rough handling of the teats such as pressing against them with the knuckles when milking may bring on infection.

With regard to mastitis, it is the opinion of the members of this Committee that the following problems should be solved:

- 1 How much public health significance has mastitis?
- 2 Has the hemolytic streptococcus (epidemicus type) in raw milk before pasteurization as much significance as typhoid organisms, tubercular organisms and other pathogens?
- 3 Should all cases of mastitis be considered a potential danger until the specific organisms causing the infection have been differentiated?
- 4 Does the abnormal milk produced by mastitis cows and included in a pasteurized supply affect its quality?
- 5 Should prevention be considered our first line of defense in the production of safe milk?
- 6 Should pasteurization be accepted as our second line of defense?
- 7 Is it safe to place all our confidence in the pasteurizing process?
- 8 Due to the magnitude of the problem, are the dairy industry and public health officials reluctant to acknowledge its importance?

STERILIZATION OF UTENSILS ON DAIRY FARMS

It is needless to discuss in a general way the sterilization of dairy utensils on the farm. However, we are anxious to

bring a few of the more important features to your attention. Milk utensils should be cleaned at the point where the water is heated. We all realize how difficult a problem it is properly to clean and sterilize dairy equipment without the aid of hot water. Within the last few years chlorine sterilization has come into use by leaps and bounds; however, the importance of having clean surfaces where chlorine is used has been efficiently demonstrated.

In the sterilization of a milking machine with chlorine it has been shown that it is more efficient to have a solution of chlorine constantly dripping through the tubing rather than place the tubing in the solution without circulating in the tubes. With chlorine sterilization it is very important that some means be used to determine the strength of the solution.

Starch iodine papers have been used successfully as a quick index to the chlorine strength. It is necessary to take into consideration the human element, and without some adequate means of check-up, such as routine quality examinations of the milk, or farm inspections at cleaning time, requirements pertaining to this item are useless.

There is much work yet to be done on all three subjects mentioned in this report. However, the Committee feels that in discussing the important problems connected with sediment, mastitis, and sterilization, it may be the means of stressing the importance of further investigations along these lines.

F. D. HOLFORD, *Chairman*

C. I. CORBIN

G. W. GRIM

C. K. JOHNS

ERNEST KELLY

J. M. LESCURE

RUSSELL PALMER

J. J. REGAN

Report of Committee On Dairy and Milk Plant Equipment*

Walter D. Tiedeman, *Chairman*

Again your committee intends to discuss trends or recent developments in milk plant equipment. We have not had the advantage of examining new models of equipment at the Dairy Industries Exposition because it follows our meeting this year instead of preceding it so we must draw on our experience in the field for material.

Many of us have felt that the great strides in the development of pasteurizing equipment during the past ten years have almost brought us to the point where we could say to the manufacturers, "Well done."

However, recent use of the phosphatase test for pasteurization indicates that although occasionally we have been criticized for being too stringent or at least too "fussy" in some of our requirements on pasteurizing equipment, this is not the case for we may have erred by being too lenient, at least in permitting the continued use of old equipment that did not quite meet new specifications. For example, we required that the leak protector grooves on outlet valves of pasteurizers mate for *every* closed position of the valve. By use of the phosphatase test on pasteurized milk we found a case in which dangerously undertreated milk was leaking past an outlet valve having grooves which did not quite mate in a partly closed position of the valve. It was only natural for the operator to keep the valve handle in the closed position which experience showed gave the least leakage onto the floor.

The frequency of the occurrence of chart pushing, particularly by inexperienced or relief operators to save time but resulting in undertreatment of the milk, leads us to the conclusion that it is ad-

visable to require a chart piercing pin on the driving hub of recording thermometers. Most new recording thermometers are so equipped. Some of the older instruments can be readily and cheaply converted by substituting a hub with a pin in it for the old hub. Others can be changed by soldering to the hub an annular ring containing a pin. It is also advisable to require that the hub be driven by a geared mechanism or other provision made to prevent turning the chart hub by hand.

A further revelation of the phosphatase test relating to equipment is a case in which undertreatment of the milk resulted from an operator forgetting to close the outlet valve on a batch pasteurizer before he introduced the raw milk. This was an accident that happened to a man we considered a good operator and it may happen to many. Of course he closed the valve as soon as he discovered his error but did not attempt to recover for treatment the raw milk that had passed the outlet valve. Test results indicated that the outlet line must have been full of raw milk to the pump. We are not prepared to make a definite recommendation but the indications are that the use of some automatic device is desirable to insure the closing of outlet valves on holders before the introduction of unpasteurized milk.

Along with this, we must again point out the desirability of a recording thermometer record that will show actual holding time of every particle of milk. Several years ago Barron¹ described the development of a milk pressure recording element on a recording thermometer chart which indicates that the practical commercial development of an instrument showing such holding time may not be far off.

*Presented at the 26th Annual Meeting of the International Association of Milk Sanitarians, Louisville, Kentucky, October 11-13, 1937.

In order to meet provisions of the revised Public Health Service milk ordinance, some manufacturers have developed flow diversion valves for use on certain continuous flow pasteurizers. These valves are designed to replace the simple pump stop and to return any underheated milk to be reheated.

Another need in this field, particularly for high temperature-short time pasteurizers, is a pump that will continuously deliver a constant volume of milk. Pumps now used gradually drop off in capacity. While this increases rather than decreases the holding time, it soon reaches the point where it affects creaming. This calls for variable speed drive which must be sealed by the inspector if there is to be any assurance that holding time will be maintained.

Notwithstanding these indications that our pasteurizing equipment has not as yet reached 100 percent efficiency, there is a present need for focusing attention upon the important problem of protecting the milk after pasteurization. Are we handling this milk in properly covered, sterilized equipment and placing it in properly washed and sterilized containers? This brings up a host of equipment problems of which we shall single out a few of the more important.

An outstanding problem is that of securing clean and sterile cans. Although the condition of the can is especially important when pasteurized milk is sold in bulk, the much bigger problem in proportion to use is the condition of the cans returned to farmers. Sterilization for these raw milk cans is not so directly important from the standpoint of public health but is all important in maintaining quality of the milk. Present equipment gives us no record of whether sterilization has been properly carried out. Further study and development along this line is necessary before any recommendations can be made.

There appears to be fairly good agreement by both health officials and milk plant field men that cans with open seams cannot be properly washed and

sterilized. A low priced seamless can is much to be desired. Such cans are now on the market but some have caused difficulty similar to that resulting from open seams. It appears that the metal is trimmed to a feather edge before welding and there is a tendency for this thin edge to curl slightly along the welds.

The problem of bottle washing is of even more direct importance. Many bottle washers are so designed that with reasonable care in maintenance and operation, bottles can be properly washed and sterilized. However, rinse tests made on bottles ready for filling at large numbers of plants have shown that many of these have not been properly washed and sterilized. Investigations have shown this to be due to many causes, including failure to maintain hot water sterilizing solutions at required temperatures. A record of sterilization of bottles similar to the record of pasteurization of the milk is desirable. It is possible to record the temperature of the hot water sterilizing solution when this type of sterilization is used but this gives no assurance that all the jets have regularly discharged into the bottles sufficient quantities of hot water to accomplish sterilization.

Furthermore, there is a question in the minds of some health officials as to whether this problem is serious enough to warrant limiting sterilization of bottles to the use of hot water particularly if satisfactory equipment is not available for use of the small dealer.

When we eliminate the bottle washer by turning to single service paper containers, we encounter new problems. Inasmuch as this subject is on the program for discussion, we shall not go into detail. It may be sufficient to suggest that we study the conclusions reached and the recommendations made by the committee which is now studying paper containers in cooperation with the industry.

Along with the glass milk bottle we have the problem of the use of caps covering the pouring lip. Most dealers are voluntarily using good types of lip covering caps on premium grades of milk

claiming added health protection. If this is so, it is even more important to cover the pouring lip on the more generally used non-premium bearing grades. The total difference in cost per year between lip covering caps and plug caps on all milk sold in most large cities will dwarf the total expenditure for milk inspection service. In an effort to reduce this differential, cheaper lip covering caps have been developed. Some of these are so easily knocked off that they are impractical. One of the latest moves is the use of an aluminum foil lip-covering cap on a small neck milk bottle. This necessitates the use of soaker type washers which leaves the small dealer without a similarly inexpensive cap. In the fairly limited trial of these caps, they appear to have merit although there have been both favorable and unfavorable consumer reactions.

General developments of the year include power bottle fillers and cappers with capacity of 18 bottles per minute

for the small dairyman; further development and improvement of plate heat exchange equipment with stainless steel heat exchange surfaces; and much needed further improvement and refinement of can washing equipment.

Your committee confidently expects continued improvement in milk plant equipment generally and directs special attention to the need for further improvement in equipment designed for holding or handling milk after pasteurization.

WALTER D. TIEDEMAN, *Chairman*
 LOOMIS BURRELL
 W. D. DOTERRER
 V. M. EHLERS
 LESLIE C. FRANK
 GILBERT H. HOOD, JR.
 RALPH E. IRWIN
 GEORGE W. PUTNAM

REFERENCE

- ¹J. L. Barion and G. W. Molyneux, 1934, 8th Annual Report N. Y. State Assn. Dairy and Milk Insp., p. 99.

NEXT ANNUAL MEETING

The Twenty-seventh Annual Meeting of the International Association of Milk Sanitarians will be held in Cleveland, Ohio, October 19, 20 and 21, 1938, with headquarters at The Allerton.

Determination of Ascorbic Acid (Vitamin C) in Milk¹

O. F. Garrett

New Jersey Agricultural Experiment Station, New Brunswick, N. J.

Recent interest in the amount of ascorbic acid (vitamin C) in milk because it is a vitamin and because of its relation to good flavor in milk has created a demand for a rapid routine laboratory method for its determination. The author has used the method about to be described with much success. It is a slight modification of the method proposed by Guthrie¹ and Sharp at Cornell University.

This paper is not a report of research but is intended to give a practical and usable method for the convenience of technicians in dairy and commercial laboratories. Methods for the preparation and standardization of all the necessary reagents are given since detailed descriptions of these methods are not always easily available to dairy technicians. Other satisfactory standardizing reagents and methods may be substituted if the operator so wishes.

Ascorbic acid is a rather strong reducing substance. It is, therefore, possible to determine it quantitatively by the use of a proper oxidizing reagent. The strong oxidizing reagents such as potassium permanganate are not satisfactory because they oxidize other organic substances in milk as well. Some of the organic oxidizing compounds are usable, however, and the organic dye, 2, 6-dichlorophenolindophenol, is very satisfactory. It is strong enough to oxidize ascorbic acid but not so strong that it attacks most of the other organic substances present. This dye is blue in neutral and alkaline solutions and red in acid solution. In its reduced form it is colorless.

REAGENTS

Preparation of the Dye: The prepared dye may be purchased on the market as sodium 2, 6-dichlorobenzenoneindophenol (Eastman) or it may be prepared in the laboratory. The author prefers to prepare his own dye according to the following directions:

To 5 grams of powdered 2, 6-dichloroquinonechlorimide in a 400-ml. beaker cooled in an ice bath, add 2.25 grams of phenol and stir thoroughly. Slowly add, with constant stirring, 18 ml. of 3 N sodium hydroxide solution. Keep the temperature near 0° C. After 30 minutes add 150 ml. of 15 per cent sodium chloride solution, stir until precipitation is complete, and filter on a Buchner funnel. Remove the dye from the funnel and stir with successive 300-ml. portions of warm distilled water until all of the dye has been dissolved (2 to 3 liters). Add dry sodium chloride to the solution until the dye again is salted out. Again catch the precipitated dye on a Buchner funnel, wash with 5 to 10 portions of ethyl ether to remove most of the red impurity and finally suck dry. Remove the dye to a desiccator containing calcium chloride. Drying can be hastened by the use of a vacuum desiccator. When dry, powder the dye in a mortar and store for use. The dye keeps well as it is quite stable in the dry state.

Standard Potassium Iodate Solution: Weigh exactly 1.7835 grams of reagent grade potassium iodate, dissolve the salt in a small amount of water, transfer the solution quantitatively to a one-liter volumetric flask and dilute to the mark with freshly distilled water. The concentration of this solution is 0.05 N. The solution in a glass-stoppered bottle will keep almost indefinitely and is to be used

1) Journal Series paper of the N. J. Agricultural Experiment Station, department of dairy husbandry.

2) Private communication.

for the standardization of sodium thiosulfate solution. Potassium dichromate may be used instead of potassium iodate.

Standard Sodium Thiosulfate Solution: Weigh approximately 12.42 grams of reagent grade sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$), dissolve the salt in a small quantity of freshly distilled water, transfer the solution quantitatively to a one-liter volumetric flask and dilute to the mark with more freshly distilled water. Store in a glass bottle and let stand about two weeks. If the solution is clear, standardize immediately; if free sulfur has separated out, siphon off the clear liquid before standardizing. The solution is standardized as follows: To 25 ml. of the standard 0.05 N potassium iodate solution in a 300-ml. Erlenmeyer flask add 10 ml. of a 10 percent solution of potassium iodide and about 20 ml. of 1 N sulfuric acid. Titrate this solution with the sodium thiosulfate solution delivered from a burette. When the iodine color has faded to a pale yellow add 1 ml. of a starch solution, prepared as described below, and continue the titration until the blue color of the starch-iodine compound has just disappeared. Titrate a blank containing all of the reagents except the potassium iodate with the thiosulfate solution. Subtract the volume of sodium thiosulfate solution used for the blank from the volume used to titrate the potassium iodate solution. This gives the true volume of sodium thiosulfate solution necessary to reduce the amount of potassium iodate used. The normality of the sodium thiosulfate solution may be calculated according to the following formula:

$$\frac{\text{Ml. of iodate solution} \times 0.05}{\text{Ml. of thiosulfate solution}} = \text{Normality of sodium thiosulfate solution}$$

Starch solution: Rub up 5 grams of soluble starch with a little cold water until a suspension has been formed. Pour the suspension into boiling water and boil for a few minutes. Add 1 gram of salicylic acid and make to a volume of 1

liter. The starch solution will keep in good condition for several months.

Approximately 1 N Sulfuric Acid: Carefully pour 30 ml. of concentrated sulfuric acid (sp. gr. 1.84) into 200-300 ml. of distilled water. Cool, dilute to 1 liter, and mix thoroughly. Approximately 0.1 N acid may be prepared by diluting 100 ml. of the 1 N acid to 1 liter.

Potassium Iodide Solution: Dissolve 100 grams of pure potassium iodide in 900 ml. of distilled water.

Standard Iodine Solution: Dissolve about 1.35 grams of pure sublimed iodine in a solution of 2.4 grams of potassium iodide in 200 ml. of distilled water and dilute to 1 liter. Store in a glass-stoppered bottle. Iodine solution changes its concentration rather easily so it is necessary to standardize it frequently—once a week during use and more frequently if necessary. It may be standardized as follows: To 25 ml. of the iodine solution in a 300-ml. Erlenmeyer flask add 20 ml. of 1 N sulfuric acid. Titrate from a burette with the standard sodium thiosulfate solution until the iodine color fades to a pale yellow. Add 1 ml. of starch solution and continue the titration until the blue starch-iodine color just disappears. No blank need be run on these reagents. The normality of the iodine solution may be calculated by the following formula:

$$\frac{\text{Ml. of thiosulphate} \times \text{normality of thiosulphate}}{\text{Ml. of iodine}} = \text{Normality of iodine solution}$$

Dye Solution: Dissolve approximately 50 mgs. of the dry 2, 6-dichlorophenol-indophenol in warm water, cool, make to a volume of 250 ml. and filter through a good grade of filter paper. Since the dye is not entirely stable in solution it is best to prepare and standardize a fresh solution for each day's use. The solution may be satisfactorily standardized as follows: Dissolve 25 mgs. of pure ascorbic acid in 0.1 N sulfuric acid, dilute to 250 ml. with the same acid solution,

and mix well. Set up two burettes; fill one with the standard iodine solution and the other with the dye solution. Quantitatively pipet 25 ml. of the ascorbic acid solution into each of two 400-ml. beakers. To the ascorbic acid solution in the beaker which is to be titrated with iodine add 1 ml. of starch solution. Simultaneously titrate the two aliquots of ascorbic acid with the iodine and the dye solutions. The end-point in the iodine titration is reached when a faint permanent blue color appears. The end-point in the dye titration is reached when a faint permanent pink color is reached. To aid in detecting the latter end-point, place near the burette a beaker containing 50 ml. of 0.1 N sulfuric acid and a few drops of the dye to give it a permanent pink color. After a few ml. of dye have been run into the ascorbic acid a pinkish amber, but not definite pink, color appears; this is not the true end-point which is reached only when a permanent and definite pink color appears. The concentration of the dye in terms of ascorbic acid is calculated according to the following formula:

$$\frac{A \times N.F. \times 100 \times 0.88}{B} = C$$

in which A = ml. of iodine solution
 N.F. = Normality of iodine solution
 B = ml. of dye solution
 C = mgs. of ascorbic acid equivalent to 1 ml. of dye

1 ml. of 0.01 N iodine solution is equivalent to 0.88 mgs of ascorbic acid.

PROCEDURE

Sunlight, whether direct or diffused, has a destructive effect on ascorbic acid. Heat accelerates the reaction. It is, therefore essential that samples be kept cold and protected from sunlight before analysis.

The determinations are best made in diffused daylight. Artificial light can be used but the end-point is more difficult to see. The following procedure for determining the amount of ascorbic acid in

milk has met with much success in the author's laboratory:

Set up two or four burettes each containing the standard dye solution. (The number of burettes used depends on the number of samples to be analyzed and the speed with which the operator works.) Accurately pipet 10 ml. of milk into each of the 400-ml. beakers, add 25 ml. of 0.1 N sulfuric acid, and set each beaker on a white surface under its burette. Run into each beaker, a few drops at a time, some of the dye solution, mix by swirling, and let stand a few seconds for the reaction between the dye and ascorbic acid in the milk to take place. An excess of the dye appears as a pink color in the acidified milk. Complete the titration slowly by adding the dye, a drop at a time, and observing the disappearance of the pink color. The end-point is reached when a single drop of the dye solution causes the faint pink color to remain about 30 seconds. Since there are substances in milk other than ascorbic acid which react with the dye, it is necessary to run a blank on a normal sample of milk which has had the ascorbic acid destroyed. This may be accomplished by adding soluble copper (copper sulfate solution) to the milk so as to get a concentration of copper amounting to about 2 parts per million and holding the sample at about 40° F. for 12 to 24 hours. This sample is titrated with the dye in the same way as is the normal milk sample.

The amount of ascorbic acid is expressed as milligrams per liter of milk and may be calculated according to the following formula:

$$(X - Y) \times A \times 100 = B$$

in which

X = mls, of dye solution required by sample.

Y = mls. of dye solution required by blank

A = equivalent wt. in mgs. of ascorbic acid per ml. of dye solution

B = mgs. of ascorbic acid per liter of milk

Certain Practical Aspects of the Use of Paper Milk Containers*

P. H. Tracy

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For many years glass bottles have been the accepted container for milk. Although the life of a glass bottle is limited, its adaptability for washing and sterilizing, and its transparency (which increases the sales appeal of the contents) have enabled it to maintain easily a complete monopoly in the milk industry.

With the recent development of store-selling of milk there has come a demand for an inexpensive single service type of milk container. The store shopper naturally prefers to buy milk in a package that does not have to be returned, and one which can be conveniently and safely carried to the home. To meet this need several paper milk containers have been developed.

According to Winslow (*The Production and Handling of Clean Milk*, pp. 140-142, 1907-1909) the paper milk container was invented by G. W. Maxwell of San Francisco, and first used by dairymen in Los Angeles. These early containers resembled an ordinary drinking glass and were sterilized by dipping into paraffin at 220° F. A special machine was used for filling and capping. According to Winslow the advantages of the paper containers are their freedom from germs, no breakage or loss of bottles, no bottle washing and sterilizing necessary, and reduced weight in transportation.

The first extensive commercial use of paper containers was probably in New York City in 1929. Since this time, however, the single service container has been introduced into several of the larger cities all over the country. There are in general three types of containers used, namely: those pre-fabricated and requir-

ing a special filling machine; those pre-fabricated but not requiring a special machine for filling, it being possible to use the regular glass bottle filling machine; and finally, those that are formed and paraffined in the dairy just before filling, requiring of course a special machine for the purpose.

While it is our intention to study all three types of containers from the standpoints of their sanitary qualities, adaptability for dairy plant operation, and acceptance by the consumer, the present report will deal only with that type of container formed and paraffined immediately before filling. The container used for this purpose was the Pure-Pak. The machine necessary for preparing and filling the container was supplied by the Ex-Cello-O Corporation, Detroit, Michigan.

The machine, without the platform, covers a floor space of approximately 2½ feet by 24 feet, and weighs 5 tons. The printed containers are fed into one end of the machine where they are formed and the bottoms glued down, after which they pass into the hot paraffin bath where they remain for 18 seconds. They then drain for 12 seconds longer before passing out of the hot paraffin compartment. The temperature of the paraffin and the air above may be varied but the minimum recommended by the manufacturers of the machine is 170° F. The container next passes through a cooling chamber where a blast of 40° F. air solidifies the paraffin and cools the container. The container is then filled with milk and any excess foam is removed by a blast of dry steam. The top is folded in, heated, and pressed along the edges so as to seal the closure. A hot (400° F.) wire staple is inserted to secure the seal, and finally the day of the week is stamped on. The containers of milk are then packed twelve to a case.

*Read before the 26th Annual Meeting of the International Association of Milk Sanitarians, Louisville, Kentucky, October 11-13, 1937.

The paper case of twelve bottles weighs approximately 28 pounds.

The amount of paraffin necessary for coating the containers varies from about 12 to 15 grams. As the temperature of dipping is raised the amount of paraffin retained decreases. In our studies, two grades of paraffin were used—the high (135°—137° F.) and the low (125°—127° F.) melting point paraffins. In actual tests the temperature at which the paraffin melted sufficiently to be detectable on absorbent paper was about five degrees below the rated melting points, so that danger from paraffin melting and running into the milk would not be evident until the container temperature reached about 120° F. in the case of the low melting point paraffin and 130° F. in the case of the high melting point paraffin.

Since there is some bending of the paraffined paper during handling and opening, an attempt was made to determine to what extent the paraffin chipped off into the milk. The average weight of paraffin found in six bottles filled with water and hauled on a milk delivery truck for eight hours was .001 gram.

As previously stated, the foam that results from filling is removed by a small jet of steam. Foaming is more of a problem in the case of homogenized milk than regular milk. The amount of foam formed is directly related to the temperature of the milk—greater at the lower temperature. The amount of steam dilution was found to average 0.3073 gram per quart of milk.

The amount of moisture absorbed by the walls of the quart containers was found to vary from 0.5 to 2.5 grams. Somewhat more moisture is retained by the heavy (0.019 inch) paper than by the light (0.016 inch) paper. The most important factors, however, were the time and temperature of storing the containers, the greatest retention taking place at the higher storage temperature and at the longer storage period.

Bulging of the side walls is one of the minor problems connected with the use

of paper milk containers. A certain rigidity of side walls is desirable from the standpoint of ease of handling and prevention of leaking. The greatest bulging naturally occurs at the higher storage temperatures. Neither the weight of the paper used nor the type of dairy product placed in the container are significant factors.

There is but slight difference in the rate of temperature change of milk in glass and paper containers, though the milk in paper warms slightly slower. When the paper and glass containers are packed in their respective cases the rise in temperature is much slower in the case of the milk in paper containers. In one experiment the milk in glass bottles in wooden cases stored at room temperature was slightly warmer after three hours than was that in paper containers stored in paper cartons after seven hours.

The detrimental effect of sunlight on the flavor of milk in glass bottles has been known for some time. While milk stored in paper containers will acquire the "sunshine flavor," the effect of the sun is not nearly so serious as it is in the case of the milk in glass bottles.

Consumer tests based upon 221 completed questionnaires returned by the milk customers on the University milk route have shown a preference in most respects for the paper. From a sanitary point of view the majority of users preferred the paper. Few thought there was any difference in the flavor of the milk, its keeping quality, and its tendency to freeze or the rate of temperature rise. It was almost a unanimous opinion that the paper containers took up less space in the refrigerator and were more convenient for picnics, etc. The glass bottle was picked for greater ease of pouring and for ease of separating the cream from the skim milk. A slight majority preferred the paper containers to the glass when the milk sold for the same price, but at one cent less, 75 percent indicated a preference for the paper container. Whether the milk was purchased from a store or was delivered made no material

difference as far as preference was concerned.

Some of the favorable individual comments were as follows:

1 Easier to handle by delivery man.....	2
2 No washing of bottles.....	51
3 No breaking or chipping of bottles....	14
4 No bottle to return	32
5 Moisture does not condense as much as on glass	1
6 Empty containers make garbage containers	4
7 Excellent for picnics, pack easily and easily disposed of	4
8 Good containers for other foods in ice box	7
9 Containers easy to dispose of	8
10 Good for kindling	6
11 More easily handled	12
12 Easier to close after being opened.....	3
13 Less weight on refrigerator shelf.....	2
14 Bottles easy to open	4
15 Eliminates noise of bottles and cases early in the morning	3

The Effect of Homogenization at Different Temperatures on Some of the Physical Properties of Milk and Cream.—*R. Whitaker and L. D. Hilker*—*J. Dairy Science* 20, 281 (1937).

The experimental data shows that homogenization at temperatures ranging from 50° to 175° F. has a marked influence on various properties of milk and cream. The fat must be in a more or less liquid state for good homogenization as evidenced by extensive subdivision of the fat globules. This is best done at a temperature of 100° F. or above. Marked differences in the properties of the homogenized cream resulted when it was held at 40° F. and then heated up to the homogenization temperature in contradistinction to the properties obtaining when the cream was heated to 145° F. and then cooled down to the given homogenization temperature. In general, the cooled cream had to be homogenized at a higher temperature than the heated cream in order to obtain comparable properties.

The Electrokinetic Potential of Milk Fat—III—RELATION TO THE FAT GLOBULE "MEMBRANE"—*E. L. Jack and C. D. Dable*—*J. Dairy Science* 20, 637-643 (1937).

The nature and distribution of the materials adsorbed on fat globules in milk have intrigued investigators for many years. This study is interesting in view of the fact that it throws light on the subject of increasing the fat content of milk (or cream). The lipoid phosphorus content per unit of fat declines slightly in cream from 17 per cent to 60-65 per cent and above 65 per cent it decreases rapidly up to a fat content of 81 per cent whereas the electrophoretic mobilities of the fat globules is constant up to a fat content of 65 per cent while above this they increase rapidly. The nitrogen content, however, decreases gradually with increasing fat content. The evidence presented seems to substantiate the author's view that the point of the sharp break in the lipoid phosphorus curve at 60-65 per cent concentration is the point at which some of the tightly held phospholipid material in the fat globule membrane must be removed if cream with a higher fat content than 60-65 per cent is to be secured.

The suggestion that the membrane on the surface of fat globules is a phospholipid-protein complex, in which the phospholipid is oriented toward the fat and the protein into the liquid phase is based on the author's negative observations that the washing of cream resulted in considerable loss of protein in the first washing with an attendant gradual decrease in protein thereafter (up to 8 washings) plus a gradual decrease in the phospholipid content with each washing whereas their affirmative observations indicated that a synthetic milk, in which the casein layer was absorbed on a phospholipid layer existing on the surface of fat globules, resembled normal milk in the position of the isoelectric point and the slope of the pH/mobility curve. The latter observation also suggested the probability of a double layer membrane on the surface of the fat globule.

M. E. PARKER.

Some Sanitary Problems in the Ice Cream Industry*

Robert C. Hibben

*Executive Secretary, International Association of Ice Cream Manufacturers,
Washington, D. C.*

The policy established by your Association several years ago of having representatives of the different branches of the dairy industry appear on your program to give their views in regard to sanitary regulations is indeed very constructive. It is this spirit of cooperation on the part of both the officials in charge of dairy sanitation and the industry that has made for the progress that has been accomplished in the dairy industry which has resulted in great benefits to the consumer in offering him a safer healthful product.

As we look back over one, two, and three decades, the ice cream industry has become not only a large but a very modern food industry and this modernization has gone forward hand in hand with the advancement of the science of sanitation.

It is the duty of the ice cream industry to produce a wholesome quality product at a reasonable cost. If the price goes too high consumption falls, with the result of loss to the industry and the dairy and fruit farmers. Sanitation costs money and, therefore, it is the duty of your group to see that only sound practical sanitation requirements are promulgated, so that we can go forward in a practical cooperative manner and produce a wholesome ice cream at a reasonable cost.

When I was invited to appear on this program I sent a letter out to about one hundred ice cream manufacturers, both large and small, in practically every state. I believe that you will be interested in the reactions I received from this group. There has been an increasing tendency to promulgate arbitrary regulations in the different states which have interfered with the free flow of cream and other dairy

products in interstate commerce and actually built up artificial tariff walls which has been very detrimental to the farming interests, both in dairying and non-dairying sections. As you study this situation, it would seem to be caused by a lack of uniformity in the different state and city health regulations. Because of this lack of uniformity in these regulations, one state will not accept the inspection of the dairy products of another state. It narrows down even to city health departments not accepting the inspection of their own state department, and in some places it is county against county. This naturally increases the cost of manufacturers doing business. From a purely economic standpoint it will hinder the future growth of the industry, for no manufacturing industry can progress unless it has a free and abundant flow of the required raw products and a broad consumer outlet.

Allow me to set forth a few examples of this serious situation in the ice cream industry at the present time, of course, deleting all company identities and locations:

The problem is stated in a nutshell in the following paragraph from a middle-west manufacturer:

"I feel that the greatest problem confronting the health regulations in the various localities throughout the United States is the lack of uniformity in the regulations on the parts of the various health authorities in the different cities. They do not seem to be able to agree on what regulations should be adopted, making it very difficult for ice cream manufacturers to sell ice cream in the different cities. In many instances, they give entirely different views regarding sanitation as far as certain specifications are con-

*Read before the 26th Annual Meeting of the International Association of Milk Sanitarians, Louisville, Kentucky, Oct. 11-13, 1937.

cerned. Either one of the two is correct, leaving the ice cream manufacturer in the middle. If some middle ground could be reached that would produce a safe product to be used in the manufacturing of ice cream, it would certainly save the ice cream industry a great deal of money and at the same time enable the manufacturer to produce a product that is safe for the public."

From the South one manufacturer writes:

"Our city ordinances prohibit the shipment of cream into our city unless the source of supply is personally inspected by the Health Inspectors of the city. This inspection is made on a mileage basis and the local department interprets the law to mean that they must not only inspect the creamery producing the cream but each individual dairyman or farmer producing the milk. For example, one of the best sources of supply of cream for us is a creamery in an adjacent state. They are supplied by about two thousand farmers, and in order to meet the requirements of our City Health Department these two thousand farms would have to be inspected once a month by our local inspector, which of course makes the cost on a mileage basis prohibitive. Occasionally they have permitted us to ship in some cream providing we color it or sweeten it at the source of supply, but you can appreciate this is not very satisfactory. Our contention is that they should admit any cream that has been passed by State inspection, and from a source that bears a certificate of the State inspector."

Again from the South:

"At present State A is inspecting our state plants which ship into State A because our state sanitary laws are different. State A's periodical inspections of course add an additional burden on our state manufacturers shipping into State A."

From the West:

"If uniform methods of inspection were developed this should, in itself, eliminate expensive and time-consuming 'duplicate' inspection. For instance, in one small town in which we operate there is a city inspector. The city is so small it represents only a small portion of the county. Therefore, we have

to submit to county inspection. The county inspector goes over the same things as the city inspector—each having different ideas on what we should do to comply. Many times their opinions have been contradictory, and as a result the city and county inspector in that particular area do not get along. To add to the inconvenience, the city is near the county line and we do business over the county line, therefore being subjected to inspection by the neighboring county. To this is added the general inspection by the state.

"This entire duplicate inspection problem would be eliminated if uniform methods of inspection were developed and made mandatory by the inspectors, and if the inspectors would accept one another's honesty. This, I believe, would make our operations more consistent. In some places the inspector is very lax, and I think this is not only bad for us but for the entire industry. Uniform inspection would undoubtedly build confidence."

An Eastern manufacturer writes:

"For example, adjacent State A must have its ice cream made out of raw materials from approved sources. They should be agreeable to accepting inspections made by our State inspectors unless they can immediately send one of their own inspectors. I believe that an exchange of inspection service between states would save the states some money and would be just as fruitful in its results. I believe that the states should work towards a uniform inspection blank or service that could be interchangeable. Certainly there seems to be no necessity for a good many trips from one state to another when the inspection is available at the source."

From the Central East comes an example of considerable confusion between city and state inspection:

"As an illustration, at one plant we are shipping cream into State A and we must have the inspection of State A, which is quite thorough. From this same plant we are shipping to City A in our own state, which will not recognize State A inspection and have one of their own. Furthermore, the local department will not accept the inspection of City A or State A—which in my opinion are both more severe than our city inspection requirements.

"We just could not have three inspectors bothering our producers—it was bad enough having two; therefore, we are not permitted to sell anything in our own city from this plant; although in my opinion the products from this plant are of higher quality than the products from 95% of the plants in our city.

"I think that if we were to ship into State B we would be required to have another inspection."

Another Eastern manufacturer points out how the regulations have cut down the source of supply:

"The greatest problem confronting us, and no doubt all other manufacturers selling their ice cream in several states and numerous incorporated municipalities, is that each Health Officer has his own requirements—in some cases conflicting requirements with other Health Officers—which limits, of course, sources of supply to those meeting the requirements of all Health Officers. This naturally sharply cuts down the sources of supply to a very small number, and does not encourage, nor does it maintain a strictly fair competitive basis for prices charged for supplies, because these sources are practically assured of the sale of their output. Because of these conflicting requirements, these Health Officers are unwittingly a party to a 'hold-up.'"

This is also voiced from another Eastern ice cream manufacturer from another state:

"The problem of procuring dairy products during the peak of the season especially disturbs us a good deal when the local or even nearby sources of supplies are inadequate to take care of our demands. Where we are located, in our particular center, most of the milk is being bought for bottling which pays a higher rate than the manufacturing price. This, of course, draws all the milk in that direction so that we can not get what we want. The Sanitation Boards require that you buy all cream approved by our state (State A). This we found to be impossible because there were times when we even tried to procure cream from sources in State B which have been State A approved but not being able to get it. I do not see why we

could not have some kind of a reciprocating sanitary law which would enable other states which had the same sanitary laws shipping this cream in and conforming with our State A requirements."

I could continue with such examples and it is obvious that there is considerable confusion arising because of this situation in this industry. These gentlemen are not theorizing, but actually are being harmed from a cost standpoint. One example was brought out where, because of requirements of one city health department which will not accept the farm inspection of an adjacent state department, the ice cream manufacturers are required to pay twenty-two cents over Chicago Extras for cream where ninety miles from this city the same cream was selling in that city for seven cents over Chicago Extras.

It is useless to criticise without giving a constructive thought on how to overcome the problem thus criticised. Your Association could accomplish a great deal if working with similar organizations and the industry the following could be established:

- (1) Uniform method of farm inspection.
- (2) Uniform requirements of quality of cream and other dairy products used in ice cream that is shipped in interstate commerce.
- (3) After a state has adopted these uniform requirements, the state inspection of one state would be accepted by other states; furthermore, that the cities within a state having such uniform requirements accept state inspection for the products used in ice cream in that city.

Another problem confronting the ice cream industry is the matter of inspection of equipment in ice cream plants. There is great lack of uniformity of requirements of the different health departments in the various states covering such requirements. Let me quote from just two of the manufacturers heard from:

- (a) "One outstanding problem is obtaining equipment that will be approved by all health officers. One health officer in our section requires that he approve all equipment before it is installed. Some firms now are ordering equipment subject to the approval of 'so and so' health officer. Regard-

less of what some people say, this man is gradually being recognized as doing a needed job and doing it well. Many equipment houses, of course, object to changing equipment to meet his sanitary specifications because only a small portion of their sales are in his territory. If cooperation between the equipment manufacturers and health officers could be gotten under way, real progress could be made toward building equipment that would be satisfactory to all. Perhaps this is too much to ever hope for, but if equipment could be sold with the approval of the 'Milk Sanitarians' which would prevent individual health officers from condemning it, a big load would be lifted from many ice cream manufacturers."

(b) "During the past year or so, particularly in the east, the various health departments have interested themselves more than ever before in the design of manufacturing equipment. This is something which, as you know, I have recommended for many years. In the past the departments have taken the attitude of refusing either to recommend or to prohibit the purchase of a piece of machinery. After the machinery has been installed and inspection is made then the company is told whether or not it satisfies the requirements of the department. I have always recommended that the department pass on machinery before it be offered for sale to the manufacturing companies.

"As stated above, the departments are now interesting themselves in equipment and suddenly, in many cases, have taken the arbitrary stand that a piece of equipment should be thrown out and replaced, even though they may have tacitly approved the old equipment for many years, by their inspectors failing to place any violations on the equipment. An arbitrary stand along these lines is apt to put a terrific burden on the manufacturing companies, causing them to replace a good portion of their entire equipment in one year. This stand I feel to be absolutely inconsistent with their former attitude and somewhat difficult for them to justify, looking back over the record of inspections.

"It certainly behooves the various health departments before a particular type of machine is recommended for the industry that

at least two and preferably more companies manufacturing this type of machinery have been approved by said health departments. This procedure is only logical for if a department should recommend only a particular manufacturer's piece of machinery and no other, the industry would be at the mercy of the manufacturer who would be in a position to charge practically any price he saw fit. I believe the Milk Sanitarians cannot help but see the justice of the request that at least two manufacturers' products be approved before the industry is required to purchase the product of one."

I know that the members of the Dairy and Ice Cream Machinery and Supplies Association are willing to cooperate with your organization and I am sure the same will hold true of the Sanitary Control Committee of the International Association of Ice Cream Manufacturers. It would be very helpful if a joint committee of these three organizations, and any other organization deemed advisable by your Association, could set up a program for approval of equipment at its source of manufacture so that this stamp of approval would be acceptable to the different city, county, and state health departments.

Another problem which is prevalent in most health departments and one that the heads of such departments always regret (and in many cases can do nothing about) is the lack of properly trained inspectors to enforce adequately the city or state sanitary laws and regulations. I could give you many examples of this, but let me confine myself to two:

(x) "Several years ago we were able to get the Department to make a ruling that the maximum bacteria count would be 100,000 but this hasn't meant a thing as they do not have inspectors enough to check the bacteria or follow up in case they were to take counts. Frankly, this is a serious health menace and the only way a correction can be made is for an epidemic to take place, and then our Association or public opinion can pick it up and push some regulations through the Committee."

(y) "I believe that the official in charge of dairy inspection should be paid a suffi-

ent salary to enable him to give his entire time to this business and that if it is found that he is dabbling in "side issues" he should be replaced. Likewise I think that inspectors should be given a course of training and study by the health department before they are hired and that there should be an end to broken down ward heelers receiving these appointments. These deputy inspectors should also receive reasonable living wages."

This problem, as I previously stated, is a budgetary problem in the different state and city departments. However, I believe we all agree that it is better to have simple sanitary regulations adequately enforced than a complicated set of sanitary regulations without enforcement.

As the ice cream industry is set up at the present time, there are three classes of manufacturers—the wholesale manufacturer who sells to ice cream retailers, the manufacturing retailer who manufactures and has his own stores, and the retailer who manufactures in his shop and sells over the counter. You as sanitary inspectors are charged with the equal enforcement of the regulations governing the product of all three types of plants. From the survey I just made of the industry, I am led to believe that the larger plants are the ones that receive the inspection and that, due in many cases to a lack of an adequate inspection force, all the plants are not covered. Let me quote from just three sections of the country:

"We have observed for quite a number of years, the tendency of inspectors to slide over infringement of regulations on the part of the smaller plants."

"With reference to sanitation, of course it is the old story of inspectors who thoroughly inspect a wholesale plant but do not pay quite such close attention to the smaller retail plants."

"The inequality of laws or enforcement of sanitary requirements as regards the operation of what might be termed wholesale manufacturers and retail manufacturers."

Immediately you are thinking that this is the old story of the big manufacturer against the little fellow but I can assure

you that of the above quotations, two of them come from small wholesale plants which are below the average in size and the third comes from a state where there are no million gallon plants.

You are charged with the duty of protecting the public against any epidemic or sickness caused through your citizens eating unwholesome ice cream. If such an epidemic breaks out it will make no difference whether the ice cream is made by a wholesaler, retailing manufacturer, or retailer. It just isn't cricket not to do a thorough job, and from the economic standpoint I quote:

"Enforcement of regulations only on a minority of manufacturers is equivalent to the government subsidy for the majority, thereby making it very difficult for the minority to conduct a profitable business."

As I study the different food industries the manufacturers fall into two classes—those who are behind the food officials in their laws and regulations, and others who are not cooperating but endeavoring through legal technicality and otherwise to break down the system of control for their own profit. In the dairy industry, and I am not confining this to the ice cream branch of the industry, we have seen such elements endeavoring to break down your regulations, standards, and inspection, even to the extent of fighting you through the courts. This is unfortunate as it is against public interest.

It was in 1910 that I first entered the creameries and ice cream plants of the middlewest. Great progress has been made in these twenty-seven years, both in the science of manufacture and improvement in equipment. However, many of the same fundamental principles of sanitation hold as good today as nearly three decades ago. No substitute has been found for live steam for sterilization in every plant manufacturing any dairy product nor for plenty of good washing powders and hot water for cleansing purposes. There is not now and never will be any short cut to cleanliness.

The ice cream industry has gone forward due to increased consumer acceptance. Formerly considered a confection with questionable standing, manufactured ice cream today is considered a wholesome food. It has public acceptance not only because of the efforts of the manufacturers to produce a wholesome product, but also due to the advances made in sanitary science by the members of your organization.

You are doing a splendid job and the industry is fortunate that it has men of your standing, sincerity, and talent to guide it in the manufacture of a wholesome product.

Mr. Putnam

*Vice-President of Creamery Package
Manufacturing Co.*

Following the annual meeting on February 15, Mr. G. E. Wallis, president of the Creamery Package Manufacturing Co., announced the election of Mr. George W. Putnam as a vice-president.

Mr. Putnam, a graduate of the University of Minnesota Engineering School, was a state sanitary engineer, and then joined the milk control staff of the Chicago Health Department under Dr. Bundesen. During this incumbency, he discovered many of the mechanical defects of pasteurization machinery and worked out their correction. He joined the Creamery Package Manufacturing Co. as a research engineer in 1928, and after several years was made Director of Research. His new duties will be those of vice-president in charge of the company's extensive research and development program.

Mr. Putnam has been an interested and active member of the International Association of Milk Sanitarians for many years and has made many valuable contributions to its programs by papers and committee work. He is an Associate Editor of this Journal.

A Study of Some Factors in the Butter Churning Process.—D. Levowitz and P. A. Van der Meulen—*J. Dairy Science* 20, 657-665 (1937).

This study is of interest in view of the fact that it tends to confirm in part, at least, the Rahn foam substance theory of butter churning rather than the Fischer-Hooker phase reversal theory. The first step in churning is assumed to lead to the production of a foam containing a high concentration of fat globules followed by the second step wherein a large proportion of the milk serum drains from the foam. Whereas Rahn assumes that the next step is the irreversible coagulation of the "foam substance" resulting in the formation of a rigid structure containing globules of butterfat still stabilized by their original protein films, the authors are of the opinion that as a result of the mechanical action of the churn, the stabilizing films of some of the fat globules are broken, liberating the oil from the least stable globules, but leaving the more stable globules essentially unchanged. In other words, the free oil produced by the rupture of the least stable globules forms a cementing material for the stable globules in its immediate vicinity. In support of this view, the authors have been able to produce butter without churning by decreasing the concentration of serum solids and by raising the temperature which was achieved by proper dilution and warming of the cream followed by subsequent centrifuging. It was further demonstrated that the relative electrical potential on the butterfat globules and the viscosity of the interglobular solutions have little, if any effect on churning time.

M. E. PARKER.

Editor's Note: In support of the author's theory of butter churning, we have the evidence of King [Kolloid, Z. 52, 319 (1930)] that the crystallization of fatty constituents, with high melting point, may be a factor in producing a stable globule, plus the additional evidence of Dr. Wm. Clayton et al. (*Nature*, Apr. 24, 1937) on the physical chemistry of butter churning as per Rahn's theory.

Report of Committee on Standard Methods for the Bioassay of Vitamin D Milk

(American Public Health Association)

The method herein described incorporates the principles of the method outlined in the U. S. Pharmacopoeia, 1937 Supplement, page 91, for the vitamin D assay of cod liver oil. Terms herein used are defined in the U. S. P. Supplement. Certain modifications of the U. S. P. method suggested by the Association of Official Agricultural Chemists (Journal of Association of Official Agricultural Chemists 20, 78, 1937) for the assay of vitamin D milks are optional with the assayer.

Collection and Preservation of the Sample

The sample of milk in the original bottle shall be shipped to the assayer immediately after collection. Shipments should be made in iced containers. Experience has demonstrated that dry ice is not suitable for refrigeration of milk during shipment unless care is exercised in packing. Even during the summer season the super cooling effect of dry ice in many instances causes the milk to freeze, resulting in the bottles cracking and a total loss of the sample. Shipping containers with icing pans (using ordinary ice) are preferable.

After receipt and acceptance by the assayer, the milk shall be immediately placed on assay or as soon thereafter as possible. If necessary to delay the assay, the milk shall be preserved in its original homogeneous state. This may be accomplished by the addition of two drops of 10% formaldehyde per quart of milk and ordinary refrigeration (40-50° F.) for a period of not more than 30 days. Once a sample of milk becomes soured, curdled, or the fat definitely separated out, it is unsuitable for assay purposes. Obviously, collection and preservation of evaporated or dried milk samples present no special problems; however, once they have been submitted to the assayer and opened, precautions with respect to preservation outlined above must be followed.

Preliminary Period

Throughout the preliminary period, each rat shall be raised under the immediate supervision of or according to directions specified by the assayer. Throughout the preliminary period, the rats shall be provided with adequate amounts of a ration which will allow for normal development in all respects. The supply of vitamin D in the diets listed below is sufficient for maintenance needs and is limited to such a degree that rats weighing between 44 and 60 gms., at an age of 21-28 days, when placed on a suitable rachitogenic diet for three weeks should manifest evidence of severe rickets.

The following ration is an example of one suitably low in antirachitic potency, for this purpose.

Yellow maize	71.0
Linseed oil meal	16.0
Crude casein	5.0
Alfalfa meal	2.0
Butter fat	5.0
Bone ash	0.5
Sodium chloride	0.5
Fed with fresh whole milk and water ad libitum.	

If it is not convenient to use fresh milk, the diet may be modified as follows:

Yellow maize	57.0
Whole milk powder	25.0
Linseed oil meal	12.0
Crude casein	3.7
Alfalfa leaf meal	1.5
Iodized sodium chloride	0.4
Calcium carbonate	0.4
With water ad libitum.	

All the solid constituents of the ration must be finely ground so as to prevent selection by the animals. Care must be exercised that milk and butter fat are used to which an antirachitic substance has not been added.

Depletion Period

A rat shall be suitable for the depletion period when the age of the rat does not exceed 28 days, and if the body weight of the rat shall exceed 44 grams and does not exceed 60 grams, and if the animal manifests no evidence of injury, disease, or anatomical abnormality which might hinder growth and development. Throughout the depletion, each rat shall be provided with the rachitogenic diet and distilled water ad libitum, and during this period no other dietary supplement shall be available to the animal. When the rats have reached the weight and age range above indicated, they are made rachitic by transference to and maintenance on a very finely ground rickets producing diet. Formulas for suitable rachitogenic diets are given below.

McCollum Diet #3143⁽¹⁾

#1. Whole yellow maize ground	33.0
Whole wheat ground	33.0
Ground gluten	15.0
Gelatin	15.0
Calcium carbonate (CaCO ₃)	3.0
Sodium chloride (NaCl)	1.0

Steenbock Diet #2965⁽²⁾

#2. Whole yellow maize ground	76.0
Ground gluten	20.0
Calcium carbonate (CaCO ₃)	3.0
Sodium chloride (NaCl)	1.0

It is advisable that each new lot of ration be used in a preliminary way to determine whether it produces satisfactory rickets.

Throughout the depletion and subsequent assay period, the rats shall be maintained on wire screens in a room away from direct or reflected sunlight of sufficient intensity to influence rickets in the rat. A range of temperature between 72-80° F. is satisfactory for the care of the animals during the depletion and subsequent test period.

(1) Journal of Biological Chemistry 51, 41, 1922.

(2) Journal of Biological Chemistry 64, 263, 1925.

Assembling Rats into Groups for Assay Period

For each milk assay there shall be one or more assay groups. In the assay of one vitamin D milk, there shall be provided at least one reference group, but a single reference group may be used for the concurrent assay of more than one vitamin D milk. On any one day during the interval of assembling rats into groups, the total number of rats that shall have been assigned to make up any one group shall not exceed by more than two the number of rats that shall have been assigned to make up any other group. For a given sample, no less than seven rats should be used, whereas ten or more rats per given assay group will reduce the error due to variation.

When the assembling of all groups shall have been completed, the total number of rats in each group shall be the same. Not more than three rats from one litter shall be assigned to the assay group unless an equal number of rats from the same litter is assigned to the reference group.

Assay Period

A rat shall be suitable for the assay period, provided that the depletion period shall have exceeded eighteen days and shall not have exceeded twenty-five days, and provided that a rat shall manifest evidence of rickets. The presence of rickets may be established by examination of a leg bone of one member of a litter by the "line test" described below, by palpation, or by X-ray examination of the animals selected for assay.

Rats suitable for the assay period are weighed and segregated in individual cages provided with screen bottoms and shall be provided with the rachitogenic diet and distilled water ad libitum. On any calendar day of the assay period, the assay and reference groups shall receive a rachitogenic diet compounded from the same lot of ingredients.

The assay period shall be seven 24-hour days in length. Throughout the first six days of the assay period, each rat in any one assay group shall be fed daily

the calculated dose of vitamin D milk, and throughout the first six days of the assay period each rat in any one reference group shall be fed daily a dose of reference oil,⁽¹⁾ except that the following deviation from the daily feeding shall be permissible: that the daily dose of milk or reference oil may be doubled on the day preceding a one day holiday falling within the first six days of the assay period. (See A.O.A.C. method referred to on page 49 for additional feeding options.) As soon as possible after the termination of the assay period, each rat shall be killed by suitable means and one or more leg bones examined for healing of the rachitic metaphyses according to the line test described below.

The reference oil shall be diluted before feeding with an edible vegetable oil free from vitamins A and D. The diluted oil shall be stored in the dark at a temperature not exceeding 50° F., and the duration of this storage shall not exceed thirty days. Not more than 0.1 cc. of the diluted reference oil shall be fed as a daily dose except as provided for above. Inasmuch as the dose of the reference oil required to give a standard narrow continuous line of healing may vary from laboratory to laboratory, depending upon conditions, the dose of reference oil to be fed shall be determined prior to the running of routine assays. By way of orientation, it may be said that a supplement falling between $\frac{1}{2}$ to $\frac{2}{3}$ U. S. P. unit of standard per day (U. S. P. reference oil) will be found to produce a narrow continuous line of calcium deposits in approximately three-fourths of the test animals. It is advisable to use the minimum amount of U. S. P. reference oil required to produce this degree of healing for comparison. The reference oil shall be diluted so that one-sixth of the dose necessary to produce positive macroscopic evidence of calcification shall be administered each day for the first six days of the assay period.

(1) There is no unanimity of opinion as to whether it is necessary, from the practical standpoint, to feed skimmed milk solids at all assay levels, and, therefore, further experimental work must be done before a recommendation can be made with regard to the feeding of the solids to the reference oil group.

In the reference group already mentioned, U. S. P. reference cod liver oil shall be used as a comparative standard for the vitamin D assay of milk.

Preparation of Standard to give $\frac{1}{2}$ to $\frac{2}{3}$ U. S. P. Unit.

SAMPLE CALCULATION

The U. S. P. reference cod liver oil now in use contains 95 U. S. P. units per gram; 1 unit is contained in 10.52 mgs. In making up each cc. of diluted oil use 52.6 mgs. of the reference oil and each 0.1 cc. of the diluted oil will contain $\frac{1}{2}$ unit of vitamin D. Other concentrations of the diluted oil can be calculated in a similar manner. From the amount of U. S. P. reference oil determined to be necessary to produce positive macroscopic evidence of calcification, the calculated amount of milk based on the unitage claimed is fed during the first six days in six equal doses. If $\frac{1}{2}$ unit per day for six days (3.0 U. S. P. or 31.56 mgs.) is necessary to produce the type of calcification above described, then the dose of vitamin D milk which would be expected to produce a degree of calcification equal to or greater than the degree of calcification obtained in the reference group may be calculated.

For a vitamin D milk carrying 200 U. S. P. units per quart, this amounts to $\frac{3}{200}$ of 946 cc. in one quart, or 14.14 cc. total dose; if fed in graded doses during the first 6 days, $14.14 \div 6 = 2.35$ cc. daily. A vitamin D milk carrying 400 U. S. P. units per quart would require just one-half, or a total dose of 7.07 cc. administered at a level of 1.18 cc. for six days. If a higher increment of U. S. P. reference oil is required, then the amount of milk to be fed, based on unitage claimed, is calculated. In the method just described, the milk shall be fed in small dishes separate and apart from the diet, and the reference oil may be fed in the same manner or directly to the rat by calibrated dropper or pipette.

Certain variations from this method, such as the length of the assay period and the manner in which the milk and

reference oil are fed, may be used without influencing the validity of the results obtained.

Line Test

The effect of the milk feeding and response to the U. S. P. reference oil is determined as follows. The line test shall be made on the proximal end of the tibiae or distal end of the radii or ulnae. The end of the desired bone is removed from the animal and cleaned of adhering tissue. A longitudinal median section shall be made through the end of the bone with a clean sharp blade to expose a plane surface through the junction of the epiphysis and diaphysis. In one assay, the same bone of all the animals must be used and sectioned through the same plane. Both sections of the bone shall be rinsed in distilled water and shall then be immersed in a freshly prepared 2% aqueous solution of silver nitrate for one minute. The sections shall then be rinsed in distilled water, and the sectioned surfaces of the bone shall be exposed in water to daylight or other source of actinic light until the calcified areas have developed a clearly defined stain without marked discoloration of the uncalcified area. Evidence of congestion in the rachitic metaphyses should be clearly distinguished from calcium salts stained with silver, as the principal criterion of healing is the development of the line at the provisional zone of calcification.

As an optional procedure, the bone after being removed and sectioned may be placed in 10% formaldehyde or 95% alcohol for a period of three to four hours, after which it is rinsed in distilled water and stained with silver nitrate in a manner previously described. The use of this modification is purely optional; however, the bone specimens seem to stain more distinctly, the tissues having been hardened and cleared. The time that the specimen is resident in the formaldehyde is too short to cause any significant decalcification due to formic acid. If longer periods of storage are used, 95% alcohol is preferable. Other modifications of the staining technique may be

used providing they are equally satisfactory in showing calcified areas.

Recording of Data

Records shall be made, immediately after staining, of the extent and degree of calcification of the rachitic metaphyses of every section. Numerical values shall be assigned to the extent and degree of calcification of the rachitic metaphyses of the bones examined by the line test so that it will be possible to average the performance of the group. On the day beginning the assay period and on the seventh day thereafter, a record shall be made of the body weight of each rat.

Vitamin D Potency of the Milk

In determining the vitamin D potency of the milk, the average performance of the reference oil group with respect to the healing of the rachitic metaphysis shall be such that two-thirds or more, but not less than 7 of the animals of this group show macroscopic evidence of calcification. When the average response of the assay group is equal to or greater than that of the reference oil group, the vitamin D content of the milk fed during the assay period is equal to, or greater than the vitamin D content of the reference oil fed during the assay period. When the average response of the assay group is less than that of the reference group, the vitamin D content of the milk fed during the assay period is less than the vitamin D content of the reference oil fed during the assay period. The data from a rat shall be considered valid for establishing the average performance of a group only on the condition that the weight of the rat at the termination of the assay period shall equal or exceed the weight of the rat on the beginning day of the assay period, and on the condition that the rat has consumed each prescribed dose of milk within twenty-four hours from the time it was fed.

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I wish to apply for membership in the International Association of Milk Sanitarians.

.....19.....

Name
(Print name in full and degree)

Address
(Street and City)

Present occupation
.....

Previous positions
.....
.....

Application is for:

.....Active membership

.....Associate membership

Person may qualify for

MEMBER if officially engaged in dairy or milk inspection, or laboratory control, or administration of such function for any country or subdivision thereof; or officially engaged in research or educational work related to dairy or milk inspection for any country or subdivision thereof.

ASSOCIATE MEMBER if interested in the promotion of dairy sanitation.

DUES: \$5.00 per year payable in advance, and includes the Association

JOURNAL OF MILK TECHNOLOGY.

Application endorsed by:

..... } Active or
..... } Associate
..... } Members

Mail with remittance to:

C. SIDNEY LEETE, *Secretary*,
Int. Assn. of Milk Sanitarians,
N. Y. State Dept. of Health,
Albany, N. Y.

INTERNATIONAL ASSOCIATION OF MILK SANITARIANS

Constitution and By-Laws

CONSTITUTION

Adopted October 16, 1911*

NAME

This Association shall be known as the International Association of Milk Sanitarians.

OBJECT

The object of this Association shall be to develop uniform and efficient inspection of dairy farms, milk establishments, milk and milk products, and to place the inspection of the same in the hands of men who have a thorough knowledge of dairy work.

MEMBERSHIP

There shall be two classes of membership in this association: Active and Associate.

The active membership shall be composed of persons who are officially engaged in dairy or milk inspection, or the laboratory control of, or the administration of such function for any country or any subdivision thereof, and of persons who are officially engaged in research or educational work related to dairy or milk inspection for any country or subdivision thereof, provided, however, that all persons who at the time of the adoption of this amendment are members of the Association, shall be active members.

The associate membership shall be composed of any persons not eligible for active membership, who are interested in the promotion of dairy sanitation. Associate members shall not be eligible to vote, serve as officers, hold the chairmanship of any committee, serve on the Resolutions Committee, or serve as majority members of any committee of this Association.

Any properly qualified person may make application for active or associate membership to the Secretary-Treasurer and if application is accepted by the Membership Committee, said applicant may become an active or associate member, as the case may be, upon payment of the annual dues of five dollars (\$5.00).

OFFICERS

The officers of this Association shall be a President, three Vice-Presidents, a Secretary-Treasurer, and two Auditors, who shall be elected by a majority ballot at the Annual Meeting of the Association, and shall hold office for one year or until their successors are elected. An Executive Board, which shall direct the affairs of the Association when not in Annual Session shall consist of the President, the three Vice-Presidents, and the Secretary-Treasurer.

AMENDMENTS

This Constitution may be amended by a two-thirds affirmative vote of those active members of the Association who register their votes with the Secretary. Any member proposing amendments must submit the same in writing to the Secretary-Treasurer at least sixty days before the date of the Annual Meeting, and the Secretary-Treasurer shall at once notify all members that the proposed amendments will be open for discussion at the Annual Meeting immediately succeeding such notification. After discussion at the Annual Meeting such Amendments, upon a majority affirmative vote of the members in attendance shall be, within 90 days, submitted to the entire membership of the Association by the Secretary-Treasurer. All members voting on such amendments shall, within 60 days after receipt of such notification, register their vote in writing with the Secretary-Treasurer on blanks furnished by the Association. These ballots shall be opened and recorded by the Executive Committee, and the results shall be reported by the Secretary-Treasurer at the next Annual Meeting; and if the amendments are passed they shall become a part of the Constitution from the date of such report by the Secretary-Treasurer at the Annual Meeting.

* Amended October 20, 1932 and October 15, 1936.

BY-LAWS**Adopted October 25, 1913****ORGANIZATION**

The Constitution shall be the basis of government of this Association.

ARTICLE 1**MEMBERSHIP**

SECTION 1. Any person eligible for membership under the Constitution who shall file an official application, accompanied by the first annual membership dues of five dollars, and whose application for membership shall have the approval of the Membership Committee, may become a member of the Association for one year.

SECTION 2. Any person having once become a member may continue membership in the Association so long as the annual membership dues are paid. Any member who shall fail to pay annual dues within thirty days after having been notified by the Secretary that said dues are due and payable, shall be dropped from membership. Any member so dropped may, within ninety days, be reinstated by the Membership Committee, upon application filed in due form and accompanied by the annual membership dues for that year.

SECTION 3. A member of the Association may be expelled for due cause upon recommendation of the Membership Committee, and a majority vote of the members at any annual meeting. Any member so expelled shall have refunded such *pro rata* part of his membership dues as may not be covered by his term of membership.

HONORARY MEMBERS

SECTION 4. Members of the Association may elect as honorary members, at any stated meeting, on the recommendation of the Membership Committee, those whose labors have substantially added to the scientific knowledge of milk supply betterment, or those who have been of pronounced practical influence in the improvement of the milk industry. From such members no dues shall be required. They shall have the privilege of attending the meetings of the Association, but they shall not be entitled to vote.

ARTICLE 2**OFFICERS**

SECTION 1. The officers of this Association shall be a President, a First, Second, and Third Vice-Presidents, a Secretary-Treasurer, and two Auditors, who shall be chosen by ballot at the annual meeting of the Association, and shall hold office for one year, or until their successors are duly elected.

SECTION 2. The Executive Board shall consist of the President, the three Vice-Presidents, and the Secretary-Treasurer.

SECTION 3. The Membership Committee shall consist of the President, the three Vice-Presidents, and the Secretary-Treasurer.

ARTICLE 3

DUTIES OF OFFICERS

SECTION 1. It shall be the duty of the President to preside at all meetings of the Association. He shall examine and approve all bills previous to their payment, appoint all committees unless otherwise directed by vote of the Association, and perform such other duties as usually devolve upon a presiding officer, or are required of him by the Association.

SECTION 2. The Vice-Presidents, in the order of their selection, shall perform the duties of the President in his absence.

SECTION 3. The Secretary-Treasurer shall record the proceedings of the Association. He shall keep a list of members, and collect all moneys due the Association, giving his receipt therefor. He shall record the amount of each payment, with the name and address of the person so paying. He shall faithfully care for all moneys entrusted to his keeping, paying out the same only with the approval of the President, and taking a receipt therefor. He shall, immediately after his election to office, file with the President of the Association a bond in the sum of five hundred dollars, the expense of which shall be borne by the Association. He shall, at the annual meeting, make a detailed statement of the financial condition of the Association.

It shall be the duty of the Secretary-Treasurer to assist in making arrangements and preparing a program for the annual meeting, and to compile and prepare for publication all papers, addresses, discussions and other matter worthy of publication, as soon as possible after the annual meeting.

SECTION 4. The full management of the affairs of the Association when the Association is not in session shall be in the hands of the Executive Board, as provided in the Constitution.

SECTION 5. It shall be the duty of the Auditors to examine and audit the accounts of the Secretary-Treasurer and all other financial accounts of the Association, and to make a full report of the condition of the same at the annual meeting.

ARTICLE 4

MEETINGS

SECTION 1. The annual meeting of the Association shall be held at such time and place during the month of October of each year or at such other time as shall be designated by the Executive Board.

SECTION 2. Special meetings of the Association may be called by the Executive Board, of which due notice shall be given to the members by the Secretary.

SECTION 3. Quorum.—Twenty-five per cent of the membership shall constitute a quorum for transaction of business at any annual meeting. Voting by proxy shall not be permitted.

ARTICLE 5

These By-Laws may be altered or amended at any annual meeting of the Association. Any member proposing amendments must seasonably submit the same in writing to the Secretary-Treasurer, who shall then give notice of the proposed amendments by mail to each member of the Association at least thirty days previous to the date of the annual meeting.

A TRIBUTE



Much credit is due to the guardians of Public Health for their cooperation in the perfection of milk control. The milk supply of metropolitan New York has improved year after year. Today, because of the high standards which have been set and met, the public has new confidence and faith in dairy practices and dairy products.

SHEFFIELD FARMS

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NEW YORK CITY

Diet for the Journal

(Bill Palmer has written to "Dr. Jones" for a prescription diet for the infant Journal. "Dr. Jones"—whose recent broadcast was printed in the last issue of this Journal—is our own Dr. Brooks).

" . . . Glad you liked the report on the journal. Sure there is a January issue, but labor troubles at the print shop and other things we could not control delayed the work, but delivery is to be made Monday. The journal will show the marks of the struggle with the forces of darkness which dog the steps of a new enterprise. However, we are changing printers for the March issue. Your anxiousness to have issues at more frequent intervals is real evidence of your keen interest in the Journal, and this is gratifying. Now you surely know that an infant is slow in getting on its feet, and the Journal, likewise, must creep and crawl before it can get into full stride. Maybe when it is just a little older it may begin to walk more rapidly.

What is the big idea of holding back subscriptions just because we are young? Again, you are well qualified to know that an infant must be kept fed if one hopes for its development. Everything should be done to help it along to become strong and healthy. If this baby journal has to wait for assistance because of a lot of buts and ifs, it may be a little delayed in getting even its first teeth to get a good bite into circulation diet which is a most excellent food. Now you're one of the doctors on the case, so may I suggest that you prescribe subscriptions as an item of its nursing care—with some ads thrown in as dietary necessities. . . . "

(Editor's note: Each member sanitarian can contribute to the infant's diet and help Dr. Jones feed this lusty child).



When you see an Alseco Aluminum Milk Hood, you understand why sanitarians endorse them. Samples of all types will be sent to you gladly. Also, any information that you may desire. Write ALUMINUM SEAL CO., 1347 Third Avenue, New Kensington, Pa.

T.M. Reg.  U.S. Pat. Off.

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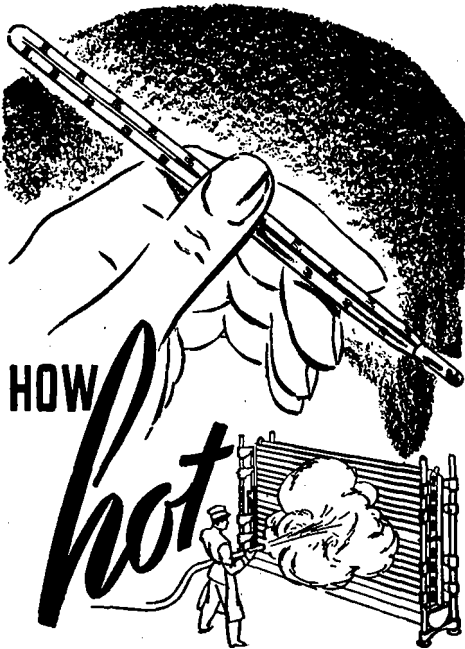
A 135 Unit Vitamin D Milk that is used in thousands of homes today. 135 U.S.P. XI units of Vitamin D in every quart. A safe and dependable source of the "Sunshine" vitamin for the entire family.

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A "400" unit Vitamin D Milk for babies under 2 years and special cases where the physician believes an extra measure of vitamin protection to be desirable. This milk is prepared with IRRADIATED ergosterol and contains 400 U.S.P. XI units of Vitamin D per quart.

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IS LIVE STEAM?

MAKE this simple test and see for yourself. A thermometer placed against the steam nozzle may read 200° F... but only one foot away it will drop to 136° F. or lower. Equipment must be heated to at least 180° F. for fully 2 minutes to really kill bacteria.

Diversol takes the guesswork out of sterilizing . . . kills bacteria quickly and surely at

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Write today for Research Bulletin on the comparative efficiency of heat versus chlorine sterilization.

MAKE THIS TEST

200° F AT NOZZLE

185° F 2" AWAY

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Place a thermometer at varying distances from the steam hose nozzle. See how quickly temperature drops below minimum necessary to kill bacteria.



DIVERSOL

KILLS BACTERIA IN COLD WATER

Coming Meetings

Interstate Junior Livestock Show, San Francisco, Cal., Mar. 21-25.

Public Health Association of New York City, April.

Dairy Products Association of the Northwest, St. Paul, Minn., April.

Ohio Federation of Public Health Officials, Columbus, Ohio, April.

American Chemical Society, Dallas, Tex., Apr. 18-21.

American Water Works Association, New Orleans, La., April 24-28.

American Institute of Nutrition, Baltimore, Spring.

Georgia Public Health Association, Atlanta, Ga., May.

Iowa Public Health Association, Des Moines, Ia., May.

Association of Food and Drug Officials of the South Central States, Biloxi, Miss., May.

Pennsylvania Public Health Association, Harrisburg, Pa., May.

South Carolina Public Health Association, Myrtle Beach, S. C., May 23-25.

American Medical Association, San Francisco, Cal., June 13-17,

National Conference on Weights and Measures, Washington, D. C., June.

Western Branch, American Public Health Association, Portland, Ore., June 6-8.

National Education Association, New York, N. Y., June 26-30.

American Veterinary Medical Association, New York, N. Y., July 5-9.

New York State Dairy and Milk Inspectors, Rochester, Sept. 14-16.

American Public Health Association, Kansas City, Mo., Oct. 25-28.

SUPERVISING . . .

The Sealtest System of Laboratory Protection was formed by a group of leading dairy and ice cream companies for the purpose of unifying and improving the scientific supervision over their products. In this System are more than 100 laboratories and several hundred technicians. Its methods and standards are under the direction of some of the nation's foremost food scientists. Both the member companies and the Sealtest Laboratories are under the same ownership.



SEALTEST, INC., 120 Broadway, New York



INGREDIENTS FOR THE STANDARD NUTRIENT AGAR

BACTO-PEPTONE is recommended in "Standard Methods of Milk Analysis" for use in preparing nutrient agar for routine plate counts of bacteria in milk. In solution Bacto-Peptone is sparklingly clear and has a reaction of pH 7.0.

BACTO-BEEF EXTRACT is also recommended in "Standard Methods" as an ingredient of the standard nutrient agar. This product has a reaction of pH 6.8 in solution.

BACTO-AGAR is a high grade product which may be used with Bacto-Peptone and Bacto-Beef Extract without adjustment of the reaction or filtration of the medium.

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