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Editorials

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Order Out of Chaos

The increasing public-health mindedness of the people has been finding at least one avenue of expression through the enactment of more effective programs for the sanitary production, processing, and distribution of milk and other dairy products. As one community after another inaugurated such control, standards for product and process were established which seemed adequate for the local conditions. Milk control islands, so to speak, came into existence in scattered localities all over the country. The continuation of this sort of development has led to an increasing heterogeneity in standards of product, requirements for production, and specifications for processing. Sometimes, those of neighboring communities are contradictory, frequently they are inconsistent, and usually they are confusing in their variety and exaggerated individuality. The situation is even more confusing where the local requirements are not printed, or even if available, are interpreted by the unpredictable impulses of the local enforcement officer.

Compliance with the local requirements may be a needlessly costly undertaking. In the case of milk production on a milk shed covered by conflicting regulations, the farmer may find himself in the predicament of the fabled chameleon (a lizard which changes its color to match its environment) which got on a Scotch plaid. It is even more expensive for an equipment manufacturer to provide special, non-standard types of machinery in a territory where aggressive individualism is nonconforming, expressive, and authoritative.

In an effort to alleviate some of these conditions, the International Association of Milk Dealers organized its Committee on Simplified Practice to help in securing agreement within the organization on uniform dimensions and certain standards for equipment and appurtenances. Secretary Hibben of the International Association of Ice Cream Manufacturers has pointed out (1) the industrial hardship of arbitrary and conflicting regulations, and urged the adoption of some procedure that would make equipment available that would be approved by all health officers. He stated that some health officials refuse to approve or condemn a piece of equipment until after it has been installed. Some suddenly condemn a piece that has been in approved operation for years. He proposed that a joint committee of the ice cream manufacturers, the supplies association, and the milk sanitarians set up a program for approval of equipment at its source of manufacture so that its stamp of approval would be acceptable to the different city, county, and state health departments.

The late President Calvert of the Dairy Industries Supply Association urged the International Association of Milk Sanitarians (2) "to join with us in an attempt to set up some forum where there will be an exchange of opinion on the details of construction and operation of dairy equipment so as to avoid the helter skelter, hit and miss method that now prevails." His association organized a Technical Committee through which they sought to establish cooperation in solving this type of their problems.

To implement these reasonable presentations, the Committee on Sanitary Procedure was appointed last year by President Tolland of the International Association of Milk Sanitarians to cooperate with the industry in a more general program of standardizing details of milk plant equipment. The first report of the work of this collaboration (3) showed that it was possible to secure an agreement on the design of recessless pipe unions, tees and crosses, bends, and union nuts for connecting thermometers to vats and sanitary pipe lines, that would meet all health department regulations. This representative and highly qualified committee held that it could "accept" a piece of equipment as being of the best possible design in the light of current knowledge, but that this action did not assume that these designs were permanent. An example of the effect of this policy of acceptance of outstanding designs on the stimulus to make further improvement was the immediate invention of an ingenious and inexpensive union nut for attaching indicating thermometers to vats and pipe lines. The success attendant on this initial action is inducive for these collaborative committees to extend their studies to other types of equipment.

The policy of the Committee on Sanitary Procedure has been to review only those designs which are submitted to it by the trade. It would seem that in the light of the above developments such conservatism is not warranted. This committee is composed of men from all parts of the country and from both the official and industrial aspects of quality and regulatory control, interested in and thoroughly conversant with all the demands on dairy equipment. They know the kind of service that is required of equipment—the needs of operations, the type of job that should be done, the wants of the health officer. They also know equipment, its limitations and possibilities. They are strategically situated to set up design and performance objectives for manufacturers of equipment to attain. The latter can do a more inelligent job when they understand clearly what is wanted. The old adage that a problem defined is already half solved is true in this instance also.

So it is hoped that this Committee will take the initiative, and announce sanitary and performance principles that should be incorporated in the design of every kind of equipment that is used in dairies. It should not set up specifications. These should be left to individual initiative and competitive effort. We do not want regimentation. Its function would be twofold, namely, to announce desirable principles that should be incorporated in design, and to accept and publicize those designs which it considers to be satisfactory. There seems to be no sound reason why the combined intelligence of this committee, collaborating with committees from the trade organizations, should not chart the course, so to speak, of desirable development, and save the industry from futile journeyings and costly groundings. Particularly valuable would be its service in facilitating the production of equipment of the kind that the industry and the health officer really needs.

1. Some sanitary problems in the ice cream industry, by R. C. Hibben. J. Milk Technol. 1 (3) 43 (1938).
2. Standardization of rulings on equipment and supplies, by H. S. Calvert. *Ibid.* 1 (2) 10 (1938).
3. Report of the Committee on Milk Plant Equipment and Committee on Sanitary Procedure, by W. D. Tiedeman, Chairman. *Ibid.* 1 (7) 4 (1938).

J. H. S.

Connecticut Association of Dairy and Milk Inspectors

It is with great pleasure that we welcome the Connecticut Association of Dairy and Milk Inspectors into the growing family of dairy associations that are affiliated with the International Association of Milk Sanitarians through the *Journal of Milk Technology*. This influential group of eastern milk inspectors took action at their annual meeting on January 10th to designate this Journal as its official organ. The field of dairy technology and supervision (both official and industrial) is broadening and becoming increasingly technical. Every person engaged in this work needs inspiration as well as information from other workers. We are sure that our new associates will make valuable contributions to knowledge in this field, and that the service rendered by the JOURNAL OF MILK TECHNOLOGY will be strengthened and improved.

J. H. S.

Bang's Disease Eradication

The plan for indemnifying owners for animals which react to the agglutination blood test for Bang's disease becomes effective under federal and state supervision on May 1, 1939. Both the tube and plate tests are being used in testing cattle under this project. The general operative plan is practically the same as that already in force for the eradication of tuberculosis and paratuberculosis, whereby the owner, the state, and the federal government respectively assume one-third of the difference between the appraised value and the salvage value at slaughter of condemned animals. Last fall, all breeding cattle over 6 months of age in 300 counties of 22 states had been tested. In 4 states, more than half of the breeding cattle are under supervision in the federal-state campaign which has been in force since 1934. During the month of December 1938, the blood agglutination tests were completed on 587,529 cattle, of which 17,302 were found to be reactors. At that time, there were a total of 1,202,195 herds, and 10,280,003 cattle under supervision, and an additional 1,015,544 cattle on the waiting list. The results of the program have shown that in the high majority of herds, Bang's disease yields to systematic control efforts.

J. H. S.

Standard Methods for the Examination of Dairy Products

The American Public Health Association announces that the new 7th edition of Standard Methods for the Examination of Dairy Products should be available for purchase early in April. On July 1, 1939, we are to begin the use of the new standard agar medium in which the peptone has been changed from a meat-digest peptone to a casein-digest peptone. A small amount of glucose is to be added, and where dilutions are greater than 1 : 10, there is to be added 1 percent of skim milk or equivalent amount of spray process powder. "The purpose in adding the milk to the higher dilutions is to eliminate the type of discrepancy in count that is produced by the presence of milk solids in plates made by the direct addition of milk or in dilutions as low as 1 : 10". Laboratorians are cautioned to watch carefully their incubation temperatures to make sure that they do not exceed the specified standard temperature of 37° C. (98.6° F.).

The several phosphatase tests will be included in an appendix, giving the latest directions for the various types of the more promising technics. No comparisons have yet been made concerning them, and therefore not any of them should be regarded as standard.

The new edition of this valuable book contains so many improvements and suggestions concerning the better use of laboratory methods that it should be in every laboratory engaged in milk work.

J. H. S.

Engineering Problems in Milk Sanitation*

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Introduction.—Until fairly recently sanitary engineers have not considered that milk sanitation was a problem with which they should much concern themselves. Conclusive evidence of this may be seen in the past curricula of sanitary engineering courses. Practically none of the graduate sanitary engineers in the field today included a study of milk sanitation in their undergraduate courses.

Indeed, milk sanitation has in the past been considered to be a problem for veterinarians, bacteriologists, and epidemiologists rather than for engineers. Milk is an animal product and its sanitation is related to the health of animals. Therefore milk sanitation is a problem for veterinarians. It is advisable to make bacteriological analyses of milk. Therefore milk sanitation is a problem for bacteriologists. Epidemics occur as a result of unsafe milk supplies. Therefore milk sanitation is a problem for epidemiologists. Thus has run the philosophy of milk control heretofore and such was the status of milk sanitation until twenty years ago and even later. At that time only one or two state sanitary engineering divisions were interesting themselves in milk control. In fact, the states in general were doing little, if any, real milk sanitation work. Actual enforcement of milk regulations was then, and still is, primarily a function of city health departments, but not a single city at that time employed a sanitary engineer in connection with milk sanitation work.

As time has gone on, however, it has become increasingly apparent that milk sanitation is not exclusively a problem for veterinarians, bacteriologists, and epidemiologists. The conviction has steadily grown that the pasteurization of all market milk supplies, an essentially engineering problem, is a vital necessity. This is because we have learned that no other measure and, in fact, no combination of other measures, gives adequate protection.

Tuberculin testing and other tests of the health of animals nearly, though not entirely, remove the bovine tuberculosis menace and reduce the danger from undulant fever, but these measures do not protect against streptococcic udder infections nor against other milk-borne disease organisms which may enter the milk after it has been drawn from the udder.

Health examinations of employees are valuable but fail to eliminate completely the typhoid fever carrier, and are relatively ineffective in preventing the contamination of milk with the organisms of septic sore throat, scarlet fever, and diphtheria. The cleaning and sterilization of containers and utensils offer valuable protection against disease organisms which may reach the milk from equipment, but cannot eliminate disease organisms which enter the milk before it comes in contact with the equipment, nor prevent subsequent contamination of the milk through spittle droplets, dust, or flies.

In short, pasteurization is the only public health measure which, if properly applied, will adequately protect against all infectious milk-borne disease organisms which may have entered the milk prior to pasteurization. Obviously the milk must be protected against recontamination.

This growing conviction of the all-importance of pasteurization has been reflected in an increase in the percentage of milk pasteurized. Thus, while at the beginning of the century the percentage of milk which was pasteurized in this country

*Presented at 1939 Annual Meeting, American Society of Civil Engineers.

was negligible, by 1936 the percentage had risen to 83 percent for communities of 10,000 population and over, and to nearly 75 percent for communities of 1,000 population and over. Such acceptance by the people of this country of the milk sanitation advice of their public health authorities should be profoundly stimulating.

Now the use of the pasteurization process at once poses problems of the design and operation of pasteurization equipment, and it is at this point that the wisdom of adding sanitary engineers to the milk sanitation staff becomes sharply apparent. This has become particularly true since the advent of automatic pasteurization systems, as will be made clear later in this paper when we come to discuss the problems of thermostatic control, milk-flow stops, valve design, air and foam heater design, regenerator design, and others.

However, the function of the sanitary engineer is not limited to the immediate problem of pasteurization. His work really begins at the producing farm. In milk control and processing, the more important items to which the sanitary engineer should devote attention are as follows:

Dairy barn and milk house design. One of the first items with which he should concern himself is the design of the dairy barn and milk house, the drafting of plans which will insure that there is adequate space to prevent contamination due to overcrowding, adequate light to insure cleanliness morale, adequate ventilation to prevent the absorption of odors and flavors and the drip from condensation on the ceiling, proper construction of floors and walls to promote easy cleaning, and proper arrangement to facilitate the required sequence of operations.

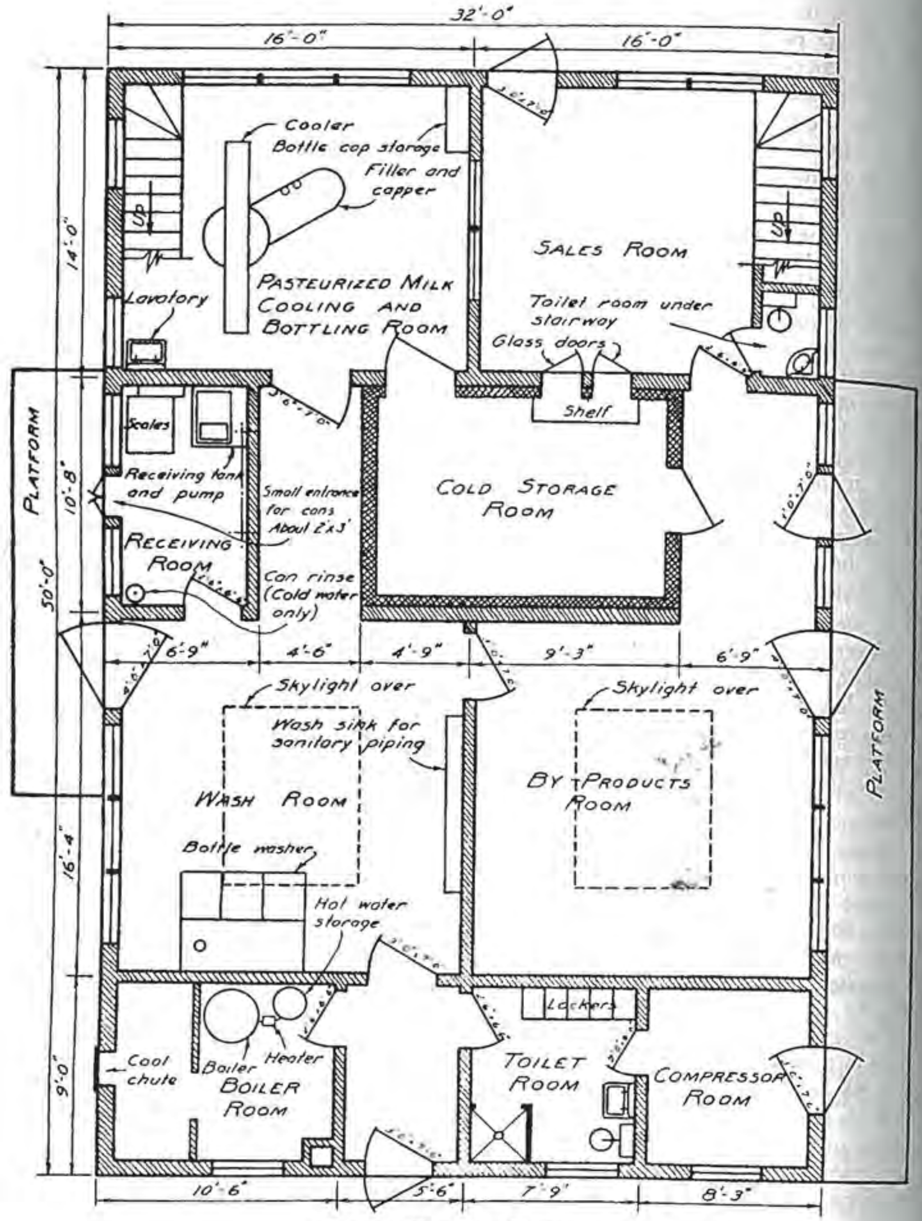
Dairy farm water supplies. The next item which should receive the attention of the sanitary engineer is the design and construction of dairy farm water supplies. Six and one-half pages of the Public Health Service Milk Code are now devoted to this item alone. The subject is important because of the intimate relationship between dairy farm water supplies and the process of milk production. Contaminated water supplies would mean that the slightest relaxation or accident in the bactericidal treatment of milk utensils and equipment which had been washed in the dairy farm water supplies might produce disaster. Local milk inspectors have paid insufficient attention to farm water supplies.

Dairy farm excreta disposal. In most cases, water carriage of excreta is not resorted to on dairy farms. Instead sanitary privies of the pit type are widely used, and while such privies are relatively simple their design and construction are within the province of the sanitary engineer. In some cases, too, farms desire to use a water carriage system of excreta disposal, and in these cases the sanitary engineer should be called upon to give advice.

Pasteurization plant design. In pasteurization plant design we have the problems of adequate light and ventilation, proper construction of floors, walls, and ceilings, proper drainage, proper layout to separate the milk receiving and utensil cleaning processes from the pasteurization and subsequent operations, so as to avoid cross-contamination, and the proper design and installation of milk receiving, filtration or clarification, pasteurization, cooling, and bottling equipment.

The engineering divisions of several state boards of health have devoted some attention to the drafting of plans for pasteurization plants. Figure 1 shows a plant developed by the sanitary engineering division of one of the southern states, namely, North Carolina. In that state, the division offers its services to milk distributors who are contemplating the construction or reconstruction of a plant.

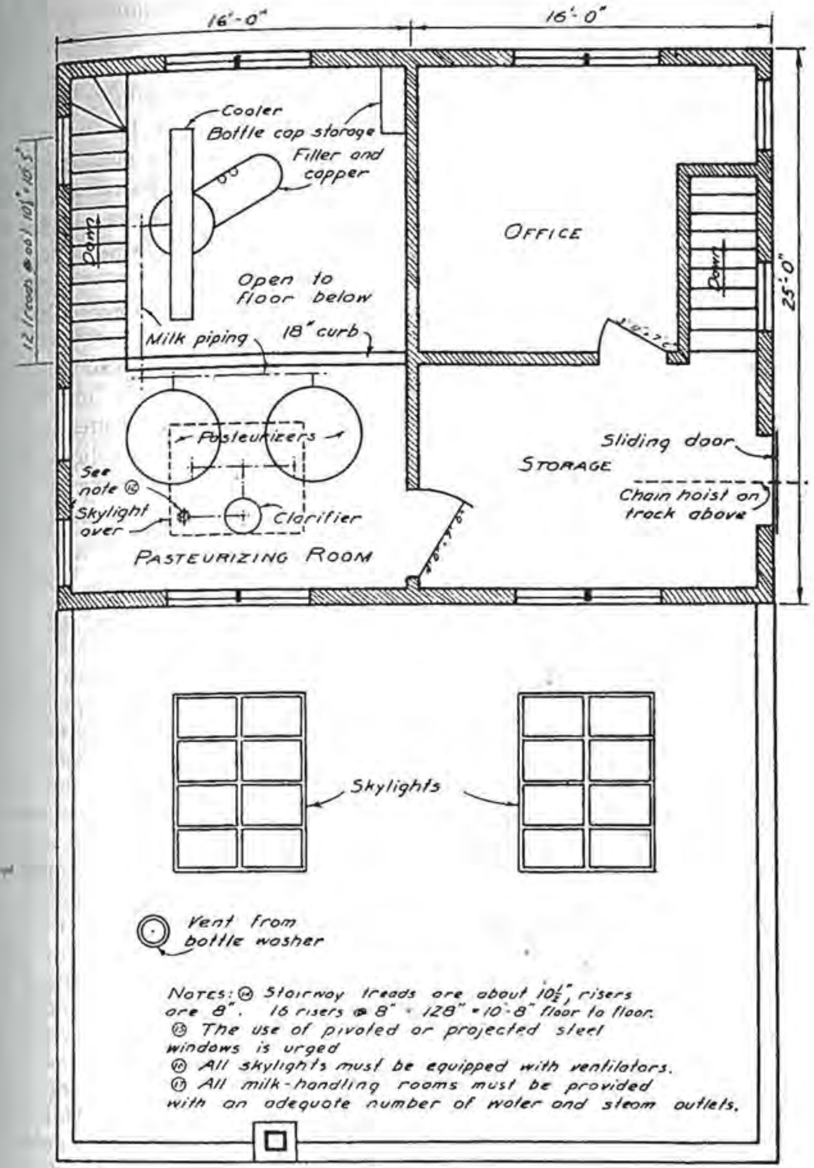
This calls attention to another and even more recent development. In the 1939 edition of the Public Health Service Milk Code there will appear the requirement that plans for all dairies and milk plants which are hereafter constructed, recon-



First Floor Plan

Figure 1

Lay-out of Milk Pasteurization Plant



Second Floor Plan

Figure 1

Lay-out of Milk Pasteurization Plant (continued)

Notes: 1 Floors shall be of concrete, tile or other impervious material and shall slope to trapped drains at the rate of about 1/4" per foot. Drains should be located at the ends of rounded gutters running along the base of the walls. Floors should slope from the center of a room toward these gutters. This method of floor drainage will insure a dry floor in the center of a room, which is the most travelled portion.

2 Walls and ceilings should be finished with tile or hard portland cement plaster.

(Valuable information on concrete and cement plaster may be obtained from the Portland Cement Association, 33 West Grand Ave., Chicago, Ill.)

3 All openings into the outer air shall be screened with 16-mesh wire screening to prevent the entrance of flies. Screen doors must open outward.

4 All doors must be self-closing.

5 Powerful fans should be installed at the outside entrances to the receiving room, wash room and loading vestibule. These fans should be operated so as to prevent the entrance of flies while these entrances are being used.

6 Separate equipment must be provided for the handling of sour milk products.

7 All milk piping must be at least 1½" in size.

8 Equipment must conform to the specifications of the United States Public Health Service Milk Ordinance and Code.

9 Refrigeration equipment should be selected before construction of cold storage and compressor rooms is begun.

10 Joints between floor and wall should be rounded to a radius of about one inch.

11 Floors should be reinforced with metal grid plates at points of hardest service, especially in the receiving and cold storage rooms and in the loading vestibule.

12 The milk pipe line from the receiving room must be brought through the floor of the pasteurizing room in such a way that floor drainage will not drip down through the opening and contaminate equipment in the receiving room below. A piece of 4" cast-iron pipe cast in the floor and projecting about 12" above the pasteurizing room floor is a good conduit.

13 The clarifier must be connected to the pasteurizers by sanitary milk piping and connections.

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structed, or extensively altered shall be submitted to the health officer for approval, and the further requirement that in the case of milk plants signed approval shall be obtained from the state health department. This requirement will parallel the similar requirement long existing in many states that plans for water and sewage structures must be approved by the state health department. It is reasonable to believe that in the future it will be a routine matter for sanitary engineering divisions of state boards of health to be required to pass upon all plans for pasteurization plant construction or reconstruction.

Pasteurization plant water supplies. At first thought it might be assumed that nearly all pasteurization plants use public water supplies exclusively and therefore do not require the special attention of the sanitary engineer, since public water supplies are presumably already within his jurisdiction. However, a number of pasteurization plants are located beyond city limits and have their own independent water supplies. In addition, a large number of plants make dual use of both an independent and a public water supply, and frequently have them cross-connected. Therefore each such plant should be studied by the sanitary engineer to determine whether such independent water supplies as are used are safe, and whether there is any cross-connection with the public water supply.

Plumbing. Pasteurization plant plumbing constitutes another important sanitary engineering problem. In 1935 W. Scott Johnson read an excellent paper on plumbing hazards in pasteurization plants before the Engineering Section of the American Public Health Association. He described the results of a plumbing survey of six pasteurization plants located in the city of St. Louis. He reported the finding of 210 separate plumbing defects involving 28 different kinds of milk plant equipment and including direct pipe connections between potable water supplies and sewage or contaminated water supplies, potable water inlets submerged so as to permit back siphonage during intervals of negative head, sewer lines located above pasteurizers or other milk processing equipment, instances of potential aerial pollution, and faulty drinking fountains.

Pasteurization plant excreta and waste disposal. This problem does not often engage the attention of a sanitary engineer, as in the majority of instances pasteurization plants are connected with a public sewer. However, some plants are located outside the public sewer districts and in these instances special sewage treatment plants must be designed. This may require experience beyond the ordinary problems related to excreta disposal as special consideration must often be given to the treatment of dairy wastes other than excreta. In the past the solution of this problem has often been unsatisfactory both because of the composition of dairy wastes and because of their extreme variability in amount and kind during a single 24-hour period. For example, within a period of a few hours, the waste may vary from buttermilk vat drainage of low pH to the relatively caustic drainage from a bottle washing machine.

Design and operation of regenerators. We have here a problem which involves an engineering study of relative pressures in various parts of a heat exchange system. A regenerator, as understood by the milk industry, is simply a heat exchanger which is designed to permit the incoming cold raw milk to recapture some of the heat from the outflowing hot pasteurized milk. The regenerator may be either of the "tube within a tube" type with the heat exchange taking place between the milk in the inside tube and the milk between the inside and the outside tubes, the latter flowing counter-current to the former; or the regenerator may be of the plate type, which consists of a series of adjacent plates separated by gaskets and with a flow system so designed that the cold raw milk and the hot pasteurized milk flow in alternate layers between the plates. Again either of these two constructions may be employed but so arranged that the pasteurized milk transfers its heat to a circulating water medium which in turn warms the raw milk.

In either case the problem arises that if leakage develops in the metal separating the raw from the pasteurized milk, or separating the milk from the heat transfer medium, and simultaneously the raw milk is under higher pressure than the pasteurized milk or the circulating medium, then the raw milk may contaminate the pasteurized milk. For example, such higher raw milk pressures are often encountered because of the practice of placing the milk pump upstream from the raw side of the regenerator.

The solution, obviously, is to develop design, installation, and operation specifications to insure that the pasteurized milk side of the regenerator is under higher pressure than the raw milk side whenever there is any raw milk in the regenerator, including not only the routine flow period but also at the beginning of the day's run and during interruption periods, when the pressure picture may be quite different. Such specifications have been worked out in detail and described in Public Health Reports (1).

The solution involves not only the proper placing in the flow line of milk pumps and heat transfer medium pumps so as to take proper advantage of the differential between suction and discharge pressures but also proper elevations for the free milk levels, upstream from and downstream from the regenerator so that proper relative pressures may obtain during shutdowns. In addition, in certain designs it is necessary that hot water, chlorine solution, or previously pasteurized milk must, at the beginning of the day's run, be introduced into the pasteurized milk side of the regenerator before raw milk is admitted to the raw milk side. Otherwise the raw milk side may at this time be above atmospheric pressure and the pasteurized milk side at atmospheric pressure. Figure 2 shows an illustrative flow chart designed to insure that the relative pressures in the regenerator will always be such as to prevent contamination of the pasteurized milk by the raw milk.

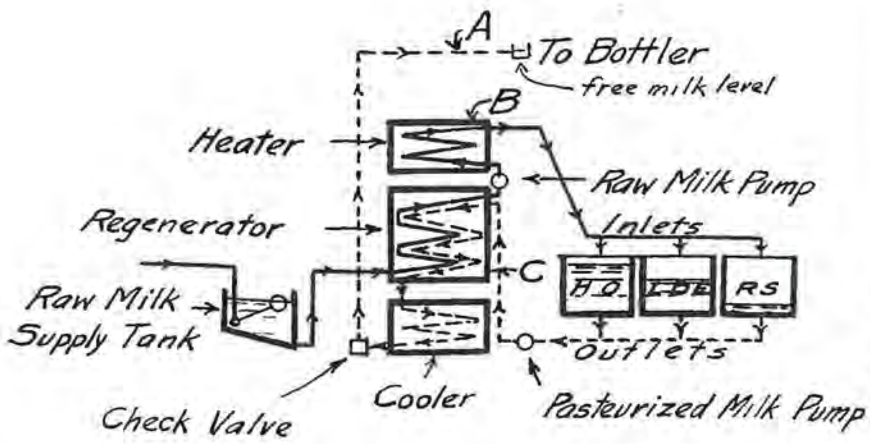

FIGURE 2

Example of Layout to Insure Proper Regenerator Pressures

Notes:—

——→——→—— = *Raw Milk*
– ← – – – – – – ← – = *Pasteurized Milk*

Raw Milk Supply Tank overflow is lower than lowest raw milk point in regenerator, hence insures negative raw milk pressures.

Raw Milk Pump sucks raw milk through regenerator to heater and holders.

Pasteurized Milk Pump forces pasteurized milk through regenerator, cooler and check valve to Point A in pasteurized milk line which is above highest raw milk point B by at least 3% of difference in elevation between B and lowest raw milk regenerator point C, thus maintaining proper relative pressures during shutdowns.

Check Valve prevents reduction of pasteurized milk pressures during shutdowns.

Special problems relating to the requirement of the definition of pasteurization that every particle of milk shall be brought to the full pasteurization temperature and held thereat for the full holding time. This brings us to the aspect of milk sanitation which has introduced the most serious sanitary engineering problems. Only a few years ago this subject seemed to offer no problem at all. The pasteurization of milk was considered to be an extremely simple process, and few milk control officials thought it involved engineering problems. Milk was merely introduced into a simple vat, then brought to the required temperature by means of a revolving hot water coil, or otherwise, held for 30 minutes, and then discharged. Temperature was shown by a simple indicating thermometer.

Then health authorities began to ask for evidence as to what had been the temperature of the batches of milk which were pasteurized during the intervals between inspections. So recording thermometers were substituted for the indicating thermometers. Shortly it was discovered that the recording thermometer was not as reliable an instrument as the indicating thermometer, and that the actual milk temperature was frequently seriously below the recorded temperature. So we began to require the use of both indicating and recording thermometers, the more reliable indicating thermometer to serve as a check upon the recorder.

Simultaneous temperature differences in the holder, and close-coupled or flush-type valves. It was discovered that the temperature of the milk at the recording

and indicating thermometer bulbs might be and frequently was higher than the temperature of the milk in other parts of the holder, e. g., the zone between the face of the outlet valve and the main body of the milk. The milk in such outlet zones was frequently found to be 10° F. or more below the temperature of the main body of the milk. As a result of this finding, the requirement was inserted in the milk code recommended by the Public Health Service that the design of the holder shall be such that simultaneous temperature differences between various points in the holder will be limited to a tolerance of not over 1° F. Furthermore all outlet valves are required to be of the flush or close-coupled type, that is, so designed as to bring the face of the outlet valve close enough to the main body of the milk in the vat to eliminate the "cold pocket" at the outlet.

Figure 3 illustrates a close-coupled valve of satisfactory design for holders in which properly designed agitators are employed, and sweep the milk currents into the outlet.

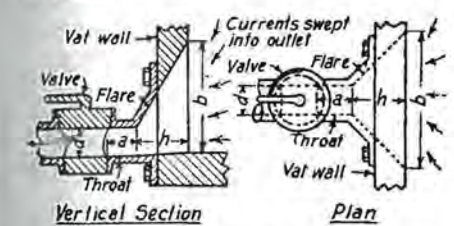

FIGURE 3

Close-Coupled Side Outlet Valve Connected to Holder. Showing Design Requirements.

d = diameter of outlet.
h = depth of flare.
a = greatest distance from valve seat to small end of flare (shall be not more than 1½d).
b = smallest diameter at large end of flare (shall be not less than h + d).

Leak-protector valves. It was also discovered that since practically all milk valves were of the metal seat type, and since practically all metal seat valves leak sooner or later, owing to such causes as scoring during cleaning, there was real danger that raw milk in the vat would leak out through the outlet valve into the pasteurized milk line before it had been completely pasteurized. It was also discovered that raw milk might leak through the inlet valve and recontaminate the milk in the vat while it was being pasteurized. So the Public Health Service inserted a requirement in its recommended Milk Code that all inlet and outlet valves must be of the leak-protector type, that is, so designed as to divert to the outside, by means of leak grooves or otherwise, any leakage which attempted to pass the valve face.

Satisfactory types of valves were developed both by the Public Health Service engineering staff and by the industry and are described on pages 88 to 97 of the Public Health Service Milk Code. Figure 4 illustrates one type of leak-protector valve.

Milk foam. Approximately simultaneously with the above development, it was also found that the foam which may be formed on the surface of the milk in a vat is likely, unless preventive measures are employed, to be colder than the main body of the milk, and this fact not be evident from the record of the temperature shown on the recording thermometer chart. Foam temperatures as much as 20° F. below the temperature of the milk proper have been encountered during studies made by the Public Health Service. Therefore it became necessary to develop means of heating or dissipating the milk foam. Our studies developed the fact that while radiant or convection heating of the air above the milk by means of electric or enclosed steam heaters was not very satisfactory because of the tendency of the dry hot air to rise away from the foam and thus not heat it, live steam admitted to the air space above the milk tended not only to heat the foam as it was formed but also to dissipate it. It was necessary, of course, to design the apparatus so as to prevent the discharge into the milk of either steam-line sediment or a significant amount of steam condensate. Furthermore, since the amount of steam required was very small, it was necessary to in-

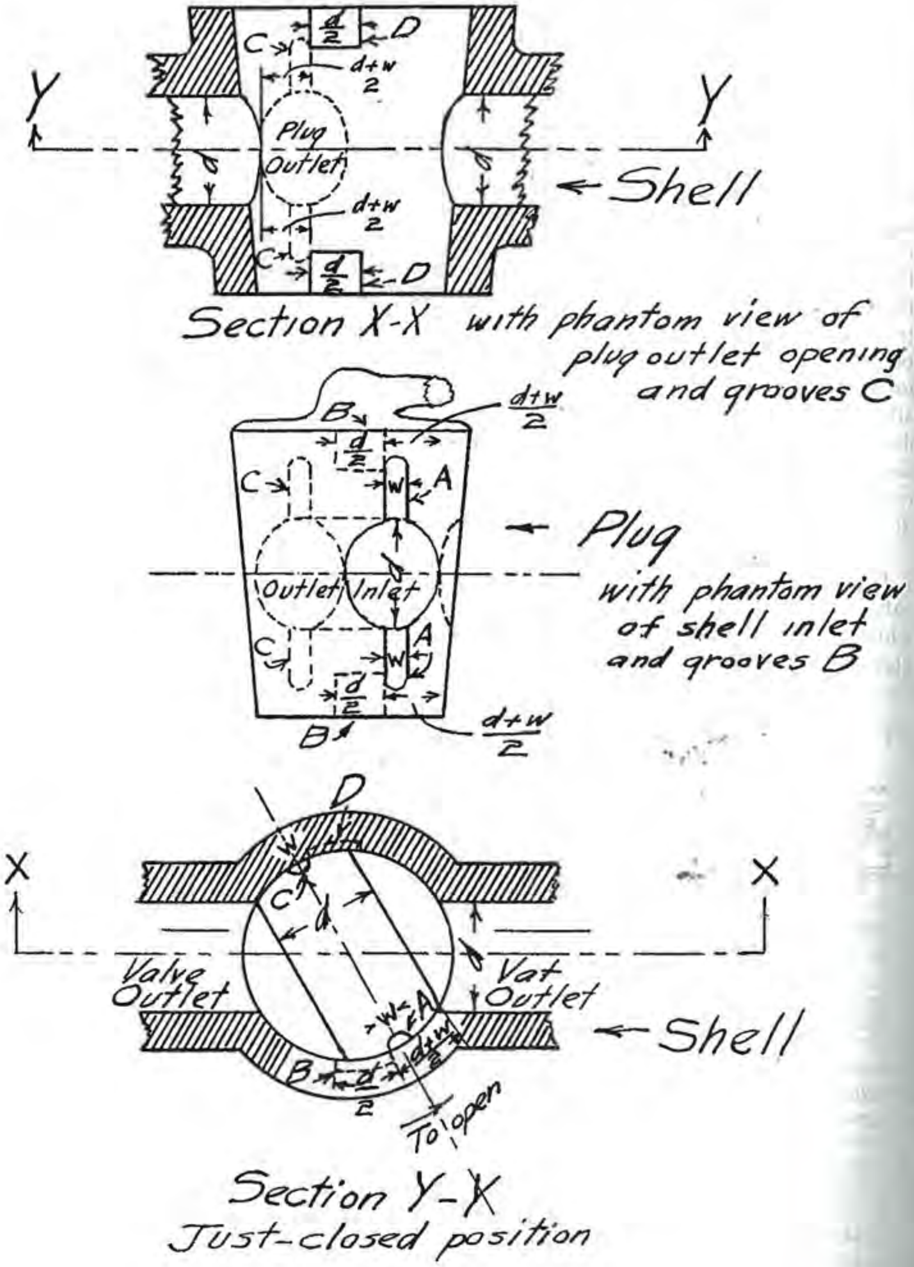

FIGURE 4

Example of Leak Protector Valve (Outlet Type)

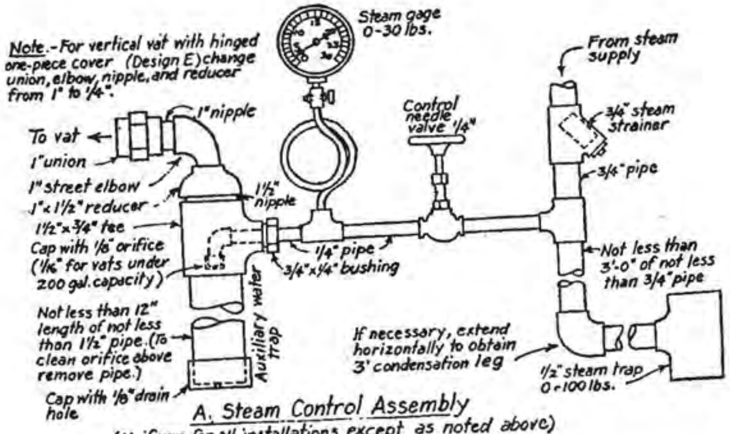

FIGURE 5

Air Space Heater to Heat and Dissipate Foam

A. Assembly

crease the sensitivity of the throat of the throttle valve to the maximum by placing a resistance in the line in such manner as to reduce the differential pressure on the two sides of the valve. This took the form of a small orifice placed downstream from the valve.

Figure 5 illustrates an air space heater as developed by the Public Health Service.

Insurance of full holding time in manual vats. Further studies showed that even when the recording thermometer charts indicate that the milk in the vat had been held at the required temperature for the full holding time it might nevertheless be true that the holding time is less than the required holding time. Suppose, for example, that the milk is discharged from the pasteurization vat at the pasteurization temperature. It may take 10 minutes or longer for the descending milk level to drop to the recording thermometer bulb. During this interval the recording thermometer will continue to show the pasteurization temperature. Later, when the milk control official inspects the charts, which are required to be preserved for his inspection, he may find charts which show 143° F. for the full required 30-minute period and yet some of the milk will have been discharged from the vat to the cooler after only 20 minutes holding. For this reason the Public Health Service Milk Code

B. Installation

now requires that if cooling is begun in the holder after the opening of the outlet valve, or is done entirely outside of the holder, the recording thermometer charts shall show not merely 30 minutes, but 30 minutes plus the emptying time down to the level of the recording thermometer bulb.

Automatic pasteurization systems. Automatic pasteurization is rapidly replacing manual pasteurization, particularly in the larger plants. This trend, as might be expected, is introducing a whole series of sanitary engineering problems. In the case of the relatively simple manually operated vats, if the design requirements previously described have been satisfied, and if the thermometers show that the pasteurization temperature has been applied for the full holding time, the operator can open the outlet valve and discharge the milk with the assurance that it has been properly pasteurized. If the recording thermometer does not show both the required temperature and the required holding time he can either increase the temperature or the holding time, or both, before opening the outlet valve. The point is that the milk is not discharged to the cooler and bottler until the operator deliberately opens the outlet valve. It is his duty and he always has the opportunity to assure himself that the process has been properly applied before he opens the valve.

In the case of automatic pasteurization, however, both admission to and discharge from the holder are automatic and unless otherwise prevented will take place *even if the milk has not been brought to the proper temperature or held at that temperature for the proper time.* Furthermore, since the holding time is automatically controlled, any temperature failure in the holder would require emergency manipulation of the automatic time control, or diversion of the entire supply back to the heater until the temperature failure had been corrected. This, in the case of batch type holders, would be extremely hazardous because of the quantity of milk which would be required to be repasteurized and the ever-present temptation on the part of the operator to shirk the responsibility in order to save time. In these cases it has been considered fundamentally necessary, in the formulation of the Public Health Service Milk Code, to surround all automatic pasteurizers with all necessary safeguards to insure that the likelihood of either temperature or holding time failure will be reduced to the very minimum.

Thermostatic control. Accordingly the first requirement which has been laid down in the Public Health Service Milk Code is that all automatic systems must be provided with *thermostatic control* of the temperature of the milk entering the holder. This requirement has further been expanded, for purposes of convenience, and in order to avoid what might be termed "hay-wire" pasteurization, to include any system in which the milk is brought to the pasteurization temperature before it enters the holder. Obviously it would be possible to have an operator continuously present at a temperature control valve as a substitute for thermostatic control, but while this might give good results most of the time, it is obvious that the slightest lapse in attention would result in the passing of unsafe milk.

Automatic milk-flow-stops. Since even the best thermostatic control occasionally fails, it was highly advisable to include an additional safeguard which would function at such times and serve as an extra factor of safety. The best such safeguard is a device which will automatically halt the flow of milk beyond the holder if the thermostat fails or if any temperature drop occurs in the holder. It was soon found that such a "milk-flow-stop" could take either of two forms:

(1) An automatic milk pump stop which would automatically stop the milk pump motors whenever the milk temperature dropped below the pasteurization temperature and automatically restart the motors whenever the required milk temperature was again reached, or

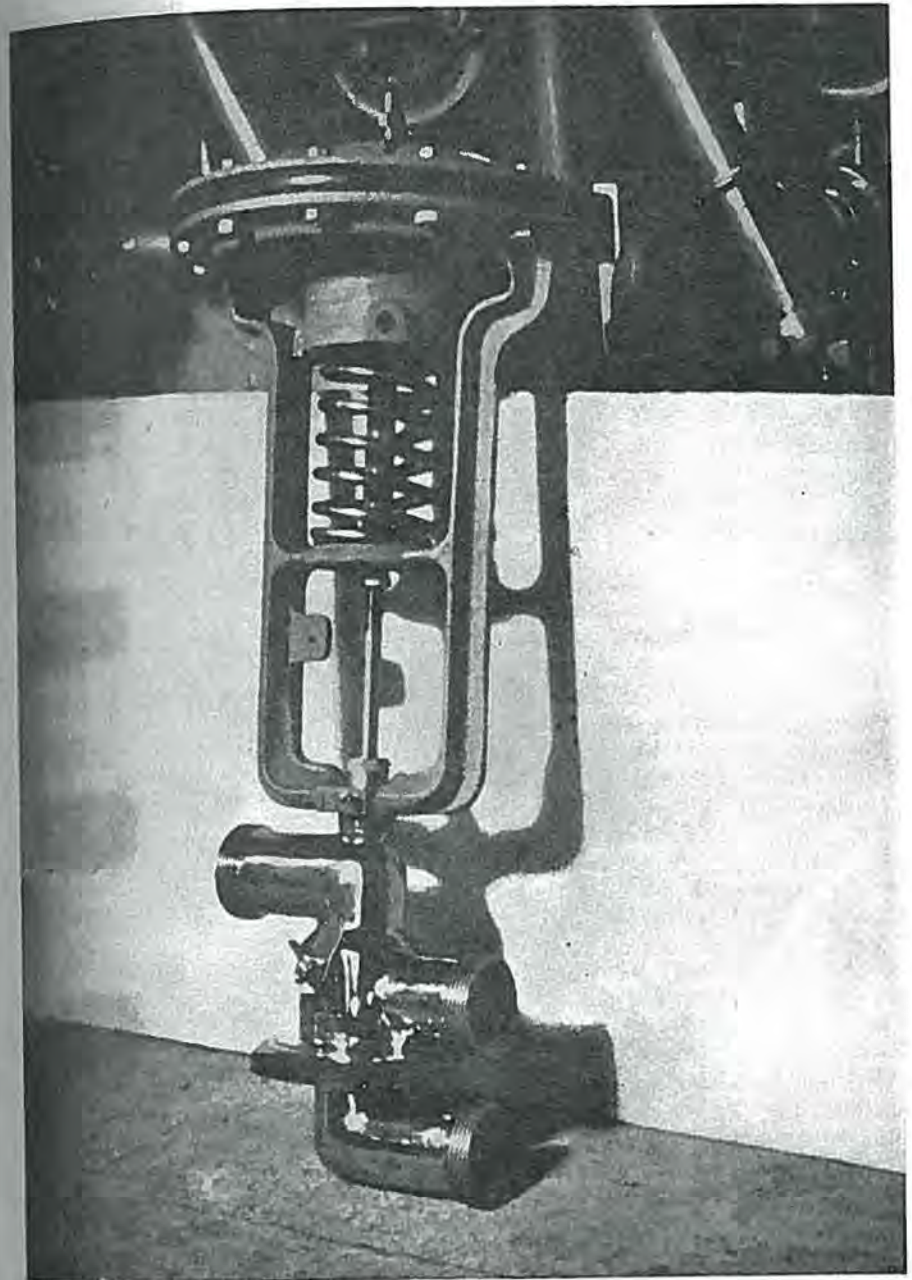

FIGURE 6
Flow-diversion valve

(2) An automatic milk-flow diversion device which would automatically divert the milk away from all downstream points whenever its temperature dropped below the required pasteurization temperature, and automatically reestablish forward flow when the milk again reached the required temperature.

Figure 6 illustrates an automatic flow stop of the diversion valve type.

The requirement that a milk-flow stop be installed immediately brought into focus two collateral problems, namely:

(1) What should be included in the specifications for "milk-flow stops"? and

(2) Where should they be required to be located?

After careful study a set of specifications for milk-flow stops was inserted in the Public Health Service Milk Code. These include (a) the sealing of the milk-flow stop setting so as to insure that any change in the setting will come to the attention of the health officer, (b) the prohibition of manual switches which would permit cutting out a milk-pump stop, (c) the prohibition of any by-pass, (d) required routine daily tests for cut-out and cut-in temperatures, (e) the requirement that failure of the primary motivating power will automatically stop or divert the flow, (f) the requirement of leak-protector features on all flow-diversion valves, (g) the requirement that the actuating bulb of the flow-diversion device shall be located immediately upstream from the valve, and (h) a limitation of thermometric lag, and routine tests required to determine its magnitude.

With reference to the location of the milk-flow stop, it became apparent that if the holder system is so designed that the milk therein can neither increase nor significantly decrease in temperature between the time it leaves the heater and the end of the holding period, the milk-flow stop may safely be located *either upstream from or downstream from the holder.*

If on the other hand the holder is provided with a supplementary heating device intended to insure that all zones will remain at or above the pasteurization temperature, it is necessary that a milk-flow stop be located *upstream from the holder,* as otherwise milk might enter the holder below the pasteurization temperature, be raised to or above the pasteurization temperature during the holding period by the supplementary heating device, and thus pass the milk-flow stop with impunity if it were located downstream from the holder.

Again, if the holder is so designed that some of the milk may drop significantly in temperature before the end of the holding period it is considered necessary that a flow stop be *located downstream from the holder,* as otherwise milk may enter the holder at the pasteurization temperature, drop below it during the holding period, and thus have passed the milk-flow stop with impunity if it were located at the inlet to the holder and not at the outlet.

Finally, if the holder is so designed that the milk in it may either rise in temperature or drop significantly in temperature before the end of the holding period, it is, of course, necessary to require a milk-flow stop both upstream from and downstream from the holder.

Figure 7 illustrates a flow diagram for an automatic 30-minute pasteurizer of the multiple holder type, with a flow diversion valve located upstream from the holder.

It at once becomes apparent that the above specifications are dependent for their effectiveness upon a proper definition of "significant temperature drop". After careful consideration this term was defined in such manner as to allow a temperature drop of not more than 1° F. when only automatically controlled holder heaters are turned on during the holding period, and of not more than 2½° F. even if all automatically controlled holder heaters cease functioning at the beginning of the holding period. Automatically controlled holder heaters are defined as heaters which are connected with an upstream milk-flow stop in such manner as to stop the flow of milk into the holder when the heating medium drops below the temperature required to keep the milk throughout the holder at the required temperature.

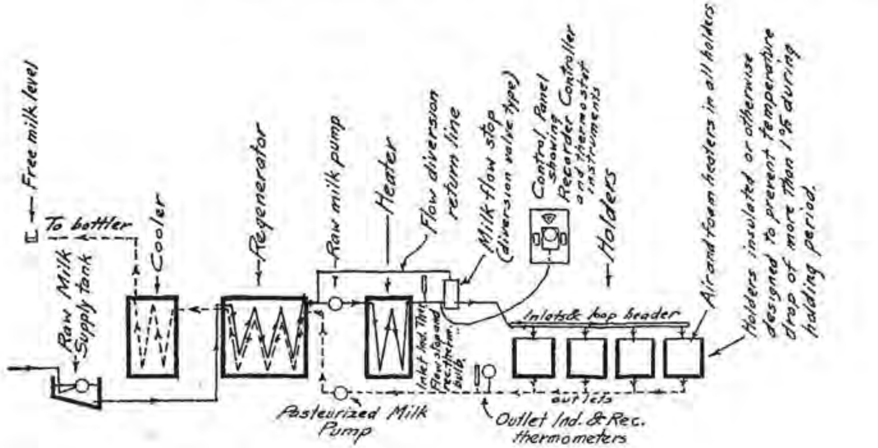

FIGURE 7

Automatic Pasteurization System with Thermostatic Control and Flow Diversion Valve. (diagramatic elevation)

Further study showed the necessity for a number of special requirements for systems in which the milk-flow stop is located upstream from the holder, and other special requirements for systems in which the milk-flow stop is located downstream from the holder. To give the details of these special requirements would undesirably expand this paper.

There are obviously also special requirements with reference to time control for automatic systems. These include requirements relative to the use of constant-speed motors or limited maximum-speed motors on milk pumps and timing devices, the prevention of inter-pocket flow, the prevention of air or gas accumulation in tubular or equivalent stream-flow holders, and the checking of the holding time by means of dye tests, or otherwise, immediately after installation or after any replacement or alteration in design.

Conclusion. Many details have necessarily been omitted in the above discussion, but enough has been said to demonstrate two important facts:

(1) *Milk sanitation is a problem which now requires and will in the future increasingly require the serious attention of sanitary engineers.*

It is rapidly becoming apparent to state boards of health that their sanitary engineering divisions should be related to the problem of milk sanitation. Information collected by the Public Health Service shows that in at least 25 states milk sanitation work is now being done by the divisions or bureaus of sanitary engineering, whereas two decades ago only one or two state sanitary engineering bureaus interested themselves in the problem. A similar tendency is beginning to appear in some of our local health departments. The total number of sanitary engineers engaged in milk control in this country is now:

(a) By the state boards of health—17 full time and 75 part time, and

(b) By local boards of health—14 full time and 36 part time.

This paper should not be understood to imply that only public health engineers should be employed in milk sanitation. That would be as unwise as to insist that only veterinarians, or only bacteriologists, or only epidemiologists, or only dairying graduates should be employed in this field. Nor should this paper be understood to imply that all milk sanitation work must necessarily be under the administrative direction of a sanitary engineer. The capacity for administration does not reside solely in any one profession. If a state board of health employs more than one individual in milk control, the one who shows the best administrative capacity should be placed in administrative charge, irrespective of whether he is engineer, veterinarian, bacteriologist, epidemiologist, or dairy expert.

Nevertheless it seems inescapable, from the facts presented in this paper, that every state health department without exception, should employ at least one sanitary engineer full-time on milk sanitation work and, where possible, the milk control work should be a function of the state sanitary engineering division. Except in the case of large cities which employ their own sanitary engineers, no pasteurization plant should be constructed or reconstructed and no pasteurization equipment should be installed or modified without the approval of the milk sanitation engineer. His services should be available to all city health departments in connection with the interpretation of any item of sanitation which is of an engineering character, and he should be prepared to give the city health departments advisory assistance in connection with the testing of holding time, thermometric lag, the approval of indicating and recording thermometers, milk-flow stops, regenerators, etc. In addition, the services of the sanitary engineer should be available on all other items previously referred to in this paper, such as the sanitation of water supplies, excreta disposal, dairy wastes disposal, etc.

(2) *Sanitary engineers should be adequately trained to discharge their milk sanitation functions.*

It has been emphasized in this paper that the sanitary engineers of this country face a grave responsibility in connection with milk sanitation. As evidence of the magnitude of this responsibility a survey conducted by the Public Health Service for the year 1936 developed the fact that in communities of more than 1,000 population, over 5,000,000 gallons of milk per day, or over 1,800,000,000 gallons of milk per year are pasteurized. To insure that no part of this ocean of milk may transmit disease is a problem of such magnitude that it is not too much to ask that the future graduate sanitary engineers who will engage in this work be properly trained for it. It is still true that most of the sanitary engineers who graduate today are without the necessary specialized training and it is believed that every institution which prepares men for the sanitary engineering field should ponder the desirability of including milk sanitation as one of the subjects of instruction.

Those sanitary engineers who have already graduated and who are now engaged in or may in the future wish to undertake milk sanitation work, should either attend post-graduate courses in milk sanitation or one or more of the milk sanitation short courses or seminars which are being conducted by various state boards of health and the Public Health Service.

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1. Contamination of Pasteurized Milk by Improper Relative Pressures in Regenerators. Reprint 1921 from the Public Health Reports, April 1, 1938.

Symposium on Frozen Desserts

F. W. Fabian, *Editor*

Michigan State College, East Lansing, Michigan.

The American Public Health Association considered the subject of frozen desserts of sufficient and timely interest to devote a symposium to it at the last annual meeting at Kansas City, October, 1938. These papers are devoted to bringing out the various aspects of this whole subject with a view to familiarizing health officials with the problems in the field, and thereby assisting them in coping with the situations encountered. We are indebted to the officials of the American Public Health Association for their kind permission to release the papers for publication herewith.

In order to avoid any unnecessary duplication within the Association and with other associations engaged in similar lines of work, an explanation will be given of the organization of the work for the study of frozen desserts.

JOINT COMMITTEE FOR ANALYZING FROZEN DESSERTS

Sanitarians and public health officials have believed for some time that sufficient information was available and that there was a need for a standardized procedure for analyzing not only frozen desserts but also the ingredients from which they were made. These sentiments were crystallized at a joint session of the Laboratory Section and the Food and Nutrition Section of the American Public Health Association at the Sixty-Fifth Annual Meeting in New Orleans in 1936. Action was taken to establish a joint committee composed of members of these sections. This Joint Committee for Analyzing Frozen Desserts was placed under the supervision of and was made responsible to the Coordinating Committee on Standard Methods of the Laboratory Section, and is allocated to the Committee on Research and Standards. The work has been integrated with that of other associations working in this field, and many of the referees (committee members) and associate referees are active in committee work on frozen desserts in other associations. The organization of the Joint Committee is as follows:

Friend Lee Mickle, Chairman.

A. H. Robertson, Referee, Microbiological Examination of Frozen Desserts.

F. W. Fabian, Referee, Microbiological Examination of Ingredients.

M. J. Prucha, Associate Referee, Microbiological Examination of Flavors, Colors, and Extracts.

P. A. Downs, Associate Referee, Microbiological Examination of Condensed and Evaporated Milk.

P. S. Prickett, Associate Referee, Microbiological Examination of Dry Milk.

H. H. Hall, Associate Referee, Microbiological Examination of Sugars, and Sweetening Agents.

P. H. Tracy, Associate Referee, Microbiological Examination of Fruits and Nuts.

L. H. James, Associate Referee, Microbiological Examination of Eggs and Egg Products.

James Gibbard, Referee, Microbiological Examination of Stabilizers.

Associate Referees: P. S. Lucas, T. B. Downey, A. C. Fay, A. G. Lochhead, A. C. Dahlberg, A. S. Ambrose and M. P. Horwood. (added later).

J. H. Shrader, Referee, Chemical Analysis of Frozen Desserts and Ingredients.

C. D. Dahle, Associate Referee, Determination of Milk Solids in Sherbets.

W. H. Martin, Associate Referee, Use of Modified Babcock Methods for Ice Cream.

H. H. Sommer, Associate Referee, Determination of Acidity in Frozen Desserts.

M. E. Parker, Referee, Sediment Testing of Frozen Desserts and Ingredients.

E. C. Thompson, Associate Referee, Sediment Testing of Condensed and Dry Milks.

G. F. Stewart, Associate Referee, Sediment Testing of Butter and Egg Products. (Succeeded by B. E. Proctor).

The Committee is assembling material from which to formulate standard methods for the bacteriological, chemical, and physical examination of frozen desserts, as well as the ingredients used in making the finished products. This is an ambitious program that will require considerable time as indicated by the vast amount of work and the years of time that have been expended in producing Standard Methods of Milk and of Water Analysis.

PLAN OF PROCEDURE

When practicable methods have been formulated by referees or associate referees, and approved by the Joint Committee, they will be mimeographed and sent to as many laboratories as possible for trial and criticism. These preliminary methods will be revised and published in the Year Book of the American Public Health Association for further trial and criticism. After this, they will be available as standard methods, either tentative or official, as a part of future editions of Standard Methods for the Analysis of Dairy Products. This may seem a long and unnecessary procedure but the Committee feels that this is the only way to develop satisfactory methods.

Many of the methods are already written, and soon will be mimeographed and ready for distribution. The Committee solicits the generous cooperation of all workers in this field in trying out these methods, and submitting criticisms and comments. Anyone will be placed on the mailing list for receiving these mimeographed copies of reports and methods by writing to the Chairman of the Committee.

FRIEND LEE MICKLE, *Chairman*.
P. O. Box 1139, Hartford, Conn.

What Are Frozen Desserts?

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Michigan State College, East Lansing, Michigan

INTRODUCTION

The tremendous increase in the use of frozen desserts in America during the past few decades has been built around ice cream. When one goes back and analyzes the cause of the deserved popularity of ice cream, it can be traced to the chemical, physical, and sanitary standardization of the product as well as to improved machinery.

Since ice cream has risen to such prominence in the frozen desserts field, naturally there are going to be many imitations, variations, and substitutions for the real product. For this reason it has been necessary for control officials to define legally not only ice cream but all the frozen desserts. In this paper I shall review briefly these definitions and attempt to classify the frozen desserts according to these definitions.

The definitions given here are in no way legal definitions, but simply an attempt to set forth in a general way some of the outstanding characteristics of frozen desserts as commonly found in laws and textbooks upon the subject.

GENERAL DEFINITION OF FROZEN DESSERTS

Frozen desserts shall include ice cream, and the various kinds of ice cream such as parfait, nut, fruit, bisque, mousse, puddings, custards, as well as sherbets, ices, milks, and special forms of desserts in which there is a combination of any two or more of the above kinds of desserts or any flavored and/or colored, sweetened water (such as popsicles), natural fruit, vegetable, or other juices with or without milk solids in which sufficient heat has been removed from the liquid mixture so as to convert it into a semi-solid or solid mass with or without agitation.

DEFINITION OF SPECIFIC FROZEN DESSERTS

The definitions given here must of necessity be general and condensed since the legal definitions by the various units of government in America are lengthy, and vary somewhat in their minimum requirements. However, the fundamental essentials will be considered here in outline form.

I. *Ice Cream* is a frozen dessert in which the freezing has been accompanied by agitation of the ingredients and which contains in the finished product:

A. Not less than: (See Table 1).
   1. 10 percentum by weight of milk fat. (1)
   2. 20 percentum by weight of total milk solids. (2)
   3. 1.6 lbs. of food solids per gallon. (see Table 2). (3)

B. May or may not contain:
   1. Eggs or egg products. (4)
   2. Approved flavoring. (5)
   3. Natural and/or synthetic certified food coloring. (6)
   4. Approved edible stabilizer (7) which if present should not be in excess of $\frac{1}{2}$ of 1 percentum by weight. (see Table 1).

C. It should not contain any:
   1. Boric acid, formaldehyde, chlorine, or preservative of any kind.
   2. Oils, paraffin or fats, other than milk fat, except in the case of chocolate ice cream which may contain cocoa fat in an amount normal to the cocoa or chocolate used.
   3. Saccharin.
   4. Neutralizer.
   5. Any added substance harmful to health.
   6. Fillers of any kind such as starch, flour, etc.

D. Pasteurization.

1. All ice cream mix should be pasteurized at a temperature of not less than 150° F. for a period of not less than 30 minutes, and promptly cooled to a temperature of at least 50° F. or lower, and held at this temperature until used, for a period not exceeding seven days.
2. All products entering the ice cream mix subsequent to pasteurization should receive a germicidal treatment comparable to pasteurization before they are added to the mix.

E. Bacteriological specifications.

1. The finished ice cream or ice cream mix should not at any time after manufacture have a standard plate count in excess of 100,000 bacteria per gram.
2. The ingredients added to the ice cream mix subsequent to its pasteurization should not have a standard plate count in excess of 5,000 bacteria per gram.
3. The machinery and utensils used to make and store ice cream should not contain more than 100 bacteria per ml. when rinsed in a standard amount of sterile water.

SOURCE OF INGREDIENTS

(1) *Milk fat* may be secured from any of the following sources: wholesome, unadulterated cream and/or sweet milk, evaporated or condensed milk, dry cream, dry milk, pure milk fat, wholesome sweet butter.

(2) *Total milk solids* may be secured from any of the following sources: wholesome, unadulterated cream and/or sweet milk, skim milk, evaporated or condensed milk, evaporated or condensed skim milk, dry cream, dry milk, pure milk fat and wholesome sweet butter.

(3) *Total food solids* may be secured from any of the following sources: milk solids as in (2) above, sugar (cane, beet, corn, maple, malt), honey, eggs as in (4) below, approved flavoring as in (5) below, or coloring as in (6) below, stabilizer as in (7) below.

In fruit, chocolate, and nut ice cream, these substances also serve as the source of the total food solids.

(4) *Eggs* include the whole fresh egg, whole frozen egg, or whole dried egg. Since the yolk is more directly responsible for improved flavor, texture, and whipping quality of the mix, it is used and specified in most laws. Egg yolk may be either fresh, dried, or frozen.

(5) *Harmless flavoring materials* include the following:

(a) Natural: vanilla, cocoa, chocolate, coconut, fruits, fruit extracts, nuts, and spices.

(b) Artificial: imitation vanilla flavors, imitation fruit flavors, imitation nut and maple flavors, etc.

(6) *Harmless coloring materials* include the following: Burnt sugar or caramel flavoring, dyes certified for use in food products which include the following: *Blue*—indigo disulfoacid. *Red*—ponceau 3R, amaranth, erythrosine. *Orange*—orange I. *Yellow*—naphthol yellow S, tartrazine, yellow AB, Yellow B. *Green*—guinea green, light green SF yellowish, fast green FCF.

(7) *Approved edible stabilizers* include the following: Gelatin, gum tragacanth, India gum, and agar-agar.

(8) (a) *Fruit* includes the following: Fresh, cold-packed, canned (either whole, sliced, or crushed), preserves, candied, and dried.

(b) *Fruit juices* include the following: Frozen, canned or bottled, either concentrated or unconcentrated.

(9) *Nuts* include the following: Walnuts, pecans, filberts, hazelnuts, Brazil, pistachio, peanuts, almonds. They may be roasted or not as the requirements demand.

OTHER ICE CREAMS

II. *Fruit ice cream* is a frozen dessert in which the freezing has been accompanied by agitation and which contains in the finished product:

A. Not less than (see Table 1):

1. 8 percentum by weight of milk fat.
2. 18 percentum by weight of total milk solids.

3. 1.6 lbs. of food solids per gallon.
4. 5 percentum by weight of clean, mature, sound fruit or the juice thereof, or the equivalent thereof, and conforms in name to the fruit or the fruit juice used in its preparation. (See (8) under Source of Ingredients)

B. Same as I, B.
C. Same as I, C.
D. Same as I, D.
E. Same as I, E.

III. *Nut ice cream* is defined the same as fruit ice cream except the following should be substituted in A 4:

A. Not less than:

4. 2 percentum by weight of sound non-rancid nut meats, and conforms in name to the nuts and/or flavors used therein. (See (9) under Source of Ingredients)

IV. *Chocolate ice cream* is defined the same as fruit or nut ice cream except that chocolate or cocoa are used as the flavoring material. The minimum amount that can be used is not set forth in most laws since the amount is variable depending upon such factors as the quality of the chocolate or cocoa, the consumer preference, etc. The amount of cocoa most commonly used ranges from 1.0 to 2.5 percent, and for chocolate 2 to 5 percentum.

V. *Parfait* (synonyms=French, New York, Neapolitan, or cooked ice cream) is a frozen dessert in which freezing has been accompanied by agitation of the ingredients and which contains in the finished product:

A. Not less than:

1. 10 percentum by weight of milk fat.
2. 20 percentum by weight of total milk solids.
3. 1.6 lbs. of food solids per gallon.
4. For each 90 lbs. of frozen product
   a. 5 dozen clean, wholesome egg yolks, or
   b. 1.5 lbs. of wholesome dry egg yolk containing not to exceed 7 percent of moisture, or
   c. 3 lbs. of wholesome egg yolk containing not to exceed 55 percent moisture, or
   d. the equivalent of wholesome egg yolk in any other form.
5. With or without fruit or nuts.

In making a parfait, the yolks are added to milk and sugar, and the mixture is cooked for a short time. This basic mixture is sufficiently cooked when a thin film coats the blade of a knife when it is inserted into the cooking mixture.

B. Same I, C.
C. Same as I, D.
D. Same as I, E.

VI. *Bisque ice cream* is a frozen dessert which may be defined the same as plain ice cream except that it contains in addition a bread or cake product. (See classification IV.)

VII. *Candy ice cream* is a frozen dessert which may be defined the same as plain ice cream except it contains in addition, candy. (See classification V.)

VIII. *Mousse* is a frozen dessert made by whipping cream to the consistency of "whipped cream" after which sugar and the desired flavoring materials are added and to which fruits or fruit juices may or may not be added. This mixture is then placed in a hardening room or freezing mixture and hardened.

In practice it is made in either one of two ways:

A. The cream is whipped and the sugar and flavoring materials are then folded in, after which soft ice cream is added and mixed with it. This mixture is then hardened.

B. Rich cream and sugar are added to the ice cream mix, and the resulting mixture frozen to a semi-solid state by agitation in a freezer the same as with regular ice cream mix. It is then drawn off and allowed to harden.

In the final analysis mousse is nothing but very rich (i. e. having a high milk fat, sugar, and total solids content) ice cream.

IX. *Pudding* is a frozen dessert in which freezing has been accompanied by agitation of the ingredients, and which contains in the finished product:

A. Not less than:
1. 16 percentum by weight of milk fat.
2. 25 percentum by weight of total milk solids.
3. 45 percentum by weight of total food solids.
4. Eggs—5 dozen whole eggs.
5. Fruit—10 percentum by weight, and/or
6. Nuts—6 percentum by weight.

All other requirements should be the same as for plain ice cream. Puddings have a higher percentage of milk fat, the same amount of eggs as a parfait except whole eggs are used instead of just the yolks, and more fruit or nuts than are used in fruit or nut ice cream. If they do not contain higher percentages of these ingredients, they should not be labeled as a pudding since they are nothing more than plain, fruit, or nut ice cream as the case may be. The base for a pudding is made by using at least 5 dozen whole eggs for each 90 lbs. of frozen product. The yolks are separated from the whites. Then milk and sugar are added to the yolks and the mixture cooked for a short time. The test used to determine the proper amount of cooking is made by inserting a knife blade into the heating mixture. When a thin coating of material forms on the knife blade, the base has been cooked sufficiently.

The whites of the eggs are not cooked but added to the mix separately. This is the only difference between a pudding and a parfait.

X. *Custard* is a frozen dessert made from a custard base prepared from sugar, milk, and whole eggs. A base consisting of the yolks, sugar, and milk is heated sufficiently to cook the ingredients. (see Puddings). After cooling, cream, sugar and flavoring are added, and the mixture frozen with or without agitation. If the product is sold to the public, it should meet all the requirements of parfait; the only essential difference is the addition of the whites of the eggs in the case of custards.

Custards were formerly made from a base containing milk, eggs, and starch, but since starch is not permitted to be used by law in most states, it is not used in commercial ice cream any more. However, the above base is commonly used in making most home-made ice creams, and if they contain starch and are sold to the public it is a violation of the law. Since commercial custards are not different from puddings, the term "custard" should be reserved for home-made ice cream to be consumed in the home and not to be sold to the public.

XI. *Ices* are frozen desserts in which the freezing has been accompanied by agitation of the ingredients. They are made from water, fruit, or fruit juices, sugar or honey, with or without stabilizer, which if present should not exceed 0.6 of one percentum by weight, with or without eggs, approved coloring, and flavoring. The acidity of ices should not be less than 0.35 of one percentum expressed as lactic acid, and derived in whole or in part from the fruit or fruit flavoring material or by the addition of citric, tartaric, or lactic acids.

A. *Frappe* is an ice which is served in a semi-solid condition.

B. *Punch* is an ice flavored with liquors or highly flavored with fruit juices or spices, and are served in a semi-frozen condition at about the same consistency as when they were drawn from the freezers. They should be made and served at once or on the same day.

C. *Granite* is an ice frozen to such consistency as to resemble broken granite and usually the color of granite.

XII. *Sherbet* is an ice which in addition contains not more than 2.5 percentum by weight of milk fat and not less than 5.0 percentum by weight of total milk solids.

A. *Soufflé* is a sherbet to which has been added whole eggs.

B. *Lacto* is a sherbet made with sour milk instead of sweet milk.

XIII. *Sickles* are a colored, flavored and sweetened water, frozen solid without agitation.

TABLE 1

Showing approximate percentage of various ingredients commonly used by manufacturers in making a balanced ice cream.

	Butter Fat	Serum Solids	Sugar	Gelatin	Fruit	Nuts	Cocoa or Chocolate	Eggs
PLAIN, FRUIT, NUT, OR CHOCOLATE								
	8	10.5 -11	12 -17	0.3-0.5	3-8	1-5	1-5	....
	10	9.5 -10	12 -17	0.3-0.5	3-8	1-5	1-5	....
	12	9 - 9.5	12 -17	0.3-0.5	3-8	1-5	1-5	....
	14	8.75- 9	12 -17	0.3-0.5	3-8	1-5	1-5	....
SPECIAL ICE CREAMS								
Parfait	10-14	9.5 - 9	12 -17	0.3-0.5	3-8	1-5	....	0.5-1.0
Mousse	18-25	2 - 3	20 -25	0.3-0.5	3-8	1-5	....	0.1-0.25
Puddings	16-20	8.75- 9	14 -18	0.3-0.5	12-36	6-8	....	0.5-1.0
Custards	10-14	9.0 - 9.5	12 -20	0.3-0.5	3-8	1-5	....	0.5-1.0
SPECIAL FROZEN DESSERTS								
Sherbet	2- 2.5	2 - 3.5	2.7- 3.2	0.3-0.5	15-25	0	....	0.3-0.6

If one calculated the percentage of each ingredient present in many standard formulas for frozen desserts, he would find that there is a considerable difference in the amounts of the ingredients given. There are certain quite well defined zones governing the chemical composition of frozen desserts which influence the physical characteristics of frozen desserts, such as sandiness or smoothness of texture; viscosity; flavor; heavy, soggy, or pasty body; snowy or flaky texture; etc. Table 1 has been prepared to give some idea of the approximate ranges used by ice cream manufacturers in making a commercial product.

INCONSISTENCIES IN LEGAL DEFINITIONS

In reading the definitions of frozen desserts in most laws and ordinances, one finds this expression: ". . . a combination of two or more of the following ingredients: Milk products, eggs, water, sugar, . . ." This is very poorly worded since it would be impossible to make ice cream conforming to the requirements which are later set forth from any two of the ingredients such as eggs and water, sugar and water, or even eggs, sugar and water. A more correct wording would be: ". . . a suitable combination of milk products, eggs, water, sugar, . . ." Our knowledge of frozen desserts has progressed sufficiently far now so that it is not only desirable but possible to define minimum percentages or limits for every ingredient in all frozen desserts.

CLASSIFICATION OF FROZEN DESSERTS

I. Plain ice cream includes the following flavors:

A. Clove
B. Coffee
C. Currant
D. Maple
E. Mint
F. Vanilla
G. Wintergreen
H. Any other flavor

II. Nut ice cream includes the addition of the following nuts to plain ice cream:

A. Almonds
B. Brazil
C. Butternuts
D. Chestnuts
E. Filberts
F. Peanuts
G. Pecans
H. Pistachio
I. Walnuts
J. Any other suitable nuts

III. Fruit ice cream includes the addition of the following fruits to plain ice cream:

A. Apple
B. Apricot
C. Banana
D. Blackberry
E. Blueberry
F. Cherry
G. Cranberry
H. Date
I. Fig
J. Orange-pineapple
K. Peach
L. Pineapple
M. Pear
N. Prune
O. Raisin
P. Raspberry
Q. Strawberry
R. Tutti-frutti
S. Any other suitable fruit

IV. Chocolate:

A. Cocoa
B. Chocolate

V. Bisque ice cream includes the addition of the following substances to plain ice cream:

A. Grape Nuts
B. Lady fingers
C. Macaroons
D. Sponge Cake
E. Any other suitable bread or cake product

VI. Candy ice cream includes the addition of the following substances to plain ice cream:

A. Almond toffee
B. Butterscotch
C. Caramel
D. Chocolate chips
E. Honey
F. Marshmallows
G. Peanut brittle
H. Peppermint sticks
I. Wintergreen sticks
J. Any other suitable confection or candy

VII. Parfait or New York ice cream includes the addition of egg yolks to plain ice cream. (Sometimes called French or Neapolitan.)

A. Coffee
B. Lemon or Orange
C. Maple
D. Vanilla or Golden
E. Tutti-frutti
F. Walnut
G. Any other suitable flavor

VIII. Mousse is made from "whipped cream" with the addition of sugar, flavoring extract, and fruits. The mixture is then frozen without agitation by placing at a low temperature.

A. Maple — C. Vanilla
B. Strawberry — D. Any other flavor

IX. Puddings usually consist of a mixture of fruits and nuts added to a mix containing whole eggs.

A. English Plum — D. Nesselrole
B. Manhattan — E. Oriental
C. Marshmallow divinity — F. Tropical fruit
G. Any other kind

X. Custards are made from a custard base prepared from milk, eggs, with or without starch, to which are added cream, sugar, and flavoring. (For home consumption only.)

XI. Ices.

- A. Fruit ices—frozen to consistency of ice cream.
  1. Blackberry
  2. Cranberry
  3. Grape
  4. Lemon
  5. Lime
  6. Mint
  7. Orange
  8. Pineapple
  9. Pistachio
  10. Raspberry
  11. Any other suitable flavor.
- B. Frappé—frozen to a slushy consistency.
- C. Punches—ices in which a part or all the fruit juice has been replaced with an alcoholic liquor or spiced fruit juice.
  1. Claret—Claret flavoring
  2. Cordial—port wine flavoring
  3. Pomona—cider
  4. Roman—imitation rum flavoring

XII. Sherbets

- A. Chocolate
- B. Fruit
- C. Lacto—sour milk used instead of sweet milk in making the sherbet.
- D. Souffle—addition of egg yolks to a fruit sherbet.
- E. Vanilla.

XIII. Special forms of frozen desserts.

- A. Aufait is a two layer brick ice cream with fruit between the layers.
- B. Decorated slices.
- C. Eskimo pie is a chocolate coated ice cream bar.
- D. Fancy center bricks.
- E. Individual molds.
- F. Neapolitan ice cream is brick ice cream having several layers—usually three.
- G. Spumoni is a combination of vanilla and chocolate ice cream with or without finely chopped fruit and/or nuts.
- H. Sultana roll is a roll in which the center of the roll is made of tutti-frutti ice cream and the outside of pistachio mousse.

XIV. Sickles.

- A. Pop
- B. Suckers

IMITATION ICE CREAM

Many states permit the sale of imitation ice cream provided it is plainly labeled as such; other states such as New York prohibits its sale. Some states require that a license be obtained for making imitation ice cream and that it be plainly labeled as such.

A good definition for *imitation ice cream* is: Any frozen substance, mixture, or compound, regardless of the name under which it is sold or offered for sale, in which the freezing is accompanied by agitation of the ingredients, or which is made in imitation or semblance of ice cream, or is prepared or frozen as ice cream is customarily prepared or frozen, and which fails to conform with the statutory definitions for ice cream, or any of the different kinds of ice cream such as fruit, nut, chocolate, bisque, candy, parfait, mousse, puddings, etc., or which fails to conform with the statutory definitions for sherbet or ice shall be deemed imitation ice cream and shall be labeled accordingly.

Such a provision permits the manufacture and sale of such products as frozen milk, frosted malted milks, and other specialties which are not ice cream but obviously would be considered as ice cream by the ordinary consumer unless they were labeled "imitation ice cream". However, when manufacturers find that they must label such products as an imitation, they soon lose their enthusiasm for making them.

CHEMICAL REQUIREMENTS FOR FROZEN DESSERTS

When ice cream, sherbets, and ices first came into general use, it soon became apparent that legal definitions were necessary to protect both the public and legitimate manufacturers from unscrupulous manufacturers who made an imitation product and sold it to the public. The first step in this direction was to establish chemical standards, and one of the first ingredients to be defined legally was the milk fat content. Within the last decade, public control officials have come to realize that there is more to ice cream than the milk fat content. Accordingly, they have in many instances defined the total milk solids and total food solids as well as the amount of stabilizer permitted. This is welcomed by both manufacturer and consumer alike.

Many control officials and the public believe that if the amount of stabilizer permitted is not carefully controlled, the manufacturer would make ice cream mostly from stabilizer. This is entirely erroneous because approved stabilizers are the most expensive food solids added to ice cream.

There is some variation in the minimum legal requirements of the chemical composition for frozen desserts in different states, and in different cities. Many factors govern these requirements. No attempt has been made to examine all the legal requirements in the United States covering frozen desserts, but a sufficient number of representative ones have been consulted to get some idea of the range of them. They are set forth in Table 2.

SANITARY REQUIREMENTS

Sanitary requirements are equally if not more important than either the chemical or physical requisites, since it would be better not to eat frozen desserts at all than to eat a product that was dangerous to health. Sanitary requirements, like physical requirements, have been slow in coming and are neglected in many places.

Time will not permit any detailed discussion here. Several outstanding things should be mentioned, however. Pasteurization should be adequately defined, the time and temperature of which should be 150° F. for 30 minutes. A bacterial standard of not more than 100,000 organisms per gram of finished product should be established. A method should be required for washing the utensils and machinery, and a method prescribed for sterilizing them, such as in flowing steam until the steam showed a temperature of 185° F. or more for one minute, or in hot water maintained at 180° F. or higher for two minutes or longer. Then a method should be prescribed for rinsing them, such as 100 p.p.m. of chlorine prior to using. The construction, equipment, and sanitation of the buildings are usually given in detail since most of them are adopted from the milk requirements, as are many of the other requirements for frozen deserts. Sanitation has been considered in detail in other papers presented before this Association in past years, and will not be considered here.

It should be mentioned, however, that there are now 12 states that have a minimum bacteria standard for ice cream ranging from 75,000 to 500,000 per gram whereas in 1926 there were no bacterial standards in any state. The past decade has seen a decided improvement in all sanitary requirements throughout the country.

TABLE 2.

Range of Minimum Legal Requirements of Chemical Composition of Frozen Desserts

	Milk fat	Total milk solids		Total food solids		Wt. per				*Stabilizer
	% by wt.	% by wt.	Wt./gal.	% by wt.	Wt./gal.	gal.	Eggs	Nuts	Fruit	% by wt.
I. Plain Ice Cream	8 – 14	18 – 20	0.9 –	30 – 33	1.6 – 1.8	4.25 – 4.75	±			0.5 – 1.0
II. Nut Ice Cream	6 – 12	16 – 20		28 – 33	1.6 – 1.8	4.25 – 4.75	±	1 – 2		0.5 – 1.0
III. Fruit Ice Cream	6 – 12	16 – 20		28 – 33	1.6 – 1.8	4.25 – 4.75	±		2 – 5	0.5 – 1.0
IV. Parfait	8 – 14	18 – 20		30 – 34	1.6 – 1.8	4.25 – 4.75	+			0.5 – 1.0
V. Sherbet	2 – 3.5	4 – 5.5					±		5	0.5 – 1.0

* Maximum permitted.
± Optional whether present or not.
\+ Required.

PHYSICAL REQUIREMENTS FOR FROZEN DESSERTS

Recently it has been recognized that to control frozen desserts adequately it is necessary to have physical as well as chemical requirements. This became necessary when control officials found that a frozen dessert could comply with all the chemical requisites and yet cheat the public. This was possible because all the legal definitions pertaining to the chemistry of the product were on a percentage by weight basis while the product as actually sold was on a volume basis. Thus, two five-gallon containers of ice cream having the same chemical composition could vary greatly in weight depending upon the amount of air that had been incorporated in each during the freezing process. This point is very important to control officials and one that is not generally appreciated by a great many of them as yet. Only a few states have this under control.

To correct this condition many states have placed ice cream on a definite weight per gallon basis. Some states stipulate only the weight of the total food solids per gallon, while others stipulate both weight and total food solids per gallon. In the opinion of many ice cream men, only the weight of food solids per gallon, such as 1.6 lbs., should be specified in a legal requirement, and not the weight of the ice cream per gallon, such as 4.5 lbs. per gallon, nor the percentage by weight of total food solids per gallon, such as 35 percent of total food solids. They claim that the latter two stipulations favor an inferior ice cream since the ice cream can be loaded with cheap materials such as sugar having a high specific gravity whereas milk fat has a low specific gravity. They also have other pertinent objections to these last two requirements.

However, the trend is toward a definite weight basis for food solids as evidenced by the fact that in 1936 sixteen states had some sort of law regulating the weight of ice cream. Total food solids apparently is the method preferred by most control officials since ten of the sixteen states which have a law controlling the weight have specified 1.6 pounds of total food solids per gallon.

AGITATION VERSUS NON-AGITATION

Many legal definitions do not state the manner of freezing frozen desserts. Every legal definition should contain a sentence or phrase to the effect that "during the manufacture freezing has been accompanied by agitation of the ingredients." Unless this is done you may encounter trouble in keeping certain types of frozen desserts off the market which can be made without agitation.

To take care of certain types of frozen desserts such as "popsicles" and the like in which agitation is not necessary, and which are not agitated during freezing, the words or phrase "during the manufacture of which freezing has not been accompanied by agitation of the ingredients" could be inserted into the legal definition. This would at least give a more concise legal definition and a greater degree of control.

OVERRUN IN FROZEN DESSERTS

Another physical consideration is overrun. In ice cream the overrun is usually between 80 and 120 percent. In sherbets it ranges between 25 and 50 percent, while in ices it approximates 25 percent.

NO MAN'S LAND

As new frozen desserts have appeared on the market, it became apparent that many of them did not comply with existing legal definitions. A case in point is frosted malted milk. Here was a product which had too much milk fat to meet the requirements of a sherbet and not enough to qualify as an ice cream. In other words, the composition of it was such that it failed to comply with any of the existing legal definitions in many states, and as a result it became an "outlaw frozen dessert" in most states.

The question now arises, what shall be done about such types of frozen desserts? Shall we revise our existing legal definitions, or shall we exclude them entirely? Briefly, some of the arguments against expanding our present law is that it would be necessary to exercise a great deal more supervision over frozen desserts to tell whether they fell into the proper legal class or not. Furthermore, provision is now made in most laws for "imitation ice cream" or other imitation products and if any new product does not fall into any legally constituted class, then it can be labeled "imitation."

In the case of frosted malted milk the makers said that if it contained 8 or 10 percent butter fat by weight it was too rich. According to C. S. Ladd, Food Commissioner and Chemist for North Dakota, investigation showed that the richness was due to too much sugar and not to too much milk fat, and that when the sugar was kept within the proper limits there were no complaints of excessive richness. Thus it would seem that in this instance, the new product could be made to conform with existing laws without injuring its quality or palatability. Whether this will be the case with all new products remains to be seen.

However, the chief objection is that many of the makers of frozen desserts containing less milk fat than ice cream are hoping to capitalize on the fact that their product resembles ice cream, and, therefore, the public will think it is ice cream.

Moreover if the idea is to increase the consumption of milk products, then it cannot be done by putting less total milk solids into a product.

Another interesting thing brought out by the development of frosted malted milk was the influence of the physical state of the product being sold upon its legality. Malted milk as ordinarily made and sold in the liquid state did not need to comply with a legal definition, but as soon as a part of the heat energy was removed by refrigeration then it became subject to the frozen desserts law in many states and came under the heading of ice cream. Since frosted malted milk as commonly made only contained between 6 and 7 percent butter fat, it was clearly a violation of the law and its sale prohibited.

ICE MILK

Some states, such as Arizona, California, Connecticut, Florida, Maryland, Massachusetts, and Wisconsin, define and permit the sale of ice milk. Other states, such as Indiana, Kentucky, Michigan, New Jersey, New York, Pennsylvania, and Virginia, have no definitions covering frozen milk, but may or may not permit it to be sold as imitation ice cream.

The range in the legal definitions for the milk fat in sherbets is from 2 to 3.5 percent by weight, and if total milk solids are mentioned they range from not less than 4 percent up. The range for milk fat in the legal definitions covering ice cream starts at 8 percent by weight as a minimum and has no maximum limit. The minimum requirements for total milk solids in ice cream start at 16 percent by weight with no maximum specified. This leaves an open space then between 2 and 8 percent for milk fat and 4 and 16 percent for total milk solids for which there is no legally defined frozen dessert. Evidently some states believe that there is a place for ice milk and accordingly have defined and legalized the product. States legalizing products such as sherbet, ice milk, and ice cream where the chemical composition of one product starts in where the other leaves off must of necessity do a great deal of control work to keep all the products within the prescribed legal limits, otherwise there would be a great deal of ice milk sold as ice cream. Unless frequent chemical analysis were made of the various frozen desserts being made and sold in such states, they would become a real bonanza for the "chiseler" and the unscrupulous manufacturer. In any event, legalizing ice milk would greatly increase the load on any control agent and would require a more constant vigilance to protect the public adequately.

The field of frozen desserts is a large one and is steadily increasing. Intelligent legislation and proper supervision is needed to protect properly the industry as a whole and to insure the public of a wholesome product.

Notes on Microbiological Analysis of Ice Cream

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The volume of frozen dessert products consumed daily, the conditions under which some of them are prepared, and the fact that all are subject to contamination somewhat similar to fluid milk, makes it pertinent in the interest of public health that the manufacture and sale of these products be under sanitary supervision. Regulatory health officials, workers at Agricultural Experiment Stations, and the organized industry have pioneered in the development and application of sanitary methods of production and sale. Both the ingredients before use and the retailed products have been examined. The natural trend has been to employ methods of examination similar to those used for market milk products wherever it was practical.

Since ice cream is stored in a frozen condition and usually consumed before it has completely melted, it is natural to expect fewer food poisoning outbreaks associated with it than with fluid milk products. In spite of this, a number of serious outbreaks are traceable directly to frozen desserts. The need for pasteurization of the mix before freezing has been well established and most health codes at present specify this requirement.

It is not the province of the Laboratory Methods Committee for the Examination of Frozen Desserts to establish standards of quality. Their activity is confined to the preparation of methods of sampling and of analysis, and to such suggestions as seem essential for the interpretation of the analysis.

Ice cream placed in packages by the manufacturer for retail trade presents no sampling problem because the entire unopened package serves as a sample for the laboratory. The inspector and analyst are confronted with the problem of representative sampling of bulk ice cream. Although the mix is usually homogenized before freezing, there is no assurance of the uniform distribution of the bacteria after entering the cans preparatory to storage. Contamination from the frozen dessert container, although usually slight, is not and cannot be distributed uniformly throughout the frozen mass until the latter has been melted and subjected to vigorous agitation. Similarly in opened cans from which the retailer has removed portions, surface contamination is not redistributable uniformly throughout the mass.

The prevailing custom has been to remove a surface portion from the frozen mass before taking a portion from beneath for the official sample. If either the manufacturer or the retailer have been careless, there is no justification for protecting their interests at the expense of the consumer. If careless methods are prevalent, the evidence should not be diluted or removed. It is believed that the surface portion removed with that which naturally becomes a part of it, usually to a depth of about an inch, is as reasonably representative a portion of the frozen dessert about to be consumed as is possible to obtain under practical conditions. Certainly it might prove embarrassing in a case of food poisoning outbreak if litigation disclosed that the portion subjected to analysis had been selected to avoid surface contamination.

If the extent of contamination attributable to retailing operations is to be determined, the vendor may be asked for a serving of the frozen dessert which, after receipt, may be transferred aseptically to a sterile container for laboratory examination. Obviously, a sample from the bulk unserved ice cream taken by the inspector is essential for comparison with the former sample.

Samples may be removed from frozen dessert containers with sterile spoons, butter triers or other similar suitable instruments. Spoons and triers may be placed with handles outward in glass or metal containers and sterilized with heat. If preferred, they may be sterilized immediately before removing the sample by dipping in alcohol and burning off the alcohol remaining on them.

Samples may be taken of unfrozen or partially frozen mixes from the homogenizer or the freezer by passing the sampling bottle under the opening at intervals during the discharge. If sampling tubes are used to remove portions of mixes from cans or vats, the same care should be exercised as when sampling milk and cream.

For retail packaged samples and for samples dipped from bulk by the merchant for the consumer, the portion vended in its original container or a representative portion consisting of not less than 50 grams after transferring it aseptically to a sterile container, may be submitted to the laboratory. All samples are to be maintained at a temperature not exceeding 40° F., and transported promptly to the laboratory. The samples are then melted, thoroughly and vigorously agitated, avoiding churning of the fat, and portions removed for the necessary tests. Usually the quantity of the bulk sample is such that it can be melted by placing the container in water at 45° C. (113° F.) for 15 minutes. Because the volume to be melted influences the time required for melting at 45° C., suitable representative portions of packaged samples may be removed aseptically at the laboratory also and prepared for analysis identically as described for bulk samples.

On account of variations in the density of frozen desserts, the volumetric measurement of units for analysis is not considered satisfactory. It is recommended that the desired quantity of ice cream be weighed aseptically into a sterile butter boat or directly into the dilution bottle. The butter boat is placed in a test tube plugged with cotton and sterilized by heat before use. The width of the boat may be modified to fit within the neck of the dilution bottle. When weighing the sample, the boat is adjusted so that it extends about three-fourths of an inch out of the test tube. After weighing the portion needed to the accuracy of the second decimal place on a sensitive balance, slide the boat and contents out of the tube and into the dilution bottle containing 99 ml. of sterile water.

Comparisons have been made between the bacterial counts obtained at 32° C. and 37° C. both with the present standard nutrient agar and with the proposed tryptone-glucose-skim-milk agar. The results indicate that if the product is of good quality, it will meet the present sanitary regulations even if the proposed agar is used and the plates are incubated at 32° C. In addition to the standard plate count of the bacteria in frozen desserts, the value of a test for the presence of coliform organisms is of additional aid in determining the character and the source of the contamination. There is reason to believe that methods proposed for the detection of certain pathogenic, thermophilic, psychrophilic, saccharophilic, and other types of bacteria that do not develop readily on standard nutrient agar as applied to fluid milk and cream, may be applied with or without slight modifications to frozen dessert products.

High bacterial counts in frozen desserts may be caused by one or more of the following:

1. Ingredients of poor quality such as cream, milk, gelatin, frozen or powdered egg, sugar, flavoring material, etc.

2. Improper processing such as inefficient pasteurization, repasteurization, or aging too long at too high temperatures.

3. Ineffective cleaning of equipment such as storage vats, homogenizer, pasteurizer, aging vats, pipe lines, cans, etc.

4. Careless employees who deliberately or through ignorance neglect to process

the mix properly or to clean the equipment carefully.

Excessive numbers of bacteria in frozen desserts usually indicates a neglected product. Like milk, however, a low count does not necessarily mean a safe product and a high count does not necessarily indicate the presence of disease-producing bacteria. A high count does mean general insanitation and the need for the examination of samples taken at various stages in the process to determine at what point the contamination is introduced.

Septic Sore Throat Spread by Bulk Milk

(Editor: The following report of a milk-borne outbreak of septic sore throat is abstracted from a report in the Baltimore Health News, July 1938. It illustrates the hazard that exists in the sale of bulk milk when the protection of pasteurization and sanitary handling is vitiated by contamination of the milk during its dispensing.)

An explosive institutional outbreak of 75 cases of septic sore throat was traced to the faulty handling of pasteurized milk delivered in bulk to a cafeteria. The disease manifested itself by a severe sore throat in most instances, by fever ranging up to 104° F., and other characteristic symptoms. Only one case had a severe complication which was a late kidney involvement. The diagnosis of all cases were confirmed by positive laboratory findings. There were no fatalities in this outbreak, and excepting for it the city record of no known milk-borne disease since 1917 remains unbroken.

Epidemiological study of the outbreak made it quite clear that the milk in question had reached the institution adequately protected by pasteurization. Large numbers of persons in the institution who drank milk from the same pasteurization plant, served to them from individual bottles, were completely free from the infection, and this is true also of other groups outside of the particular institution served during the same time from the same source of milk supply.

The use of bulk milk in institutions is not prohibited under the city milk ordinance. This milk is intended for cooking purposes. Investigation of this outbreak indicated that in the cafeteria, pasteurized milk from five-gallon cans was poured into pitchers and then into glasses prior to each meal, and the glasses were then placed on trays in a refrigerator until meal-time. The trays were then placed on the counter for distribution among the individuals patronizing the cafeteria. At the end of each meal, any of the glasses which had not been removed from the trays were emptied back into the pitchers, and these were replaced in the refrigerator until the following meal was served. This remaining milk and additional milk were then used in the same manner as has been described.

One of the employees serving in the cafeteria had been suffering with a sore throat for approximately three days prior to the sudden appearance of the first twenty cases of septic sore throat among the milk drinkers in the cafeteria. This worker was examined at the time that the first cases became ill, and was found to have a temperature of 102.8° F. He had a very severe sore throat with greatly enlarged and infected tonsils. This man was immediately isolated, and the outbreak promptly terminated. There seems to be no reasonable doubt but that this outbreak was caused by direct infection of the milk by an employee ill with septic sore throat.

This outbreak shows that milk thoroughly protected by pasteurization may produce disease if the seal of pasteurization is broken and there is exposure of the milk to pathogenic bacteria before the food reaches the consumer.

J. H. S.

Sediment Tests on Frozen Desserts

M. E. Parker

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The sediment testing of milk as a means of determining its physical contamination with visible and insoluble foreign particles is a practice which has been efficacious in causing a reduction of dirt in any milk supply subjected to its scrutiny during the past thirty-five years. While it is a method with empirical limitations, its simplicity in application and interpretaton does guarantee its understanding and acceptance. In other words, dirt particles on a sediment disc is indisputable evidence of their presence in the sample of milk being tested, and consequently the result is subject to no equivocation. There is, however, one major objection to the sediment test. This is stated fully and concisely in Standard Methods of Milk Analysis, 1934, as follows:

> "With the development of efficient single service strainers for use on dairy farms, and efficient strainers, filters, and clarifiers for use in milk receiving plants, the sediment test is becoming more and more a measure of the efficiency of these sediment moving devices. In most cases, it is necessary to visit the farm during the milk operation in order to determine whether the product delivered is 'clean' or 'cleaned' milk."

Experience has demonstrated that dirt in milk will not afford a reliable index of its influence upon the bacteria count. However, dirt in itself is sufficiently objectionable to be condemned. Generally, the sediment in milk has been associated with the dirt commonly found on the farm. As the name implies, "sediment" refers to the visible and insoluble particles which would settle out and thereby impair the attractiveness of the finished product. Undoubtedly the glass milk bottle has contributed in hastening the recognition of the sediment problem in market milk. Unfortunately, any exact measurement of the amount of sediment has not been practical on a quantitative basis such as a gravimetric determination, because appearance has been the ultimate criterion. Therefore, inasmuch as the presence of macroscopic particles of varying size, identity and distribution is the essential prerequisite of a "sediment" condition, it is probably futile to hope for precision in evaluating the degree of sediment quantitatively.

Attempts have been made to evaluate the relative amounts of sediment in milk by the preparation of standard sediment discs (4) showing definite amounts of sediment. In fact, an excellent set of standard discs has been prepared and photographed by the Connecticut State Department of Health Laboratory (3). As standards, it would appear that these photographic discs are worthy of serious consideration, if only on the basis of their relative numerical values without any regard to the Connecticut State Health Department's interpretation or definition of what constitutes "clean", "acceptable", "slightly dirty", "dirty", or "very dirty" milk. As a matter of fact, a numerical value considered as "acceptable" today might well become "dirty" with the passage of time and the improvement of production methods. Such a set of standard discs based upon a photographic record commends itself for consideration because the standards at least would be uniform. True, a set of standard discs can be prepared, but their application is limited because comparatively they cannot be duplicated elsewhere or even by the same worker using the same material. No such criticism can be levcled at a photographic set of standards once it has been adopted. What a photographic set of standards might lack in realism due to its "black" and "white" character would be compensated for in uniformity. Even if more realism might be introduced by deft color photography, it probably would be more confusing than the well defined "black" and "white" record.

While it is true that the character of the "dirt" normally found in milk and cream might differ in some respects from that found in some of the other ingredients of frozen desserts—for example, flavoring extracts, emulsions, stabilizers, etc.—the fact remains that any *extraneous or foreign material* found in such ingredients can be estimated and classified similarly to the manner employed in the sediment testing of milk. As a matter of fact, in the examination and classification of the sediment discs obtained from testing frozen desserts and its ingredients other than milk or cream, *extraneous matter* only can be classed as "dirt" or sediment. Fruit fibers, seeds, nuts, etc., cannot be considered as sediment if the frozen dessert is flavored with fruit or nuts. Therefore, they would be excluded from the sediment test unless the flavoring materials can be successfully screened out or the fibers, nuts, seeds, etc., identified by careful examination with proper magnification.

The sediment in frozen desserts can be determined by either the hot water or the soda method (8). However, a 100 gram sample is not recommended inasmuch as the sediment test as applied to milk is based on a pint sample. It would, therefore, appear desirable that frozen desserts and their ingredients be subjected to similar conditions in order that an equitable comparison may result. Normally, ice cream will vary from 10 to 14 percent in butterfat; from 9 to 11 percent in serum solids; from 14 to 16 percent in sugar; from 1/4 to 1/2 percent in stabilizers, and from 0.3 to 0.6 percent in egg solids. This means that ice cream will vary approximately 25 percent in its total solids content based upon the higher total solids content. Milk, on the other hand, will normally have from 12½ to 14½ percent total solids; a variation of only 15 percent on the same basis. Accordingly, precision in comparing ice cream to milk on a basis of total solids content is not to be expected. Even if we were to limit the comparison to milk solids (in the case of ice cream) the variation in composition will be approximately the same.

Assuming milk to have an average of 13½ percent total solids content, a pint sample would yield approximately 61 grams of milk solids. Therefore, in order to get the same yield of milk solids in an average ice cream or mix of 38 percent total solids content containing 22 percent milk solids, a 280 gram sample would be necessary. Such a sample would be approximately 10 percent heavier than one-half pint of such ice cream mix weighing 9 pounds per gallon. When other types of frozen desserts other than ice cream are considered, the variations in composition indicate the futility of using a sample of a specific weight which will give an exact comparison with milk on a milk solids basis. Inasmuch as a pint sample is used in sediment testing of milk, due probably to considerations of convenience, perhaps the same principle should apply in the case of frozen desserts. Therefore, a half-pint sample of mix or a pint sample of the frozen dessert is suggested as the most practical solution to what otherwise can prove a complex mathematical problem. The greater volume of the frozen dessert sample, as compared to the mix sample, is necessary due to the fact that there is approximately a 100 percent increase in volume (overrun) during the freezing of such products in order to render them palatable.

In the examination of frozen desserts we are concerned with a variety of milk products which have undergone varying degrees of processing; whereas, in market milk, we have a product of more limited processing. Therefore, we should normally expect the sediment condition of frozen desserts to be comparatively better than that of market milk. Microscopic

inspection of the sediment found in frozen desserts, however, has been demonstrated to be very similar in character to that found in market milk. Incidentally, this observation has been made on ice cream samples examined from the products made in practically all sections of the United States. Accordingly, there is no reason to suspect that there is any need for different sediment standards for frozen desserts than would obtain for either raw milk supplies or market milk. In other words, in comparing frozen desserts with milk supplies, the essential difference in sediment is one of degree and not in kind.

In the sediment testing of stabilizers, a 1½ gram sample is recommended. This represents the maximum concentration which would ordinarily be found in a pint sample of ice cream.

Salt, sugar, inert sugar, syrups, as well as the water used in making syrups and in washing the equipment can all be tested for sediment by applying the hot water method described for the finished frozen desserts, except that 50 gm. samples are recommended instead of the pint samples recommended for frozen desserts. By using 50 gm. samples of sugars and syrups, the results obtained will be representative under all conditions of the amounts of these ingredients which would ordinarily be found in any frozen dessert.

Extracts are readily tested for sediment without any treatment whatsoever although applying the hot water method described for the finished frozen desserts is recommended. The extracts will tint the sediment discs, but this does not interfere with the examination for sediment. Extracts which have been tested with satisfactory results include vanilla, vanillin, orange, lemon, and maple flavors. It is not possible to specify any amount of sample of extracts which would be representative of the amounts contained in a finished frozen dessert because of the infinitesimal quantities that would be involved. Therefore, we have recommended the testing of these products the same as for sugar, syrups, etc.

Evaporated milks and sweetened condensed milks can be satisfactorily tested for sediment by applying the hot water method for frozen desserts. We have not adjusted the amount of sample of evaporated or sweetened condensed milks in order to avoid confusion in the testing of these products as finished dairy products. The same will apply to dry milks and butter. Dry milks or milk powders, however, will require a different procedure. The methods described by the American Dry Milk Institute (5) for spray, vacuum drum and roller process powders are recommended. The method for the sediment testing of butter, including the hot water and acid procedures, is suggested as adequate for this ingredient of ice cream or as a separate dairy product (6) (7). Incidentally, the Food and Drug Administration of the United States Department of Agriculture has developed a method for the detection and identifying of extraneous material in butter which is designed primarily for purposes of prosecution in the enforcement of the Federal Food, Drugs, and Cosmetic Act.

In the sediment testing of frozen desserts and their ingredients, we have endeavored to retain substantially the same method which has been applied to milk so successfully. The suggested procedure or modifications for the ingredients so far considered have retained the essential features of the suction or pressure type of sediment tester and the use of standard lintine discs. In determining the extraneous matter in fruits, nutmeats and purees or ground fruits, we have found it possible also to retain the same features, providing these samples were properly prepared. In such work, we have found the flotation procedures of B. J. Howard (1) (2) of invaluable assistance in preparing such products for the sediment test.

In all the methods outlined, we have endeavored to retain the essential "modus operandi" of the sediment test as it is applied to milk. Actually, our reason is that it is generally recognized that the sediment test has been the means of developing a more sediment free, cleaner milk supply in the past thirty-five years. It is true, of course, from the derivation of the word "sediment" (L., sedimentum —a settling; fr. sedere—to sit) that we are concerned primarily with particles which settle. Webster confines the definition to "the matter which settles to the bottom from a liquid." Technically, therefore, there would be no sediment in a frozen dessert inasmuch as it is a semi-plastic mass whose physical state would minimize or prevent any settling of particles. On the other hand, the "sediment test" as we know it is, accurately speaking, a confusion in nomenclature. In applying the same to milk, we do not actually cause any settling of particles, but provide essentially a procedure for physically removing extraneous matter from the liquid which is collected on a filtering substance whose white character provides a contrasting medium for accentuating the dirt particles contained in the liquid being tested and which are retained on the filter surface.

Simplicity in operation and interpretation has been the major reason for the successful application of the sediment testing of milk. It is, therefore, logical to assume that similar results might be expected in applying it to frozen desserts and particularly to the ingredients of frozen desserts heretofore not so scrutinized. "Seeing is believing" or as the Chinese say: "One picture is worth ten thousand words." In such philosophy is found the virtue of sediment testing.

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Editor's Note: The other papers that were presented at the Symposium will be published in the May issue of this Journal.

Three Associations Standards

A ray of sunshine for those who have been decrying the lack of uniformity in the field of milk sanitation may be seen in the recent inauguration of a program by cooperating committees of three associations for the standardization of designs for commonly used items of milk plant equipment.

General recognition of these accepted standards by health officials, milk dealers, and equipment manufacturers is urged officially by these committees.

The cooperating agencies are the Committee on Sanitary Procedure of the International Association of Milk Sanitarians*, the Simplified Practice Committee of the International Association of Milk Dealers,** and the Technical Committee of the Dairy and Ice Cream Machinery and Supplies Association.***

To date the committees have accepted standards for (1) a recessless sanitary union for sanitary pipe lines, (2) threaded fittings including bends for use with this union, and (3) improved indicating and recording thermometer connections for vats and for pipe lines. Details of these accepted standards were shown in the November, 1938 issue of this journal. The above thermometer fittings are illustrated in Fgures 1 to 4.

It is obvious that it will take months for manufacturers to get the new standards into production. In the interim, present standards should be accepted.

As soon as the new equipment is available, each committee will urge its constituents to produce, accept, and demand standard equipment as the case may be.

Of course it is expected that additional items will be standardized from time to time as such items are presented to the committees for consideration.

Photographs by Courtesy of Taylor Instrument Companies.

FIGURE 1. Temperature Tube System with 3A Type RN sanitary fittings for installation in jacketed vats and tanks.

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F. H. Kuhlman, Jr., Bowman Dairy Co., Chicago, Ill.
G. L. Nourse, H. P. Hood and Sons, Inc., Boston, Mass.
H. S. VanBomel, Sheffield Farms Co., New York, N. Y.

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Loomis Burrell, Cherry-Burrell Corp., Little Falls, N. Y.
F. G. Cornell, Jr., Jensen Creamery Machinery Co., Inc., Bloomfield, N. J.
Timothy Mojonnier, Mojonnier Bros. Co., Chicago, Ill.
C. Mortensen, Standard Milk Machinery Co., Louisville, Ky.
R. E. Olson, Taylor Instrument Companies, Rochester, N. Y.
C. A. Rogers, C. E. Rogers Co., Detroit, Mich.
R. C. Strachan, The Pfaudler Co., Elyria, Ohio
R. V. Thomas, York Ice Machinery Corp., Canton, Ohio
Theodore Thompson, Emery Thompson Machine & Supply Co., New York, N. Y.

W. D. TIEDEMAN,
Chairman.

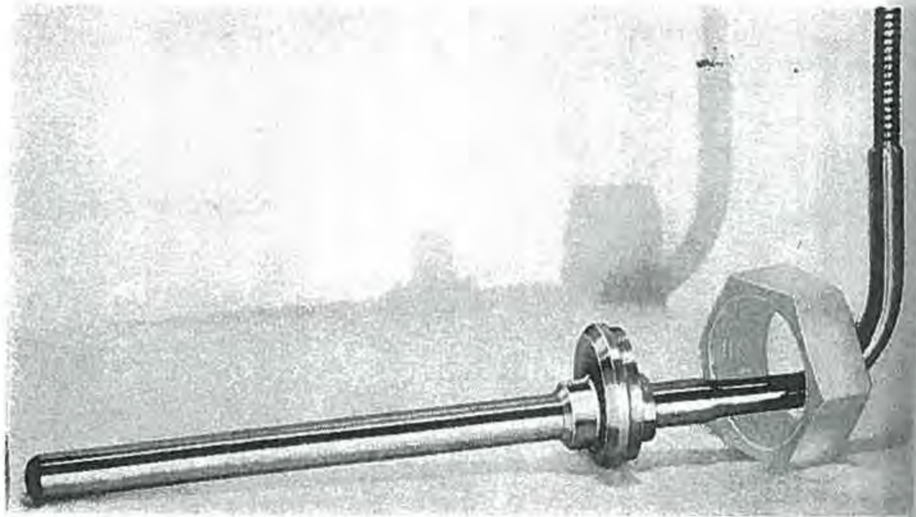


FIGURE 2. Temperature Tube System with 3A Tyne RN sanitary fittings for installation in milk lines. These fittings are provided with special adapters for various sizes of piping.

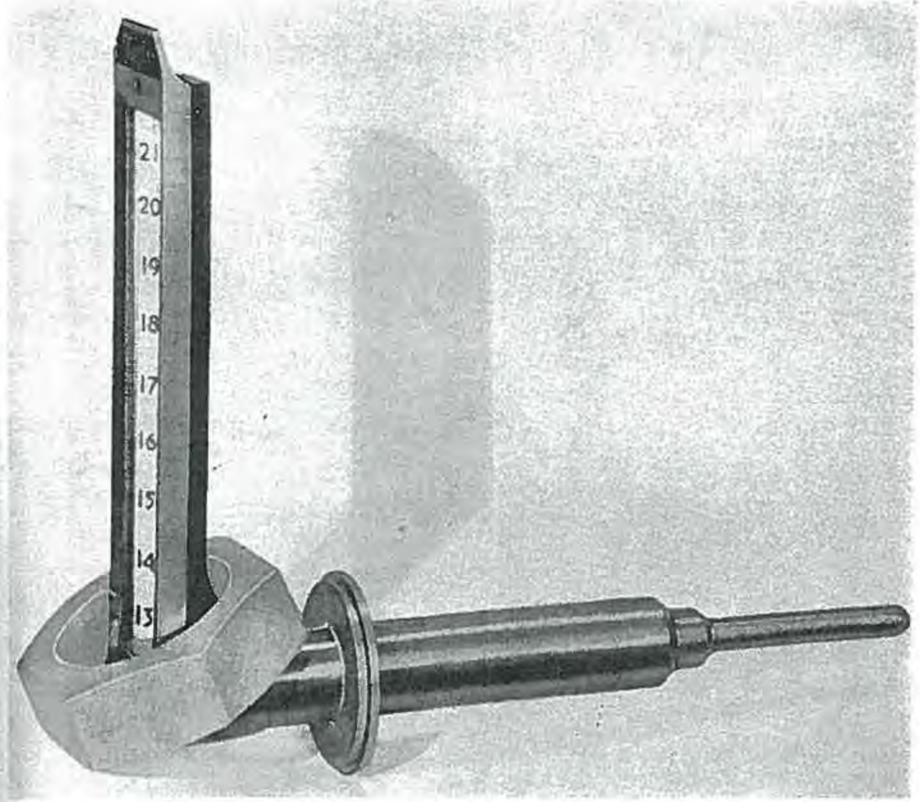


FIGURE 3. Industrial Thermometer with 3A Type RN sanitary fittings for installation in jacketed tanks and vats.

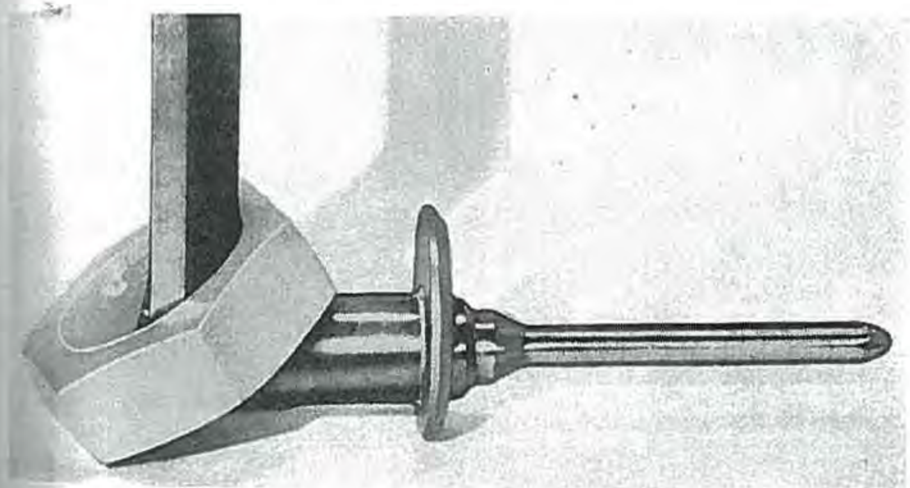
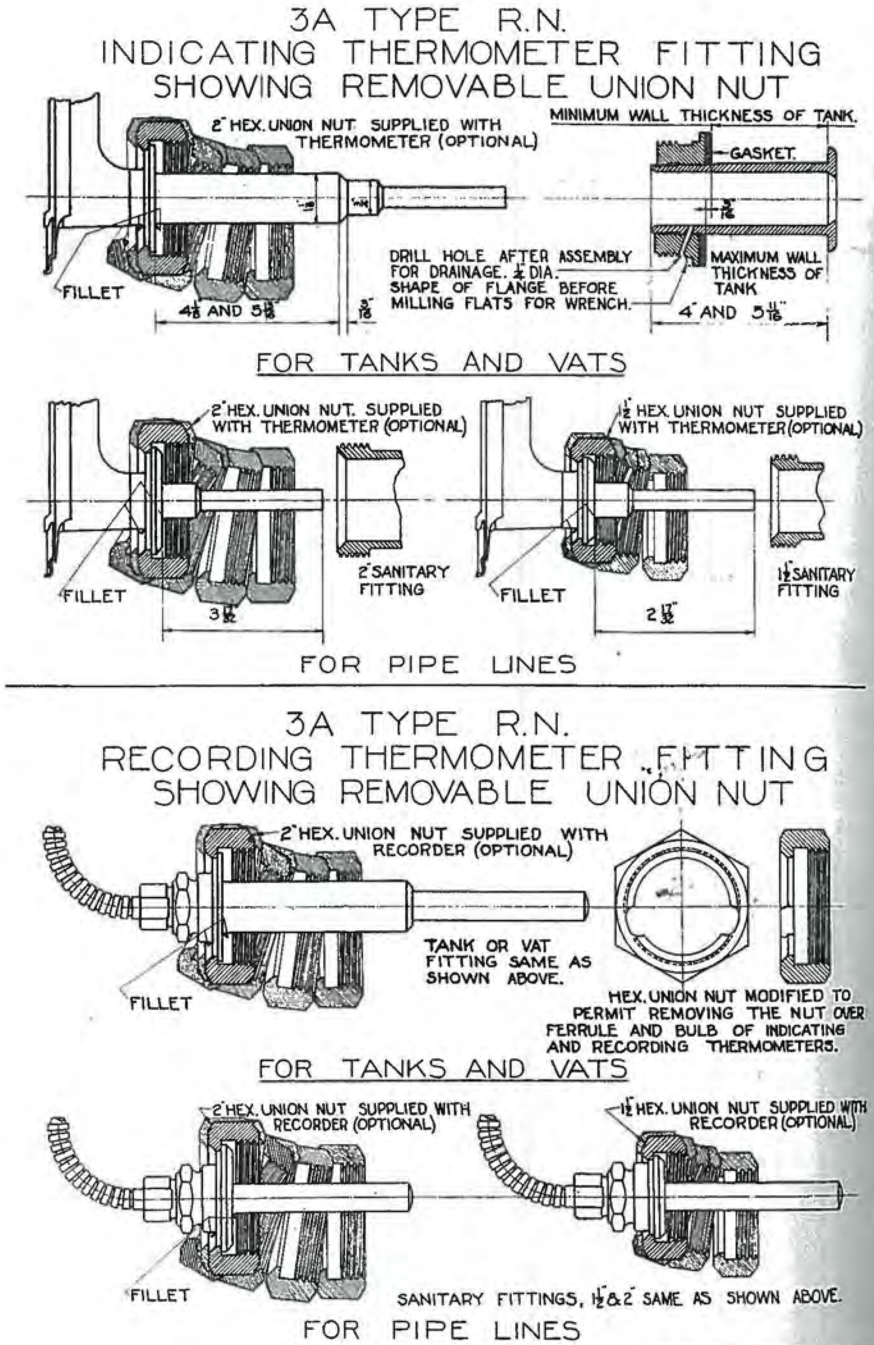


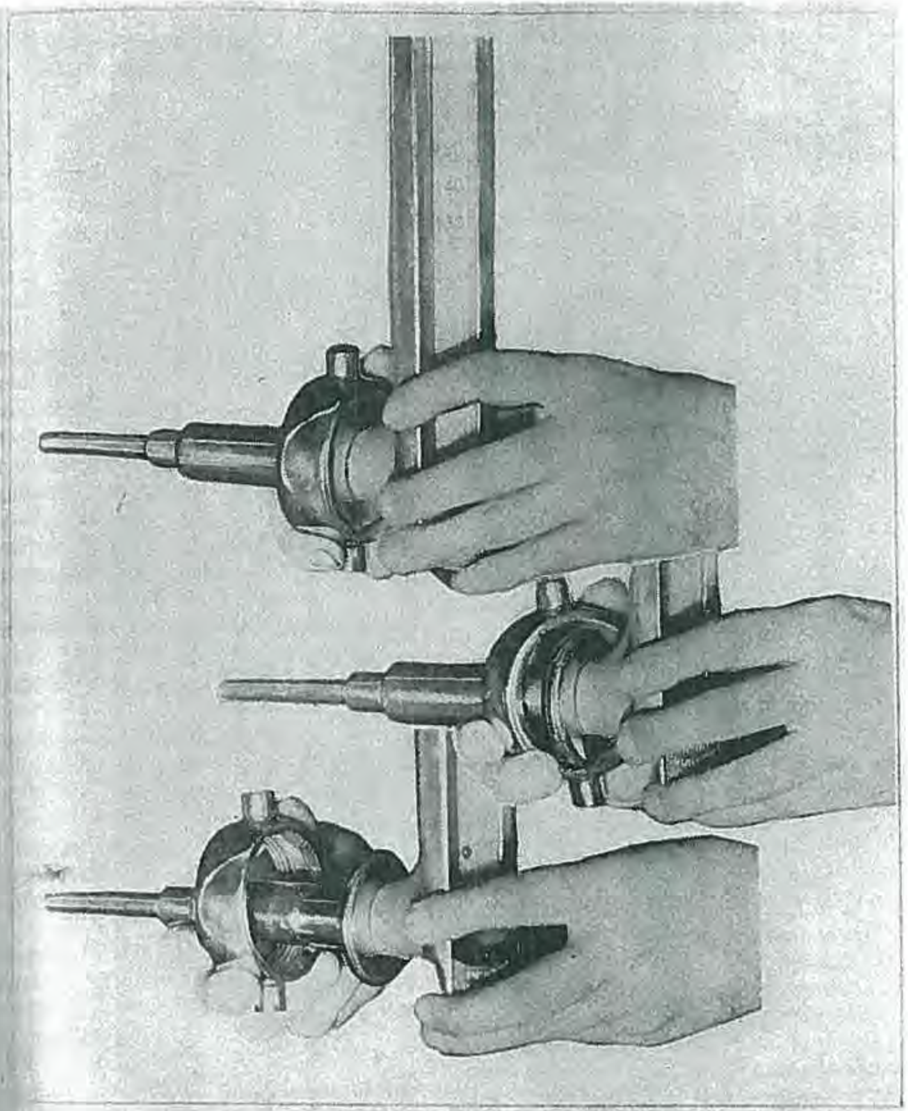
FIGURE 4. Industrial Thermometer with 3A Tyne RN sanitary fittings for installation in milk lines. These fittings are provided with special adapters for various sizes of piping.



Drawing by courtesy of American S. & B. Instrument Division, Manning, Maxwell & Moore, Inc., Bridgeport, Conn.

FIGURE 5

Drawings of Removable Union Nuts



Photograph by courtesy of American S & B Instrument Division, Manning, Maxwell, & Moore, Inc., Bridgeport, Conn.

FIGURE 6

Manner of Removal of Union Nut over Ferrule

The improved indicating and recording thermometer connections are illustrated in Figures 1, 2, 3, and 4. In each instance, the union nuts are taken off over the thermometer scale case.

A newly designed union nut has been accepted for removing over the ferrule and stem of the thermometer. This is illustrated in Figure 5 and Figure 6.

Editor

Reduction of Milk Losses in Milk Plants*

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In all manufacturing plants there are certain losses in material which are inherent to the process. In the interests of economy these losses must be reduced to a minimum. The problem of milk losses in milk plants is peculiarly complicated because the value of the lost milk is only one of the involved problems. There is also the problem of stream pollution, especially in the smaller communities where most of the milk receiving plants must be located. Morever there is the problem of sound public health inspection of the salvaging of milk which might normally be lost.

The extent of the milk losses within a given milk receiving plant may be materially reduced by proper selection and installation of equipment together with sound operating procedures. The problem of milk losses will still be present, however, in spite of the best possible construction and operation of milk plants.

The magnitude of losses which may occur within milk plants is of such economic importance and has such a direct bearing on stream pollution in many localities that it is the obligation of milk sanitarians to give special consideration to this problem to learn if they can be of material assistance in its proper solution. The importance of this problem was brought to us by men within the dairy industry. As a result of their interest, we undertook an experimental survey of the problem for the purpose of determining the extent of these losses and what might be reasonably done to reduce them to a minimum.

* Read at the 12th Annual Meeting of the N. Y. State Assoc. of Dairy and Milk Inspectors at Rochester, N. Y., Sept. 15, 1938.

THE EXTENT OF THE MILK LOSSES

During the winter months and later during the summer of 1938 an endeavor was made to determine the extent of these losses in eight milk receiving plants. Five of these plants were not selected but were taken solely because of the convenience of location. One plant was selected because it was known that the milk losses were particularly high; one plant was selected because it was known that the losses were especially low due to very few pieces of equipment; and another plant was selected because it was definitely known that the method of operation was to save all possible milk losses.

There can be no absolutely satisfactory manner of determining the exact magnitude of the losses within individual plants to secure strictly comparative results. This is due to two primary reasons. The milk plant may be operating without much attention to these milk losses or it may be endeavoring to save all possible milk. The milk inspection through the departments of health may permit the milk plant to save all possible losses or it may forbid the plant to save any of this milk which cannot readily go into the fluid milk supply. For these reasons the data as collected varied considerably and this variation will be pointed out for individual plants.

The procedure for collecting milk losses was to drain all equipment at the end of the day's run to secure whole milk which was left in the vats, internal tubular heaters, pipe lines, etc. Milk from faulty bottles was also collected. Following the drainage of the equipment, the dump vat was rinsed with clean warm water and this water was pumped through the equipment. The vats were rinsed with warm water and all of this water rinse was collected for analysis. The line of demarcation of milk forced through the equipment and the water which is forcing it through is definite so that it is easy to avoid much water dilution except where pieces of equipment are being rinsed with water. An endeavor was also made to secure the milk left in the farmers' cans after dumping by a few seconds of drainage between the dump vat and the can washer.

PLANT 1 WHICH BOTTLED MILK AND CREAM

The first plant studied was a large one receiving approximately 96,000 pounds of milk daily. The milk losses were known to be especially high. This plant bottles milk and cream. The milk as received had a freezing point of −.56° C. and contained 3.9 percent of fat. The freezing point figures were used for calculating water dilution rather than the percentage of milk solids – not – fat because it was soon found that the former was more accurate.

In this plant the daily drainage of milk from the cans amounted to 145 pounds testing 6 percent. This illustrates that the milk which adheres to the cans after dumping is actually considerably richer in fat than the milk which is dumped. There was practically no water dilution in this milk and it contained nearly 9 pounds of milk fat.

This plant contained three large glass-lined storage tanks in which some of the milk was held over night. The rinse water from these tanks tested 8 percent fat, and the 7 pounds of milk fat were recovered from the drained tanks. After making calculations to eliminate the water used for rinsing, it was found that the milk recovered from the tanks contained 14 percent of butter fat. In this plant all of the milk left in the various pieces of equipment after the day's operation had been completed was saved, and this milk together with all of the water rinses was placed into one large vat. The total amount of this drainage-rinse milk amounted to 1456 pounds, and it tested 4.5 percent of fat. It had a water dilution of approximately 13 percent so that the recovered milk without the water tested 5.1 percent. This drainage-milk was run through the cream separator, and 147 pounds of cream testing 47 percent and containing 69 pounds of milk fat were recovered each day during the two days that the test was made in this plant. The high sanitary quality of this milk is evidenced from the fact that the direct microscopic counts on this cream made the second day after it was recovered were between one million and two million with a considerable number of organisms which were probably thermophilic. This cream was repasteurized and churned into butter. Repasteurization was essential as part of the cream was secured from raw milk. Two independent scorings of this butter showed it to be 93 score butter. It was placed in cold storage for four months whenupon the outside layers of the butter had deteriorated probably due to oxidation whereas the inner portions of the butter still scored 92. It is obvious that this butter was of excellent sanitary quality.

PLANT 2 WHICH ONLY RECEIVED AND SHIPPED MILK

The second plant was especially selected for the reason that the installation was particularly simple, and every precaution was being taken to reduce milk losses within the plant. The total receipts of milk amounted to 28,000 pounds testing 3.8 percent. The milk was dumped into the weigh tank, was run into the receiving tank, and then through an internal tubular cooler from which it ran directly into a tank car. The internal tubular cooler filled from the top and was blown out with air after the day's run. The little milk which was left in the internal tubular cooler was drained out and used by men at the plant.

In this plant there was no opportunity to collect all of the drainage from the emptied milk cans as the installation was such that dumped cans had to be placed almost directly over the water rinse jets in the can washer. Nevertheless 60 pounds of milk drainage containing 6.3 percent of fat were collected. This drainage milk actually contained 39 percent of added water from the spray jets in the can washer so that the fat content of the milk itself as it drained from the cans amounted to 5.9 percent. The total fat recovered amounted to 2.2 pounds daily. The water rinse from the air blown and drained equipment contained 0.8 pound of fat so that the total recovery of fat amounted to 3 pounds daily. This figure actually represents the minimum of milk plant losses and it does illustrate that a considerable quantity of milk could have been recovered from the emptied milk cans.

PLANT 3 WHICH BOTTLES MILK AND CREAM

This small milk plant received approximately 12,000 pounds of milk daily testing 4.4 percent of fat. The equipment was drained and rinsed with water as part of the regular plant process but an endeavor was made to determine the amount of milk which the plant recovered as well as the amount of milk which the plant did not recover.

In this plant the time required to dump cans into the weigh can was approximately twice that of the other plants. From two to three seconds was required to dump the cans and about two seconds were allowed for the can to drain. Under these circumstances the cans were completely dumped so that only 0.2 pound of fat was recovered daily. This illustrates that two or three seconds of drainage after dumping is ample to secure most of the milk which normally remains in the dumped cans. The internal tubular cooler for cooling the raw milk as received was found to contain one ten gallon can of milk but this milk was regularly recovered by drainage. Then too, the bottled milk amounted to 24 pounds but this was also regularly recovered. This plant therefore recovered 4.8 pounds of milk fat daily as a result of a cooperative understanding with the milk sanitarians. This milk did not go into the regular milk supply but was used for manufacturing purposes. In addition to these losses at the milk plant, there was recovered within the plant a total of 1.8 pounds of fat which was a loss even in a plant that regularly rinsed the equipment. Incidentally most of this loss occurred in the cream separator and the surface tubular cooler separating the cream.

SUMMATION OF PLANT LOSSES

The average daily milk received by the eight plants under study was 62,442 pounds containing 2148 pounds of fat. The average quantity of fat recovered from the dumped cans and which actually should have gone into the dump vat amounted to 2.5 pounds per day. If we assume there are 1500 milk receiving plants in New York State, then this daily loss from milk cans amounted to 3750 pounds of milk fat which is worth $938 per day at the rate of 25 cents per pound of fat. The total average milk fat loss per plant was 13.6 pounds but it should be borne in mind that a considerable part of this loss was actually recovered in some of the plants particularly in three of them. This total loss amounts to $5,000 a day for New York State which alone is sufficient to emphasize the necessity for milk sanitarians and milk plant operators to give more attention to this question of fat losses in order that this great loss may be reduced to a minimum.

From the viewpoint of sewage disposal this loss has a tremendous significance. The milk saved within the plants studied will amount to approximately 500,000 pounds daily. This milk if run into streams and lakes becomes a major problem in reducing the oxygen content of the water to a point that fish and other aquatic life will be suffocated. Eldridge of Michigan states that milk should be diluted approximately one to twenty-five thousand in fresh stream water of excellent quality to maintain satisfactory oxygen content in the water for fish life. On this basis the daily requirement of water amounts to the equivalent of a flowing stream 10 feet deep, 1/5 mile wide, and 4 miles long.

Observation would indicate clearly that the saving of this milk would reduce the milk losses within milk receiving and bottling plants to a point where it is insignificant in stream pollution.

SUGGESTIONS

Milk can drainage obviously should be credited to the farmer who delivered it. It seems obvious that the procedure for dumping milk can be varied enough to allow an extra few seconds per can for drainage. Perhaps the most obvious manner would be to have a supporting bar for the dumped can so that it can rest in position draining into the weigh can while the second can is being dumped. I doubt that this would increase the time of dumping the milk as the can could be dumped a fraction of a second faster. This would give time enough to change hands from one can to the other because the first can that had been drained would be ready for the can washer at the time the second can was dumped.

The second procedure by which this milk can drainage may be saved would be to extend can washers slightly so that the can would remain outside the washer while the next can ahead was being rinsed. This is now true of some washers. The milk drainage can be caught in cans and sold for manufacturing purposes. If such milk is used for manufacturing into butter, the separated skimmilk is usually fed to stock or made into cheese. If the milk is used for cheese making, the whey is generally used for stock feeding. In either case there is practically no material quantities of milk waste for sewage disposal. It is very obvious that milk plant equipment can be readily drained after the daily operations are complete for fluid milk. Some of the milk can be forced into the regular fluid supply by proper drainage and installation of equipment, and by air blowing of internal tubular heaters and coolers. There will always be considerable milk which can be drained and which is very satisfactory for manufacturing purposes.

The water rinse presents a more or less difficult problem for the reason that it is relatively high in fat content and very low in skimmilk solids. The quantity of this rinse is rather low, however, and in all of the plants which we studied the water rinse introduced a dilution of 10 to 20 percent in the total milk. This quantity of dilution is not a factor to be considered in butter making and is not a serious factor in cheese making.

In conclusion I wish to again emphasize that this problem is so important both economically and from the viewpoint of stream pollution that it ought to be given very careful cooperative consideration with milk sanitarians and milk plant operators. We undoubtedly all agree that these milk losses should not be used in the fluid milk supply, yet at the same time we also agree that such milk is of excellent quality for manufacturing purposes.

Administration and Procedure in the Enforcement of Milk Regulations

John L. Rice, M. D.

Commissioner of Health, New York City

The enforcement of milk regulations in this State is thoroughly accepted and is a matter taken for granted. This is a clear sign that on the whole the administration of the sanitary control of milk has been reasonable and based on common sense. In the long record of freedom from milk borne outbreaks, at least as far as the larger communities are concerned, there is proof that the high standards that have been set have been fully warranted. Fortunately, we here, different from the case at present in England, are long past the stage where health officials are called upon by the producers, the dealers, or the public to present a justification for sanitary milk regulations. Our discussions concern themselves with specific aspects regarding the manner of administering the control or to particular requirements, while the main basic principles, sanitary milk production, pasteurization, and direct safeguards to eliminate contamination or the possibility of spread of disease, go forward unchallenged.

The machinery set up at the beginning of milk control in some respects was crude and haphazard. Pasteurization control was very inefficient. A great portion of the work was directed toward detection of frauds, such as the addition of water and chemical preservatives. However, with the advancement of knowledge and experience, greater emphasis was placed on the more direct health aspects of the milk control program.

Our experience in the enforcement of milk regulations has caused us to divide the work roughly into three distinct phases: (a) country or source of supply control, (b) city or point of distribution control, and (c) laboratory control. Of course, the size of New York City necessitates a large staff for the work, but the principle of checking the three phases mentioned also holds good for smaller municipalities, even though one man may take care of more than one of the phases involved.

Milk control should primarily be directed to the field examination of the product itself for safety and sanitary quality, and to the supervision of the production, processing, and distribution of the milk; and secondarily, to the physical condition of establishments and equipment. The improvement brought about through the field examination of the product is well illustrated in our own City of New York where following the introduction of the deck examination of milk in 1936, the logarithmic averages of standard plate counts of Grade B raw milk were reduced from 140,400 per ml. in 1935 to 85,600 in 1937. We all know the many improvements brought about in the efficiency of pasteurization after the recent introduction of the phosphatase test. Such field tests not only make it possible to exclude unfit and unsafe products from channels of trade and consumption, but they also have educational and psychological value. These tests convincingly illustrate to the producer or dealer the fitness or unfitness of the product. The fact that any inspector, through the use of field equipment, can in a few minutes determine gross irregularity, has a tendency to discourage violations of the regulations or attempts to deliver poor quality milk.

Delivered at the 12th Annual Meeting of the New York State Association of Dairy and Milk Inspectors, at Rochester, N. Y., Sept. 16, 1938.

Of course, it is necessary to adhere to specifications governing physical condition of establishments and their equipment, in order to make possible sanitation and satisfactory operation, and also to guide the industry and to provide a means of uniform enforcement for the inspectorial personnel.

It might be well to mention at this point that we have found it advisable to require plant operators to submit for our approval blue prints of all proposed new construction or major alterations. This eliminates the necessity for future expensive modifications due to failure of compliance with our regulations. We specify that written approval be obtained from us before installing new equipment in plants, etc. Many insanitary features which had hitherto been carried from year to year, have thus been corrected, and it is very gratifying to note that we have received a high degree of cooperation from both the milk dealers and the equipment makers in this program.

Such procedure not only aids the Department of Health in predetermining that the plant or equipment will be satisfactory, but it also serves to assure the operator that he can safely proceed with the construction work and installation of equipment without fear of having new changes forced upon him soon after completion of the work.

To carry out efficiently such a program, it becomes increasingly apparent that the milk inspector has to be a person of highly specialized ability and training who must devote full time to the problem of safeguarding the milk supply. The inspector has to be enough of an architect to give advice on the construction and layout of a milk plant, and enough of a mechanical engineer to pass judgment on the sanitary construction and proper operation of milk equipment. He should be enough of an expert on water supply and sewage disposal, at least to have sufficient ability to detect irregularities, and understand the operation and sanitary precautions for the relatively simple water or sewage plants. He must to some extent be a bacteriologist and chemist in order to make microscopic counts and simple field tests and interpret the results, and to understand laboratory reports of analyses. He should be a psychologist and educator of sufficient ability to sell himself and his milk control program to producers and dealers of milk. He must have poise, alertness, and at times a knowledge of court procedure in the event that court action becomes necessary.

Among other matters to be considered in the administration of a sound milk program is the necessity of having sufficient personnel and facilities to do the work properly. Dr. Wilson G. Smilie, in his book on "Public Health Administration in the United States," says that a municipality of 100,000 people would require two milk inspectors. Due to the large concentration of population in New York City, we are able to carry on by having two milk inspectors per 225,000 population.

I know of no official city budget that carries an item for milk inspection that is large enough to assure by itself, complete, satisfactory supervision of a milk supply. The operators themselves have a real responsibility in supervising the production and handling of their own products. Veterinary examination, dairy inspection, deck examination of milk, and bacteriological control of products can be cited as examples of this self-supervision. Since the operators and their supervisory employees are essential factors influencing milk quality, it is important that careful consideration be given by the dealers to the qualifications of their personnel and the character of operator or manager.

It is frequently necessary to carry on educational activities among producers and dealers to get them to adopt procedures and methods found advisable by enforcement authorities. Every minute matter cannot be made the subject of legal regulation and there has been considerable success in having dealers voluntarily adopt procedures upon our recommendation. We generally find it desirable to hold meetings with the milk and associated industries to get their reaction to proposed new procedures or changes.

Within the department also we have the necessity of a continued personnel educational program. Inspectors are usually busily engaged in their work of checking plants and products, which tends to become routinized. Unless their attention is called to new developments and procedures by means of periodic conferences, association meetings, discussions by specialists and research workers, publications, etc., an inspection service is apt to find itself antiquated, left behind by the march of progress. The staff, by keeping mentally alert and generally aware of new developments, maintains its status as a missionary for advancing milk sanitation.

Just as it is necessary to have cooperation between the industry and the health department, so is it essential for a successful administration of a milk program that the local, state and federal agencies concerned work together on their mutual problems. A good illustration of this kind of cooperation is the arrangement between the New York State and New York City Health Departments, whereby the former checks and reports on water supplies at our country milk plants, and also through local and district health officers determines whether the state and our city regulations are met in the event of contagious disease cases on dairy farms.

Today, as in the past, the primary task of health departments in their milk control activities is concerned with the assurance of a safe and wholesome milk supply, and yet the time has arrived when we must realize and be sensitive to the point, that in the whole milk picture there is an economic phase that is very troublesome and important. We should be quick to understand that the producer has to make a living, and the consumer's ability to buy is not unlimited. Health department personnel should be eager to cooperate whenever possible with other agencies who have the main responsibility for this phase. More than ever in carrying forward our activities for safety and wholesomeness of milk, we should have in mind economics. While we should never compromise with adequate standards for safety and wholesomeness, we should always be sure that our regulating administration and our control procedure are free from fancy work that is expensive and cannot be justified.

I wish to emphasize one of my early statements concerning the application of common sense in the enforcement of milk regulations. Strict adherence to the letter of the law combined with rigid policing is one method of procedure, but the procedure which obtains results with a minimum of hardship and without sacrificing principles is the better one to follow.

Abstracts of Technical Papers Presented at Thirtieth Annual Meeting of the American Butter Institute

November 29-30, 1938, Chicago, Illinois.

Reported by M. E. Parker

Copper Contamination

E. H. Harvey

Dr. E. H. Harvey, Chief Chemist of Wilson & Company, discussed the results of applying Horrall's modification of the Ritter test for copper in milk whereby butter is tested directly without ashing or separation of the fat. Quantitative determinations of copper using the method of Williams indicated that the modified Ritter test will react positive to 0.4 ppm or above. It was also ascertained that this test is inactivated by the presence of Vitamin C (not a factor in creamery butter) while the presence of a large amount of peroxides will give a false positive test (not a serious defect inasmuch as butter becomes inedible with the development of any appreciable peroxide value).

In a series of experiments using copper lactate as the contaminating factor, it was observed that after the inoculated samples had been incubated at 21° C. for 7 days, an inordinate drop in score resulted when more than 0.3 - 0.5 ppm of copper was added to butter having an initial score of 92 points and giving a negative modified Ritter test with an actual copper content of 0.075 ppm. When the addition of copper lactate exceeded 1 ppm, definite tallowy flavors were noted, and an excessive drop in score resulted. Accordingly, the Horrall modification of the Ritter test appears to be of possible value as a quality control procedure. (*More confirmatory data appears to be necessary before this can be definitely established as other investigators have noted some unexplained discrepancies in applying the modified Ritter test of Horrall to butter.*—Editor's note.)

The retardation of changes (peroxide formation and development of tallowy flavor) induced by copper contamination of butter was found to apply to ascorbic acid and ethyl tyrosine while common antioxidants such as vegetable lecithin, nicotinic acid, and oat oil were found to be of no value. Oat flour, maleic acid, and aqueous extracts of oat flour completely retarded peroxide formation but introduced characteristic off-flavors which render them of doubtful value.

The exposure of cream to copper particularly in forewarming vats (which appears to be the most common source) is indicated to be a doubtful production practice, as isolated samples of butter have been found with a copper content of as high as 8 ppm, such butter incidentally developing tallowy flavors rapidly although no bleaching or rancidity occurred. Initial churnings invariably show more copper than later churnings while the last churnings may be almost free of copper in creameries where there is a moderate amount of exposed copper in their equipment.

(*To be continued in May issue*)

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International Association of Milk Sanitarians

The 28th annual meeting of the International Association of Milk Sanitarians will be held in Jacksonville, Florida, on October 25, 26, and 27. Mr. H. N. Parker of Jacksonville has been appointed chairman of the local committee. The headquarters hotel will be announced later.

The program of this meeting will contain some items of unusual interest. No milk sanitarian can afford to miss it. Plan now to attend.

Back copies of the annual reports of the International Association of Dairy and Milk Inspectors for the years 1927, and 1929 to 1936 inclusive may be purchased, as long as the present supply is available, at a price of $5.00 plus postage for the set, or for single copies $1.00 including postage.

C. S. Leete,
Secretary-Treasurer

New York State Association of Dairy and Milk Inspectors

President Kern expects to call a meeting of the Executive Committee in the near future to discuss the program for the next annual meeting. Suggestions from members as to subjects they would like to hear discussed are invited and should be forwarded to the secretary.

W. D. Tiedeman,
Secretary-Treasurer.

Massachusetts Milk Inspectors' Association

At the annual meeting held in Worcester, Mass., on January 4th and 5th, the following officers were elected:

President, Edward J. O'Connell, Holyoke, Mass.
Vice-president, John B. Enright, Fitchburg, Mass.
Secretary-Treasurer, Robert E. Bemis, Cambridge, Mass.
Executive Committee:
A. R. Tolland, Boston, Mass.
George D. Melican, Worcester, Mass.
George A. Flanagan, Lynn, Mass.
Patrick C. Bruno, Revere, Mass.

R. E. Bemis,
Secretary-Treasurer

Certain Dairy Products Exempted from Immediate Formulation of Federal Standards

Under the provisions of the new Federal Food, Drug, and Cosmetic Act, the Secretary of Agriculture is authorized to promulgate reasonable definitions and standards of identity for any food under its common or usual name. In the absence of such definitions, any food that contains two or more ingredients must declare them on the label. Inasmuch as the Secretary has not yet had time to formulate standards for all such foods, he has announced exemption for a period of two years of a number of foods including the following dairy products:

Evaporated milk	Cheeses
Sweetened condensed milk	Oleomargarine
	Sweet milk chocolate
Malted milk	Milk bread

During this period, the above foods are exempt from a declaration of each ingredient although it does not exempt them from stating the presence of any artificial flavoring, artificial coloring, or chemical preservative.

J. H. Shrader