JOURNAL
of
MILK TECHNOLOGY

Volume 2 July, 1939 Number 4

Editorials

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Public Recognition of Achievements in Improved Milk Sanitation

It is generally recognized that we can be so close to a situation that we fail to recognize great achievements in the making. As we view the field of milk sanitation as it exists today, and then in retrospect look at the situation as it was ten to fifteen years ago, we become aware of the distance that we have traveled in the improvement of milk sanitary practices.

These accomplishments have been the result of two lines of development. One of these has come through the small but frequent contributions of sanitarians in their daily routine of supervisory duties. "Precept upon precept; . . . . line upon line; here a little, there a little." Conscientious, enthusiastic, and intelligent milk inspection cannot help but occasionally lead to an improvement in some practice of milk handling in the district of the faithful sanitarian. The sum total of all these minor steps builds up a body of knowledge which is large in the aggregate.

The other line of advance comes through the outstanding achievements of individual sanitarians. The field of milk sanitation and technology, like all other lines of human endeavor, is fertile with the possibilities of discovery and development by individuals with adequate training, initiative, and vision. What are some of these outstanding accomplishments?

In the early days of milk inspection and the inauguration of the program for the eradication of bovine tuberculosis, who ever thought that we should achieve anything more than numerous modified accredited areas? Some one had the vision and the persistence to keep the program alive.

Try to visualize milk inspection without the aid of the direct microscopic examination. This one technic has probably exerted more influence in the improvement of milk quality than all other milk supply inspection procedures combined. Its value alone warrants all the appropriations expended by the State of New York for the Geneva Experiment Station—although the latter has made many other contributions in numerous fields.

Some of us recall the time when there was no general recognition that there existed a field for dairy engineering other than what then obtained. A tank was a tank; a pipe that could be dismantled rather easily was generally satisfactory; a valve

that looked clean and that was demountable was accepted. Continuity in milk pasteurization was limited to multiple batch installations. Foam was considered like death and taxes. Look at the situation now. How did it come about? One man had the ability and energy to examine critically his supervisory responsibilities, saw the mechanical deficiencies of equipment, and showed how they could be corrected. He created a new field of milk engineering.

For years, we have depended on proper installation, the temperature-time charts on pasteurizers, and the apparent intelligence and presumable integrity of the operator to pasteurize milk safely. A given bottle of milk, labeled as pasteurized, was hoped to be safe because previous bottles had been so (and several days hence we may know that this bottle is safe also). Now, we can examine the milk from this bottle, and know in a few hours whether it had been properly pasteurized. How did we get such a tool? A chemist, working in a dairy laboratory on a "high brow" problem of milk composition, had the ability to see the unexpected value of a by-product of his research. So he obtained the phosphatase test for the detection of improperly processed milk.

As we used to look over great areas of our country, we have regretted the lack of effective milk quality supervision, with the attendant low per capita milk consumption. This has changed. One man saw a need—and acted. So developed the Public Health Milk Ordinance with its effective and influential program of improved sanitation, technology, and education.

Why does one state have all the septic sore throat in the country? One man is pondering on what he observes, and is making significant discoveries in etiology and diagnosis of several serious milk-borne diseases.

Abortion and undulant fever—some one showed the relation and the hazard.

Shall we only just go ahead occupying ourselves as usual and applying freely the technics and the knowledge unselfishly developed by various outstanding contributors? These latter do not think about any reward. They give their data freely to the world.

In spite of professional and personal modesty, every person likes to be appreciated by his fellows. Conventionally, this takes the form of granting an award for outstanding accomplishments in some defined field. We contend that there is no field where personal achievements are more worthy of public recognition than the one of milk sanitation.

But personal acclaim is not all that is involved. The public granting of a professional award to an accomplished "medalist" exercises an influence on the common weal that is noteworthy. The very fact that a person is so honored constitutes news. The ceremony itself is performed under circumstances of dignity and more or less pageantry, all of which attracts attention. These are featured in the professional and daily news press. The event emphasizes what the profession considers to be the "newer knowledge" in this field. It brings forcibly to general attention an outstanding development which otherwise the public might never know about. It earmarks, so to speak, that which has been *found* to be important, effective and saleable—in general, practical.

With regard to ways and means for implementing these considerations, opinions may differ. We might suggest that the recipient of the award should be one who is nominated by the Executive Committee of the International Association of Milk Sanitarians. The actual form of the award might consist of an engrossed appreciation, together with a monetary honorarium. The statement can be framed to give a continuous service on the wall in the office of the recipient whereas a medal is cased and ceases to be seen (and useful) after the ceremony of its award. The monetary part, possibly contributed by a foundation or industrial organization in the interest of public benefaction, would impart intrinsic value and substance.

Therefore, the International Association of Milk Sanitarians can do well to consider the establishment of an award for achievement in milk sanitation and allied technology. This undertaking would both honor the recipient and publicize an important item in sound governmental function. It would afford an excellent opportunity to educate the public in a necessary phase of public health, and also would strengthen milk inspection wherever the news is broadcast, especially in the territory where the meeting is held. Peace has its victories no less than war, and we could do well to honor our notables.

J. H. S.

The Bacteriology of High-Short Pasteurization

The bactericidal effectiveness of a commercial installation of a high temperature-short time pasteurizer (called herein high-short) has recently been reported in detail by Dotterrer (1). His data on two hundred samples of milk over a period of nine days shows a percentage decrease of bacteria colonies by the plate technic of 96.84 when the milk is held 30 minutes (presumably at 144° F.) as compared with a decrease of 93.31 by the high-short process. Dotterrer elsewhere states that "some organisms would be classed as heat resistant to short time pasteurization but not to 30 minute pasteurization," and points out that thermoduric organisms must be eliminated from the raw milk if bacterial counts by the high-short method are to be comparable to those by 30 minute holding pasteurization (herein called low-long). Furthermore, he states that " . . . . the margin of safety would seem to be less in short time pasteurization than in the case of 30 minute holding . . . . "

Krueger (2) when reporting on the Chicago studies in high-short as compared with low-long pasteurization (presumably including much of the work reported above in more detail by Dotterrer) states that " . . . . high counts might occur at any time without notice and disappear as rapidly," and also " . . . . high counts were found either existing momentarily or persisting for longer periods of time." Krueger and Dotterrer both agree that thermoduric organisms are sometimes found in low-long processing, and that cleaning up the raw supply eliminates them.

Two possible explanations for these phenomena present themselves to us. The first one is a purely physical one. It might be that the sampling in the high-short process picks up milk that has not been well mixed and therefore exhibits the quality of individual cans of milk carrying a preponderant thermoduric flora. On the other hand, samples of low-long milk are always taken from large batches where the milk of individual cans is so mixed with milk from many sources that a thermoduric flora from a few farms will be distributed throughout the whole batch without revealing its character.

The other explanation for the irregular finding of high counts is the one offered by Dotterrer and earlier by Mattick (see below), namely, that the bacteriological margin of safety for the high-short process is not as great as that for the low-long treatment, and that some types of organisms may be thermoduric to one of these processes but not to the other. His remedy is to locate all such milk supplies and eliminate this flora.

This second explanation raises a very serious question, namely: Are all the pathogenic types of organisms found in milk heat-sensitive to high-short pasteuriza-

tion? Are we to expect that some pathogens may be thermoduric to the high-short process that are not so resistant to the low-long treatment?

Much information is available to indicate that the present specification of heating at a temperature of 160° F. for 15 seconds is bactericidal for most of the organisms commonly encountered. The Committee on Milk Supply of the Engineering Section of the American Public Health Association and the Committee on Milk Sanitation of the Conference of State Sanitary Engineers (3) have listed several investigations which reported the bactericidal effectiveness of high-short pasteurization (although the details of this bacteriological work are not available in publications). The workers in Chicago and also Kay and Neave (4) report that pathogenic microorganisms are destroyed before the enzyme phosphatase. Kay (5) states that phosphatase is less readily destroyed by heat than *M. tuberculosis*, and that the enzyme is just completely destroyed by the minimum temperature and time required for legal pasteurization in Great Britain, namely, 145° F. for 30 minutes.

Mattick and Hiscox (6) had previously obtained results very similar to those reported by Dotterrer. They compared the bacterial reduction of milk pasteurized by holding in the laboratory with that pasteurized by a commercial Stassinizing pasteurizer. They state: "The corresponding figure for the milk pasteurized by the laboratory holder process shows that the reduction accomplished by the machine was not the maximum possible. In general, it seems that, in spite of the most precise control, the margin of safety is too small to inspire confidence. Organisms which have some degree of heat resistance, without being thermoduric in the accepted sense, clearly escape destruction, and they appear to constitute a fairly high proportion of an ordinary milk flora."

Mattick reports (7) that holding at 160° F. for 15 seconds or at 164° F. without holding killed all tubercle bacilli and hemolytic streptococci. In the 1936 Annual Report of the National Institute for Research in Dairying, it is stated that the pasteurization of milk in the A. P. V. plate pasteurizer at 162° F. for 15 seconds, and in the Stassinizer at 165° to 166 ° F., under commercial conditions, revealed that both machines showed an efficiency practically equal to that of pasteurization at 145° F. for 30 minutes in the laboratory. We know that in commercial operations pasteurization by the long holding process is more bactericidal than laboratory pasteurization in a test tube. Therefore, the above high-short data, if only equal to laboratory pasteurization, must not be as effective as commercial low-long pasteurization.

An excellent review of the relative performance of high-short and low-long pasteurization on the bacterial and organoleptic quality of milk was published by Yale in 1933 (8). There is general agreement among investigators that all pathogens are killed (or inactivated) in both processes and that standard plate colony counts do not regularly run as low in milk from the short treatment as in that from the long one. No information is available as to the relative bactericidal effectiveness of the two processes from the quantitative standpoint.

It would seem that our knowledge of the bacteriology involved is capable of much greater development. A recent paper by Beamer and Tanner (9) indicates that the thermal death curves of non-spore-forming bacteria are as amenable to mathematical expression as those of spore-formers, so admirably demonstrated by Bigelow, Ball and their associates (10). We are impressed with the relative meagerness of our information concerning the detailed bacteriology of high-short pasteurization. Careful studies of the bacteriological aspects should be conducted with the finesse that would render the work susceptible to mathematical expression. They should be of such broad and fundamental significance that they might well serve as an adequate foundation on which to build a sound milk-processing technology.

The mechanical engineering of high-short pasteurization has progressed faster than our knowledge of the fundamental bacteriology concerned. It is possible that also the chemistry of milk so treated could be elucidated. A balanced technology needs all three sciences. Our knowledge of those involved in high-short pasteurization is not well established.

(1) High temperature short time pasteurization. W. D. Dotterrer. Papers Presented at Dairy Manufacturers' Conference, March 14-16, 1939, University of Wisconsin, Madison, Wis. See *J. Milk Tech.* this issue, p. 197.
(2) The introduction into Chicago of the high-temperature short-time method of milk pasteurization. P. F. Krueger. *J. Milk Tech. 1*, No. 7, 29 (1938).
(3) High-temperature short-time pasteurization. Mimeographed pamphlet, 1931. U. S. Public Health Service, Washington, D. C.
(4) Some results of the application of a simple test for efficiency of pasteurization. H. D. Kay and F. K. Neave. Lancet *1*, 1516 (1935).
(5) Control of the efficiency of pasteurization of milk: the phosphatase test. H. D. Kay. *Can. Pub. Health J. 27*, 551-4 (1936); Chem. Abs. *31*, 2302 (1937).
(6) High temperature short time pasteurization. A. R. T. Mattick and E. N. Hiscox. Internat. Dairy Congress, 10th. Rome-Milan, 1937, 124-III, p. 199.
(7) High temperature short time pasteurization by the Aluminum Plant and Vessel Company's Plate Machine-Experiments on the destruction of tubercle bacilli and streptococci. A R. T. Mattick. Nat. Inst. Res. Dairying, 1937.
(8) High-temperature short-time holding pasteurization in the United States. M. W. Yale. *26th Ann. Conv. Internat. Assoc. Milk Dealers, Lab. Sec.*, 1933.
(9) Resistance of non-spore-forming bacteria to heat. P. R. Beamer and F. W. Tanner. Zentr. Bakt. Parasitenk. Infek. II. Abt. *100*, 81-98 (1939).
(10) Heat penetration in processing canned foods. W. D. Bigelow, G. S. Bohart, A. C. Richardson, and C. O. Ball Nat Canners' Assoc. Bul. 16-L, 1920.
Mathematical solution of problems on thermal processing of canned food. C. O. Ball. Univ. of Calif. Publ. in Pub. Health *1*, 15 (1928). J. H. S.

Missouri Association of Milk Sanitarians

It is with great satisfaction that we welcome the Missouri Association of Milk Sanitarians into the family of organizations which have designated the JOURNAL OF MILK TECHNOLOGY as their official organ. We recall how sanitary engineers from this state showed that important aspects of milk plant equipment, considered up to that time perfectly satisfactory, were really faulty in design and operation, and needed correction. We hope and expect that this new affiliation of kindred interests will further stimulate all milk sanitarians to examine critically their daily round of activities and ascertain whether they are neglecting important items, heretofore too familiar to be noticed. Missourians jolted us into an increased supervisory alertness. We hope that they will do it again. J. H. S.

The Pennsylvania Association of Dairy Sanitarians

The recent action of the Pennsylvania Association of Dairy Sanitarians in designating the JOURNAL OF MILK TECHNOLOGY as their official organ greatly strengthens the field of milk sanitation. Their membership includes names long known well in this work—names of men who have pioneered in helping to make possible this increasingly bright day of recognition of the importance of milk sanitation. Sanitary engineering, dairy technology, and milk quality control, under both official and private auspices, have received strong emphasis in this great state. This influence has been widely felt. As the International Association of Milk Sanitarians further develops its program of improved milk quality, it welcomes this new affiliation with our Keystone associates. The increased inspiration and strength afforded may be expected to yield good dividends in the public interest. J. H. S.

Educational Methods in Relation to Milk Sanitation *

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The purpose of this paper is to present certain types of educational methods which have been found valuable and effective in milk control work. A casual analysis of the problem indicates that milk sanitarians have to deal with at least four distinct units or groups: the milk producer, the milk hauler, the plant operator and his employees, and finally the consuming public. There is, quite obviously, still another very important group which most certainly cannot be overlooked, namely, milk control officials themselves.

EDUCATION OF INSPECTOR

The first and foremost group to keep in constant touch with new developments and technics in milk control work is the inspector himself. Many states have associations such as ours, notably California and New York, where stimulating and informative programs are arranged and two or three day conferences held. The program for the 1938 Regional Training School for Dairy and Milk Inspectors of New York State is a three-day conference giving comprehensive consideration to many phases of milk sanitation from the time the milk leaves the cow until it reaches the consumer. Included in the course is a thorough discussion of laboratory procedures.

Mr. C. Sidney Leete, of the New York Department of Health, makes this comment of significance:

"We believe that the education and training of the various local milk inspectors is a function which will produce lasting results insofar as milk sanitation is concerned. In cooperation with other agencies of the state we are conducting three-day milk inspectors' schools in various places of the state. A ... two weeks school is conducted at the N... York State College of Agriculture, Cornell U... versity, and is intended primarily for milk ... spectors in the large centers. At these sc... we endeavor to get across our interpretatio... the various laws and also our ideas as to ... value of milk and the necessity for its ... and strict supervision."

Refresher courses and conferences ... this type are always stimulating and va... uable.

EDUCATION OF PRODUCERS

In an effort to determine what me... and methods other health departmen... and inspectors have found to be effectiv... educational tools, I sent questionnaires ... one hundred and twenty-five persons e... gaged in public health work, scattere... throughout the country. The replies re... ceived indicated that few departmen... have a definite, planned program of or... ganized producer education. Those th... did depended for the most part upo... sending periodic news letters to produc... and the distribution of pertinent print... material. Many who replied stated th... they felt that information relating to in... terpretation of regulations and ordinanc... governing the production of milk could be considered educational in nature. The opinion was expressed, and justifiably so, that personal contact was of significant importance in producer education.

With regard to personal contact, how... ever, many of us are faced, particularly in larger communities, with limited per... sonnel. Consistent personal contact with producers under such circumstances is beyond the realm of possibility. Therefore, a mass educational approach seems the most logical one to follow. Possibilities are open through several chan... nels. In Flint last summer we arranged in cooperation with our milk plants a ... with a well known Chicago manufacturer of dairy cleaners and sterilizers, a series of meetings over our milk shed. We held fourteen meetings in areas where many producers lived. The general attendance was quite encouraging. The farmers' families were invited, the plants supplied ice cream, and a representative of the company showed a film on quality milk production. Our attendance was over 2,000, and it was felt that considerable value was derived from these meetings. A similar series of producers' meetings has also been held in the Lansing, Michigan, milk shed. County or district units can pattern after this plan on a smaller scale, and by enlisting the cooperation of the plants, meetings for their producers can be held. An elaborate program does not have to be arranged. A talk illustrated with stereopticon slides can be made valuable. A set of a dozen or so pictures or a film strip, illustrating sanitary methods of milk production, can be obtained, or you can make your own if you plan in advance procedures you want to illustrate. Many state colleges have some very good slides, and these, I am sure, can be obtained on loan for special meetings.

Demonstrations offer another valuable tool. The Detroit Health Department, about three years ago, enlisted the assistance of the Agricultural Engineering Department, at Michigan State College, and an exhibit was provided to show proper methods and details for providing insulated milk cooling tanks. A cut-away model of a cooling tank was provided to show the correct procedure for installing insulation. Two men accompanied the exhibit, one gave a talk on factors of importance in the production of quality milk, the other discussed details for the construction of cooling tanks with insulation correctly installed.

This accomplished two things. First, it gave positive assurance to the producer that the Health Department wanted to be of service so that the tank he was about to provide would be acceptable. Second, it offered an opportunity to mention factors of importance in milk production with emphasis placed upon the importance of cooling. No doubt, Detroit's program in relation to this went over much easier than would have been the case had no attempt been made to amplify and explain the new regulation.

In the southwestern part of Michigan a plan was developed in cooperation with the W. K. Kellog Foundation Units and local veterinarians. Realizing that the veterinarian is an influential person in the community as far as molding the viewpoints of farmers is concerned, a plan was evolved to enlist the cooperation of this group. In addition, this plan was developed to render service to dairymen for controlling and eliminating mastitis from dairy herds. This type of educational approach depends upon the ability of an organization to enlist, partly through subsidy, the cooperation of a profession already doing work in the field. Apparently, however, the plan was not considered feasible since after approximately two years operation, that part of the program dealing with the examination of cattle for mastitis was dropped. However, this brings up an important point, veterinarians can be very helpful allies. If they understand the policy of the Health Department in its program to improve milk sanitation, their opinions, when voiced to the dairymen, become a valuable asset to the milk sanitarian.

A rather novel type of producer education with which some may be acquainted was adopted by the Baltimore City Health Department a few years ago, and since found to be extremely effective. Under this plan, inspectors established demonstration herds throughout the milk shed. Milk producers in the vicinity of these herds were requested to attend, and the inspectors then proceeded to go through the exact steps necessary for the proper production of high quality milk as required by the Baltimore Ordinance. To supplement the demonstrations, the Health Department published a very comprehensive bulletin, profusely illustrated, for producers to study. Although somewhat time-consuming, I am certain that

* Presented at the March, 1939, meeting of the Michigan Milk Inspectors' Association, Detroit, Michigan.

this is a very effective means of producer education.

This plan calls to mind the possibility of using some of our own resources along this line. While in county work, I had hoped to try it, in fact did get to the point where the county 4-H Club leader and I discussed it. I refer to the feasibility of using a team of two or three boys each to conduct demonstrations at selected farms to show producers in the area correct procedures in sanitary milk production. Four-H Club boys take up projects dealing with other phases of agriculture, including judging, fitting and showing dairy animals, and projects of similar nature. I believe your County Agent, or boys' leader, would subscribe to and assist in such a proposal. I hope some of our members can and will try to develop this plan. Baltimore now conducts a contest of this nature among students in rural schools under the guidance of district dairy inspectors.

No specific mention has yet been made of visual education. The number of films available which deal with a step by step picturization of milk production is not very numerous. I am advised by Mr. Grey Turney, of the Lansing Health Department, that he has recently prepared a motion picture film on milk production. The March of Time film, "The U. S. Milky Way" has a high degree of general popular interest and appeal for the producer, the dealer, and the public. Effective visual education for milk producers must have more than general appeal. It must give, step by step, a resumé of the factors important in sanitary milk production. Motion pictures are, for the most part, rather expensive, but certainly men in city or county can get together sufficient photographs to make up a film strip or a series of stereopticon slides in lieu of this general lack of suitable motion picture films. Since milk sanitarians in an effort to improve milk production methods should be prepared at all times to address any group such as the Grange, local milk producers' associations, and community clubs, a series of slides or a motion picture on milk will be of great aid and will make a talk much more effective.

EDUCATION OF MILK HAULERS AND HANDLERS

The milk hauler sees the dairymen nearly every day and often brings back news of the milk plant or of the health department. Every reasonable courtesy should be extended to these individuals. When literature and announcements are to be sent to dairymen in the milk shed the hauler usually delivers them. He in turn becomes acquainted with their content and may assist the producer in an interpretation of them. When meetings are held for plant operators and their employees, the hauler should be accorded an invitation. In arranging our program of farm meetings during the summer of 1938, we, in Flint, invited all plant operators, their employees, and their milk haulers to a meeting for the purpose of explaining our projected program of farmer meetings. This gave both groups first hand knowledge of what we were planning to put across.

Although not specifically intended for instruction in milk handling or milk plant methods, we have been conducting in Flint, during the last ten months, an instruction period for food and milk handlers. Attendance is compulsory before a so-called "food handlers' working card" is issued. Two sessions are held each week, and since the program was established, nearly five thousand persons have attended. As a matter of interest I presume you would like to know what the content of these sessions has been. We have relied almost wholly upon visual education. During the summer of 1938 we showed a film called "Our Common Enemy" which depicted the part the fly can play in the transmission of disease. Later we used a March of Time sound film on cancer, then a sound film entitled "Body Defenses Against Disease". Specific in nature was a series of twelve stereopticon slides illustrating proper procedures in food handling. We are using at the present time a film strip with sound and entitled "For All Our Sakes" dealing with syphilis and its control. We have established this instruction period to substitute a semi-annual physical examination which was formerly required.

EDUCATION OF PLANT OPERATORS

A most general training program of milk plant operators and employees is one carried on by the Lansing Health Department. The plan seems to merit attention, not only from our Association, but from others throughout the country. Programs were arranged by the Health Department in cooperation with the Michigan State College. Preliminary to the establishment of this training course, the Chief Milk Inspector, Mr. Turney, suggested the plan before a meeting of milk plant operators who reacted very favorably to the idea. As a consequence, each week for ten weeks during a three months period, meetings were held at the Dairy Building at the Michigan State College. The Lansing Department knew in advance the things about which the plant men needed most to know. One of the inspectors made a practice of writing down, at the time of inspection, questions which were asked. The attendance ran from 45 to 65 at each meeting. Some of the subjects discussed were as follows: Mastitis, Bang's Disease, Off-Flavors of Milk, The Health and Disease of the Food Handler, Consideration of Laboratory Technics, and a session dealing with Washing and Sterilizing Methods. Another session was devoted to Problems of Refrigeration. As a sort of grand finale, a banquet was held at the completion of the course.

Certain points come to mind from a valuable program like this. First, the inspector had foresight enough to keep a list of some of the problems that disturbed milk plant operators; therefore, a definite program of real value was built. Another point is that the men who attended these meetings came because of an active interest, were in a responsive state of mind, and were able to get some of their problems partially if not entirely settled.

Any one could enlist the cooperation of college authorities or the College Extension Service, and hold at least two or three meetings over a period of time as convenient. If such a program can be successful in Lansing, it can also be worthwhile and valuable in other communities. One other point that must not be overlooked is this: the milk inspector, himself, derives considerable benefit from these gatherings. We can be justly criticized for not keeping account of the different problems that plant operators call to our attention. Even if you do not know the answer at the time, the information can be obtained and a report made to the person at a later date. He will appreciate it in terms of service and interest on your part.

Perhaps you feel that these somewhat elaborate approaches are unnecessary, or at least, difficult to attain. In answer to that let me say that personal interviews and the individual inspection can always be of definite value if the person doing the work makes it educational in nature. I am afraid that many of us have a tendency to hurry through a plant and not spend as much time as we might discussing plant operation with either the manager, the operator, or both. Do not forget the other employees, as well. It is a good practice occasionally to get their slant on general procedures. Many times they will ask a question which may bring out some fact, the significance of which you had not previously taken into account. I believe all will agree that quality of inspection counts much more than quantity.

It appears that there is a general lack of organized educational programs for plant employees. Certainly this group of people, entrusted with processing and pasteurizing milk, should be fully aware of their responsibility. I am convinced that the municipal health department and for rural areas, the state bureau of dairying, should set up a rather comprehensive course of instruction for all persons who are engaged in the actual processing and pasteurization of milk. Many are in favor of licensing all persons to whom is

delegated the responsibility for pasteurizing plant operation. This point must be borne in mind, however, that the licensing of such persons should follow a fair and rather comprehensive course of instruction. We license people who run other mechanical equipment to protect the safety and well-being of the community, and it certainly is not unreasonable to make this requirement applicable to milk.

EDUCATION OF THE PUBLIC

Up to this point our discussion has been concerned with those groups whose livelihood is derived mainly from the milk business. The improvement in practices and methods of milk handling is our responsibility so that the next group about whom I wish to speak will be benefitted and protected. This group represents the consumers of milk, the general public. They are not subject to regulatory control like the milk industry. Mr. John Q. Citizen buys his milk wherever he pleases, uses as much or as little as he cares to, and does most anything he desires with it after it is placed in his possession. Now it may be felt by some that the most we can do is to assure the consumer a good safe milk supply, and after that our responsibility ends. I cannot subscribe to this attitude. Certainly our fundamental responsibility to the consumer is to guarantee him a wholesome milk supply, but we do not want to drop him there. We want him to know why it is a good supply, what could happen if it were not rigidly supervised, what advantage pasteurization is from the standpoint of safety, and what value he and the other citizens of the community are getting for their money in terms of protection through our efforts. When the public appreciates that, then you can feel pretty sure that a good job of health education has been done. What are some methods that can be used to attain this desired objective?

Possibly one or two examples will help in this respect. Here is one. A few months ago a Flint physician came into my office and said, "What do you know about the supervision of milk supplies in the state of 'X'? I have a son attending a small college there, and he tells me that they use raw milk. I can't quite understand it. In fact, knowing some of the dangers of raw milk, I'm frankly pretty concerned." I told him I did not know too much about the milk situation in that state, but should write and find out. The information received indicated that state health department jurisdiction extended to pasteurized supplies but not to raw. After receiving this inquiry from me, the state authorities wrote the college and expressed the view that the use of a good pasteurized supply was advisable. Then the Flint physician enlisted the support of two other local men whose sons were attending this college and requested that pasteurized milk be used. Shortly after the Christmas Holidays, a letter was received from the college by my doctor friend, stating that pasteurized milk was now being served in the dining hall. It might be said that by power of suggestion, Michigan had a little part to play in the milk supply of a neighboring state. However, this does bring out the point that no opportunity should be missed to be of service and to foster the use of pasteurized milk. I believe this definitely is one type of consumer education. At least the college authorities saw the light. Sometimes we realize accomplishment in rather unprecedented ways. Be sure to take advantage of situations like this. Many times they pay fine dividends.

Here is another idea. You all have inquiries now and again by persons wishing to know something about milk or about the local supply. Make it a practice to ask the person's name and address, then in a day or two send them a copy of Leslie Frank's article, "What the Public Should Know About Milk". Perhaps they will not read the article all through, but at least they will have a more sympathetic attitude, through your interest, toward the health department and its milk program. Or, if you think Frank's article a little too detailed, run off a few mimeographed copies of an article by Guy G. Stevens, D.V.M., entitled "Why Milk is Safe for Babies", which appeared in the July, 1936, edition of the Reader's Digest. That is a good article for consumer enlightenment.

Newspaper publicity on milk is valuable, too. Make your articles informative and newsy. Do not forget that if an outbreak of milk-borne disease should occur in your community, you at least will derive some personal satisfaction in being able to pull from your file newspaper articles which you wrote, at intervals, stressing the advantage of pasteurization. And in future talks or articles, be sure to point out how neglected points of sanitation brought about such an outbreak.

Other means are open to most of us for consumer education, lectures, bulletins, exhibits, radio, and visual education. One, however, which does not permit enlarging upon and which is rarely used, is the promotion of inspection trips to milk plants by consumer groups. Those plants which have something to show encourage this; those who do not are afraid of it. We could enlighten, possibly startle, the public a bit, and give some plant operators more concern about their equipment and practices if this educational approach were used to any great extent. It is something to think about.

EDUCATIONAL PROGRAMS ELSEWHERE

In conclusion, it would be of interest to point out some of the facts gathered from a recent questionnaire which was sent to milk control officials throughout the country. The questionnaire was used to determine what other departments are doing in the educational field. The results tabulated from replies indicated the following:

1. Fifteen out of fifty departments had no definite planned educational program in milk sanitation.
2. Twenty-one out of the fifty had a planned program for the education of plant operators.
3. Thirty-two of the fifty conducted a program of consumer education.
4. Most effective* methods reported for each of these three groups were as follows:

I *Producers*	II *Plant Operators*	III *The Public*
Demonstrations	Same as for producers	Lectures
Printed Material		Radio
Meetings and Lectures		Visual Education
		Exhibits
		News releases

5. In reply to the question, "Do you feel that the so-called 'educational approach' is sometimes used as an excuse for laxity in the enforcement of important regulations and laws", twenty-five felt that it was, seven did not give an opinion, and the remainder felt that it was not.

Splendid possibilities are open to all sanitarians if some of these valuable educational approaches are used in milk control programs.

* Personal contact was of course mentioned by nearly all who replied.

Research in Sewage Chemistry, Sewage Treatment, and Stream Pollution. Gail P. Edwards and others. *Sewage Works J. 10*, No. 2, March 1938). pp. 173-208. *P. H. Eng. Abs.* xix. S, 1939. 2-18-39.

This article is in itself an abstract of 123 articles appearing in the literature of 1937. It does not lend itself to further condensing and the reader is referred to the original article. The subject is reviewed under the headings: (1) Chemistry and Biology, (2) Activated Sludge, (3) Sludge Digestion, (4) Chemical Treatment, (5) Chlorination, (6) Industrial Wastes, (7) Mechanical Equipment.

Automatic Pumping Equipment. S. A. Canariis. *J. Am. Water Works Assoc. 30*, 1388-1398 (1938). *P. H. Eng. Abs.* xix, W., 25.

Equipment for automatic control of pumping is discussed in considerable detail. Topics considered include self-priming devices, selection of valves for automatic operation, relief valves, water strainers, pump motors, electric and thermo-electric devices for motor control, pump and motor bearings, protection of equipment against corrosion due to condensation, and devices for automatic regulation of pumps.

J. H. SHRADER.

A Study of Milkborne Epidemics *

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EPIDEMIOLOGY

In the twenty-two year period 1917-1938 inclusive, New York State, exclusive of New York City, recorded 151 milkborne outbreaks of sickness. New York City, with no raw milk other than a relatively small amount of certified milk, recorded none. Of the diseases involved, typhoid and paratyphoid fever contributed the largest number of outbreaks (75) but in two-thirds as many outbreaks of streptococcus infection—scarlet fever and septic sore throat—the total number of victims was nearly five times as great. The other diseases were diphtheria, poliomyelitis, bacillary dysentery, and gastroenteritis.

Sixty-nine of these outbreaks occurred during the last twelve years of the period, and a study of the data on these has revealed some interesting and significant facts. All excepting four occurred in rural towns and villages. The source of infection in eight was not determined but the other sixty-one originated *at the farm*. This illustrates the fallacy of the still popular idea that milk is safe if it comes directly from the farm to the consumer.

Direct contamination by cases or carriers on the farms appears to have been responsible for about half of the sixty-nine outbreaks, if we include a few in which the opportunity for such contamination was suspected but not proven. Responsible cases of mastitis were located in twenty-four other outbreaks of septic sore throat, scarlet fever, and gastroenteritis.

Considering as one group the thirty-nine outbreaks of scarlet fever and septic sore throat occurring in the twelve-year period, responsible cases of mastitis were discovered in eighteen. It is almost certain that some were missed, due to the investigators getting on the job too late and to reticence or actual concealment on the part of dairymen. In eleven of the eighteen, the probable human source of infection of the cows' udders was located. We believe, of course, that there were human sources in the other seven. The conditions from which the eleven infected persons suffered were about evenly divided between throat and wound infections, the latter most often on the hands.

ADMINISTRATIVE QUESTIONS RAISED BY EPIDEMICS

Twenty-five of the more important outbreaks, of which a majority were of scarlet fever and septic sore throat, were selected as the basis of an inquiry designed to find the answers to some questions of interest primarily from an administrative standpoint. This revealed, among other things, that in only five of sixteen outbreaks did physicians attending cases report them promptly to the local health officers, as they are legally required to do. In only ten out of nineteen instances did local health officers report to the State Department of Health without serious delay. In many of the outbreaks of streptococcus infection in which bovine udders were infected by milkers having sore throat or discharging sores or wounds the dairymen apparently knew of the condition of the milkers before the bovine infection occurred. In connection with eighteen outbreaks, it was reported that dealers whose milk was responsible went out of business in eight instances, in three the dealers lost some of their trade, and in seven their business apparently was not affected. In one of the latter instances it was reported that gross negligence on the part of the dealer was responsible for the outbreak—one of our most serious.

Indeed, it is a regrettable fact that there is evidence in our files which forces us to the conclusions that ignorance of facts which should be common knowledge among intelligent dairymen and dealers, failure to conform to commonly recognized standards of practice in the milk business and to legal requirements, carelessness, or negligence—one or all have been factors in the causation of many if not most of our outbreaks.

Reference has been made to the after-effect, if any, on the business of dealers whose milk was responsible for eighteen epidemics. Through the cooperation of the secretary of the local Chamber of Commerce, we were able to get some interesting data on the effect of one of these on business in general. This was an epidemic of 511 cases of scarlet fever in a village with a population of 4742: about 1 in 9 of the population having been ill. A canvass was made of two manufacturing plants and sixteen other places of business. The estimated aggregate loss from falling off of business was the closing of one of the manufacturing plants was $149,721. Considering that the canvass did not include all places of business and that no attempt was made to determine the cost of families of victims of the epidemic, this figure would seem sufficiently impressive to convince business men, not otherwise convinced, of the importance of preventing such epidemics.

ILLUSTRATIVE OUTBREAK FROM STAPHYLOCOCCI

A brief reference to two outbreaks will illustrate the possibility of trouble from carelessness and disregard of legal requirements, and will bring out some other points. One was an outbreak of [illegible] cases of gastroenteritis in two associated private summer camps, one for boys, the other for girls. These camps received daily about 240 quarts of supposedly pasteurized milk, in cans, from a producer-dealer who also sold about 220 quarts daily to other customers. The cases in the two camps occurred, at different times on the same day, about five hours after consumption of milk. At the time of investigation some of this milk remained in one can and, when the phosphatase test was applied, gave a complete raw reaction. The laboratory reported both *Staphylococcus aureus* and hemolytic streptococci in samples from the can. At the dairy ten cows were found to have mastitis. The usual practice was to cool the raw milk in a vat at the farm milkhouse and to store the cans of bulk pasteurized milk in a vat off the pasteurizing room. The investigation report indicated that the milkhouse vat had been out of commission because of a leak; and all of the cans, unlabeled, were cooled in one vat, the raw milk at one end, pasteurized at the other. An employee at the plant agreed that on the day of the outbreak he may have gotten two cans of raw milk by mistake—as he apparently did. When I say the milk was cooled, I say it with reservations: the temperature of milk in the vat at one visit was 70° F. Counts on two bottles of pasteurized milk from the plant were 150,000 and 360,000 colonies per ml. The sanitary code limit for the grade is 30,000.

This outbreak, presumably due to consumption of *Staphylococcus aureus* toxin, quite evidently was the result of inadequate supervision by the proprietor and of careless methods both at the farm and in the plant: milk from cows with mastitis being used, cans not properly labeled and separated, and inadequate cooling giving opportunity for pathogenic organisms to multiply and develop toxin. This producer-dealer is said to have lost considerable business and appears to have learned his lesson.

OUTBREAK OF TYPHOID FEVER

An outbreak of seven cases of typhoid fever in a small city demonstrates

* This article, prepared by request, represents a combination of parts of two papers. One on Streptococcic Mastitis was presented before the American Veterinary Medical Association in July, 1938; the other on Milkborne Epidemics in New York State, before the International Association of Milk Sanitarians at Cleveland, Ohio, October 19, 1938.

the weakness of control measures when we are dealing with unreliable individuals. The patients were Italian and Polish and their infection was traced to milk, supposedly pasteurized, from a Polish dealer. He served about 780 patrons daily. It developed that at the time when the infection presumably occurred, he was buying twelve to fifteen quarts of milk daily from a four-cow dairy on which there was a Polish woman, known and registered as a typhoid carrier under the supervision of the health officer of the township in which the farm was located. Previously, on the carrier agreeing to have no contact with milk or utensils, the dairyman had been authorized to send his milk to another city for pasteurization. Instead of this, it had gone, at least for a time, to the local dealer. Both the dairyman and dealer denied this until confronted with proof. The carrier had been washing utensils on the farm. The dealer was reported finally to have admitted that, on some occasion when he ran short of pasteurized milk, he might have bottled this raw milk. This presumably was what happened. The dealer paid a penalty of fifty dollars. The dairyman was forbidden to keep cows on the farm as long as the carrier remained and eventually sold out.

While we have had a few milkborne outbreaks traceable to known typhoid carriers, the unrecognized carrier naturally is a greater source of danger when milk is not pasteurized. An outbreak of thirteen cases of typhoid fever a year ago in a small village illustrates what may happen. A small raw milk producer-dealer needed more milk and, without authorization from the health officer, got fifty quarts daily from a relative's farm which was conveniently located. The cases began developing shortly after this milk was added. The relative turned out to be a typhoid carrier who had had typhoid fever eighteen years before. For several years his milk had been going to a city pasteurizing plant and nothing had happened.

In this outbreak it was the people who used the most milk, generally speaking, who became infected. Among 141 who used the milk and were not infected, the average amount consumed daily per person was 0.98 pint. The average among those who contracted the disease was 2.5 pints daily. This outbreak also illustrates the point that the extent of an outbreak is not the only measure of its seriousness. Among the thirteen victims there were three deaths (a fatality rate of 23 percent): a girl of thirteen, a boy of eighteen and a man of seventy-three. The latter's wife also had the disease but survived.

OUTBREAK OF SEPTIC SORE THROAT

An outbreak of 33 cases of septic sore throat in a small village had some interesting features. This was an explosive outbreak limited to employees of a milk collecting plant, their families, and a few intimate friends. The plant was shipping raw milk to a large city for pasteurization. The employees were permitted to take milk from the plant, in their own containers, for family use. Ordinarily this milk was drawn from the cooler into a can at about the same time each day and later was measured into the employees' pails. This milk was the only thing in common among the plant employees and there had been no previous illness among them. Milk came to the plant from 199 herds, representing about 3600 cows. Trying to find the ultimate source of infection seemed like "looking for a needle in a haystack". Nevertheless, one of our optimistic milk sanitarians began making Breed smears of milk from each dairy, as it arrived at the plant. "Lady Luck" was on his side: he had examined only a few smears when he found one in which there were large numbers of streptococci and leucocytes. A "Breed smear" of a similar sample is shown in Figure 1. A visit to this farm revealed a cow with mastitis, from whose milk hemolytic streptococci of Lancefield's Group A were later isolated. The milk from this farm usually reached the plant at about the time the employees' supply was being taken out.

Further investigation revealed the probable source of infection of the cow's udder. She had come from another farm. Late in December (the epidemic was in April) the man who milked her had "a severe sore throat", as his mother also did. Later in the winter, the cow sickened and developed what was described as a severe "caked udder". At the time of the epidemic, this man still had hemolytic streptococci in his throat and there is little doubt but that he was the ultimate source of the epidemic. And here let me repeat what can not be repeated too often: the only cases of mastitis responsible for septic sore throat or scarlet fever, so far as we know, are those arising from infection with hemolytic streptococci from a human source.

Three of the four outbreaks thus far mentioned were from milk intended to be pasteurized before being used. This observation, plus the fact that in New York State in at least fifteen years we have discovered no outbreaks from milk even partially pasteurized, gives us some idea as to what even imperfect pasteurization saves us from. It suggests, also, that failure to pasteurize (the "human element") is, in general, a much greater source of danger than defective pasteurizing apparatus. It does not minimize the importance of efficient apparatus but it supports the belief that there is a considerable margin of safety in the standard procedures.

ASSOCIATED OUTBREAKS OF SCARLET FEVER AND SEPTIC SORE THROAT

Now, in order to bring out some special points, I want to make brief references to two associated small outbreaks of scarlet fever and two much larger ones of septic sore throat.

The two scarlet fever outbreaks, one of sixteen cases, the other of nine, although they occurred in different counties eight months apart, were traced to the infected udder of one cow—or, to go back a little further, to a milker who, several weeks before the first outbreak, had what was evidently mild scarlet fever. At the time of this first outbreak the cow was found to have mastitis; and Beta-hemolytic streptococci of Lancefield's group A, corresponding to those on patient cultures, were isolated. The cow "dried off" and, due to an unfortunate combination of circumstances, instead of be-

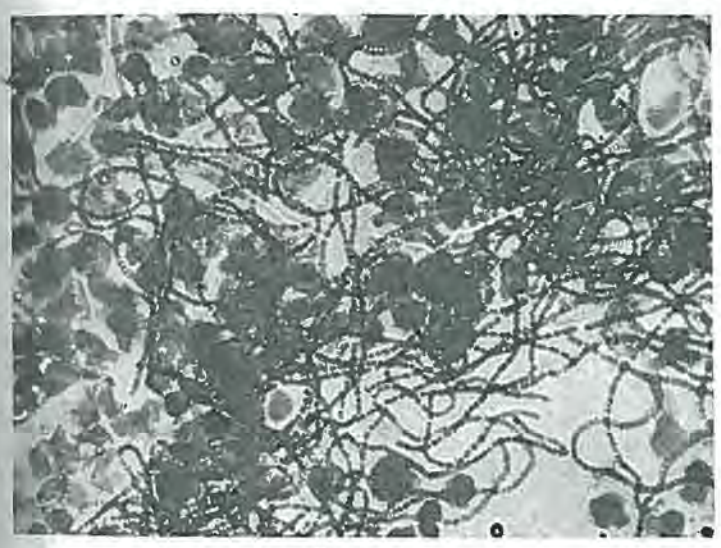
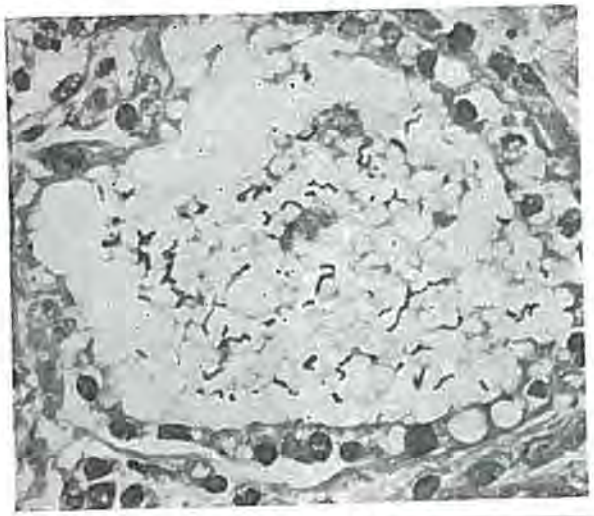


FIGURE 1

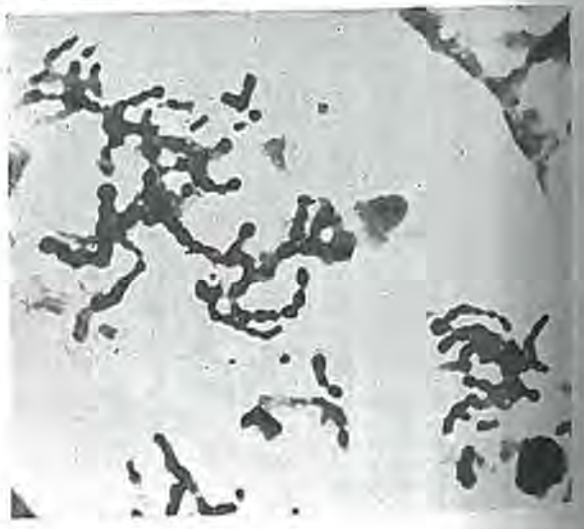
"Breed smear" of milk from cow with mastitis, taken in connection with milkborne outbreak. Shows large number of long chain streptococci and leucocytes.

ing slaughtered, was sold, changed hands several times, and eight months after the first outbreak, arrived on a farm in an adjoining county. There she freshened, her mastitis recurred, and the second outbreak followed. Nine persons, all members of the families of the proprietor and hired man, used the milk, and all developed scarlet fever. The same organisms were again isolated from the milk. The photomicrographs shown in Figure 2 (for which I am indebted to Dr. J. I. Schleifstein of our laboratory staff) are unique: the first ever made and published of sections of an udder responsible for two scarlet fever outbreaks eight months apart—with the streptococci appearing "in person."

The winter before last we had an outbreak of 375 cases of septic sore throat in a village of 1900: one-fifth of the population affected. It is a coincidence that the producer-dealer whose raw milk was responsible sold approximately one-fifth of the village supply. The only other circumstances I want to mention are that seventeen of the 375 patients were said to have had typical scarlet fever and another seventeen to have "peeled", while one patient had erysipelas.



A. Magnification 650 diameters



B. Magnification 2000 diameters

FIGURE 2

Microphotograph of section of udder of cow responsible for two milkborne outbreaks of scarlet fever, six months apart.

In an epidemic of 500 cases of septic sore throat in a good-sized village (about one in eight of the population affected), there were six cases of erysipelas: two with erysipelas alone and four with erysipelas complicating throat infections. No typical scarlet fever cases were seen but several patients had a typical rash. The responsible cow had a teat injury; an unsterilized teat dilator was used and acute mastitis followed.

ASSOCIATED ETIOLOGY OF SCARLET FEVER, SEPTIC SORE THROAT, AND ERYSIPELAS

I am referring to the clinical features, particularly, in these two epidemics because the study of milkborne epidemics of scarlet fever and septic sore throat has helped to throw new light on the subject of beta-hemolytic streptococcus infection in general. The idea has prevailed for many years that scarlet fever, septic sore throat, and erysipelas were separate and distinct diseases, incited by different types or strains of organisms. However, in our epidemics it has been repeatedly observed that when a cow's udder is infected by one individual who may have either scarlet fever, sore throat alone, or a wound infection, the ensuing epidemic produces cases with and without scarlatinal rash (apparently the only distinction between scarlet fever and septic sore throat) as well as cases of erysipelas. When all of these conditions can be incited, as quite evidently they are, by the same organism, it seems equally obvious that they are simply different manifestations of the same infection. Apparently, if the infection is inoculated into the skin of a susceptible individual, erysipelas results. If the infection passes through the usual oral channel, the reaction seems to depend partly on the toxin-producing power of the organism and partly on the susceptibility of the patient. If the original infection came from a case of so-called scarlet fever, it appears that the susceptible recipients develop scarlet fever if they have not had it or have been artificially immunized against it; otherwise they have what we have been calling septic sore throat. If the original source were a case of septic sore throat, it would appear that only those patients who are especially susceptible would react to the small amount of rash-producing toxin by developing a scarlatiniform rash as well as the throat and other symptoms. Perhaps if I were more of a scientist, I should be more cautious about expounding these still theoretical explanations—but there they are, for whatever they are worth.

CLASSIFICATION OF INCITANT STREPTOCOCCI

Finally, having ventured so far, I am going to venture a little further and say something about classification of streptococci, this time with the reservation that I am not a bacteriologist and can give only my understanding of the facts. The changes from old to new terms and classifications are confusing. If my attempt at explanation does not clarify, I trust it at least will not add to the confusion because it is quite necessary to get some of these things straight if we are to understand the relationship between bovine and human streptococcic infections.

The latest and most generally accepted classification into Alpha, Beta, and Gamma streptococci is based on the reactions produced by the organisms when incubated on blood-agar plates. The Alpha group, which includes what we have called *Streptococcus viridans,* produce a brown discoloration and only slight or incomplete hemolysis (dissolving of red blood cells) around the colonies. Those of the Beta group produce clear, colorless zones of hemolysis, and so are spoken of as Beta-hemolytic streptococci. This is the group that concerns us here. Those of the Gamma group produce no hemolysis.

Lancefield, on the basis of serological tests, has subdivided the Beta-hemolytic streptococci into nine sub-groups, which she has designated as A, B, C, D, E, F, G, H and K. This is called Lancefield's classification and appears to have been quite generally accepted.

Group B probably corresponds roughly to the old agalactae or *Streptococcus mastitides* grouping, because it is those of this group which are the chief cause of bovine mastitis. However, it is Group A which concerns us in this discussion because it consists almost wholly of Betahemolytic streptococci of human origin and includes the incitants of so-called scarlet fever, septic sore throat, and erysipelas, as well as serious wound infections. They are also highly infective for the bovine udder when there are breaks in the protective tissues through which they can enter. This explains the risk which dairymen take when they allow persons with sore throats and wound infections to milk their cows.

SUMMARY

So there are some very practical conclusions which can be drawn from such a study as this of milkborne epidemics. Such epidemics occasion serious inconvenience and financial loss as well as danger to life and health. Theoretically they are preventable by strict compliance with health regulations and intelligent and conscientious application of satisfactory trade practices and hygienic principles which should be a matter of common knowledge among ordinarily well-informed people. Viewing the matter practically, however, not all people in the milk business are intelligent and honest, any more than are all people in any other line and not all intelligent and honest people are well-informed concerning hygienic principles. Generally speaking, therefore, the "human element" can not be trusted. Our hope of protection from milkborne infection, to repeat what is becoming an axiom and again speaking generally, lies in pasteurization.

Milkmeter—A Slide Rule for the Dairy Industries

B. I. Masurovsky

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The determination of milk-solids-not-fat is usually calculated arithmetically by subtracting the butter fat content from the total milk solids. The latter are determined chemically, either by the gravimetric or volumetric methods. In everyday practice, however, the use of a lactometer eliminates the intricate procedure in determining total solids by chemical methods, and the only milk constituent that is determined chemically is that of butter fat or milk fat.

Babcock prepared a formula for the calculation of milk-solids-not-fat in milk when the butter fat content and the specific gravity as shown by a lactometer are known. This formula reads as follows:

$$M.S.N.F. = \tfrac{1}{4} L + 0.2 f$$

where L stands for Quevenne lactometer reading at 60° F. and f for percentage of butter fat in the given sample of milk. In other words, there is an established relationship of $M.S.N.F.$ to $L.$ and to f, and this has been utilized in the construction of the scale on a slide rule, Masurovsky's Milkmeter. Furthermore, the equivalents of Quevenne and Board of Health lactometer degrees are included, facilitating the transposition of one kind of lactometer degrees into another.

The slide rule is also provided with a scale for adjusting the lactometer readings at the standard temperature of 60° F. in case the lactometer readings are made at temperatures in a range between 40° and 80° F.

Measuring the Bacteriological Quality of Milk*

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Of the wide variety of methods proposed for the bacteriological analysis of milk, only three have come into sufficiently general use to be adopted on this continent as official methods (1). Opinions may differ concerning the relative value of these three tests (plate count, direct microscopic count, and methylene blue reduction test), yet properly used, each can help bring about a considerable improvement in the quality of a milk supply.

It should be unnecessary to stress at the outset that none of the routine bacteriological tests tells anything concerning the *safety* of the milk. All of them can, with varying degrees of success, reflect something of the history of a given milk and furnish an indication of its keeping quality. While the milk sanitarian has generally tended to concentrate exclusively upon the former aspect, it should not be forgotten that the industry and the consumer are at least equally interested in the latter. Perhaps this aspect deserves more consideration than it has received of recent years.

PLATE COUNT

The seniority of the plate count appears to have established in many minds the opinion that it is the infallible yardstick by which the accuracy of more recent tests should be determined. The fact that numerical bacteria standards are almost always stated in terms of the plate count also tends to accentuate the feeling that this is the one true test. Research workers have long appreciated the shortcomings of the plate count, and more recent studies have revealed a degree of experimental error of such great magnitude as to cause some workers to shy away from the test almost entirely. While there may be situations where the plate count is still the most satisfactory test, there appears to be a tendency to replacing it with simpler and quicker methods where the latter will furnish information of equal value. For example, in the grading of incoming raw milks, some cities have replaced it with the methylene blue reduction test (4). Again, in England a modified methylene blue test has officially supplanted the plate count for the analysis of graded raw milks (15).

One shortcoming of the plate count is its inability to reflect the true number of organisms present because of: (1) their uneven distribution in milk, and (2) their tendency to remain in clumps. Neither changing to a more suitable agar medium (3) nor lowering the incubation temperature (18) will improve this situation. Contamination from shipping cans, milking machines, and other utensils generally brings large masses of bacteria into the milk. This type of contamination, therefore, is not adequately indicated by the plate count (17, 24).

A feature of both the plate count and the Breed direct microscopic count is that they furnish no indication of the state of activity of the organisms in the milk. Milk sanitarians of recent years have tended to think of bacteriological quality almost exclusively in terms of bacterial numbers. It is true that there is a definite relationship between the care taken in producing and handling the milk and the bacterial content. It is also true, though less well recognized, that there is a definite relationship between cooling practices and the state of activity of the

* Contribution No. 53 (Journal Series) from the Division of Bacteriology, Science Service, Dominion Department of Agriculture, Ottawa, Ontario. Read at the 27th Annual Meeting of the International Association of Milk Sanitarians, Cleveland, Ohio, Oct. 19-21, 1938.

organisms. Some data bearing on this point are presented in Table 1.

Samples were obtained from the pooled milk of three to eight cows at milking time and immediately brought to the laboratory. Portions of each sample were then poured into contaminated utensils to simulate careless conditions of production. Each lot was further divided into two, one of which was immediately cooled in water to around 60° F. while the other was held at 90° F. for 1 hour before starting cooling. All portions were held at 54° to 61° F. until the 18th hour in order to permit a certain amount of bacterial activity, when they were again analysed. The data indicate a marked drop in keeping quality as a result of the delay in starting the cooling. This is also reflected quite sharply in the reduction time and Breed count, but to a lesser degree by the plate count. If, now, the values at the start are compared with those for the promptly cooled milk after 18 hours, it will be noted that the plate counts indicate little or no change in the condition of the milk. The other methods, however, indicate quite definitely that there has been a significant lowering of quality during this period. Since the Breed count indicates an increase in the number of organisms during this time, it seems probable that they have remained in clumps or groups and not increased the colony count to any extent. It seems difficult to avoid the conclusion that the plate count furnishes less reliable information concerning the bacteriological condition of such milks than is furnished by other and simpler methods.

It has been generally held that no other method is as suitable as the plate count for the analysis of pasteurized milks. It seems not unlikely, however, that less emphasis will be placed upon plate counts in the future. With the development of the phosphatase test by Kay and Graham (11), and its subsequent modifications, the control official has at last a means of determining with precision whether or not milk has been properly pasteurized. After all, the safety of the milk is his chief concern, and this the plate count

TABLE I.

Influence of One Hour Delay in Starting Cooling as Reflected By Various Tests

	At Start				After 18 hours at 12-16° C. (54-61° F.)			
	Plate[1] count	Direct[2] microscopic count	Methylene blue[3] reduction time (hours)	Keeping[4] time (hours)		Plate count	Direct microscopic count	Methylene blue reduction time (hours)	Keeping time (hours)
A	4,500	< 16,000	11¼	52	Ao	7,500	101,000	10	41
					A1	22,900	1,270,000	6¾	31
B	1,100	< 16,000	9½	51	Bo	1,800	< 16,000	9	41
					B1	3,700	32,000	7¼	33
C	30,000	1,143,000	8	30½	Co	34,000	13,970,000	6¼	19
					C1	170,000	?	2½	12
D	103,000	540,000	6¼	30	Do	112,000	1,130,000	4¾	21
					D1	495,000	6,200,000	3	15

Ao-Do=Cooling started immediately.
A1-D1=Cooling started 1 hour later.

1. Count on dextrose-tryptone-skimmilk agar incubated at 32° C. (89.6° F.) for 48 hours.
2. Average of 60 fields.
3. Tube inverted at 2 hour intervals.
4. Time required to reduce methylene blue when incubated at 37.8° C. (100° F.)

annot be expected to indicate. If the osphatase test can tell whether or not milk has been properly pasteurized, d the coliform test (13, 14) whether has been recontaminated subsequent to urization, one wonders whether there much justification for continuing to ke routine plate counts. Is it not pos- le that some simpler, quicker, and aper method can supply sufficient in- mation concerning the bacterial con- nt?

DIRECT MICROSCOPIC COUNT

As a means of diagnosing the cause poor quality, there is general agree- nt that the direct microscopic (Breed) thod is unexcelled. An experienced rker can usually determine whether gh counts are due to contamination, ulty cooling, or mastitis in the case of w milk, or whether thermophilic or ther- oduric types are present in significant mbers in the pasteurized product. While this method will readily detect or quality milks, it involves more ex- nsive equipment, more technically ined personnel, and greater fatigue than methylene blue or resazurin tests. The Breed method is less reliable for the ding of really good milks; hence as ality improves, its usefulness decreases. greatest value would appear to be as a pplement to one of the other tests.

REDUCTASE TEST

The methylene blue reduction test, like other methods, has its shortcomings. However, the attitude of some control ficials in dismissing the test because it es not always correlate well with the te count is obviously unfair. The ex- ing evidence leads us to suspect that in ny instances the plate count, rather n the reduction test, is in error. The has been criticized chiefly on the fol- ing points:

1. Since the reduction time depends on both numbers and reducing intensity of the bacteria present, the *type* of organisms becomes increasingly important in low count milks (5).
2. The test does not always detect high count milks in the winter months (12, 21).
3. The error introduced by the sweeping of the bacteria to the surface with the rising butterfat increases as reduction time lengthens. Therefore the test has been regarded as not reasonably accurate after the 5½ hour period (22, 23).

Although the practical significance of the first objection has yet to be determined, it is true that one does occasionally encounter milks with a weakly reducing flora. Milks in which *Strept. agalactiae* preponderate, for example, often show an unusually long reduction time and slow decolorization (10). These fortunately are not met with very frequently. The second objection is not so much a criticism of the test as it is of the official practice in England of holding samples at outdoor shade temperature for 12 to 16 hours before starting the test (15). In winter, promptly cooled milk may contain numerous bacteria and yet not reduce methylene blue in 5½ hours. Such milks, however, show much better keeping quality than the counts indicate (9). It is open to question, therefore, whether such milks are actually inferior to those containing fewer bacteria in a more active state.

Mention has been made of the English practice of holding samples at atmospheric temperature before analysis. This was recommended by Wilson (28) on the grounds that such a method enables a better differentiation to be made between varying conditions of production. Although the employment of atmospheric temperature is open to criticism, there is a good deal to be said for the underlying principle of preliminary incubation. When milk is held at a temperature of 55° F. (12.8° C.) for 18 hours, as advocated by the writer (7), the saprophytic types introduced by contamination have an opportunity to grow while the udder flora remain inactive. Since it is the former that are mainly concerned in the spoilage of milk, a reduction test run following

this preliminary incubation furnishes a much better indication of production practices and resultant keeping quality than is obtained where this is omitted. This method has proven very useful in detecting faulty farm practices and has the further advantage of shortening the reduction time appreciably (9).

The importance of the errors resulting from undisturbed creaming of good milks is generally recognized. To avoid them, a modified technic, in which tubes are inverted every half-hour, has been officially adopted in England (15) for the analysis of graded raw milks. With this modification, reduction time is generally shortened, variations between replicate tubes practically disappear, and decolourization is uniform (6, 8, 26, 28). Frayer (6) and Johns (8) favour the adoption of a mixing modification on this continent, but Thornton (25, 26, 27) disagrees, feeling that the high coefficient of correlation between the two tests indicates little difference in their *average* accuracy, while the complication of the technic may limit the use of the test.

Although admitting that "the variability displayed by the standard test may lead to inaccuracy in the case of an individual sample", Thornton appears to overlook the fact that it is not the *average* for a *series* of samples, but the reliability of the value obtained for each *individual* sample, with which we are concerned. He also appears to overlook a point of fundamental importance in any discussion of the relative accuracies of the two tests. Whether regarded as an index of initial bacterial content or of keeping quality, the test will obviously be most accurate where it reflects the oxygen consuming activity of *all* of the bacteria growing in the milk. To do this, the bacteria must remain uniformly dispersed throughout the milk. This would furnish what may be called the *true* reduction time. Under the standard technic, however, we measure the time required by the highly variable fraction of the total bacteria reaching swept to the surface (10) to reduce the dye in the body of the milk. Any appreciable modification of technic which will maintain a more uniform dispersion of the organisms will yield results approaching the true reduction time and must surely be regarded as more accurate than the standard test. That the modified technic does correlate more closely with the actual bacterial content (as indicated by Breed counts of individual organisms on 60 to 80 fields) is indicated by the data from 171 samples presented in a recent paper (10).

Admittedly, the English modified technic, with its half-hourly inversion, does complicate the operation of the test in some places. We have found, however, that inversion once every 2 hours yields results in good agreement with those from more frequent mixing (10). By reading the tubes after 2, 4, and 6 hours and inverting those not reduced, a series of milks may be placed in four grades with improved accuracy and shorter incubation period to compensate for the slight extra effort involved.

RESAZURIN TEST

The resazurin test, originally developed in Germany, has recently been advocated to supplant the methylene blue reduction test (2, 16, 19). The two chief advantages claimed for it are: (1) that as much information is obtainable after 1 hour's incubation as with 5 to 7 hours with methylene blue, and (2) greater sensitivity to physiologically or pathologically abnormal milks.

It was expected that this reported sensitivity to abnormal milks would seriously interfere with attempts to correlate the resazurin colour with the bacterial content (direct microscopic count). However, this was found not to be particularly significant. Instead, the poorest correlation was noted with milks showing the minimum change in colour, many of these showing high counts[2]. Although not free from criticism in this respect the modified methylene blue test appears

TABLE 2.

Sensitivity of Resazurin and Methylene Blue Reduction Tests to Market Milks with High Cell Counts.

Sample No.	Direct microscopic count[1] per ml. Cells	Direct microscopic count[1] per ml. Bacteria	Resazurin[2] colour number at 1 hour	Methylene blue[3] reduction time hours
L4	2,290,000	1,700,000[x]	1	6½
CA7	2,130,000	143,000	6	5¾
E20	2,060,000	8,500,000[x]	8	3¼
C39	1,650,000	255,000	10	6¾
B5	1,590,000	113,000	1	6¼
A11	1,510,000	42,000	8	7¼
E11	1,460,000	1,030,000	1	6¾
D12	1,360,000	48,000	6	7
C5	1,310,000	32,000	6	5
B6	1,250,000	42,000	1	7¼
E29	1,200,000	48,000	4	5¼
E9	1,180,000	32,000	1	6
A26	1,140,000	21,000	4	7
A27	1,020,000	21,000	2	5½
A19	1,020,000	21,000	6	6¾
A14	995,000	105,000	4	7¼
C49	910,000	96,000	5	7¾
A9	863,000	21,000	7	6¾
B12	863,000	21,000	1	6
A24	765,000	42,000	3	7¼

1 60 fields counted.
2 Numbers represent shades between initial colour (0) and full pink (16).
3 Tubes inverted at 2 hour intervals until incipient reduction noted.
4 Long chain streptococci preponderant.

to detect a significantly larger proportion of these high count milks (10).

In our studies the resazurin colour number was recorded each hour until complete decolorization was noted. When the time required for reduction of resazurin to the pink resorufin was compared with the methylene blue reduction time[3], there was excellent agreement between the two tests, the pink stage being reached in about three-quarters of the time required for decolorization of methylene blue or resazurin. Used in this manner, the resazurin test appears to be much more reliable than with the customary one-hour reading, but loses much of its advantage in the saving of time.

The reported sensitivity of resazurin to abnormal milks has, in our studies, been much less consistent with market milks than with samples from individual cows or quarters. The data in Table 2 indicate the wide differences encountered in certain samples of market milk, and suggest that the resazurin test cannot be relied upon to detect milks with high cell counts.

Whether or not resazurin will replace methylene blue remains to be seen. At present, practically nothing is known concerning the chemistry of the dye and its reactions in milk, while there are a number of features which require explanation. Until our knowledge of the various factors concerned is comparable to that in the case of methylene blue, it seems wise to defer final judgment.

SUMMARY

No one test can give us all the information we desire. For the rapid detection of the poorest milks, the resazurin and methylene blue tests appear to have distinct advantages. They fail, however, to indicate the source of the trouble, and here the direct microscopic examination is unexcelled. For the routine grading of a series of samples, the modified methylene blue test has the advantages of cheapness, reliability, and simplicity. (Preliminary tests indicate that it may

1 These grade limits correspond, *on the average*, to standard reduction times of 2, 5, and 8½ hours (9).

2 This lack of sensitivity of resazurin is the basis for the rejection of this test in Switzerland (20).

3 In both tests the tubes were inverted every 2 hours to redistribute the bacteria.

furnish as useful information as the standard plate count in the examination of pasteurized milks.) Both the resazurin and methylene blue tests are sensitive to the state of activity of the organisms, a feature not possessed by the counting methods, hence give a more accurate indication of the true bacteriological condition of the milk.

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"In these days of expansion of the air-conditioning industry, many buildings installing this equipment find it desirable to provide their own water supply for cooling purposes. Also in some instances where shallow ground water is easily available, certain industries have installed their own water supply systems for industrial and domestic use. It is usually the case, however, that these same buildings are also served by the municipal water supply. Some place within the building the two sources of supply are usually connected to the same plumbing system, with that supply not in use being separated from the plumbing with a gate valve, check valve, or a combination of both. This type of connection creates a physical cross connection which should not be permitted unless the private supply meets all sanitary standards as applied to the municipal system. Gate valves and check valves are not positive insurance against the passage of water through the same. We all know that sometime or another valves of all types leak. When a safe water supply is separated from a non-potable supply by valves only, the latter may contaminate the former. Assuming that this condition exists in some building within your city, should the valve separating the two leak, water from the private supply could enter the distributing system when the static pressure of the unsafe supply exceeds that in the distribution system. Usually city pressure exceeds that of any private system under normal conditions. It is a fact, however, that there are times in practically every distribution system when a negative pressure may exist. During these times, there will be a flow of water from the private system to the public supply. Such conditions have resulted in contamination of many public water supplies with the consequent death toll from typhoid fever and other water-borne diseases.—South Dakota State Department of Health."

J. H. SHRADER.

The Use of the Phosphatase Test by New York City *

John L. Rice, M. D.

Commissioner of Health, City of New York

It is generally recognized that pasteurization is the most effective public health measure available for the prevention of diseases which are related to milk. It is therefore important that means be available to ascertain whether or not a milk supply is properly pasteurized. Obviously, it is impossible to determine this by physical inspection of plants or products. For this reason, health departments and other agencies interested in milk control have long sought a test that would differentiate between properly and improperly pasteurized milk.

DEVELOPMENT OF TEST

Early efforts evolved chemical and microscopic tests which discriminate between boiled and raw milk. Other attempts to use the plate count or *B. coli* determinations, involving careful technic and a long period of time, have not been found reliable. Chemical tests, such as the amylase test, have also been found wanting. None of these tests can definitely indicate when a milk sample had been correctly pasteurized at 143° F.

The problem seemed solved when Kay and Graham of England published their phosphatase test in 1935. Our study of this technic demonstrated that, while the published method was good, it was too involved and gave results too late for an efficient control of a city's milk supply. Mr. Scharer and other chemists in the laboratory began to work on this problem and soon made significant modifications and simplifications in the English test. Two test procedures were finally established: one, a *laboratory test* which could be completed in about an hour, and the other, a *field test* requiring about 15 minutes, capable of being easily used by inspectors. Improvements in the field test allow very sensitive determinations of the efficiency of pasteurization, even by persons having no technical training. Using a compact kit containing the few necessary reagents and apparatus, the inspector virtually brings the laboratory to wherever milk is found. These two methods are comparable in accuracy to the Kay and Graham technic, in that they will detect the presence of as little as 1/5 percent of raw milk. The technical details of the tests have been published in the Journal of Dairy Science (**21**, 21, 1938) and the Journal of Milk Technology **1**, (No. 5) 35, 1938, and **2** (No. 1) 16, 1939.

ADMINISTRATIVE USE OF TEST

We employ the laboratory procedure on all samples of pasteurized milk and cream routinely submitted for chemical or bacteriological examination. Results are available the same day that the samples are submitted and, if necessary, within an hour or two after receipt of the samples. When an improperly pasteurized milk is found by the laboratory, a city inspector can be sent immediately to the distribution point involved, to make further examinations on the premises by means of the field test, and to take such action as is warranted by the results of his findings. In this fashion, improperly pasteurized products still on hand can be withheld from distribution, and the cause of the irregularity corrected before the next pasteurizing operation. Upon a report of positive finding involving country pasteurization plants, the country inspector is immediately notified. Taking along his field test kit, he makes an inspection of the plant in his district, while a city inspector is sent to intercept

* Presented at Sixty-seventh Annual Meeting of American Public Health Association in Kansas City, Mo., Oct. 28, 1938. Current data added.

that day's shipment as it enters New York City. The action taken relative to the shipment will depend on the results of the tests and the reports from the plant inspections.

As illustrative of how this procedure has worked, I might cite two examples. In one case, cream samples collected from a distributing establishment in the city and routinely submitted for chemical examination were found to show considerable phosphatase enzyme activity. The source of this cream was traced to a large cream separating and pasteurizing plant located 300 miles from the city. Our city inspectors intercepted the next shipment from this plant the same night at the railroad terminal, and tested 50 out of a lot of 100 cans of cream by means of the field test. These tests likewise indicated a varying degree of phosphatase activity and the cream was not permitted to be used for fluid purposes. In the meantime, a telegram was sent to the country milk inspector to visit the pasteurizing plant at once. After considerable checking of all equipment and steps in the operation, certain irregularities were found, including leaking outlet valves. The plant representatives were shown the phosphatase test and adopted it at once as a routine check on their operations. Shipments of cream were discontinued for several days until all irregularities were corrected. Thereafter, no further improper pasteurization was noted and all phosphatase tests have been satisfactory from this source.

Another instance involving a city pasteurizing plant was discovered by the finding of postive phosphatase reaction on routinely submitted samples, collected in the morning, for bacteriological examination. The information of the positive reaction was forwarded to the milk division in the afternoon, and that same evening inspectors were sent to the pasteurization plant to make further checks and note operations. The field phosphatase test showed milk stored in the icebox and representing milk that had just been processed that night as being practically raw. Inspectors then proceeded to the pasteurization room. They found the milk being conveyed directly from the heater to the cooler and bottler without being held for the required thirty minutes. There had been a breakdown the previous night in the master valve of the automatic holding equipment. Attempts made by the operator to repair the valve had proven unsuccessful. The inspectors embargoed all the bottled milk on the premises and stopped the operation. This pasteurization plant was closed for a period of three weeks.

The modified phosphatase tests were established as a routine procedure in the Department in March 1937, after making a great number of experimental determinations. Both the city and country inspectors use the field test to check the operating efficiency of the pasteurizing plants in their districts at the time of their regular inspections. We are now examining approximately 800 samples of milk and cream weekly by the laboratory method alone. Altogether more than 100,000 determinations have been made by our staff. This figure includes tests on routine milk and cream samples done in the laboratory and a large number of field tests.

We have acquainted the industry with the technic and application of the test through lectures and demonstrations. Operators of pasteurizing plants have more voluntarily adopted these tests for the control of pasteurization; they have found the routine use of the field test most suitable for this purpose.

RESULTS OF USE OF TEST

When the test was first employed, about 1.5 percent of the samples examined showed positive findings representing gross irregularities in pasteurization. Within a few months, the results indicating such irregularities were markedly reduced; during the past year practically no gross irregularities have been discovered. During the first three months after the tests were routinely used, 4 percent of the samples showed slight deviations from proper pasteurization. At present, such minor irregularities occur in about 2 percent of the samples examined. We now have inspectors follow up the reports on milk or cream samples showing phosphatase results which are equivalent to the addition of 1 percent of raw milk, or indicate over 2 degrees drop in temperature, or a reduction of 5 minutes in holding time. I should add that most of the irregularities have been found in samples of cream.

The success of the phosphatase test in controlling the efficiency of pasteurization has been fully covered in many papers during the past year. These have enumerated common defects in pasteurization, detected through application of the test. Most of these instances in New York City were not due to wilfullness, but rather to slight shortcomings of equipment or to other factors of which the operator was not aware, and which could easily be detected easily by routine physical inspection of plants. The significance of the test in milk regulation is well indicated by its widespread adoption by health officials throughout the country, within a comparatively short period of time.

During the past year, the laboratory has investigated the application of these tests to the determination of the efficiency of pasteurization of dairy by-products, such as chocolate drinks, ice cream mix, cheese, and butter. The results, so far achieved, hold promise of a means of controlling the efficiency of pasteurization of these products. A technical article presenting the experimental work carried out thus far appeared in the January 1939 issue of the Journal of Milk Technology. At this time, our chemists feel that they can detect a butter or cheese made from raw milk or cream and differentiate it from a product made from properly pasteurized ingredients.

In summarizing, it can be stated that the modified phosphatase test has given to the health officials a new tool of undoubted value in further assuring that the milk as furnished to consumers is safe and not likely to be a carrier of disease. It may some day be found that the development of the phosphatase test has been the most important contribution to sanitary milk control since the inception of pasteurization.

Individual Tumblers of Milk for Restaurant Trade. *The Milk Dealer.* April 1938. *The Sanitarian, 1,* No. 2, July p. 21 (1938). *P. H. Abs. 19,* Mi, 6, 3-4-39.

The Harding Hotel Co., Chicago, Ill. realizing that milk need not be handled more than once, recently initiated the scheme of bottling and capping tumblers of homogenized, pasteurized milk which can be placed upon the restaurant table for immediate use. An aluminum hood completely covers the drinking lip of the tumbler, thus protecting the glass from handling. A practice is made of removing the hood at the restaurant table before the customer. By drinking the milk directly from the tumbler it avoids the use of an additional glass which is usually heated to room temperature and often dusty. This method also assures the customer of the proper proportion of cream in his glass of milk. A further consideration would be whether or not the tumbler were sufficiently strong and durable and adequately protected from chipping on the drinking lip, and if, possessing these qualities, it were pleasing to drink from."

Report of Committee on Laboratory Methods

A. H. Robertson, *Chairman*

State Office Building, Albany, N. Y.

The official method for determining the fat content in frozen desserts is the time-honored Roese-Gottlieb procedure. Some public health laboratories are not too familiar with this official procedure and others do not have the Mojonnier fat testing equipment which is essentially the mechanically-improved, assembled Roese-Gottlieb apparatus. Because the official fat extraction method is somewhat time-consuming, especially where the analysis is required on large numbers of samples, numerous modifications of the Babcock method have been introduced for estimating the fat content of frozen desserts.

Obviously the Babcock procedure is a rapid technic originally designed only for milk and cream, and even as such, a slight degree of accuracy has been sacrificed for this adaptation. When workers attempt to apply the original technic or one of its various modifications to frozen desserts, needless to say, confusion exists because the accuracy is invariably further decreased according to the skill of the operator.

The presence of cane sugar and chocolate (or cocoa) and the fact that the mix is homogenized are direct causes of irregularities in the results when the usual modifications of the Babcock procedure are used. As a result, non-acid, fat-liberating agents have been suggested as substitutes for the original acid digestion procedure. Some workers, preliminary to the acid digestion, have made a partial ether extraction of the fat in the Babcock bottle, but with only limited success. The variety of simplified tests is such that it is apt to confuse the laboratory worker because so little is said about their limitations. Because of the irregularities reported by collaborators studying different modified rapid technics, the Association of Official Agricultural Chemists (1936) has deemed it unwise to adopt officially any of them for determining the fat content of ice cream. In spite of this action, there does seem to be a real need for a rapid sorting test whereby all samples could be examined and those which approach, or are below, the statutory standard might be selected for further examination by the official Roese-Gottlieb method.

Among the frozen dessert products are the regular ice creams, sherbets, ices, custards and the miscellaneous group of frozen confections, specialties, novelties, etc. Attention has been focused on the ice cream products and these have been subdivided arbitrarily into three groups: —the extract flavored, the fruit, nut or seed flavored, and the chocolate flavored ice creams, because of different conditions encountered in the anlysis of each.

The 1936 survey by the Committee showed that the following rapid methods were used most commonly: (1) glacial acetic acid-sulfuric acid Babcock modification, (2) Lichtenburg, (3) Illinois or Garrett-Overman, (4) Minnesota, (5) Nebraska or Crowe, (6) Fucoma or Gerber, and (7) Pennsylvania or Doan method.

The original plan this year was to compare each of the several methods with the Roese-Gottlieb procedure in order to determine which could be recommended with the least reservations. Only a few members of the 1938 Committee were able to aid in the comparisons, and consequently the data from which to draw conclusions are not as complete as might be desired. Your chairman has examined other sets of comparative analyses which show definitely that fairly good agreement can be obtained with many of the rapid technics, providing the worker has developed a high degree of expertness. In other words, the results from a laboratory in which a particular test was developed probably would agree better with those by the Roese-Gottlieb method than similar comparisons between methods not developed or commonly used in that laboratory. The results of the 1938 comparisons no doubt have been influenced by such facts.

The number of methods are limited because whatever ones are given tentative recognition herewith to be used as sorting tests only, will be used indiscriminately in some laboratories. Because of the general lack of expertness and the need for selection of a procedure least apt to cause confusion, only three are listed as follows:

1. Pennsylvania or Doan.
2. Fucoma or Gerber.
3. Illinois or Garrett-Overman.

1. PENNSYLVANIA OR DOAN METHOD FOR DETERMINING FAT CONTENT OF ICE CREAM

Apparatus:

1. Standard ice cream test bottles, 6 inch, 9 gram, 20 percent, with graduation marks at each 0.2 percent.
2. Babcock centrifuge.
3. Torsion balance.
4. 9 cc. pipette.

Reagents:

1. Ammonium hydroxide c.p., 28 to 29 percent.
2. Normal butyl alcohol, c.p.
3. Diluted sulfuric acid, s.g. 1.73.

Procedure:

1. Mark bottles plainly.
2. Balance two bottles on a sensitive Torsion balance.
3. Bring ice cream in the closed jar to a temperature slightly below 80° F., thoroughly redistribute the fat, preferably by rotating the bottle, but do not churn it. Mix thoroughly with spatula, removing all tenacious materials from the sides of the container and breaking up all lumps.
4. Immediately weigh 9 grams of the mixture into the previously balanced milk test bottle.
5. Add 2 cc. of ammonium hydroxide and mix thoroughly.
6. Add 3 cc. of normal butyl alcohol and mix thoroughly.
7. Add 17.5 cc. of sulfuric acid and mix thoroughly.
8. Centrifuge at regulation speed for your machine for 5, 2 and 1 minutes adding water at 180 to 200° F. as in the regular Bacbock method. Use heated machine at about 160° F. Do not shake bottles between periods of centrifuging as this will drastically lower the fat reading.
9. Place bottles in water bath at 135 to 140° F. for five minutes. Carefully add two or three drops of glymol* and read using dividers. Measure from bottom of lower meniscus to line between glymol and fat.

2. FUCOMA OR GERBER METHOD FOR DETERMINING FAT CONTENT OF ICE CREAM

Apparatus:

1. 15 percent or 25 percent, 5 gram ice cream test bottles (Gerber style).
2. Special adjustable stoppers for Gerber bottles and adjusting key.
3. Gerber centrifuge or 9 inch Babcock centrifuge. A short piece of rubber hose, large enough to fit around the test bottle and into the bottle holders, in a Babcock machine serves as a satisfactory adapter for the latter type of machine.
4. Torsion balance.
5. 10 cc. pipette for acid.
6. 5 cc. pipette for water.
7. 1 cc. pipette for amyl alcohol.

Reagents:

1. For ice cream other than chocolate flavored—
   Regular sulfuric acid s.g. 1.82 to 1.83 at 68° F.—87 parts, and water—13 parts.
2. For chocolate flavored ice cream only—
   Regular sulfuric acid s.g. 1.82 to 1.83 at 68° F.—94 parts and water—6 parts.
   (Always add acid to water, never add water to acid).
3. Amyl alcohol, special for milk fat determination.

Procedure:

1. Mark bottles plainly.
2. Measure 10 cc. of acid of the proper strength into two ice cream bottles.
3. Balance the bottles on a sensitive Torsion balance.
4. Bring ice cream in the closed jar to a temperature slightly below 80° F., thoroughly redistribute the fat but do not churn it. Mix thoroughly with spatula removing all tenaceous materials from the sides of the container and breaking up all lumps.
5. Carefully weigh 5 grams of the ice cream mixture into the previously balanced test bottle.
6. Add 5 cc. of water and 1 cc. of amyl alcohol.
7. Insert stopper and shake until all curd is dissolved.

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* Glymol is a mixture of mineral oil containing a small percentage of a red or blue oil soluble dye. A few drops of this mixture placed in the neck of the bottles makes a sharp line distinction over the top of the milk fat column.

8. Then mix acid remaining in neck of bottle by inverting test bottle several times.
9. Centrifuge for 6 minutes at regulation speed for your centrifuge at approximately 160° F. (heated machine).
10. Place bottles in a water bath at 135 to 140° F. for 5 minutes before reading the fat column.
11. Read percentage of fat promptly by adjusting the height of the fat column to zero or some other whole percentage graduation. Use stopper key for this adjustment.

Note: The Gerber test bottles can not be used in a standard Babcock centrifuge for 6 inch bottles. Difficulty has occasionally been experienced in getting uniform test bottles from the manufacturer through their representative, Dairy Industries Supply Co., 216-218 Water Street, New York City.

3. ILLINOIS OR GARRETT-OVERMAN METHOD FOR DETERMINING FAT CONTENT OF ICE CREAM

Apparatus:

1. Standard ice cream test bottles, 6 inch, 9 gram, 20 percent, with graduation marks at each 0.2 percent.
2. Babcock centrifuge.
3. Torsion balance.
4. 9 cc. pipette.
5. Shallow pan, 2½" deep, which can be heated to 212° F.
6. Burette measuring in 0.5 cc. graduations or a 2.5 cc. transfer pipette.

Reagents:

A. Mixture of 75 cc. of ammonium hydroxide c.p., (28-29%); 35 cc. of normal butyl alcohol; and 15 cc. of 95% ethyl alcohol. Keep in tightly stoppered bottle.
B. Mixture of 200 grams of trisodium phosphate and 150 grams of sodium acetate dissolved in 1000 cc. of distilled water. Keep in tightly stoppered bottle.

Procedure:

1. Mark bottles plainly.
2. Balance two bottles on the Torsion balance.
3. Bring ice cream in the closed jar to a temperature slightly below 80° F., thoroughly redistribute the fat, preferably by rotating the bottle, but do not churn it. Mix thoroughly with spatula removing all tenacious materials from the sides of the container and breaking up all lumps.
4. Immediately weigh 9 grams of the mixture into the previously balanced milk test bottle.
5. Add exactly 2.5 cc. of reagent A and mix thoroughly.
6. Add 9 to 10 cc. of reagent B and mix thoroughly.
7. Place test bottle in a shallow water bath, heat to boiling, and continue heating for several minutes. Shake two or three times during heating interval. Usually the fat will spread on the surface in a clear yellow liquid in from 15 to 30 minutes. Heat until the fat has definitely separated from the dark portion of the liquid and has become perfectly clear.
8. Centrifuge at regulation speed for your machine for 5, 2 and 1 minutes adding water at 180 to 200° F. as in the regular Babcock procedure, using a machine at approximately 160° F. Do not soften the water with acid.
9. Place bottles in water bath at 135 to 140° F. for 5 minutes. Do not add glymol. Readings are more nearly correct if the fat column is measured from the bottom to the extreme top of the fat column as in the regular Babcock test when applied to whole milk.*

There are some objections to the use of a tempering bath at 135 to 140° F., because occasionally seeds and other bits of non-fatty materials attach themselves so firmly to the glass in the neck of the test bottle that they are not drawn downward beneath the fat column as the latter is cooled to the proper temperature for reading. This occurs in both the Gerber and Babcock test bottles. In spite of this objection, the use of tempering baths is recommended where a large number of tests are to be read immediately after centrifuging. Readings based on fat columns containing bits of foreign materials are unreliable.

The above sorting methods are to be used for picking out frozen dessert products suspected of having a fat content below standard. Samples thus suspected are to be examined further by the Roese-Gottlieb method. An adaptation of the latter, using in part the Mojonnier extraction flasks and aluminum fat drying dishes, is herewith described, especially for the benefit of those laboratories who think they must have the complete Mojonnier Milk Testing outfit before they can perform a test in accordance with official methods.

* Personal communication from Dr. O. R. Overman, Assoc. Professor of Dairy Chemistry, Dept. of Dairy Husbandry, Univ. of Illinois, Urbana, Ill.

ROESE-GOTTLEIB METHOD, OFFICIAL FOR DETERMINING THE FAT CONTENT OF ICE CREAM

Apparatus:

1. Analytical balance.
2. Beaker, 100 cc.
3. Steam water bath.
4. Drying oven operated at 100° C.
5. Mojonnier extraction flasks.
6. Mojonnier fat drying dishes.
7. Funnels, 3 inch diameter.
8. Desiccator.

Materials:

1. Ethyl ether.
2. Petroleum ether.
3. Filter paper.
4. Ammonium hydroxide, c.p., 28-29%.

Procedure:

Weigh 4 g. of the thoroughly mixed sample into a small dry beaker; add 3 cc. of H_2O; thoroughly mix with a glass rod; and transfer to a Röhrig tube or a similar apparatus (use Mojonnier fat extraction flask), washing out the remaining portion with the aid of an additional 3cc. of H_2O. Add 2 cc. of NH_4OH, mix thoroughly, and heat in a water bath at 60°. Add 10 cc. of 95% alcohol and mix well. Add 25 cc. of ether, shake vigorously for 30 seconds, add 25 cc. of petroleum ether (redistilled slowly at a temperature below 65°), and shake again for 30 seconds. Let stand 20 minutes, or until the upper liquid is practically clear. Draw off into a flask (use Mojonnier fat drying dishes) through a small, quick-acting filter as much as possible of the ether-fat soln (usually 0.5-0.8 cc. will be left.) Again extract the liquid remaining in the tube, this time with 15 cc. of each ether; shake vigorously 30 seconds after each addition; and allow to settle. Draw off the clear soln through the small filter into the same flask as before and wash the tip of the spigot, the funnel, and the filter with a few cc. of a mixture of the two ethers, in equal parts, free from suspended H_2O. To insure complete removal of the fat, a third extraction is necessary. This third extraction yields less than 1 mg. of fat if the previous ether-fat solns have been drawn off closely. Add a glass bead and evaporate the ethers slowly on a steam bath; then dry the fat in a boiling water oven to constant weight. Weigh the flask with a similar flask as a counterpoise. Do not wipe the flask immediately before weighing.

Remove the fat completely with petroleum ether. Deduct the weight of the dried flask with residue and bead to obtain weight of fat. Finally, correct this weight by a blank determination on the reagents used.

A. H. ROBERTSON, *Chairman.*
GEORGE E. BOLLING, Brockton, Mass.
H. E. BOWMAN, North Acton, Mass.
JAMES P. BUCKLEY, Philadelphia, Pa.
R. L. GRIFFITH, Oakland, Cal.
D. W. HORN, Bryn Mawr, Pa.
C. K. JOHNS, Ottawa, Canada
H. W. LEAHY, Rochester, N. Y.
F. L. MICKLE, Hartford, Conn.
HORATIO N. PARKER, Jacksonville, Fla.
M. E. PARKER, Chicago, Ill.
J. H. SHRADER, East Orange, N. J.
H. R. THORNTON, Edmonton, Alberta
H. O. WAY, Cleveland, Ohio
F. P. WILCOX, Los Angeles, Cal.

New Connecticut Sediment Standards

A new 1939 edition of the Connecticut Official Milk Sediment Standard has been approved jointly by the State Dairy and Food Commissioner and the State Commissioner of Health for laboratory, plant and field use in Connecticut. This new standard is a considerable improvement over the old.

The seldom used "Excessively Dirty" discs, have been eliminated in the 1939 standard which carries only three sediment discs, and which grades the milk into four cleanliness grades, namely: clean, good, poor, dirty. The amounts of sediment on the pads on this new standard correspond roughly with sediment scores of 13, 50, 100 on the 1931 edition.

The Bureau of Laboratories in this Department will place this standard in use on the first of July of this year. Public Health Laboratories approved for the Examination of Milk should arrange to use the 1939 edition as soon as possible and should have it in use not later than December 31, 1939. The 1931 edition should not be used after that date.

Copies of the 1939 standard will be available for distribution probably within the next two or three weeks, at fifty cents a copy. This price covers the cost to this Department plus the necessary mailing charges. Remittance should accompany order. A set of directions will be mailed to each purchaser. For the sake of uniform grading of milk sediment throughout the State, it is hoped that the directions will be carefully followed in each approved laboratory.

STANLEY H. OSBORN,
Commissioner.

A Note on Ice Lump Formation in Ice Cream Frozen in Continuous Freezers

David Levowitz, Ph.D.,

Director, New Jersey Dairy Laboratories, New Brunswick, N. J.

Ice cream frozen in continuous freezers has sometimes been found to contain small lumps of ice. Ramsey, of the Telling Belle Vernon Company, Cleveland, presented a paper entitled, "The Cause and Remedy for the Separation of Milk Solids in Ice Cream Frozen in Continuous Freezers," at the recent International Association of Ice Cream Manufacturers convention. This was the first time at which this ice lump formation has been recognized as a definite problem.

Ramsey described the defect as arising in ice cream which left the freezers with a "wet" sheen; such ice creams contained small ice lumps (approximately 1/32 of an inch in diameter) at the mouth of the freezer. After passage through a pipe line and fruit injector, larger lumps (approximately 1/8 of an inch in diameter) were visible. The lumps were dispersed uniformly through the product. When the ice cream came from the freezer "moist", overruns were difficult to control. The hardened ice cream did not show the presence of ice lumps as specific units, but did show large air bubbles; the ice cream possessed poor texture; seemed to possess less fat, on tasting, than its composition indicated; and imparted a "cold" feeling to the mouth.

The research division of the freezer manufacturing company explained the ice lump formation as due to incomplete stabilization of the mix, due to the insufficient protein hydration. Mr. Ramsey found that the temperature of the mix entering the freezer, the temperature control of the freezer itself, the condition of the freezer blades and the composition of the mix were all related to the appearance of the "wet" sheen of the product leaving the freezer.

Serious ice lump formation was encountered in the ice cream manufactured at a New Jersey plant recently, after a new fruit injector was installed. This plant, equipped with newly reconditioned continuous freezers, had been operating satisfactorily prior to the advent of the fruit device. The equipment manufacturer's representatives informed the plant management that the defect was probably due to the composition of the mix, since all other factors were satisfactory, and a New York plant, employing identical equipment, experienced no difficulties.

RELATION OF ICE TO OVERRUN

Mix prepared at the local plant was brought to the New York factory. It was found that the mix yielded a sound "dry surfaced" product, when the freezers were maintained at the same adjustments used by the New York company. The overruns for which the freezers were adjusted were between 110 and 120%. The New Jersey plant supplied its trade with a product drawn between 65 and 70% overrun. When the freezers were adjusted to yield this low overrun, both plants' mixes yielded "moist" surfaced products, which showed small ice lumps when sampled at the mouth of the freezer, and contained large ice lumps after passage through the pipe line and fruit injector. These trials indicated that the overruns at which the mixes were drawn were related to the development of the ice lumps in the frozen product.

The relationship between the sheen of the frozen ice cream and its overrun was determined on the local plant's regular mix. It was found that the mix gave rise to a perfect "dry-surfaced" ice cream at the mouth of the freezer down to 90% overrun. At 80% overrun, the ice cream seemed slightly moist, while it was noticeably moist at 70% overrun, and very definitely moist at 60% overrun. Small (pinpoint) ice lumps were noticeable at 60% overrun. At 50% overrun, small ice lumps (approximately 1/32 of an inch in diameter) were readily observed.

A by-pass valve attached to the mouth of the continuous freezer allowed the diversion of ice cream at the various overruns through the pipe lines and fruit injector assembly. It was found that pinpoint ice particles were present in the ice cream drawn from the fruit feeder at 90% overrun; the particles were approximately 1/32 of an inch in diameter at 80% overrun; at 70% overrun the particles were 1/16 of an inch in diameter; while at 60% they were more than 1/8 of an inch in diameter—the product at this point looked like oat-meal. At 50% overrun, the product could hardly be called ice cream; it resembled puffed-rice, if the cereal analogy is permissable.

The regular "basic" mix contained 12% fat and 39.4% total solids. The fat was contributed in equal portions by fresh fluid cream and by frozen cream. The serum solids were completed by condensed skim milk. Non-dairy solids were supplied by sugar syrup, desiccated egg yolk, and gelatin.

The "novelty" mix prepared at this plant, testing 10% fat and 37.3% total solids, was subjected to a freezing trial similar to that given the basic mix. The fat in this mix was supplied by butter and fresh 40% cream; other ingredients were the same except that no egg yolk was used. This mix is not passed through the fruit feeder, and is drawn off at 100% overrun normally. It was found that this mix seemed "wetter" at 70% overrun than did the basic mix. The "oatmeal" texture was noted at this percentage when the ice cream passed through the fruit injector while it was not seen until 60% with the basic mix.

RELATION OF ICE TO COMPOSITION OF MIX

To determine what relationship existed between the sources of serum solids and the development of the ice lumps (which is presumably related to the extent of protein hydration) a batch of mix was prepared which was identical in composition to the basic mix, but which employed skim powder to complete its serum solids. This mix developed moist sheen and ice lumps at the mouth, and after passage through the fruit injector at the same overruns which were observed with the basic mix. A novelty mix prepared with skim powder also behaved in the same manner as did the original novelty mix.

The substitution of vegetable gum for gelatin in both basic and novelty mixes did not change the overruns at which moist sheen and ice lump formation were noticed. Increasing the amount of stabilizer and omitting it completely also seemed without particular effect.

A batch of high fat mix (18% fat, 42.9% total solids) used for a special account was put through a freezing trial. This mix was found to get to the oat-meal stage at 50% overrun as against 60% for the basic mix. This high fat mix was made from the same ingredients used in the preparation of the basic.

Our findings indicated that the points at which lump formation appeared in the novelty, basic, and high fat mixes were related, possibly, to the concentration of either fat, or serum solids, or total solids in these mixes. The total solids were increased 3% in one mix by substituting a portion of the cane sugar by corn sugar. Passage of this mix showed a definite retardation of the point at which ice lump formation became troublesome. Another mix, in which the concentration of serum solids was increased 2 percent by using delactosed skim product also showed a delayed development of ice lumps. Since the increase of fat is accompanied by the decrease of serum solids in the normal constitution of the novelty, basic and high fat mixes, the elevation of total solids by increase of fat content had also been found to be effective in retarding the appearance of the "wet" sheen-surfaced product.

It was found that increasing the total solids contents of the specific mix in any manner delayed the appearance of the "moist" surface of the ice cream at the mouth of the freezer, and of the "oatmeal" consistency at the mouth of the fruit injector.

HYPOTHESIS FOR ICE FORMATION

When an ice cream leaves the mouth of the continuous freezer with a "dry" surface, it passes through pipe lines as a plug, and will pass through a fruit injector with little or no alteration. The "moist" surfaced product will offer friction to the walls of the pipes and the surfaces of the fruit injector, and will be "rolled" rather than be "pushed" through.

The surface condition of the ice cream leaving the freezer is indicative of the proportional amount of moisture in the air cell walls. On the assumption that continuous freezers yield air cells of constant size, the thickness of the cell walls depends on the ice cream's overrun; high overruns mean thin cell walls, while low percentages mean thicker cell walls. The thicker cell walls will contain a larger proportion of available moisture, since more or less constant percentages of water are converted into ice in the freezing process. A hypothesis is offered: these thicker more fluid cell walls will present less resistance to torque than the thinner, drier cell walls. Under the influence of the friction of the freezer barrel, or pipe lines, the thick, fluid cell walls will be deformed, and the water held in the walls may be made available to the ice crystals already formed, so that their size increases, or the ice crystals from one section of the cell may be brought into proximity with those of another section, to cause the formation of larger ice aggregates.

The hypothesis indicates that the defect could be eliminated by the reduction of the size of the air cells in the ice cream. A greater number of air cells per unit weight would result in thinner foam walls, which would contain less free water at the time of emerging from the freezer, and therefore resist torque to a greater degree. Modification of the continuous freezer motor drives would be necessary to decrease the size of the air cells, since the present models are generally equipped with constant speed dashers, which do not allow the sizes of the air cells to vary.

The trials reported above were undertaken to obtain a practical solution to a troublesome plant condition. The method detailed eliminated the difficulty for the plant concerned. It is hoped that this method may aid other plant men, at least until such time that carefully controlled research work on the problem of ice lump formation leads to a more perfect understanding of the mechanism involved, and to better methods.

A Method for Checking the Holding Time in Short Time High Temperature Pasteurizers

D. M. Roger

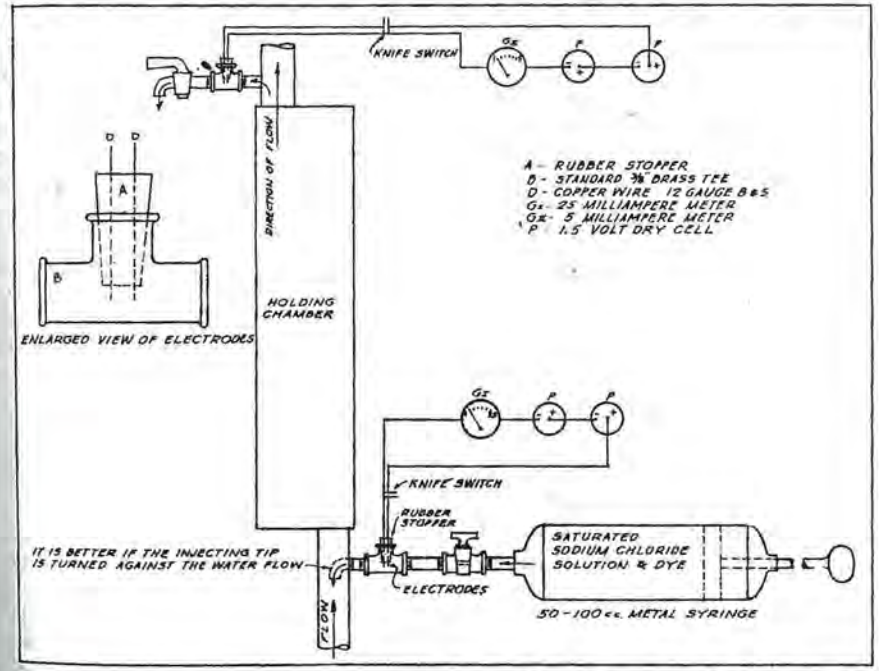
Laboratory Dept., The Borden Farm Products Co., Brooklyn, N. Y.

The usual method of checking the holding time of a short time-high temperature pasteurizer is to pasteurize water, inject dye at the entrance of the holding chamber, and measure the elapse of time before the dye can be detected at the outlet of the holding chamber. Anyone who has worked with this method is fully aware of the attending complications.

The following procedure seems to have some advantages over the dye method.

A saturated sodium chloride solution is injected into the stream of water entering the holding chamber. At this point the salt solution passes a pair of electrodes connected to a circuit joining dry cells and a microammeter. Another pair of electrodes connected to a similar circuit is placed at the outlet of the holding chamber. The salt solution passing these electrodes will increase the conductivity, and allow more current to pass through the circuit, causing a sharp deflection of the ammeter. The arrangement of the apparatus is illustrated in Figure 1.

The operation is simple: One person injects the salt solution. Another operator starts the stop watch when the



Drawing by courtesy of Mr. N. A. Walby

FIGURE 1

Equipment assembly for determining holding time for high-short pasteurizers.

galvanometer at the entrance shows a deflection, and stops it when the galvanometer at the outlet shows a deflection. When dye was added to the salt solution it was found that this method would predict the exact moment when the first dye might be detected at the outlet. It is much easier to watch for and time the deflection of a galvanometer than it is to catch and time the first appearance of dye.

It does not require much ability as an electrician to prepare this equipment. It was found that the polarization of the electrodes did not interfere, but care was taken not to close the switch until just before the test.

A 25 milliampere meter subdivided into milliamperes was used at the inlet of the holding chamber; at the outlet of the holding chamber, a 5 milliampere meter subdivided into 0.1 milliampere.

These milliammeters need not be accurate but they should be sensitive. Meters of this type can usually be purchased cheaply at any store dealing in used radio parts.

An electrode is made by passing two 12 gauge B & S copper wires through a rubber stopper, and fastening the stopper in a 3/8" brass T. By adjusting the area of the electrode to be exposed to the salt solution, a suitable deflection on the milliammeter can be obtained.

Cross-Connections in Plumbing Systems

Information on which to base effective health regulations pertaining to the installation of plumbing is supplied in this publication. It deals principally with the technical aspects of the problem of preventing the backflow of water from plumbing fixtures into water supply systems.

It starts with a general review of the subject, including a brief history of previous work on the subject, a classification of cross-connections, and a brief discussion of vacua and siphon action. This is followed by a mathematical and experimental analysis of the conditions tending to produce backflow into a supply line. This analysis makes it possible to determine the worst conditions, as regards backflow, that can occur in any building supply system, and to determine minimum requirements for the positive prevention of backflow under these conditions. Specifically, the minimum pressure that can occur in any system, the maximum rate at which water can be removed from the supply risers under this minimum pressure, the smallest air gap between a faucet and plumbing fixture that can be safely allowed under the worst conditions, and the essential performance characteristics of a siphon-breaker are determined. The effectiveness of various types of siphon-breakers in preventing backflow is discussed, and the operation of one type of flush valve is explained in order to show the essentials of a table flush valve, that is, one which will not open under any possible reduction in supply pressure. Finally, there is given a brief review of the entire subject of preventing backflow from plumbing fixtures, in which two distinct methods of attack are pointed out, and the merits of each are discussed. The conclusions relate only to the technical aspects of the subject and do not take the form of proposed health or plumbing regulations.

It is well illustrated with sketches of supply systems, cross connections, general layout, siphon-breakers, flush valves, and testing apparatus, and contains a bibliography of 29 references—Roy B. Hunter, Gene E. Golden, and Herbert N. Eaton, Journal of Research of the National Bureau of Standards, Vol. 20, April, pp. 479-542, 1938. This report can be purchased as Research Paper RP 1086, Superintendent of Documents, Washington, D. C., price 15c.

J. H. SHRADER.

Report of Committee on Ice Cream Sanitation*

F. W. Fabian, *Chairman*

Michigan State College, East Lansing, Mich.

The Committee wishes to bring to the attention of the Association several developments in the frozen desserts field that have taken place during the year. Throughout the whole country a greater interest is being taken in frozen desserts, as evidenced by the enactment of laws by many states and cities and the drafting of a Frozen Desserts Ordinance by the U. S. Public Health Service.

The foundation for the whole industry has been built around one product—ice cream. While ice cream still leads all other forms of frozen desserts in production and doubtless will for many years to come, there is evidence to indicate that other forms of frozen desserts are gaining in popularity, and that more cognizance should be taken of them.

The American Public Health Association has just recently appointed a joint Committee on Frozen Desserts consisting of members from the Laboratory Section and from the Food and Nutrition Section. This committee is now busy preparing standard methods for the analysis of frozen desserts, to be eventually published doubtlessly in conjunction with the Standard Methods of Milk Analysis.

In view of the broadening scope of this field, your Committee suggests that proper steps be taken to change the name from the Committee on Ice Cream Sanitation to that of the Committee on Frozen Desserts Sanitation.

FROSTED MALTED MILK

The appearance of a new frozen dessert on the market known as frosted malted milk brought out some rather interesting things relative to our frozen desserts laws. Here was a product that did not have sufficient milk fat to qualify as ice cream but more than enough to classify it as a sherbet which, as a rule, has approximately 2 percent milk fat. The fact that malted milk was frozen changed the whole picture from a legal standpoint. There has been no objection to selling malted milks in a liquid state no matter what their milk fat content might be but when heat was removed the status of the whole problem changed. Here is an example of where the physical rather than the chemical composition determined the legality of the product.

The reason is clear to those familiar with the situation since it is evident that with the frosted malted milk, or any other similar frozen dessert, it is an attempt to imitate ice cream. With any frozen milk of whatever flavor, it would be hard for the public to distinguish between a frozen milk containing 6 or 7 percent of milk fat by weight, and chocolate or fruit ice cream containing 8 percent by weight of milk fat as required in many state laws.

IMITATION ICE CREAM

Furthermore, many states provide for just such products by requiring that they be labelled imitation ice cream. Some states even require that a license be secured before such products can be manufactured. So far, there has been little excuse for the manufacture of products covering the range between sherbets containing from 2 to 3 percent milk fat and ice cream containing 8 to 10 percent milk fat. Some might think that it would be a fine way to utilize more milk. However, they lose sight of the fact that this type of frozen dessert sells for the same price as ice cream so no greater sales volume may be expected, and those who

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* Presented at the Twenty-seventh Annual Meeting of International Association of Milk Sanitarians, Cleveland, Ohio, Oct. 19-21, 1938.

eat this type of frozen dessert actually get less milk fat and solids and therefore less nutritional value.

Horatio N. Parker, of our Committee, states,

> "I think this product raises a rather serious question, because if it is accepted it will not be long before someone else is in the market with another product that does not conform to the standards established by law and that would require a special dispensation to permit its sale. Our experience with these novelties is that they are flashes in the pan that go for a little while and then the public forgets."

WEIGHT VERSUS VOLUME

For years ice cream was sold on a volume basis only. As the industry increased in size and competition became keener, the amount of air incorporated into the mix during freezing by some manufacturers reached fraudulent proportions. It soon became evident to control officials and to the manufacturers who had the best interests of the industry at heart that something should be done to control the amount of air permitted in the finished product.

Different states have attempted to correct the abuse in various ways. Some states, such as Wisconsin, specify the amount of overrun permitted. Other states, such as Alabama, California, Connecticut, Florida, Idaho, Massachusetts, Michigan, New York, South Dakota, and Utah, stipulate the minimum weight per gallon in terms of food solids per gallon (1.6 lbs. food solids per gallon.)

Another variation of the same idea is defining both the weight and food solids per gallon as in South Carolina (weight—4.5 lbs. and food solids per gallon—1.6 lbs.) and Pennsylvania (weight—4.75 lbs. and food solids per gallon—1.8 lbs.) or just the weight per gallon as in North Dakota and Ohio which require a minimum of 4.25 lbs., and Virginia and Maryland which require a minimum of 4.5 lbs. of ice cream per gallon.

Of the three ways, percent overrun, weight per gallon, and food solids per gallon, the last named method seems to have been adopted by the greatest number of states. It is likewise the method preferred by most ice cream manufacturers. With a minimum weight of food solids per gallon specified, it is not possible to whip too much air into the mix during freezing, and it also eliminates the loading of ice cream with materials such as sugar and water, having a higher specific gravity than milk fat.

PAPER CONTAINERS AND CARTONS

A new development in the milk industry has been the sanitary regulation of the manufacture and sanitary control of paper containers and cartons used in the dispensing of milk. Paper cartons and containers are used more extensively for storing and dispensing frozen desserts than for milk. Furthermore, the same precautions, as a rule, have to be taken in their manufacture and storage as are being advocated for milk.

There is no reason to believe that the same sanitary requirements should not be enforced in the manufacture and subsequent handling of paper containers and cartons for frozen desserts as for milk. Your Committee, therefore, recommends that this Association in the future shall consider only those paper containers and cartons satisfactory for storing and retailing frozen desserts when they have satisfied all the principles of sanitation to be observed in their manufacture and use as are stipulated in the Journal of Milk Technology, Volume I, No. 5, pp. 50-53, Items 1 to 11 inclusive, that are being advocated for paper containers to be used for milk.

BACTERIAL STANDARDS

Each year a few more states are added to the list of those having a bacterial standard for ice cream. In 1927 California established a maximum legal bacterial standard for ice cream. Since that time the number of states enacting similar laws have increased until now there are 12 states having such standards. The list of states together with their respective standards is given herewith.

BACTERIAL STANDARDS

Twelve states at present have statements of the maximum bacterial content allowed as follows:

1. Indiana	100,000 per gram	
2. Connecticut	100,000 per cc.	
3. California	75,000 per gram	
4. Michigan	150,000 per gram	
5. Mississippi	250,000 per cc.	
6. Iowa	250,000 per cc.	
7. South Dakota	250,000 per cc.	
8. Georgia	500,000 per cc.	
9. W. Virginia	500,000 per cc.	
10. Utah	100,000 per cc.	plain
	500,000 per cc.	fruit & nut
11. Wisconsin	100,000 per gram	
12. Kansas	100,000 per gram	

AGENCIES CONTROLLING MILK HYGIENE

Public health laws and regulations derive their validity from police force, which constitutionally resides in the state governments. The administration of the laws may be vested in various state agencies. A survey by the special Committee of the American Veterinary Medical Association on Food Hygiene in 1937 showed that in the 48 states the milk hygiene control is distributed among the following agencies:

Number of states in which milk sanitation is done by:

State Health Department	22
State Agricultural Department	12
State Health Dept. and other Agency	10
Some other dept.	4
Total	48

OTHER SANITARY CONSIDERATIONS

Mr. Ralph E. Irwin states that:

"The following three questions are under consideration here in Pennsylvania:

1. From a public health standpoint should we permit the preparation of milk and ice cream in the same room in the milk and ice cream plant? In doing this, we will have equipment for pasteurizing, cooling, bottling and separating and equipment for pasteurizing ice cream mix, homogenizing, cooling, freezing, and the many additional activities carried on in the preparation of milk and ice cream.
2. Should we permit milk and ice cream to be prepared in the same equipment? May we pasteurize milk and ice cream mix in the same pasteurizer, cooled over the same cooler, etc.
3. How far should we go in providing fly protection for rooms in which milk is handled during and after pasteurization, and in which cleansed containers are stored? Likewise, how far should we go in fly protection in rooms in which ice cream is prepared and packaged? Apparently the only door entering such rooms which is closed during the fly season is a door connected with the cold room. Therefore, should we require that the entrance to the milk room and the ice cream room should be through a cold room if fly protection is not given in another manner?"

Dr. Andrew J. Krog has the following comments and suggestions to make:

"A. Homogenizers: The present type of asbestos rubber packed pistons used in homogenizing should be replaced by a device of a more sanitary nature. Homogenizers designed to be taken down rapidly, and capable of complete sterilization without the destruction of packings, should be adopted as standard equipment. There is such equipment on the market at the present time.

B. Food Colors: Aqueous solutions of certified colors for ice cream are generally made up from powder bases at ice cream plants and are in most instances stored for a comparatively long period of time at room temperature. Their composition, time of storage, and room temperature enable them to become excellent culture media for organisms which may be introduced through contamination. Methods for the stabilization of these color solutions should be adopted, and use of a chemical preservative may be considered. I think this is a decided factor in the bacterial content of ice cream.

C. Flavors: It has been generally believed that concentrates in alcoholic vehicles are free of foreign organisms. However, a sufficient number of them have been found to harbor a large number of spore cells which would seem to me to be an indication that bacterio-

logical check-ups of concentrates are warranted.

As we all know, fruits prepared for ice cream use have been found to be contaminated with many organisms so frequently that routine control of these products should be definitely adopted. Such control should also be exercised over nut meats and ground flavoring substances such as vanilla, chocolate, etc.

D. Hand Operations: The cutting and wrapping of bricks, the filling of fancy molds, the capping of cups, and the packaging of novelties by hand should be eliminated as rapidly as possible. The use of so-called "utility rags" by operators involved in these processes has been found to be an unfortunately excellent means of transferring organisms to the various areas involved. Considerable thought should be given to the types of molds used. It has been my experience that very few of the various pieces of equipment used for making fancy forms are so designed as to permit proper cleansing.

1. Presumptive test: The standard presumptive test media for water analysis do not concern themselves with large quantities of organic matter in the water. Presumptive test media for dairy products should be modified to allow for the reaction between prohibitive dye-stuffs and organic matter.
2. Presumptive test: It has been found that the greatest efficiencies granted to the best presumptive media are approximately 80%, therefore, more efficient media must be developed.
3. Presumptive test: Controls for spores in running presumptive tests will avoid false positives and will tend to make "the most probable number more probable." This may be rather vague, but it is the only way I can express my point.
4. Thermal death-point: Researches on the extension of the thermal death-point of members of the colon group by growth in various media and by manipulation of the incubator temperatures have proven that temperatures resistant characteristics may be developed. The processing of the ingredients of ice cream mixes should be started to determine if this mechanism is operative in their manufacture."

CONCLUSIONS

It will be seen from this brief discussion that the sanitary band is gradually tightening about frozen desserts. Each year new and more stringent laws are added to the statute books. Additional states are following the example of other states in controlling frozen desserts.

F. W. FABIAN, *Chairman*
W. C. CAMERON
RALPH E. IRWIN
A. J. KROG
PAUL F. KRUEGER
J. M. LESCURE
HORATIO N. PARKER
R. V. STONE

High-Short Pasteurization — A Digest of Papers Presented at the Dairy Manufacturers' Conference, March 14-16, 1939, University of Wisconsin, Madison, Wis.

High Temperature Short Time Pasteurization

W. D. Dotterrer,

Bowman Dairy Co., Chicago, Ill.

The data from the tests recorded in this paper were determined on a Cherry-Burrell Duo-short time pasteurizer, installed to determine the effect on bacteria counts, cream volume, flavor, and phosphatase reaction.

Comparisons were made between regular pasteurization with 30 minute holding and Duo-short time pasteurization. In this latter process, milk from the regenerator is heated to 157° F., cooled to 143° F., heated to 161.5° F. where it is held for 16 seconds, and cooled through the regenerator and cooler. Averages of the bacteria colony counts from the experimental run were as follows:

Raw milk bacteria colony count..	99,000
Regular Duo-process	10,700
Reduction 89.2 percent.	
Regular 30 min, holding	7,800
Reduction 92.1 percent.	
Raw milk bacteria colony count..	116,000
Duo-process plus an additional heat treatment of 9.5 sec. holding at 157° F.....	12,100
Reduction 89.6 percent.	
Regular 30 min. holding.....	6,800
Reduction 94.1 percent.	

The additional heating did not appreciably improve the bacterial reduction. The cream volume was considerably decreased. The phosphatase tests were all satisfactory at temperatures of 160° and over. They were unsatisfactory at 158° and lower.

Installations were made in a plant where milk from a single vat could be pasteurized by different methods. A series of tests was made on milk from the same vat, and pasteurized with and without the Duo feature (the preliminary heating and cooling between the regenerator and the holder). The results of all the data in a run of 13 days are summarized as follows:

	Bacteria colony counts Without Duo	With Duo
Raw milk 160,000		148,000
Pasteurized milk..	10,200	10,700
Reduction	93.6%	92.8%

These data indicate that the Duo-short time pasteurizer has no advantage over the same equipment operating without the Duo feature.

A comparison of the short time method and the 30 minutes holding, as shown by the results from more than 200 samples run on nine days, gave the following results:

Number	Percentage bacteria reduction Short time	30 min. holding
1	96.20	99.21
2	96.45	97.50
3	90.70	95.00
4	98.74	99.40
5	98.40	98.00
6	98.40	98.00
7	71.00	93.00
8	96.28	98.16
9	93.60	93.25
Average	93.31	96.84

With the omission of the results of the run of short time test No. 7, the average becomes 96.10. (We know of no reason for omitting this figure.)

Experience indicated that thermoduric organisms resist short time pasteurization to a greater degree than they resist 30 minutes holding. In other words, some organisms would be classed as heat resistant to short-time pasteurization but not to 30 minutes holding.

Tests were made to determine the effect of clarification on bacterial counts.

Milk from a regenerator was clarified at a temperature of 137° F. (for 10 seconds) with the following average results:

	Bacteria counts	
	Before clarification	After clarification
Average of 19 samples	183,000	87,300

Clarification under these conditions effected a reduction of 52 percent of the bacterial count.

The effect of high-short and regular 30 minute (low-long) pasteurization of milk from the same tank on the cream volume gave the following values:

	Cream volume	
	High-short clarified	Low-long filtered
Average of 6 tests	12.74%	13.09%

The filtered, long-holding treatment showed a better cream volume than the high-short clarification treatment.

In order to determine the relative effect of clarification versus filtration in high-short pasteurization, the following data were secured on milk from the same vat:

	Cream volume	
	Clarified	Filtered
Average of 5 tests	13.09%	13.83%

The filtered milk showed a better cream volume.

A crucial test was made on the cream volume from high-short pasteurization as compared with low-long holding, in both cases using milk from the same vat, and filtering.

	Cream volume	
	High-short	Low-long
Average of 4 tests	13.57%	13.43%

No appreciable advantage in cream volume is attributable to one process over the other.

Less cooked flavor was noted in milk pasteurized by the high-short process than with the low-long method. No thermophilic bacteria were ever found in the high-short process, thereby offsetting to some extent the greater number of thermoduric organisms which survive high-short pasteurization.

"If a conclusion were to be written from the information given in this discussion it would be that short time high temperature pasteurization can be used with a fair degree of satisfaction, if the quality of raw milk being used is satisfactory. It will be necessary to keep the number of thermoduric bacteria as low as possible if low counts are to be secured on milk pasteurized by the short time method. This calls for a great amount of laboratory pasteurization of farmers' samples and a greater amount of field work to eliminate thermoduric organisms from the utensils".

High Temperature Short Time Pasteurization of Milk

F. M. Keller,
Chicago Board of Health, Chicago, Ill.

The minimum time and temperature for high-short pasteurization, accepted by the U. S. Public Health Service Ordinance and Code, is 160° F. for 15 seconds. Under these conditions, tubercle bacilli and hemolytic streptococci are killed, and phosphatase tests are comparable to a heat treatment of 143° F. for 30 minutes. When holding at 144° F. for 30 minutes is required, it was found that 161° F. for 16 seconds will give similar results.

The common construction at the present time for short-time high-temperature equipment is the plate type heater with milk to milk regenerators. Some installations also include plate type coolers. The generally used holders are of sanitary milk pipe, sometimes called "tubular holders". There is also a unit on the market which uses a cabinet heater and cooler with milk to water to milk regeneration and an open gravity holder.

The U. S. Public Health Service has promulgated requirements for the construction and operation of high-short pasteurizers, summarized as follows:

(a) All surfaces with which milk comes in contact shall be smooth, not readily corrodible metal or unbroken vitreous material.

(b) Easily accessible for cleaning and inspection.

(c) Self draining.

(d) In good repair, free from cracks and corroded places.

(e) No threads exposed to milk.

(f) Pressure-tight seats on thermometer submerged openings.

The temperature control shall consist of a dependable automatic thermostat with a milk flow diversion device installed at the holder outlet. The diversion device is intended to prevent the forward flow of imperfectly pasteurized milk if the thermostat fails or any other irregularity arises which causes the milk to drop below the pasteurizing temperature. The entire flow of milk must pass through the flow diversion device. In the case of the valve type diversion device, which is the common type, a leak escape groove shall be located on the forward flow side of the valve seat and leakage drain completely outside of the valve body. The diversion valve is the main safety control on the unit and consequently it is imperative that its construction be such that its proper operation will always be assured.

The efficiency of the diverting valve depends to a large extent on its speed of operation. It must be combined with the recording thermometer which registers temperatures and cut-in and cut-out responses, and actuated by the same bulb system.

The recorder must meet the requirements for recorders located in pasteurization pipe lines.

The indicating thermometer should be located as close to the recording thermometer bulb as possible and also meet the requirements of indicating thermometers located on pasteurization pipe lines.

The holding time is dependent upon the size of the holder pipe, the pressure and vacuum, and the speed of the pump. Immediately after installation or any repair or change in the equipment, it is necessary to test the holder for compliance with the holding requirement. This is done by running water at the pasteurizing temperature with all flow-impeding devices open to their fullest extent. The test is made by injecting a dye or starch solution into a petcock at the holder inlet and taking samples at one second intervals from a petcock just ahead of the diversion device. Maintenance of the required holding time necessitates the use of a positive milk pump geared directly to a constant speed motor. Any variable speed gears or pulleys must be sealed so that the speed of the pump cannot be changed without the knowledge of the health officer.

At all times the pasteurized milk must be under greater pressure during regeneration than the raw milk to prevent contamination of the pasteurized milk with the raw milk in case of a leakage of the latter.

Satisfactory bactericidal treatment of the unit can be accomplished by circulating hot water at a temperature of 170° F. for five minutes, then dropping the temperature to the desired operating temperature and running the water on through the unit. As soon as the surge tank is empty, the raw milk is admitted. At this time the pasteurized water should be running over the cooler, or coming out of the pipe line open to the atmosphere in case a plate cooler is used.

"In conclusion, the short-time high temperature method of pasteurization is satisfactory providing these construction and operation requirements are observed. There is equipment on the market which meets the construction requirements and, if properly operated, will give results which are comparable to the low-temperature long-holding method with an adequate margin of safety."

Short Time Pasteurization from the Standpoint of the Machinery Manufacturer

A. H. Rishoi,

Cherry-Burrell Corporation, Chicago, Ill.

Early in the history of pasteurization in the United States, questions arose regarding the efficiency of various methods and machines. The results of studies by Farrington and Russell in 1898 on pasteurization as applied to buttermaking left the impression that flash pasteurization was less efficient than the holder method. Later experiments by Harding and Rogers in 1899 demonstrated that in order to obtain satisfactory bacterial reduction from flash pasteurization, it was necessary to heat the milk to above 158° F. That milk supposedly pasteurized by the continuous flash process might in fact have been improperly heated may be taken for granted, for in several epidemics traced to milk some of the latter was flash pasteurized milk. The result was that for a period of years around 1900 to 1920, flash pasteurization was in many places held in disrepute. Most state laws and city ordinances defined the pasteurization of milk so as to eliminate any method other than that which we know as holder type pasteurization.

The term "high-temperature short time hold pasteurization" was probably first used by Mr. Leslie C. Frank about 1931 or 1932. The U. S. Public Health Service Ordinance requires heating at 160° F. and holding for 15 seconds. The City of Chicago requires 161° F. for not less than 16 seconds. The following requirements must be controlled with great accuracy:

1. Flow of milk—pump capacity
2. Heating water temperature and flow
3. Final temperature of the milk
4. Holding time of the heated milk

In addition, other requirements such as the pressure relationships between the raw and the pasteurized milk at various points in its course through the machine must be maintained to prevent any leakage of raw milk into the pasteurized milk.

PUMP CAPACITY

If the milk pump delivers *less* than the proper amount of milk, the flow of milk will be retarded so that it will remain in the holding tube longer than necessary, and also reaches the desired temperature sooner than it should, adding still more to the holding time. This impairs the cream line, because heating at 161° F. for 16 seconds is about the maximum time-temperature treatment for normal creaming.

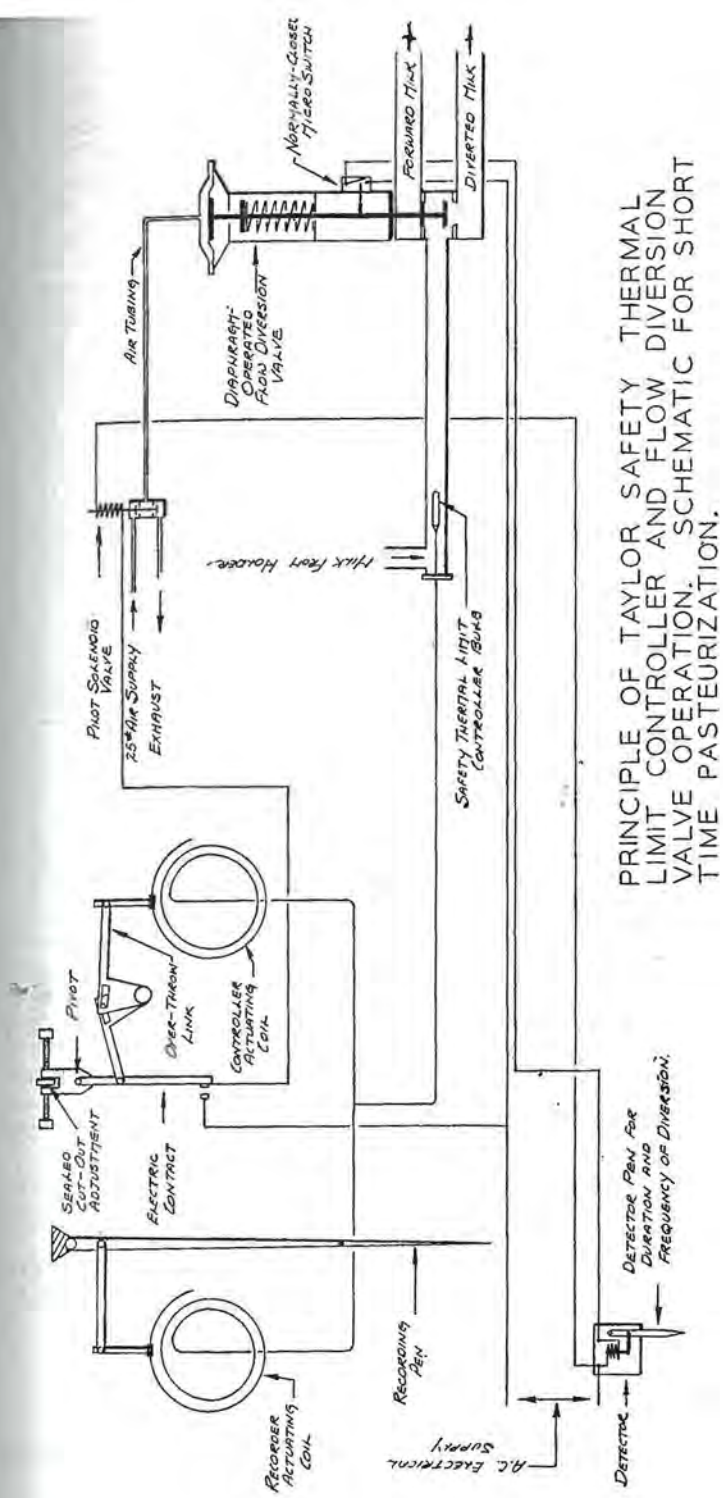
On the other hand, if the pump delivers *more* milk than it should, there is greater difficulty experienced in getting the milk to the proper temperature, thereby overworking the flow diversion valve and effecting an irregular bacterial reduction.

Factors which influence pump capacity are voltage variation (sometimes as much as 10 percent in a day run) and pressure as built up by filters, fittings, pipes, clarifiers, and plates. Also, there is the natural wear of a pump. The amount of milk processed during a day run is recorded on recording thermometer charts.

TEMPERATURE CONTROL MECHANISM

Some slight temperature fluctuations are more or less inevitable, and accordingly some means must be available to insure that no inadequately heated milk leaves the pasteurizing machine. This was accomplished originally by the flow pump stop or more generally now by the flow diversion valve.

A flow diversion valve may be said to be a modified three way valve, automatically activated to direct milk below a given temperature through one outlet and milk at or above that given temperature through another. The flow diver-



PRINCIPLE OF TAYLOR SAFETY THERMAL LIMIT CONTROLLER AND FLOW DIVERSION VALVE OPERATION. SCHEMATIC FOR SHORT TIME PASTEURIZATION.

FIGURE 1

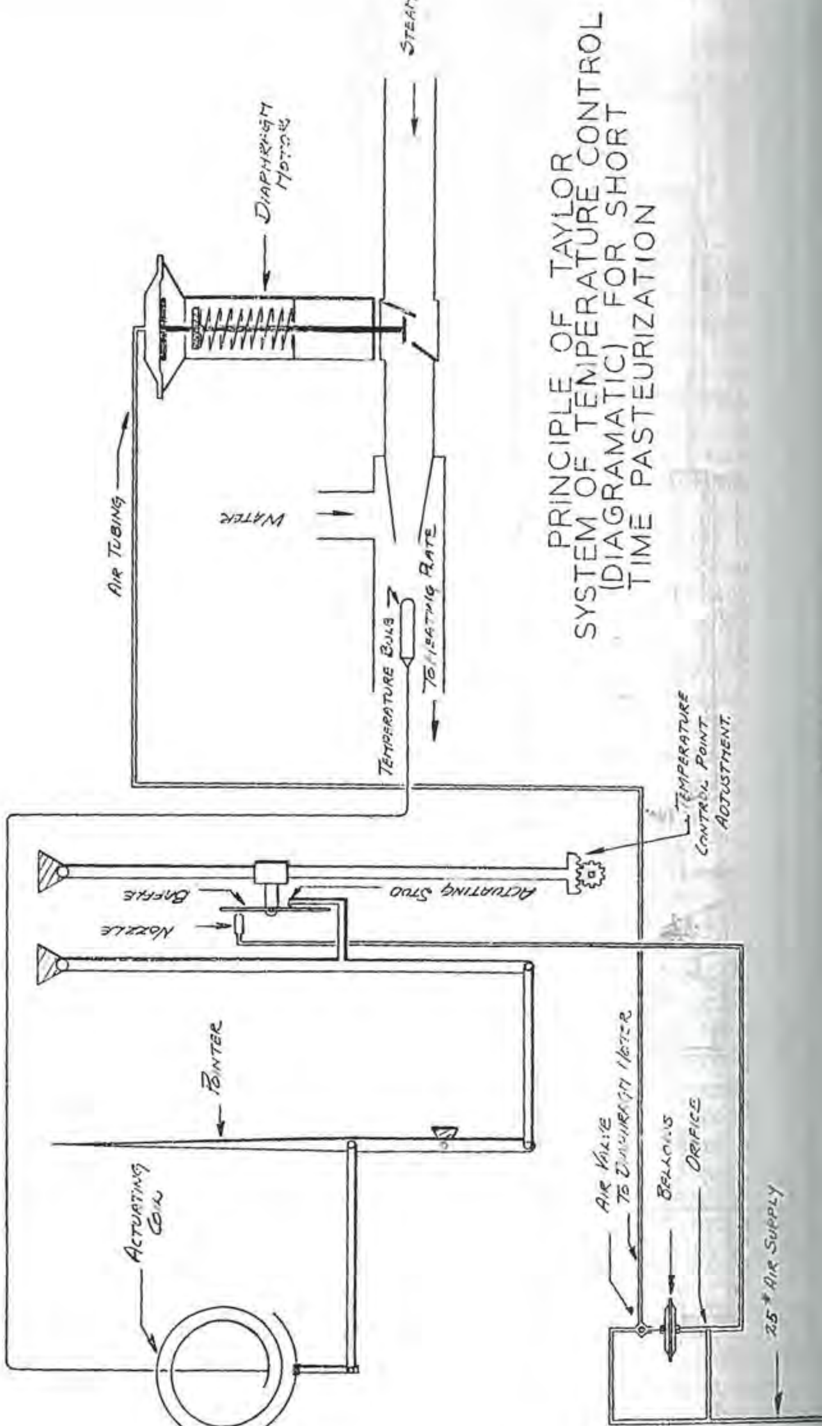


FIGURE 2

...on valve is so constructed and operated that when it is in its normal position, that is, subjected to no outside forces, it is in the diverting position. The mechanism of the operation of the diversion valve is controlled by means of air pressure. Briefly, this may be described as being accomplished by means of a solenoid valve arrangement in which the opening or closing of an electric circuit is operated by bellows which in turn are operated by variable air pressure controlled through the contraction or expansion of the thermometer spiral caused by the changes in temperature of the milk entering the flow diversion valve. The principle upon which the flow diversion valve functions is shown in Figure 1.

The mechanism controlling the temperature of the heating medium is operated in a somewhat similar manner. But while the flow diversion valve operates when the temperature of the milk reaches a certain minimum, the control for the heating medium is operated to control maximum temperature of the heating medium. The heating-water temperature control devices and principles upon which they operate are represented graphically in Figure 2. Briefly, the temperature of the heating medium is controlled by means of a diaphragm bellows which inflate and deflate with varying air pressure. Inflation, caused by a partial closing of an air bleeding nozzle due to the rise in temperature of the heating medium, partially closes the air supply to the diaphragm of the steam valve. It also allows some of the air above the diaphragm to escape, opening the valve. By a similar route deflation of the bellows closes the steam valve to the heating medium. The sensitivity of the mechanism is such that it responds to fluctuations to less than 1° F.

The response of the diversion mechanism must be ± 0.25° F. It must be so adjusted that the flow of milk is diverted when the temperature of the milk reaches a specified minimum. The lapse of time from the thermometer response must be no greater than 1 second, but it usually acts to divert the flow in 0.32 second and acts to cause forward flow in 0.49 second.

PRESSURE RELATIONSHIPS

In the case of milk to milk regeneration, the pasteurized milk must be held under greater pressure than that of the unpasteurized milk so that if leakage occurs the pasteurized milk will leak into the raw milk, eliminating the possibility of contaminating the finished product.

ECONOMIES OF HIGH-SHORT PASTEURIZATION

Some of the reasons for the economic soundness of short time pasteurization are the following:

- The cost of machinery is about one-half as compared to similar 30 minunite holding equipment.
- On a 4 hour run there is a considerable (about 1/3) saving in steam consumption.
- Considering plate machines for short time pasteurization, the floor space is about 20 percent of that required for 30 minute hold.
- Plate apparatus gives more regeneration than tubular heater-holders.
- The cleaning time for plate machines is about 40 - 50 percent less than that required for 30 minute hold installations.
- Short time pasteurization is effective and safe from the public health standpoint.

As yet, high-short pasteurization does not seem to be practical for small plants, but does seem to be logical for a continuous system of pasteurization.

J. H. SHRADER.

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

(Continued from May Issue)

Bacteriological Defects of Butter

B. W. Hammer

The flavor defects of butter that are caused by the growth of organisms in it are of various types because there is a variety of bacteria which can develop. Some of the organisms produce materials with objectionable flavors from the fat, others from the protein, while still others use a constituent present in a relatively low percentage, such as the lactose. Certain organisms actively attack two of the butter constituents.

Ordinarily, a bacteriological flavor defect of butter can be reproduced by inoculating the butter into well pasteurized cream and then churning. Such attempts are more likely to be successful if the various factors influencing the growth of bacteria in butter are recognized in making and holding the butter. When a defect is reproduced in this way, particularly when it is carried through successive lots of butter, the action of organisms is clearly established.

In general, a flavor defect due to bacteria is a changing thing and is not rapidly developed to a certain point at which it remains stationary. At first the defect is slight, and then as the growth of the organisms continue it becomes more pronounced. Later, the defect may even become less intense. The situation is especially confusing with certain organisms that attack two of the butter constituents because one type of decomposition is the more conspicuous at first and the other is the more prominent later. Various organisms that attack both protein and fat may first give a defect suggestive of protein decomposition whereas later the defect is indicative of a breakdown.

A specific off flavor commonly can be produced in butter by more than one kind of organism. This is in agreement with the situation in the spoilage of various food products. Protein decomposition in eggs, or in meats, is not always brought about by the same organism. The study of off flavors in butter is often complicated by the presence of two or more objectionable types of bacteria in a sample. Plant conditions which permit the entrance of harmful bacteria into butter often are not selective enough to limit the contamination to only one type. In this connection it should be noted that many of the bacteria which contaminate butter have no effect on the flavor. They may grow extensively and still not produce objectionable changes because of the nature of the products formed.

Even with the uncertainties involved, a more or less definite classification of the bacteriological flavor defects of butter has been developed by butter judges, and a number of rather definite defects are recognized.

Theoretically, control of the bacteriological defects of butter is relatively simple. The various bacteria responsible for them are easily killed by heat, so that the usual pasteurization exposures destroy them, and if the pasteurized cream and the butter are protected from contamination the butter should be free of the organisms that cause defects under ordinary conditions. Practically, however, there are various opportunities for a break in the chain of protection that modern manufacturing methods should give butter. One possibility is inefficient pasteurization of the cream. While the exposures intended to be used with cream are never so low that a survival of objectionable organisms is probable, there may be contamination with under-heated cream because of inadequate by-passing, leaky valves, dead ends, etc. Another possibility is contamination of the pasteurized cream or the butter. The problem of preventing such contamination is complicated because of the many sources from which organisms can come and the great difficulty in keeping certain pieces of equipment, especially the churns, in a satisfactory condition bacteriologically. The complexity of the problem is emphasized by the instances in which a serious attempt is made to control all the sources from which the pasteurized cream and the butter can be contaminated only to find that certain churnings of the butter develop cheesiness, rancidity, or some other defect under commercial conditions.

A source of objectionable organisms in butter that is receiving increasing attention is the water used to wash butter since it has been the source of the causative organisms in various outbreaks of bacterial spoilage. A sample of water may contain several kinds of bacteria, each of which is capable of causing deterioration in butter. Experimentally, it has been found repeatedly that enough organisms are retained when butter is washed with water containing objectionable organisms to produce the defect expected on the basis of the organisms in the water. In this connection it should be recognized that the wash water and the water added in establishing the desired moisture content in butter are rarely as finely divided as the water carried into the butter from the cream, which may mean that each organism in the added water has a better opportunity for growth than if it were in a comparatively small water droplet. Water that is at all questionable should be treated in some way before it is used to wash butter. The wide application of chlorination to general water supplies suggests its use in connection with water intended for washing butter. Such treatment has been found satisfactory in numerous instances.

International Association of Milk Sanitarians

The chairmen of the several committees of the Association is announced as follows:

Communicable Diseases Affecting Man,
P. B. BROOKS, Albany, N. Y.

Sanitary Procedure,
W. D. TIEDEMAN, Albany, N. Y.

Dairy Farm Methods,
F. D. HOLFORD, New York, N. Y.

Sanitary Control of Ice Cream,
F. W. FABIAN, East Lansing, Mich.

Laboratory Methods,
C. A. ABELE, Montgomery, Ala.

Education and Training,
L. C. FRANK, Washington, D. C.

Resolutions,
E. KELLY, Washington, D. C.

Florida Committee,
H. N. PARKER, Jacksonville, Fla.

Enlarged Field for Mr. Frank

The former Sanitation Section of the National Institute of Health, except the experimental pasteurization plant, has been combined with the former Engineering Section of the Domestic Quarantine Division to form a new Sanitation Section in this Division with Mr. Leslie C. Frank as Section Chief.

JOURNAL OF MILK TECHNOLOGY

Official Publication of the

International Association of Milk Sanitarians

(Association Organized 1911)

THE JOURNAL OF MILK TECHNOLOGY is issued bimonthly beginning with the January number. Each volume comprises six numbers. It is published by the International Association of Milk Sanitarians, and is printed by The Chronicle Press, Inc., Orange, N. J., U. S. A.

Subscriptions: The subscription rate is $3.00 per volume. Single copy, 60 cents.

Advertising: All correspondence concerning advertising, reprints, subscriptions, and all other business matters should be addressed to the Managing Editor, W. B. Palmer, 29 North Day Street, Orange, N. J.

Manuscripts: All correspondence regarding manuscripts, editorials, news items, announcements, and other reading material should be addressed to the Editor, J. H. Shrader, 339 Springdale Avenue, East Orange, N. J.

Membership and Dues: Active and Associate Memberships in the Association are $5.00 per year. This includes all issues of the Journal. All correspondence concerning membership in the INTERNATIONAL ASSOCIATION OF MILK SANITARIANS, including applications for membership, remittances for dues, failure to receive copies of the JOURNAL OF MILK TECHNOLOGY, and other such matters should be addressed to the Secretary of the Association, C. Sidney Leete, State Department of Health, Albany, N. Y.

Association News

Milk Section of Texas Public Health Association

One of the schools of the second annual Texas Milk Sanitarians' Short Course was held at A. & M. College, April 24, 25, and 26, 1939, under the auspices of Texas A. & M. College, the Committee on Milk of the Texas Public Health Association, and the Texas State Department of Health.

Besides the lectures that were given each day on the subjects relating to milk and milk sanitation, laboratory facilities and competent instruction were provided each afternoon for those desiring actual demonstration and practice on methylene blue, plate count, resazurin, and phosphatase tests, and tests for adulterants, etc.

Forty-eight persons took the milk sanitarians' examination for a Registered Milk Sanitarian's license. There were 24 inspectors registered and 10 plant men, making a total of 34 or more persons in attendance during the entire 3 day course.

Another school was held at Texas Technological College, Lubbock, Texas, May 1, 2, and 3.

This meeting was attended by city, county, district and state milk sanitarians from the Panhandle, west Texas, and New Mexico. There were some 56 sanitarians registered for the short school and several students attended from the college each day. Lectures were given by the dairy manufacturers staff from the college, and papers were presented as follows: "Recent Changes in the U. S. Public Health Service Milk Code" by Dr. F. A. Clark, Milk Specialist, U. S. Public Health Service; "A State-wide Dairy Development Program" by Mr. M. E. McMurray, General Manager Texas Dairy Products Association; "Selling the People by Means of Educational Programs" by Mrs. Heard, Banner Creameries, Abilene, Texas; and, "The Public Health Control of Milk Supplies" by Dr. J. M. Hooper, Director, Public Health District No. 1, Floydada, Texas.

Michigan Association of Dairy and Milk Inspectors

The Annual Summer Training Conference for Dairy Inspectors will be held at Michigan State College, East Lansing, on July 13, 14, and 15, 1939. Lecture sessions, held in the forenoon, will cover (1) ice cream sanitation, (2) production of quality butter, (3) milk plant equipment, (4) licensing dairy inspectors, and (5) farm sanitation.

Laboratory courses in the afternoon will have three sections, and will deal with (1) use of microscope, (2) plate counts and their interpretation, (3) phosphatase test, (4) methlyene blue and resazurin tests, and (5) butterfat tests.

At noon on Thursday the 13th, there will be a picnic lunch, followed by a golf tournament. A ball game will be held Friday afternoon and a banquet in the evening.

Visitors will be lodged in the college dormitories.

HAROLD J. BARNUM,
Secretary-Treasurer.

Metropolitan Dairy Technology Society

The last meeting of the season was held on the fourth Tuesday of the month, June 27. The speaker was Mr. Walter Page of the Page Industries, New York City, and his subject was "Problems Connected with the Evaporated and Condensed Milk Industry." The fall meetings of the Society will begin on the third Tuesday of September.

O. F. GARRETT,
Secretary-Treasurer.

The Chicago Dairy Technology Society

The annual dinner dance was held at the Panther Room of the Hotel Sherman on June 6. The next regular meeting will be held September 12. The speaker will be Dr. Jessee Sampson, the subject "Mastitis Control."

P. H. TRACY,
Secretary.

Jacksonville

The palm-fringed fairways and velvet greens of sporty Ponte Vedra links at Ponte Vedra Beach, near Jacksonville, Florida, will be the scene of the greatest links battle in the history of the Southeastern P.G.A. Championship September 20-22, judging by the record number of top-flight golfers already entered. The 1938 Southern Amateur Championship held here last June was the most successful in the history of that classic. The famous island ninth green nestles in a lagoon near The Inn, brilliant new resort hotel that has already become the talk of the smart resort world.

Rates of Hotels in Jacksonville, Fla.

HOTEL MAYFLOWER (Headquarters)
$2.50 to $3.50 per day—single rooms
$4.00 to $5.00 per day—room with double bed
$5.00 to $6.00 per day—room with twin beds
All rooms equipped with private bath

HOTEL WINDSOR
$2.50 to $3.00 per day—single room with bath
$4.00 per day—double room with bath, double bed
$5.00 per day—double room with bath, twin beds

HOTEL SEMINOLE
HOTEL GEORGE WASHINGTON
THE ROOSEVELT
} same rates as above.

Twenty-eighth Annual Meeting
October 25 - 27, 1939