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Editorials

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

Skim Milk—What Shall We Do About It?

MARK TWAIN once said that everybody talks about the weather but no one ever does anything about it. We are reminded of this witticism when the problem of disposing of skim milk is raised. How about a little action!

This "problem-child" of the dairy industry is presented to us again forcefully in the thought-provoking address * of Walter P. Cotton, Director of Economic Research, Dairy Industry Committee. He states:

> ". . . The chart shows clearly that the only way that we can maintain a high rate of consumption of dairy products other than butter and at the same time increase our butter supply is through expanded milk production. But such an expansion of butter and milk production increases the problem of disposing of non-fat solids. As business and consumption of whole milk products decline, the problem of moving the ever growing volume of non-fat solids becomes increasingly acute. . . ."

The industry in general is of course aware of this rising tide. Much effort has been expended toward its marketing. The product has found increasing outlet in the several dried milks, skim condensed in ice cream, baking, animal and poultry feeds, candy-making, packing plant products, and some home cooking, together with use for such industrial products as paint, sizing, glue, textiles, chemicals, plastics, and others.

As is well known, skim milk is composed mostly of lactose and the two proteins casein and lactalbumin. Both are excellent foods. However, their utilization directly as human food is relatively small. A fairly sizeable indirect consumption obtains through animal and poultry feeding.

The per capita consumption of lean meat (including poultry and fish) in the United States is recommended in the 1939 Yearbook of the U. S. Department of Agriculture to be 130 pounds of meat per year for moderately active men of 20 years and over. Assuming an average protein content of meat to run about 25 percent, a simple calculation reveals that this amounts to about 33 pounds of protein consumed per capita in meat per year.

Mr. Cotton estimates that by the year 1950, assuming a condition of moderate

* *Trends in the Production and Consumption of Dairy Products.* (Address given by Walter P. Cotton, Director of Economic Research, Dairy Industry Committee, at the Annual Meeting of the National Dairy Council, Pittsburgh, Pa., January 10, 1946.)

employment, we shall be producing an excess skim milk supply of 45.8 billion pounds. The protein in this amounts to about 1⅓ billion pounds (assuming a yield of about 3 percent). On the per capita basis (of 144,000,000 persons in our 1950 census), this protein figure would run about 9½ pounds or over one-fourth of our entire protein requirements. This figure would run higher if we allowed for the smaller consumption by women and children.

Paradox—The best protein in nature's world is being made into paint, glue, plastics, and textiles while half the world starves. We fiddle while Rome burns.

What can we do about it all!

In the first place we should keep on doing what we now are doing to expand the market outlets for skim milk and its products in food channels.

But we should do more. This "more" is, first, to face the situation and recognize that this is a problem, not only of industrial and economic importance but also of humanitarian and sociological significance. The size of the problem determines the character of the remedial effort.

Second, we should publicize the need for one or more processes and/or products that utilize skim milk for direct human consumption. We need something new. We must have a food outlet that opens up a vast marketing area that has not yet been recognized. For example, we might develop a protein food that would serve our dietary (and nutritional) needs, somewhat as meat now serves. We need not necessarily pattern this development along the lines of the oleomargarine-butter wrangle. But assuming the worst and supposing that a palatable, nutritious, and moderately-priced meat substitute should be developed, the dairy industry would be stronger and the hungry people better protein-fed than they are likely to be with the ever increasing price of meat and its allied protein foods.

We propose that a symposium be called to present this whole situation. The latter would emphasize the rising amounts of skim milk, their effect on increased milk and butter production, and their food value. Then there might follow a presentation of the protein commercial products that are now beginning to appear—and some are good. Others that we now know nothing about would probably be revealed. Out of such a discussion, the attendant publicity would stimulate inventiveness, especially if an attractive prize were offered. In fact, Napoleon initiated canning and the Le Blanc process (for making soda) by similar means. Oleomargarine was invented by a French chemist, Mége-Mourize, to provide poor people with a cheaper and more stable product than butter (Sherman).

The coming dairy meetings (this fall) at Atlantic City would constitute an excellent setting for such a project. We have talked about the food value of skim milk for a long time. Let's act as if we believed it. J. H. S.

The Virginia Association of Milk Sanitarians

The old-timers in milk sanitation will recall the pioneer work of Dr. Levy, Health Officer of Richmond, and his chief milk inspector, Thomas J. Strauch, in showing the "why" and "how" of milk control. The writer well recalls Strauch's astounding (to us) assertion that the question of unclean milk utensils on dairy farms was no problem down there. Our visit to his milk shed confirmed his statement. That was about twenty years ago. Those stalwarts are now deceased, but we are glad to note that their work, so well begun, is being conserved and developed. We welcome the Virginia Association of Milk Sanitarians into the family of organized milk sanitarians—doubly welcome because of the Old Dominion and our old friend Strauch. J. H. S.

M. D. Munn

Marcus D. Munn, 88, founder and President-Emeritus of the National Dairy Council, died in Passavant Memorial Hospital, Chicago, on April 9th, after an extended illness. Funeral services were held on April 11th in Chicago. Surviving Mr. Munn are his widow, the former Gertrude Alling, a Wellesley girl and sweetheart of college days, and three daughters, Mrs. Victor E. Anderson, Minneapolis, Minnesota; Miss Gertrude Munn, Chicago; and Mrs. George H. Putney, North Fork, California. The Munns have lived at 215 East Chestnut Street, Chicago, for a number of years.

Mr. Munn was a leader in the dairy industry for more than thirty years. He was born on a farm in Connecticut, February 22, 1858. He was graduated from Yale with high scholastic honors in 1883, and moved to St. Paul, Minnesota, where he opened a law office.

Over a period of years as an outstanding corporation lawyer, Mr. Munn developed a large and important clientele, among them the Soo Railroad. However, he never lost his love for the country. He purchased a beautiful farm near Forest Lake, Minnesota, where he developed an outstanding herd of Jersey cattle which became nationally famous for its show ring winnings as well as for high production records. Mr. Munn's accomplishments as a Jersey breeder and his interest in the American Jersey Cattle Club won him the post of president of this club in 1915. He held it eleven years.

Mr. Munn's greatest contribution to the welfare of the dairy industry was his part in the development of the National Dairy Council in 1918. This organization really had its start in the winter and early spring of 1915. The foot and mouth disease epidemic that year had caught several million dollars worth of pure bred cattle in the Chicago stock yards during the National Dairy Show, and the government quarantined these valuable animals. Mr. Munn was most active in the battle to get these animals released to their owners. Later he led a movement to raise funds for a modest commercial advertising campaign by the organization.

In 1918, a group of dairy leaders became fearful of the future because dairy products had been short in World War I, even as they were to be in World War II. This group had hopes of building the industry to a point where it would offer a greater contribution to national health and well-being. They developed plans which ultimately led to establishment of the National Dairy Council as it now operates.

The idea of increasing consumption of dairy products by an educational program was new and untried. All food promotion work had previously been carried on by commercial advertising. It was Mr. Munn's vision of the future that enabled him to see that with health education and nutrition being introduced into the schools, it was of the utmost importance that the dairy industry develop its educational program to fit into the new trends in education.

Mr. Munn also was one of the first to maintain that the National Dairy Council must keep clear of all controversies in the dairy industry. It was his opinion that other organizations were better designed and equipped to handle such matters as legislative and economic problems. It was his contention that if the organization was to win the confidence of educators and professional leaders, it must confine its activities to an educational program. His ideas prevailed. Today few people would question the wisdom of his judgment.

Another indication of Mr. Munn's clearness of vision and organizational ability developed when it became apparent that the establishment of state Dairy Council units was not practical in all sections of the country. The practice of organizing local affiliated Dairy Council units around important market centers resulted. In June, 1920, the New England Dairy and Food Council was organized in Boston. Other areas followed in rapid succession.

The first piece of printed educational material was a booklet, "Milk, the Necessary Food for Growth and Health." This booklet was the first of the stream to follow, which now has exceeded 500,000,000 pieces. From this small beginning, hundreds of thousands of school teachers, millions of school children, countless numbers of doctors and nurses, dentists, and health authorities have come to rely on National Dairy Council literature for authoritative and adaptable material.

In 1921, the National Dairy Council, at Mr. Munn's instigation, added a nutrition director. This was the first step in the establishment of the Nutrition Department which enjoys the confidence of food authorities and educational leaders throughout the nation.

Over a period of years, Mr. Munn guided the growth of the organization until it had the support of the industry generally, as well as the respect of educational and professional leaders. He had hoped to retire shortly after the organization of the National Dairy Council, but it was not until 1936 that the industry was willing to let him step aside. Even after his retirement with the title of President-Emeritus, he continued to give generously of his time and effort toward perfection of the policies and activities of the organization.

An indication of the esteem in which the dairy industry held Mr. Munn was the result of a survey made by one of the leading dairy publications in 1928. Leading educators, scientists, and dairy organization leaders were asked to name the men whom they felt had contributed most to the dairy industry. Mr. Munn ranked high among the leaders even though his ideal, at this date, had not yet reached its fruition.

Mr. Munn was noted for his keen intellect, his well organized ideas, and his forceful presentations. By any analysis, he stands out as a great man in the dairy industry. He was courageous when men needed courage. During the early and often difficult years of the National Dairy Council, and again in the great depression, he never hesitated even though less courageous men fell by the wayside. In his clear vision, he always saw, out on the horizon, a great dairy industry as the bulwark of a strong, vigorous. vital humanity.

He did more than build up the dairy industry. He showed that information, emanating from industry avowedly as sales promotion, was not necessarily just "sales talk" and "*only* advertising" but that it could be presented so professionally ethical and scientifically correct that the public in general and the school people in particular could use it factually and dependably. He built nutrition-mindedness and milk-consciousness into the life of this generation. So the quality of his thinking and the strength of his character will live on in a stronger, healthier people.

Cheese as the Cause of Epidemics

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Sanitation in cheese has always been taken for granted like a good many other things in this world. Only recently has the importance of certain sanitary procedures and precautions been thrust upon us. As usual it has taken a series of epidemics with several big ones thrown in for good measure to awaken us to the importance of cheese as a carrier of disease germs. In all the fermentation industries such as in the beer, wine, and vinegar industries there have grown up certain practices and procedures based on the trial and error method which have generally come to be known as the "art" of making these fermented products. As science has encroached upon the "art" in these industries, it has frequently been found that there was a scientific basis for many of the procedures. But it has also found that some of the taboos and practices had no foundation in fact.

The making of cheese comes under the heading of a fermentation industry and as such is bound by tradition as regards certain practices. One of the most strongly entrenched traditions in the cheese industry was that pasteurized milk did not make good cheese. Cheese makers fought pasteurization the same as market milk, butter, and ice cream makers had before them. Pasteurization has never been a welcome guest in the dairy industry whose very existence is dependent upon it. Imagine the chagrin of the old time cheese maker since it has been demonstrated that pasteurization is an important step in the production of uniformly high quality cheese. The other two steps are high quality milk and a good starter. Furthermore, if a good starter is added to high quality pasteurized milk, it is possible to reduce the aging time of cheese from 6 to 8 months to 3 to 4 months because it can be ripened at a temperature of 60° F. instead of 40 to 50° F. The quality of cheese made under these conditions develops more and a better flavor.

Early History of Cheese Poisoning

Cheese has long been considered one of the causes of food poisoning, being about on a par with sausages in this respect. Possibly this was because cheeses were fermented products and underwent digestion by enzymes attendant with odors—especially with certain types of cheese. There were several theories advanced to explain biological food poisoning which was so prevalent in the early days due to the lack of sanitation.

One of the first experimenters in the field was Albrecht von Haller (1708–1777), the distinguished Swiss physiologist, who demonstrated that aqueous extracts of putrid material injected into the veins of animals caused death. After this, much work was done with putrid material from both animals and plants in an attempt to discover the poisonous principle. For example Kerner in 1820 advanced the theory that the effects observed when poisonous sausage was eaten was due to sebacic acid. Later he modified his views, and believed the harmful effects to be due to a compound consisting of sebacic acid and a volatile principle. In 1827 Hunnefeld working with poisonous cheese accepted the ideas of Kerner regarding poisonous sausage but believed that in the case of cheese, caseic as well as sebacic acid was the active agent. During the early part of the nineteenth century the theory generally prevalent was that fatty acids such as sebacic acid were the active agents responsible for food poisoning.

In 1852, however, Schlossberger demonstrated by experiments that pure fatty acids were free from poisonous properties. In the meantime a great deal of work was being done on the basic constituents of decomposed foods which exhibited toxic symptoms when fed or injected into animals. In 1865 Selmi, an Italian toxicologist, gave the name ptomains (Greek for cadaver) to this class of substances, basic in character, which resulted from the decomposition of foods. Since they resembled the vegetable alkaloids, they were frequently called putrefactive alkaloids. Vaughan and Novy (51) later defined a ptomain as an organic compound basic in character and formed by the action of bacteria on nitrogenous matter.

After Pasteur's work showing the relationship between bacteria and disease, the attitude toward food poisoning changed. The search was for pathogenic or toxigenic bacteria or their products in poisonous foods. This is evident by the nature of the research work which followed in subsequent years.

During the years 1883 and 1884 there were reported to the Michigan Health Department about three hundred cases of cheese poisoning caused by the eating of twelve different cheeses. Vaughan (50) to whom the cheese was submitted for analysis isolated a crystalline substance which he believed caused the illness and to which he gave the name tyrotoxicon (Greek, cheese poisoning). This name he believed at the time to be original but he later found that it had been used as early as 1849 in Germany to designate poisonous cheese. The Michigan State Board of Health in 1884 obtained the aid of Sternberg, one of the outstanding bacteriologists of his time, to aid in solving the problem of poisonous cheese which was so prevalent. In 1885 Sternberg (45) reported that he found "micrococci in the fluid of the cavities of the cheese." The pure cultures which he isolated and injected subcutaneously into rabbits were without effect. So he concluded: "It seems not improbably that the poisonous principle is a ptomain developed in the cheese as a result of the vital activity of the above mentioned micrococcis." For a few years thereafter investigators spent a great deal of time looking for tyrotoxin in cheese. For example Baker (1) in 1884 reported eight outbreaks of gastroenteritis due to cheese and stated that cheese from one factory over a thirteen months period had caused a great many people to become ill. Reed (33) in 1893 reported numerous cases of poisoning in Ohio due to the eating of cheese containing tyrotoxicon. Spoiled milk used in making the cheese was considered the cause; also two sick cows were found among those supplying the milk for the cheese. Spica (46) isolated a chemical substance from cheese which he found toxic for frogs.

TRANSITION PERIOD: PTOMAINS TO BACTERIA

When Pasteur announced the germ theory of disease in 1870, search began anew for the cause of food poisoning. As new discoveries were made in the field of bacteriology, new etiological agents were found to have caused illness from eating the food in question.

Koch invented solid media in 1875 first as a gelatin tube method and later, 1883, as a plate method. About this same time Hesse introduced agar, and in 1887 Petri devised a culture dish. These were the prime requisites necessary to an era of far-reaching discoveries now known as the Golden Age in Bacteriology.

Dr. M. W. Taylor in 1857 reported

the first milk epidemic in Penrith, England, of which there is a record. Later in 1881 Dr. E. Hart of England reported a long list of epidemics due to milk including 50 due to typhoid fever, 15 to scarlet fever, and 4 to diphtheria. Yet, not until after the real cause of the epidemics was discovered was it possible to prevent them. Eberth described the typhoid bacillus in 1880, and Gaffky isolated it in 1884 by use of the new solid medium. Shortly thereafter various species of paratyphoid bacteria were isolated and identified and one of the real causes of outbreaks of disease and illness due to food was discovered for the first time.

In 1888 Gärtner isolated *Bacillus enteritidis* from an outbreak of raw meat which had caused illness in 57 people who had eaten it. This was the first report of food poisoning attributed to the Salmonella group of bacteria. In 1895 van Ermengem isolated *Clostridium botulinum* from ham which had caused illness in 23 persons and which is now recognized as botulism. In 1930 Dack and coworkers "rediscovered" what had been previously "discovered" three times, viz., that certain staphylococci under favorable conditions can cause food poisoning by the production of a toxin in the food before ingestion. It is now known that alpha type streptococci when present in large numbers in food can and do cause food poisoning. As the bacteriological agents which caused food poisoning increased, there was little room left for ptomains. Consequently they have gradually faded out of the picture until today one seldom hears the name ptomains mentioned among scientific men. In fact some doubt that they ever caused food poisoning, certainly not the many cases attributed to them. However, the idea still persists in the mind of the layman and even in the mind of the older physicians.

CHEESE IN ITS MODERN ROLE

Data on cheese as a vehicle for carrying disease germs to humans have been gradually accumulating since the advent of bacteriology and epidemiology. Novy (52) in 1890 isolated an organism from one sample of poisonous cheese which was fatal to cats after incubation at 35° C. for 24 hours in milk of which 100 ml. had been introduced into the stomach. No tyrotoxicon could be found in this or in a number of other samples of cheese which had caused illness in those eating them. Vaughan and Perkins (53) isolated a toxicogenic, micro-aerophilic bacillus from cheese which had caused illness in 12 people. It produced a powerful toxin when grown in broth or milk. Levin (25) studied cheese which had caused illness in six persons who had eaten it. He found no tyrotoxicon but a bacillus which produced a soluble thermostable toxin. Poisoning could be induced in laboratory animals either by feeding the cheese or a broth culture of the isolated organism. In 1923 Rich (35) reported an epidemic of 51 cases and 4 deaths from typhoid fever traced to cheese made from milk produced on a farm employing a typhoid carrier. The cheese was shipped green 3 to 12 days after making, and consumed probably 9 to 30 days thereafter. Another outbreak of typhoid fever, involving 29 cases and 4 deaths traced to cheese, was studied by Wade and Shere (56). The epidemiological data showed that *Eberthella typhosa* probably survived and had lived in the cheese approximately 63 days.

One of the most extensive epidemics of typhoid fever traced to cheese occurred in Canada with 627 cases and 57 deaths (13). After all other sources of infection such as milk, ice cream, butter, water, oysters, and shellfish were eliminated, it was finally traced to a fresh sweet Canadian cheese. The cheese was made by one manufacturer in one municipality of the district from the milk of several producers whose families either had or gave a history of having had typhoid fever. More recently Gauthier and Foley (16) reported an outbreak of typhoid fever due to cheese which caused 6 deaths and 40 cases of disease. The source of the infection was finally traced to a woman who had had typhoid fever 20 years previously and who had milked cows against orders from the health department. This milk was a part of a raw milk supply delivered to the R. cheese factory to which the epidemic had been traced.

An epidemic of gastroenteritis of 22 cases traced to Wisconsin Cheddar cheese in Kansas City, Kansas, and another of 9 cases in Biddeford, Maine, from imported Albanian cheese were reported by Linden, Turner, and Thom (26). They isolated a streptococcus but did not determine its origin or species. They believed that "such outbreaks are exceedingly frequent." Their data indicated that the milk would have to be pasteurized at 145° F. for 30 minutes to destroy the organism.

There are reported several outbreaks of acute gastroenteritis in which the evidence strongly points to cheese but is not absolutely conclusive since no bacteriological investigations of the cases were made. In one of the outbreaks (49) 40 of the crew of one ship who had eaten the cheese in question and 20 of the crew from another ship supplied with the same cheese had acute gastroenteritis but recovered within 24 hours. Another outbreak (34) in which no causative organism was found but in which the cheese was strongly suspected was on the U.S.S. "Ruben James." Forty members of a crew of 105 were poisoned. All messes were affected except the one which had not been served cheese. No evidence of the Salmonella group was found in the cheese upon bacterial examination.

Of 300 group and family outbreaks of food poisoning listed by Jordan (23) in the United States from October 1913 to October 1915, 31 were assigned to cheese. In addition he lists nine individual cases or a total of 40 outbreaks attributed to cheese.

In England Graham-Stewart and associates (17) reported 23 cases of milk infection traced to Italian cream cheese. *Salmonella schottmülleri* was considered the cause since agglutination tests of the blood serum definitely showed it to be the etiological factor. Out of 100 food-poisoning outbreaks in England, Savage and White (38) found 8 due to cheese. They reported (39) one epidemic traced to cheese in which 9 individuals became ill after eating the cheese. No organisms could be found in the cheese but upon the basis of absorption tests on sera from the patients they attributed the illness to *Salmonella suipestifer*. Macaulay (27) reported 126 cases of cheese poisoning which occurred in Dover due to red Canadian Cheddar cheese shipped from Montreal. No tyrotoxicon was found, nor microorganisms which were toxic, but all evidence pointed to a bacterial toxin as the cause. He believed that a toxin produced by a member of the Gaertner group was the cause. He says, "Such delicate organisms as those of the Gaertner group, introduced during the process of manufacture would be unlikely to survive during the maturation of the cheese, although their stable toxin would likely persist."

Dolman (10) stated that in Canada between 1932 and 1939 there had been 6 known cheese-borne epidemics of typhoid involving 760 persons and 71 deaths due to Cheddar cheese manufactured from raw milk. Bowman (5) reported 3 epidemics involving 100 cases of typhoid fever due to eating cheese. Epidemiological data indicated that the cheese in question most likely became infected through a contaminated raw-milk supply from a farm having a typhoid carrier.

Outbreaks of disease due to cheese have been reported in other countries. No attempt has been made to search exhaustively the literature. Levin (25) has reviewed some of the earlier outbreaks due to cheese. Blix and Tesdal (6) reported two outbreaks in Norway traced to cheese. One of 29 and the other of 26 cases of gastroenteritis. *Bacterium cholerae-suis* was isolated from the stools of two cases and also from the cheese of the one epidemic while *Salmonella aertrycke* from the cheese of the other epidemic.

Schytte and Tesdal (40) reported 65 cases and one death due to gastrointestinal infection caused by *Salmonella aertrycke* in cheese. The onset of symptoms appeared in 21 to 42 hours after ingestion of the cheese.

Swanner (43) according to Yale and Marquardt (57) has summarized 31 cheese-borne epidemics which occurred throughout the world from 1883 to 1939.

Since 1935 A. W. Fuchs, Senior Sanitary Engineer of the U. S. Public Health Service, has been including data on epidemics caused by milk products as well as milk in his yearly compilation of epidemics. To save space a tabulation of the epidemics caused by cheese has been made from these reports. This information is given in Table 1. In this 10-year period, there have been 21 epidemics of 824 cases and 18 deaths that have been attributed to various kinds of cheese or an average of more than two per year. Since these disease outbreaks were reported from only 13 states, one can hardly believe that this represents the actual total. Rather, as Fuchs has frequently pointed out, the logical explanation probably lies in their efficient epidemiological organization for discovering the outbreaks and their willingness to report them.

LONGEVITY OF PATHOGENIC BACTERIA IN CHEESE

The length of time pathogenic bacteria will live in cheese is of interest from a public health standpoint in view of certain State regulations.

Typhoid Fever and Cheese

As early as 1895 Rowland (37) investigated the viability of this group of bacteria in cheese by inoculating cheese with *Eberthella typhosa;* after a few days he could find no organisms. Later Wade and Shere (56) seeded milk with *Eberthella typhosa* and made 18 batches of experimental cheese from it. The organism died out within 8 days in 16 batches but persisted for 34 and 36 days respectively in the other two batches of the cheese. From epidemiological evidence presented, they believed that *Eberthella typhosa* probably survived in a commercial cheese for 63 days at 60° F. (15.5° C.). Ranta and Dolman (32) found the survival time of *Eberthella typhosa* in ground Cheddar cheese to be one month at room temperature and 17 weeks in a refrigerator.

Campbell and Gibbard (8) in order to determine the longevity of *E. typhosa* in cheese experimented with three different types of *E. typhosa* which they identified as phage types C, F, and M. They were all smooth Vi forms, two of recent isolation and the other a rejuvenated Rawlings strain. These various strains were inoculated into a high-quality raw milk when the acidity had reached 0.2 percent. Twenty cheeses were made on a commercial scale, 10 from phage type F, 6 from type M, and 4 from type C. Half of each type was stored at 40–42° F. and 58–60° F. respectively, and viability determinations made. *E. typhosa* died out in the majority of the cheeses stored at the higher temperature within three months, although in two out of the 10 cheeses viable organisms were isolated at the end of 196 days. At the lower storage temperature, 40–42° F., *E. typhosa* remained viable in 7 out of 10 of the cheeses for more than 10 months. In the other three they died out after 182, 210, and 252 days respectively. At the conclusion of the experiment all the cultures isolated were tested sero-

TABLE 1

SHOWING CERTAIN DATA RELATIVE TO EPIDEMICS CAUSED BY CHEESE OVER A 10-YEAR PERIOD—1935 TO 1944 INCLUSIVE

(Data compiled from U. S. Public Health Reports)

							Kind of Cheese								
							Domestic					*Imported*			
Year	*State*	*Disease and organism*	*No. of cases*	*No. of deaths*	*Cheese made from raw or past. milk*	*Source of contamination*	*Cheddar*	*Cottage*	*Roquefort*	*Longhorn*	*Munster*	*Colby*	*No name*	*Romano*	*Pecorina*
1935	Idaho	Food poisoning	12	...	...		1	..	..	..	..	..	..	..	..
	Indiana	Gastroenteritis	8	0	...		1	..	..	..	..	..	..	..	..
	Illinois	Food poisoning	51	...	...		1	..	..	..	..	..	..	..	..
1936	None reported														
1937	Minnesota	Food poisoning (Staph. albus)	37	0	Raw and past.	Unpast. cream, also other ways	..	1	..	..	..	..	..	..	..
	Washington	Food poisoning (Staph. aureus)	6	0	...		1	..	..	..	..	..	..	..	..
	Illinois	Diarrhea	11	0	...		..	..	..	..	..	..	..	1	..
	Illinois	Diarrhea	24	0	...		..	..	..	..	..	..	..	..	1
1938	Idaho	Food poisoning (tyrotoxin)	17	0	Raw	Fecal contamination	1	..	..	..	..	..	..	..	..
1939	California	Food poisoning	4	0	...		1	..	..	..	..	..	..	..	..
	Mass.	Gastroenteritis (Staph. and Strep.)	10	...	...		..	..	..	..	..	..	1	..	..
1940	California	Food poisoning	6	...	...	Home-made, Mexican style	..	1	..	..	..	..	..	..	..
1941	Illinois	Food poisoning	10	0	...	Prob. by employee with intestinal disturbance	..	..	..	1	..	..	..	..	..
	New York	Typhoid fever	19	1	Raw	(Suspected carrier)	1*	..	..	..	..	..	..	..	..
1942	New Jersey	Gastroenteritis	8	0	...		1	..	..	..	..	..	..	..	..
1943	Maryland	Food poisoning	6	0	...		..	..	..	..	1	..	..	..	..
	Kentucky	Food poisoning	86	0	...		..	1	..	..	..	..	..	..	..
1944	Michigan	Food poisoning (Proteus morgani)	104	0	...		1	..	..	..	..	..	..	..	..
	New York	Food poisoning	5	0	...		..	..	1	..	..	..	..	..	..
	Virginia	Gastroenteritis (Staph. aureus)	71	0	...		..	..	..	..	..	1	..	..	..
	Cal. & Nevada	Typhoid fever	83	4	Raw	Unripened	1	..	..	..	..	..	..	..	..
	Indiana	Typhoid fever	246	13	Raw	Green	..	..	..	..	..	1	..	..	..
		Totals	824	18			10	3	1	1	1	2	1	1	1

* Cheese curds.

logically and biochemically for identity and found to be the smooth Vi type and had not reverted to the rough or M form. As the authors point out this may be of considerable epidemiological significance.

Brucellosis and Cheese

There is no record in the literature of undulant fever caused from eating cheese made from cow's milk. The literature shows that so far no *Brucella abortus* organisms have been isolated from any sample of commercial cheese. Carpenter and Bock (7) did not find *Brucella abortus* or *Brucella melitensis* in 72 samples of various kinds of imported cheese such as Swiss, Roquefort, Reggiano, Gorgonzola, and Edam and 10 samples of domestic cheese. Smith (42) examined 63 samples of cheese of which 28 were foreign, 23 from England, 6 from the colonies, and 6 local. They include a wide variety of cheese such as Cheshire, Cheddar (red and white), Bel Paese, Convalli, Camembert, Double Gloucester, Roquefort, Gouda, Stilton, Edam, Wenslet, Gorgonzola, Chilveran, Parmesan, and cheese prepared locally in Scotland. The cheese after mincing and adding saline was injected into guinea pigs in 5 ml. amounts.

More recently Gilman *et al.* (18) have made an extensive study of the occurence and survival of *Brucella abortus* in Cheddar and Limburger cheese. They first made a preliminary study on cheese milk in New York State. Then studies were made on cheese made from milk inoculated with recently isolated cultures from naturally infected milk and on cheese made from milk produced by reacting cows whose milk was heavily infected with *Brucella abortus*. Finally, they conducted a survey to determine the contamination naturally occurring in milk of cheese-producing areas (in New York and Wisconsin where brucellosis had not been eradicated from the dairy herds) in order to determine the survival of *Brucella abortus* in naturally-infected commercial Cheddar cheese. A total of 59 vats of commercial cheese milk of which 11 were positive for *Brucella abortus* showed that of the nine Cheddar cheeses from the nine positive vats (two cheeses made from the positive milk could not be located), all were negative on first examination after storage at 1.1° to 2.7° C. for periods varying from 41 to 84 days. Likewise, they found that Limburger cheese made from milk positive for *Brucella abortus* was negative on the first test after 57 days storage. Since no *Brucella abortus* organisms were recovered from any sample of commercial cheese and since Cheddar cheese has not been proved to be a carrier of undulant fever, they feel that an aging period of 60 days is reasonable assurance against the presence of viable *Brucella abortus* organisms in Cheddar cheese.

Thompson (48) in his article on ice cream cites Voillé to the effect that *Brucella abortus* may be isolated from Roquefort cheese for as long as two months. Gilman *et al.* (18) call attention to the fact that since Roquefort cheese is made from ewe's milk, it is probable that the organism in question was of the *melitensis* rather than the *abortus* variety.

While it is apparent from the foregoing discussion that cheese made from unpasteurized cow's milk containing *Brucella abortus* is not a serious source of infection for undulant fever, this is not true of cheese from unpasteurized goat's milk. On the contrary cheese made from unpasteurized goat's milk is highly infective for man especially if consumed shortly after it is made. Eyre (12) could not isolate *Brucella melitensis* after 48 hours from cheese made from goat's milk due to the growth of lactic acid bacteria. In Brynza cheese held at 11° to 14° C., prepared from milk inoculated with *Brucella melitensis* after pasteurization, Versilova (54) found viable organisms which were infective for guinea pigs after 45 days. Peres and Granon-Fabre (31) recovered *Brucella melitensis* by guinea pig inoculation from cheese made from naturally infected goat's milk which had aged 20 days but not from the samples aged 6, 10, or 17 days. Veloppe and Jaubert (55) reported 14 cases and 2 deaths of undulant fever due to fresh cheese. According to them it is common practice to mix goat's, sheep's, and cow's milk for cheese making. They concluded that cheese infected with *Brucella melitensis* is harmless after 30 days. Stiles (44) found 8 out of 19 samples of cheese positive for *Brucella melitensis* when injected into guinea pigs. Four samples of the Feta type and three of the Romano type were made from raw goat's milk and the other, imported from Mexico, was a yellow cream cheese supposedly made from cow's milk.

Streptococci and Cheese

Hucker and Marquardt (21) made studies with *Streptococcus pyogenes* which had been isolated from milk which was responsible for an outbreak of septic sore throat. In a batch of cheese which had been made from milk seeded with the above streptococci and cured at 40° F., the organisms had increased greatly in number at the end of 160 days. In a similar batch cured at 60° F., relatively few organisms remained after 85 days. An examination of cheese known to have been made from milk containing *Strept. pyogenes* showed that this organism was present in the cheese. Yale and Marquardt (57), working with two cultures of *Strept. pyogenes* Rosenbach belonging to Lancefield's Group A which had been isolated from two outbreaks of septic sore throat caused from milk, found that the organisms died out very rapidly (within 24 hours) in cottage cheese. The organisms survived between 28 and 51 days in one lot and between 9 and 14 days in another lot of Limburger cheese. In Cheddar cheese cured at 45° F. (7.2° C.) the organisms survived for over 18 weeks and between 9 and 11 weeks in a duplicate cheese cured at 62° F. (16.6° C.). In a second lot of cheese cured at 50° F. (10° C.) the organisms survived less than 18 weeks. They concluded that the variety of cheese, its moisture and salt content, and the curing temperature are some of the important factors affecting the survival of these organisms in cheese.

It is interesting to note that to date, no epidemics of septic sore throat traced to cheese have been reported in the literature, despite the fact that there doubtless is considerable cheese made from milk so infected.

Tuberculosis and Cheese

The prevalence of bovine tuberculosis is gradually disappearing under our present system of eradication and control. However, we should not be lulled into a false sense of security but should remember that tuberculosis still ranks seventh among the first 10 causes of death in man. We should still continue our first line of defense, tuberculin testing as well as our second, pasteurization. As early as 1909 Mohler *et al.* (28) showed that *Mycobacterium tuberculosis* would live in cheese from 33 to 261 days. They quote previous work in which viable tuberculosis bacteria were found in soft cheeses such as cottage and others from 14 days to two or more months, in Emmenthaler to about the fortieth day, and in Cheddar after 104 days. Harrison (19) earlier had reported results of seeding milk with *M. tuberculosis* which was made into Swiss Emmenthaler cheese where they remained viable for 28 days and into milk which was made into American Cheddar where they remained viable for 104 days. Earlier work had shown that the tubercle bacillus would remain viable for some time since Galtier (15) in 1887 inoculated milk with *M. tuberculosis* and found it in the cheese after 70 days and Heim (20) in 1889 found it after 14 days but not after four weeks.

In 15 samples of cottage cheese examined by Hormann and Morgenroth (22), 3 contained *M. tuberculosis* and 3 out of 5 samples of cottage cheese examined by Rabinowitch (36) contained it. Harrison (19) was able to produce tuberculosis in three samples of soft cheese purchased in the market in Berne.

In this country Schroeder and Brett (41) purchased from retail dealers in Washington, D. C., 59 samples of Cheddar, 32 of Neufchatel, 31 of cottage, 131 cream, and 3 miscellaneous varieties of cheese and examined them for infective *M. tuberculosis.* They found one cottage and 18 cream cheese samples which were infective for animals.

Botulism and Cheese

Milk and milk products in general have never been a source of botulism. Although milk and its products are an excellent source of food for bacteria, yet the physiological conditions evidently are not to the liking of *Clostridium botulinum,* this despite the fact that the normal habitat of his organism is the soil and there are many chances for contamination from this source.

It is well known that *Cl. botulinum* does not flourish in an acid medium. The limiting pH for its growth is around 4.5. Nevertheless there are records of botulism occurring in supposedly acid foods such as tomato catsup, juice, and relish, in dill pickles, apple sauce, green tomatoes, and apricot butter. All except one of these, tomato catsup, were home-canned where the method of preparation may have neutralized a part of the acid so as to have brought the acidity within the pH growth range of the organism. The commercial preparation of the catsup in question may likewise have been faulty so as to have permitted the growth of *Cl. botulinum.* Thus in the case of the home-canned cheese listed in the following paragraph as causing five outbreaks of botulism, the cheese may have been green and canned within a short time after it was made so that there was no opportunity for acid development.

Dack (9) gives a table prepared by H. F. Meyer in which is listed foods which have been involved in 359 outbreaks of botulism in the United States between 1899 and 1941. Home-canned cheese is listed as causing 5, and commercially packed canned milk as having caused 2 of these outbreaks. Nevin (29) reports an outbreak with 3 deaths traced to home-made cottage cheese from which *Cl. botulinum* type B was isolated. She seeded fresh sterilized and unsterilized cottage cheese with a loopful of a 48-hour broth culture of the above organism and injected 1 ml. portion into guinea pigs with fatal results. Controls of market cheese were negative.

Escherichia coli in Cheese Poisoning

Since *Escherichia coli* is omnipresent in the barn and on the cows, there is likelihood of it getting in the milk for cheese making. That a great deal of low grade milk is so infected there can be no doubt. It is obvious that *E. coli* cannot be either very pathogenic or toxigenic under the conditions prevailing in cheese-making or else there would be many outbreaks attributed to it. Timmerman (47) likewise discounts the role of *E. coli* in cheese poisoning since it is present in about 60 percent of the samples of cheese and causes no poisoning. He is of the opinion that a larger number of cases of food poisoning are caused by staphylococci than is generally believed, and that poisonings that develop after the eating of cheese are frequently due to them.

INFLUENCE OF ACID AND TEMPERATURE

Conditions in the early stages of cheese manufacture favor the growth of most bacteria since there is moisture, sufficient heat, and plenty of food. However, certain types such as the lactic acid-producing bacteria find the conditions more suitable than other types and soon create an environment unfavorable to the growth of most other bacteria. Furthermore, both the pressing of the curd which greatly reduces the water present and the storage temperature during aging are inimical to bacterial growth. Then there is the time factor and the growth curve of bacteria to consider. Under the most favorable circumstances the bacterial growth curve reaches its peak in several days after which there is a rapid and then a steady but constant decrease in the number of bacteria. Just how long it takes them to die out depends upon how favorable or unfavorable the environment. For example high acidity and high temperature are very destructive. More so than any other combination of these two factors such as high acidity and low temperatures or low acidity and high temperatures. In the case of *Brucella abortus* in cheese, Lerche (24) found that in cheese such as Landekäse which is an acid curd-type cheese made by the natural souring of milk, the organism died promptly. However, in cheeses made by the rennet process such as Frühstückkäse and Weisskäse, *Brucella abortus* persisted for 24 days. Drescher and Hopfengärtner (11) inoculated milk with *Brucella abortus* and made several types of cheese which were sampled at intervals from near the rind and near the center. The viability of the organisms were determined by culturing and guinea pig inoculations. The cheese was stored at 4 to 5° C. In Emmenthaler cheese, the organism survived 49 days in both the rind and central portion. In Dilikatkäse they recovered the organism from the rind and central portion in 35 but not 42 days while in Tilsiterkäse they found the organism to remain viable in the inner part of the cheese for 91 days but for only 35 days in the rind by both methods. However, by the inoculation method they found it at the end of 49 days in the rind.

The longevity of *E. typhosa* in milk and milk products has long been a subject of investigation due to the large number of epidemics which it has caused in these products. One of the early investigators, Barthel (2), held that "Typhoid bacteria increase in milk and remain alive for 25 days without a decrease in number due to the formation of acid in milk" and "they themselves contribute to this acid production. In butter, typhoid bacteria are found after 10 days, especially in butter which is strongly acid, as the enclosed sour brine is a good nourishing medium." However, that this opinion was not general is indicated by the work of Bassenge (3) and Behla (4) who found that when milk, buttermilk, etc., reaches 0.4 percent lactic acid, the typhoid bacilli are killed within 24 hours. Northrup (30) investigated the influence of the natural production of lactic acid in milk by various organisms on the destruction of *E. typhosa.* She found the minimum acidity produced by *Bact. lactis acidi (Strept. lactis)* which would destroy *E. typhosa* to be +37° acid (0.55 percent lactic acid) in lactose broth which corresponded to +80° (1.2 percent lactic acid) in milk and +28° acid (0.42 percent lactic acid) in whey, while for *L. bulgaricum* it was +53° (0.8 percent lactic acid) in lactose broth which corresponded to +208° (3.12 percent lactic acid) acid milk and to +66° (1.0 percent lactic acid) acid in whey. She recognized that there were many other factors entering under natural conditions which could influence the results such as temperature, character of initial microflora, associative action, metabolic products, and antibiotic action which could either hasten or retard the destructive action of the lactic acid bacteria.

Yale and Marquardt (57) in their

work with *Streptococcus pyogenes* found that these organisms died out within 24 hours in cottage cheese at pH of 4.57 to 4.32 while in Limburger cheese where the pH values ranged from 6.6 on the interior to 4.85 near the surface the maximum survival of the organisms was between 28 and 51 days in one lot and between 9 and 14 days in another lot of this cheese. However, in Cheddar cheese where the pH values did not drop below pH 5, the *Strept. pyogenes* remained viable for 18 weeks when the cheese was cured at 45° F. and between 9 and 11 weeks in a duplicate cheese cured at 62° F. Of course there were other factors operative such as salt and moisture in addition to temperature in these cheeses. Nevertheless acidity played an important role in the viability of the bacteria.

Versilova (54) likewise found acidity and temperature were important factors in determining the viability of *Brucella melitensis* in sheep's milk. At a pH of 6.0 to 6.8, it remained viable for 22 to 40 days in sheep's milk held at 11° C. whereas at pH 4.0 to 5.0 it remained viable 15 but never more than 30 days. However, in milk kept at 37° C. it frequently died out the first few days.

More recently Campbell and Gibbard (8) in studying the longevity of various smooth type strains of *E. typhosa* in experimental commercial cheese found the temperature at which the cheese was held to be more important than the acidity on the viability of *E. typhosa*. They state, "It was expected that the acidity of the cheese might have played some part in the death of *E. typhosa* and, although it is true that the cheese held at high temperature developed acid more quickly than those held at low temperature, there does not seem to be any correlation between acidity and viability of inoculated bacteria in different cheese."

It is unfortunate that Campbell and Gibbard (8) did not record pH values as well as titratable acidity since this would have been a better indicator. However, from their table I, acidity did affect the viability of *E. typhosa* because the acidity for duplicate cheeses made from the same batch showed acidities consistently higher for those cheeses held at the higher than at the lower temperatures for both November 25, 1942, and January 23, 1943, approximately 5 to 6 and 7 to 8 months respectively after the cheese was made. It was not until approximately 10 to 11 months later, April 13, 1943, that the acidities for the cheeses held at the two temperatures were practically equal. It would appear from these and other data that the higher acidities developed at the higher temperatures was an important factor in killing off the organisms.

MINIMUM SANITARY REQUIREMENTS

A committee representing the Wisconsin Cheesemakers' Association, Wisconsin Milk Producers' Association, the University and the State Department of Agriculture of Wisconsin, and the National Cheese Institute framed acceptable minimum sanitary requirements * for cheese factories and recommended their official adoption by Wisconsin as well as by other states producing cheese.

As Freidel and Yale (14) point out the cheese industry itself is deeply concerned with proper public health protection for cheese and feels that all concerned would benefit if all states would adopt uniform regulations. Since cheese is so widely distributed, this would make compliance with state regulations much easier for the industry.

PASTEURIZED MILK FOR CHEESE

As a result of the long list of epidemics and food poisonings in which cheese was either directly or indirectly implicated, it became evident that additional safeguards were necessary in order to produce cheese free of these agents. Pasteurization was the only logical answer. In addition to pasteurization as a health measure, it has been shown by the Bureau of Dairy Industry, U. S. Department of Agriculture, that cheese made from a good grade of pasteurized milk to which has been added a good starter is more uniformly high in quality, and furthermore, that it is possible to ripen such cheese at 60° F. instead of 50° F., thereby reducing the curing time of six to eight months to three to four months. Cheese so made and cured develops more and a better flavor than cheese made from unpasteurized milk and held at 50° F. for six to eight months. Therefore, there are two most excellent reasons now for pasteurizing milk for cheese—an economic as well as a health consideration.

State Laws Requiring Pasteurization of Milk for Cheese

California in 1944 was one of the first states to pass a law requiring that all cheese sold to the retail trade shall be pasteurized or made from pasteurized cream, milk, or skim milk which has been pasteurized, except cheese which has been allowed to ripen or cure for a minimum period of sixty days. Further requirements are made for labeling the variety, grade, factory number, state of origin, and date of manufacture. This law resulted from an outbreak of typhoid fever caused by green cheese in which there were 79 cases in nine counties in California and four in Nevada.

Colorado likewise passed a similar state law which became effective January 1, 1945, which requires that all cheese shall be pasteurized or made from pasteurized cream, milk, or skim milk except cheese which has been allowed to ripen for a minimum period of 120 days or longer if deemed necessary. In the same year New York amended the State Sanitary Code to require that cheese be pasteurized or that it be made from pasteurized cream, milk, or skim milk or had been allowed to cure or ripen at a temperature of not less than 35° F. for a period of not less than 60 days, from date of manufacture.

In the meantime our good neighbor, Canada, had taken similar action to stop the numerous outbreaks of disease traced to cheese by passing a regulation which became effective August 1, 1945. This regulation requires:

1. Every manufacturer of cheese by the Cheddar or other process from raw or pasteurized milk that yields a hard-pressed cheese shall mark or brand within 24 hours after removal from the press every merchandising unit of such cheese correctly and distinctly with the date of manufacture indicating the day, month, and year when such cheese was put into press.

2. No person shall cut any Cheddar or other hard-pressed cheese made from raw or pasteurized milk for sale or consumption as such in Canada within a maturing period of 90 days from the date of manufacture. Throughout the first 10 days of said maturing period of 90 days the temperature of storage shall be maintained at not less than 58° F. and throughout the remainder of the period, at not less than 45° F.

General Discussion

A review of the literature shows that cheese has caused a great deal of food poisoning since the cause of food poisoning began to be investigated scientifically about the beginning of the nineteenth century. At first the search was for a chemical poison produced biologically during putrefaction. Thus there was isolated a class of basic chemical compounds known as ptomains such as amylamin, putrescin, cadaverin, neurin and tyrotoxicon, some of which were poisonous and some non-poisonous. However, when Pasteur announced the germ theory of disease, research workers devoted their efforts to finding a bacterial rather than a chemical cause for the effects noted. This resulted in finding that the cause of most food poisoning was due to specific bacteria or groups of bacteria such the *Salmonella, Eberthella,* staphylococci, streptococci and various strains of *Cl. botulinum* such as A, B, C, D, and E. These groups of bacteria acted principally in one of two ways either by establishing themselves in the intestinal tract or by producing a soluble thermostable toxin on the contaminated food which was responsible for the illness.

Experiments on the longevity of pathogenic bacteria in cheese show that they remain viable for varying periods of time. Two States, California and New York, have adopted a 60-day and Colorado a 120-day holding period for cheese made from unpasteurized milk or cream. Canada requires a 90-day holding period for cheese made from either raw or pasteurized milk. In view of experimental evidence, it would appear that the 60-day holding period is too short a time.

There are conflicting results on the longevity of *E. typhosa* in cheese. Experimental work on a commercial scale by two groups of investigators show different results for cheese. Wade and Shere (56) showed the longest survival time for *E. typhosa* to be 36 days whereas Campbell and Gibbard (8) found them present in some cases and under certain conditions after 10 months. The evidence would indicate that the *Salmonella* group of bacteria most likely would die out within the 60-day period. The records show that cheese does not appear to be a very serious source of undulant fever due to *Brucella abortus* but that *Brucella melitensis* is, especially cheese made from raw, unpasteurized, ewe, or goat milk. Streptococci isolated from septic sore throat persisted in Cheddar cheese for as long as 18 weeks but died off within the 60-day period in cottage and Limburger cheese. Despite this fact, there is no record in the literature of an epidemic of septic sore throat due to eating cheese.

M. tuberculosis persists for a long time in cheese according to all experiments to determine its viability in cheese. Cheese does not appear to be a serious source of botulism since very few epidemics have been traced to *Cl. botulinum.* What few there have been have been traced to home-canned cheese where doubtless the conditions of manufacture precluded the possibility of the formation of sufficient acid or other abnormal conditions not found in commercial practice.

SUMMARY AND CONCLUSIONS

Cheese has caused a great many epidemics of disease. The organisms most commonly associated with cheese-borne infections are *E. typhosa,* the *Salmonella* group such as *Salmonella aertryke, Salmonella suipestifer,* and *Salmonella schottmülleri,* of the *Brucella* group *Brucella melitensis,* and to a lesser extent *Clostridum botulinum,* and streptococci. There are no reports in the literature of undulant fever due to *Brucella abortus* or septic sore throat due to streptococci caused by eating cheese despite the fact that these organisms surely must be present at times in raw milk made into cheese. There is no evidence that *Escherichia coli* is a health hazard although it is an economic one in cheese.

The conflicting results regarding the viability of *E. typhosa* in the experiments with commercially prepared cheese may be due to the type and strain of *E. typhosa* used by the different investigators. Wade and Shere used a culture of typhoid bacilli which they isolated from a 57-year-old woman who had had typhoid fever in 1900 which was about 27 or 28 years previous. So it may have been an R or rough strain of the organism. Campbell and Gibbard used a smooth Vi strain which might be more resistant than the rough strain.

From all the available information it would seem that the 60-day holding period is too short a time. The cheese does not have time to ripen and there may also be too many viable pathogenic bacteria present at the end of this time. A 90-day holding period should be the minimum time required. This gives the cheese time to ripen, and practically all pathogenic bacteria should have died or have become attenuated by the end of this time. A 120-day holding period such as Colorado requires is much better and safer for cheese made from raw unpasteurized milk.

Pasteurization is the only safe procedure to recommend or require. It is not only a safe procedure but also an economic one since cheese made from pasteurized milk or cream can be ripened in half the time because it can be ripened at a higher temperature, 60° F. instead of 40° F. or lower. Furthermore, if pathogenic bacteria are present, they will die more rapidly at the higher than at the lower temperature in cheese.

A combination of pasteurization and a 90-day holding period would be more nearly ideal as well as economically sound since it would produce a safe as well as a mature cheese.

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GERMAN CONTINUOUS BUTTER CHURN

A novel German continuous buttermaking machine, captured in Germany by a Quartermaster Corps Intelligence Team and brought to the United States for testing.

A novel German continuous buttermaking machine has been brought to the United States for testing. Results of the test will be made available to American industry after research is completed, in about three to six months. The machine will not be displayed publicly until then.

Continuous buttermaking machines have not been used commercially in the United States, though two companies have developed experimental models and set up pilot plants. The German machine was designed to produce 1,500 pounds of butter per hour, according to the Quartermaster Corps Intelligence Team that captured it. It occupies less space than American churns of similar capacity.

The machine was produced by the Roth Moelkerei Maschinenfabrik, manufacturers of dairy equipment in Stuttgart.

Testing will be conducted by the Research Committee of the American Butter Institute, under contract with the Quartermaster Corps Food and Container Institute (formerly the Subsistence Research and Development Laboratory).

Experiments on application of the machine to American dairy plant operation will be conducted under the supervision of Dr. H. A. Ruehe of the Department of Dairy Husbandry of the University of Illinois in the Beatrice Creamery Company plant at Champaign, Ill.

The machine will be closely restricted during the tests, to make sure that all dairy and equipment companies have an equal opportunity to use the information. Findings will be reported to the Quartermaster Corps and turned over to the Office of the Publication Board for general release.

(Continued on page 155)

Interpretation of Pasteurization Recording Charts

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CHARTS of pasteurization recording thermometers are the only means available for furnishing the plant operator and owner, or the inspector and health officer with a record of the pasteurization process. It is only upon this record that the pasteurization plant operator can show that he actually has pasteurized his milk supply. Likewise, it is also upon this record that the inspector or health officer can determine whether or not the pasteurization of milk is being properly accomplished. It is essential, therefore, that the record be accurate and complete if it is to be of any value.

For the purpose of this discussion, only pasteurization recording thermometer charts for pasteurizing at 143 degrees for 30 minutes will be covered, and we will assume that the indicating, recording and air space thermometers meet the specifications for time and temperature accuracy. (Such specifications for thermometers can be found in the 1939 edition of the U.S.P.H.S. Milk Code.) We will also assume that the pasteurization vat is properly constructed, so that if properly operated, it will assure pasteurization of every particle of milk in the vat.

Assuming that the thermometers are accurate and that the pasteurization vat is properly constructed, we have but two important matters to control, insofar as pasteurization itself is concerned. They are: First, minimum holding time, and secondly, proper temperature. Other essential information should be included on the chart.

To insure a minimum holding period, when the milk is heated in the vats, the pasteurization vats or holder should be so operated that the recorder charts will indicate at least 143 degrees Fahrenheit for a period of not less than the following:

(a) If the cooling process is started in the holder simultaneously with, or before, the opening of the outlet valve, a 30-minute holding period shall be shown on the chart.

(b) If cooling is started in the pasteurization vat or holder after the opening of the outlet valve or is done entirely outside of the vat or holder, a holding period of 30 minutes plus the emptying time to the level of the recording thermometer bulb, or 30 minutes plus the time interval before the cooling of the milk was started in the vat, shall be shown on the chart.

No milk should be added to the pasteurizing vat after the start of the holding period. The holding period is calculated from the time the milk reaches the required temperature after the addition of the last milk in the vat.

The manner of providing a complete record on the chart is relatively simple. All recording thermometer charts should be preserved for a minimum of ninety days. No chart should be used for more than one day and all charts should have the following information noted on them by the operator of the pasteurizer:

(a) Date.

(b) Number or location of the recorder if more than one is used.

(c) Reading of the indicating thermometer at a time indicated on the chart during the holding

NOTE: This paper was designed to teach inspectors and sanitarians in Michigan who come in contact with the holding method of pasteurization.

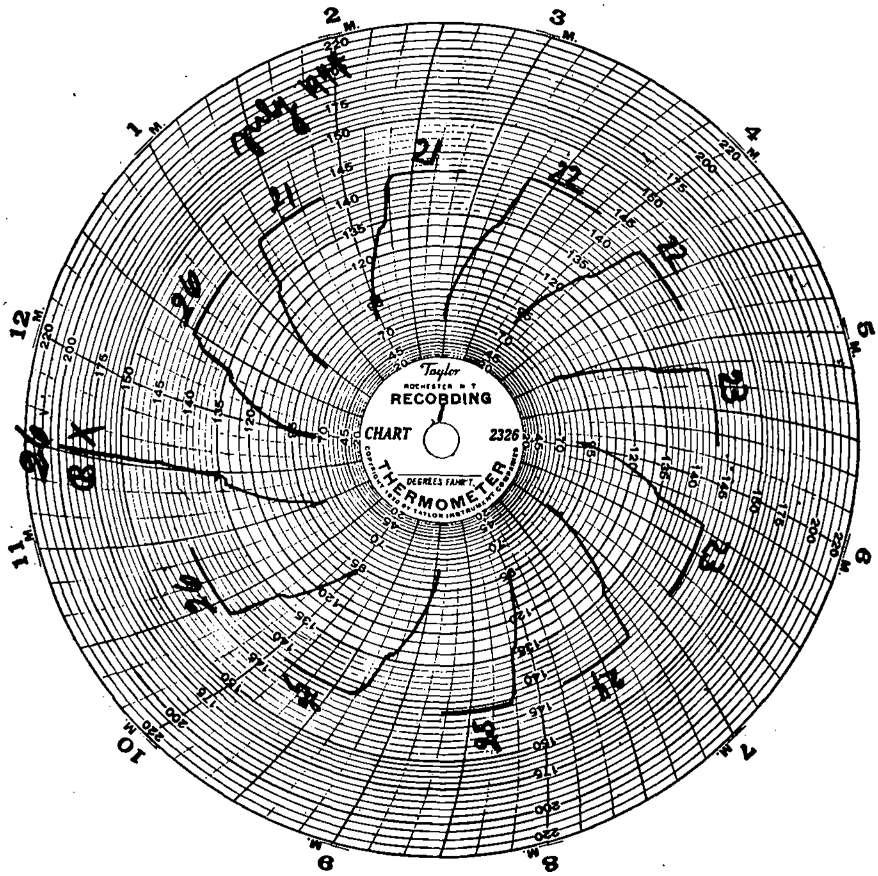


CHART I

period. This same notation shall be made at least monthly by the inspector whose initials will be entered opposite the recorded reading.

(d) The time accuracy of the recorder, as found by official tests shall be entered on the charts monthly by the inspector.

(e) Amount of milk or milk products represented by the chart.

(f) Record of unusual occurrences.

(g) Signature or initials of operator.

In order that we fully understand these principles, let us study and then discuss the following charts. (Series of slides shown.) These charts are some that have been taken directly from the field and have not been altered.

Chart No. 1. Improper Chart—This chart does not meet specifications and is of no real value.

(a) It was used for more than one day and therefore does not give any accurate information as to the actual date of pasteurization.

(b) There is no notation relative to the amount of milk or milk products that were processed.

(c) There is no signature or initial to indicate who was in charge of the processing operation.

(d) Each daily line record does not record a long enough

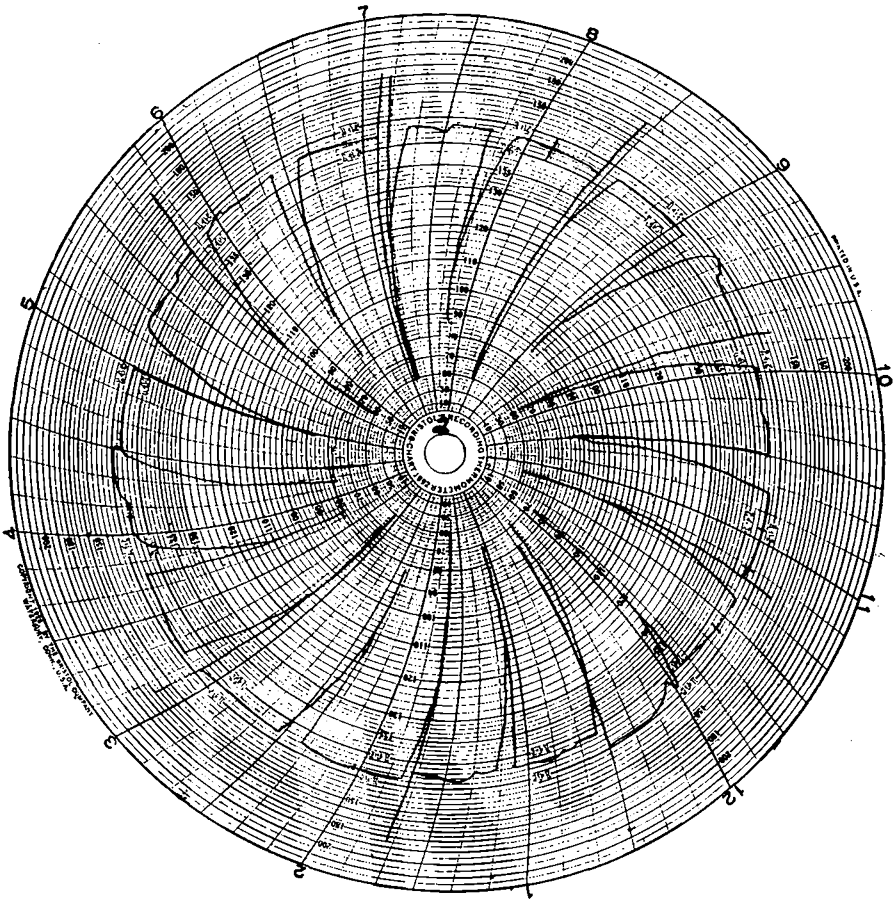


CHART II

period of operation. You will note that the line record shows only a 30-minute 143-degree Fahrenheit record and then the record is discontinued. This means that if an operator heated the milk up to 143 degrees Fahrenheit, held it at that temperature for 10 minutes and then began emptying the vat for filling and bottling and it took 20 minutes to empty the vat down to the bottom of the recorder thermometer bulb, the line record would still show 30 minutes holding when in realilty some of the milk had been held for only 10 minutes. It is because of this that it is essential to insist on a complete record of the complete pasteurization process by leaving the pen arm on the chart during entire day's operation.

Chart No. 2. Improper Chart—This chart is absolutely valueless, inasmuch as it has no definite information on it. There is no date, no signature, no indication of volume or product processed, the line records are not complete, nor are the charts identified in any manner. This type of chart indicates lack of proper supervision.

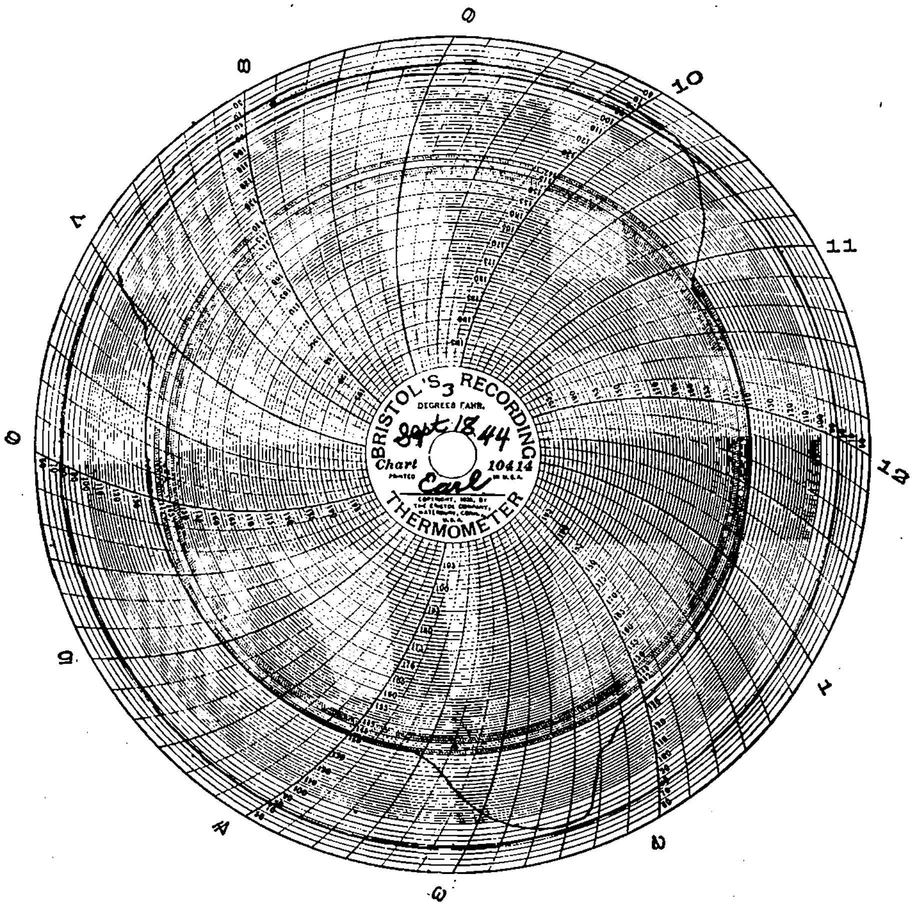


CHART III

Chart No. 3. Improper Chart—This chart has value but does not supply complete information. The chart does give a line record of the complete day's operation, yet it is dated and signed. It does not, however, give any information relative to the volume of milk processed nor the specific product processed, nor does it indicate that the thermometer reading was checked during a holding period.

With very little added information the record on this chart would be complete.

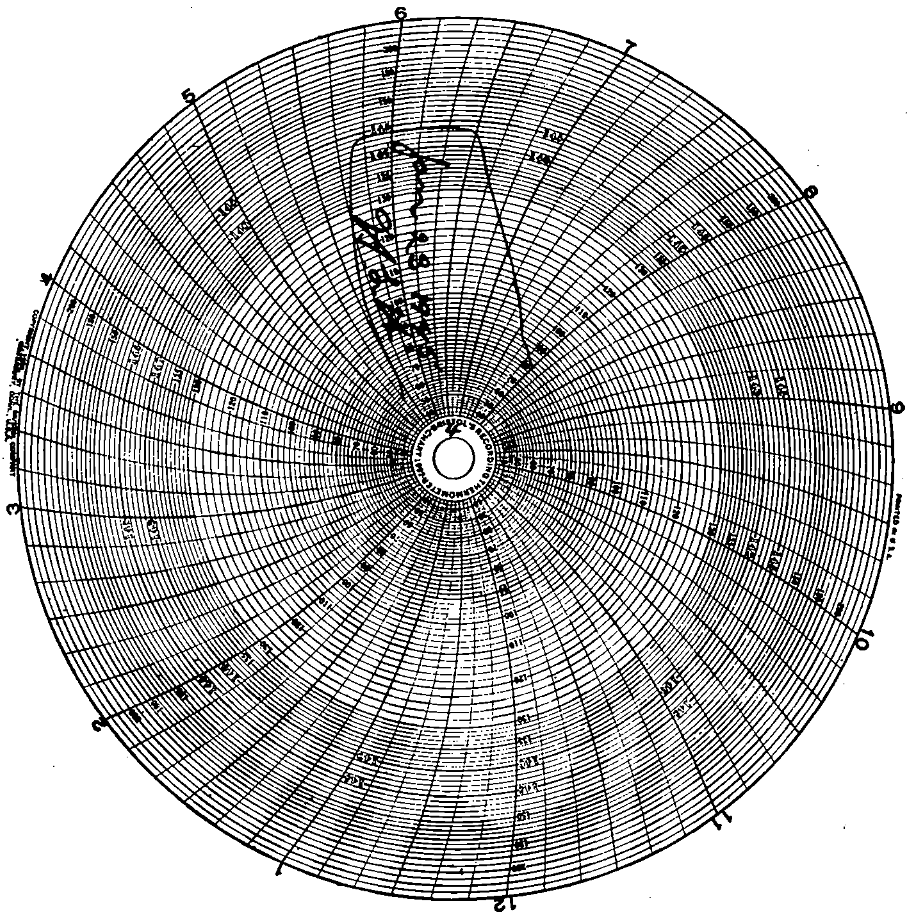


CHART IV

Chart No. 4. Improper Chart—This chart has only partial information and it was determined during inspection that the line record was in error with regard to actual time indicated.

The chart lacks information as to volume and specific product being processed and there is no indication that the thermometer reading was checked during a holding period. As a matter of fact, the pasteurization process was being carried on between 10:00 A.M. and 12:30 A.M., but the recording chart indicates that the process occurred between 5:30 and 8:00 o'clock, which is in error. This error occurred because the chart was not properly placed on the recorder. The line record, too, should be extended to tell a complete story.

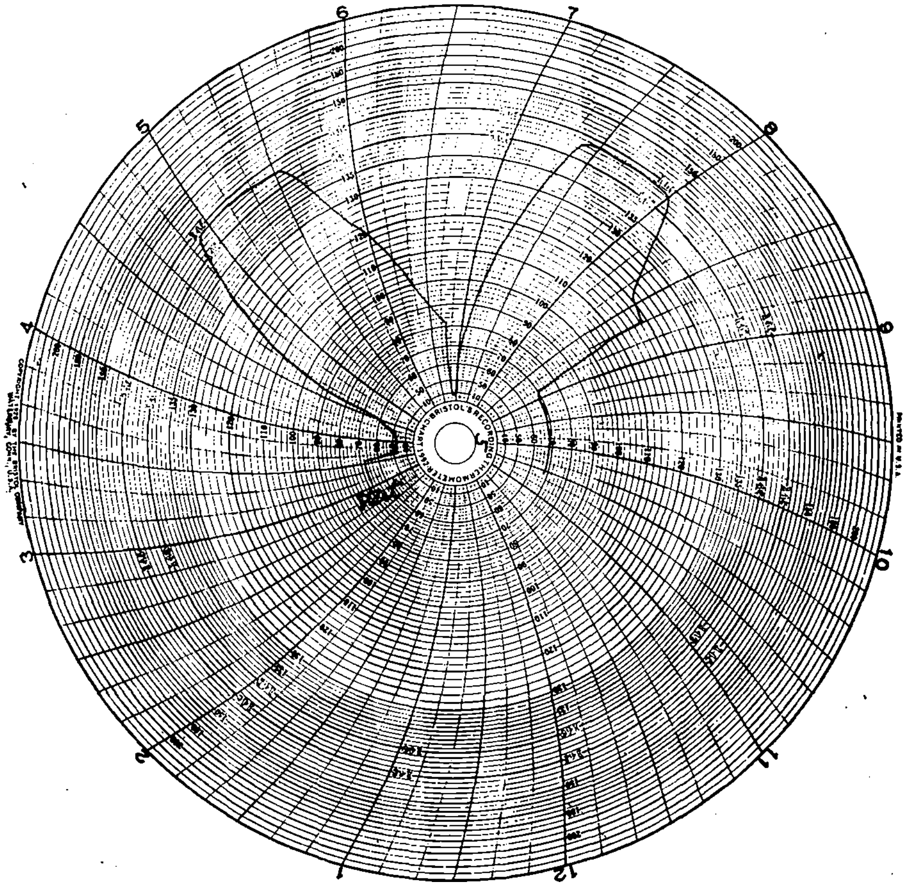


CHART V

Chart No. 5. Improper Chart—This chart looks good and does give information of value to the processor and inspector, but it lacks some necessary information. There is no notation relative to the volume of milk processed nor of the product being processed. There is no date or signature of operator and there is no indication that the thermometer reading was checked during a holding period.

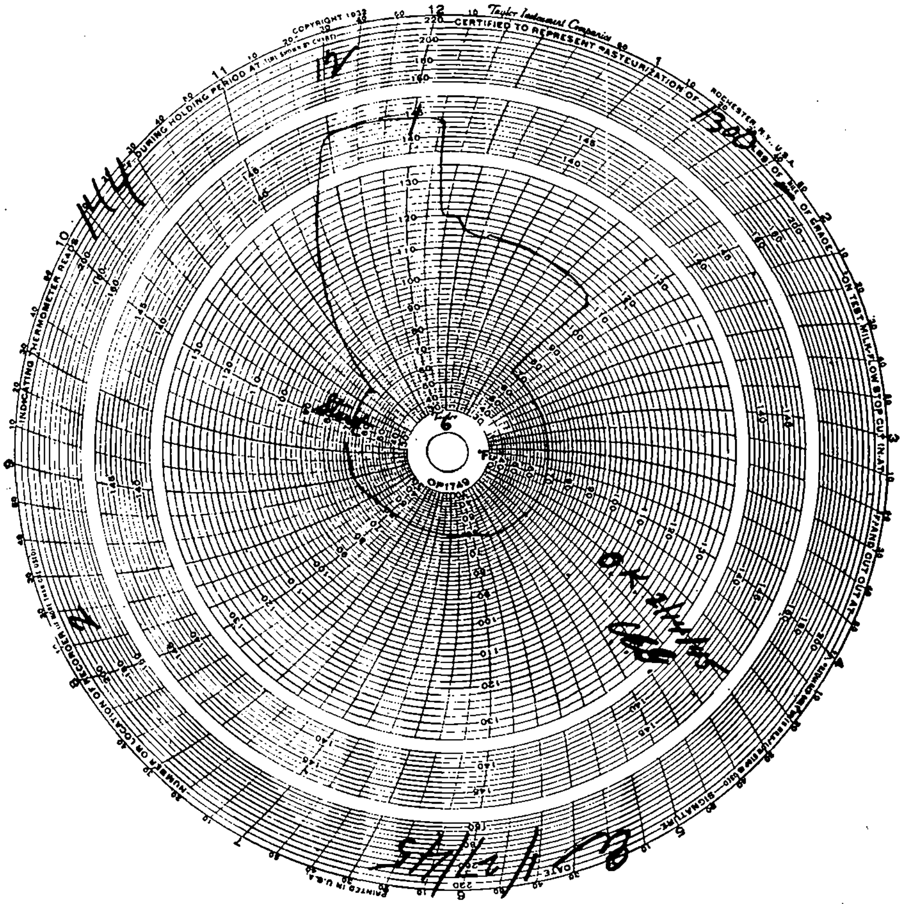


CHART VI

Chart No. 6. Proper Chart—This chart was properly maintained and has all the information needed. It does have the following:

(a) Correct starting time of operation and date.

(b) Accurate line record of complete processing.

(c) Indication that the thermometer was checked at 12:00 o'clock and that the indicating and recording thermometer checked at 144 degrees Fahrenheit during this holding period.

(d) The volume milk processed is noted.

(e) The initials of the operator have been placed on the chart.

(f) The notation that this chart is a record of the processing in vat No. 2 is also made.

(g) There is also a notation that the inspector looked at the record and okayed it on 2/14/45.

All necessary information is available and the record is of full value to the plant operator and to the inspector.

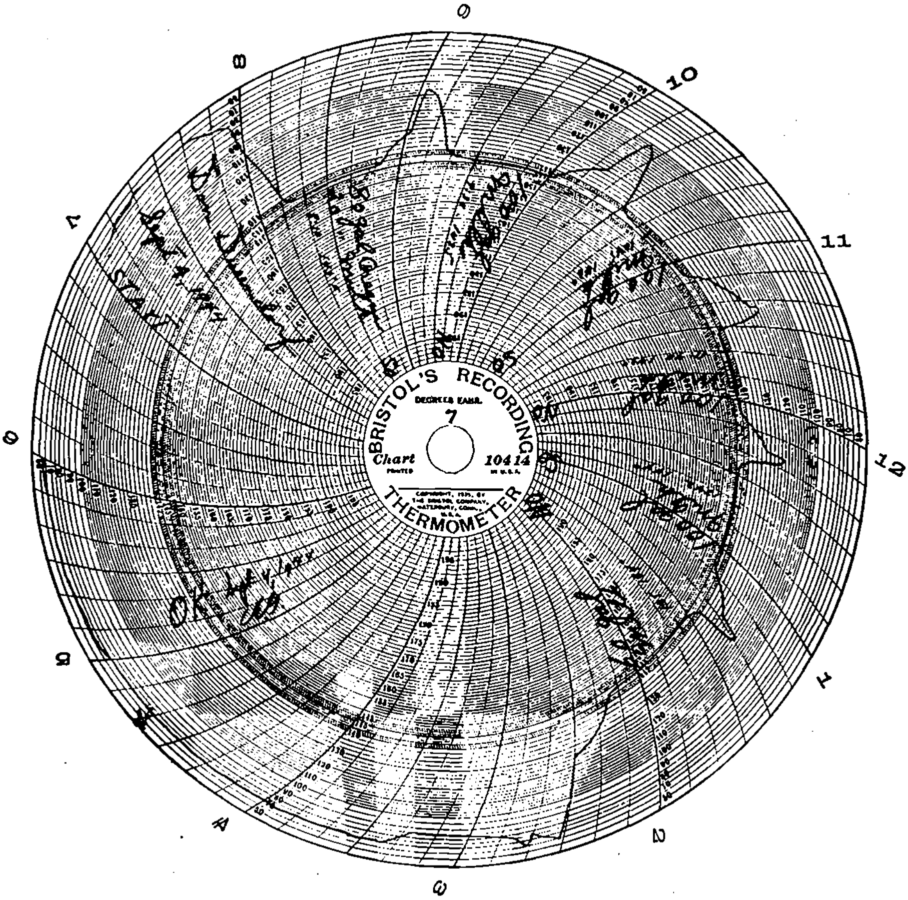


CHART VII

Chart No. 7. Proper Chart—This chart also gives all the information needed for the proper interpretation of the chart. This chart does, however, maintain a record on two pasteurization vats instead of the usual one. In this case, there are two vats, namely, the north vat and south vat. The recording chart shows that the recording thermometer was in the vats of milk being pasteurized throughout the pasteurization process.

After having studied these charts it is plain to see that they must be complete and accurate if they are to be of any value. It is also evident that the maintenance of a proper chart is relatively simple and that there can be no excuse for improper charts. Before closing we will list a few advantages of having a properly maintained chart:

1. The plant operator will be assured that his recorder chart is in full compliance with the law.
2. In case of court action involving suits or any other matters, the plant operator can have confidence that he has a complete record and can in detail explain the operations that occurred in any pasteurization vat at any time during any day.
3. In case laboratory examinations of the milk show high bacterial counts or positive phosphatase tests, the recorder charts can be of material assistance in locating the trouble.
4. It is good business to have accurate and complete records.

Sanitary Standards for Storage Tanks for Milk and Milk Products

Formulated by

INTERNATIONAL ASSOCIATION OF MILK SANITARIANS
U. S. PUBLIC HEALTH SERVICE
THE DAIRY INDUSTRY COMMITTEE

As of March 13, 1946

IT is the purpose of the IAMS, US PHS, and DIC in connection with the development of the 3A Sanitary Standards program to allow and encourage full freedom for inventive genius or new developments. Storage tank specifications heretofore or hereafter developed which so differ in design, material, construction, or otherwise as not to conform with the following standards, but which, in the fabricator's opinion, are equivalent or better, may be submitted for the joint consideration of the IAMS, USPHS, and DIC, at any time.

3A STANDARDS

Tanks to be used for the storage of milk or milk products, conforming to 3A Standards, comply with the following in design, material, and construction.

A. Size of Tank:

1. *Inside diameter or height:* Tanks having an inside diameter or inside height of more than 96 inches are provided with *specific* means that will facilitate cleaning and inspection of all interior surfaces.

Public Health Reason: 96 inches is the maximum diameter or height to which a cleaner of a tank can, without mechanical aid, effectively clean and determine by sight and/or touch the cleanliness of all parts of the interior surface.

B. Material:

1. *Inside lining:* The inside lining is of 18–8 stainless steel with a carbon content of not more than 0.12 percent. The weld area and deposited weld metal are equally as corrosion-resistant as the parent metal.

The inside lining surface is at least as smooth as No. 4 mill finish on stainless steel sheets.

The material used for the inside lining is not less than 14 U. S. standard gauge stainless steel.

Public Health Reason: Experience has demonstrated that 18–8 stainless steel with a carbon content of not more than 0.12 per cent and with No. 4 mill finish can be cleaned and remains smooth, and that stainless steel plates of the 14 U. S. standard gauge withstand buckling.

2. *Outer shell:* The outer shell on an insulated tank consists of a continuous metal covering which is smooth, sanitary, and waterproof.

3. *Insulation:* Insulating material is of a nature and amount sufficient to prevent, in 18 hours, an average temperature rise of greater than 3° F. in the tankful of water when the differential between the temperature of the water and that of the atmosphere is 30° F., provided that the material, if cork, is not less than 2 inches in thickness.

Public Health Reason: Insulation is necessary to maintain temperatures that will retard bacterial growth. The foregoing is a standard for insulation effectiveness.

C. Fabrication:

1. *Welds:* All inside and outside seams are welded. All inside welds

are ground flush with the plate surface. Outside welds of the inner shell, if reasonably smooth, need not be ground.

All welds on the inside surface are so located as to permit grinding and polishing to a finish not less than that of the adjoining surface.

The inside radii of all welded or permanent attachments are not less than ¼ inch. Attachments which are removable and which are taken out for the purpose of washing may have radii conforming with 3A Sanitary Standards for Fittings.

2. Construction: The tank is so constructed that it will not sag, buckle, or prevent complete drainage.

Where the inside head joins the lining of the tank the radius is not less than ¾ inch.

No longitudinal welds are within one foot of the bottom center (drainage) line.

Public Health Reason: This type of fabrication and construction assures an uninterrupted, easily accessible, smooth surface, and complete drainage, which permit and facilitate effective cleaning.

3. Legs: Adjustable legs of round stock with sealed bases are provided of sufficient size and spacing to carry the tank when full and to raise the milk outlet sufficiently high to allow for adequate cleaning. The tank or bracing has a minimum clearance of 8 inches from the floor.

Leg socket exteriors are corrosion-resistant and readily cleanable. Paint on non-wearing surfaces is considered corrosion-resistant.

Public Health Reasoning: Legs of round stock are more readily kept free of accumulated residues of floor washings; sealing of the bases prevents accumulations within the leg stock. Ample space for cleaning the floor under the tank, and the lower portions of the tank and its supports is essential.

D. Openings:

1. Outlet: The outlet is of the flange type, stainless steel. The minimum diameter of the outlet opening is 1½ inches. The outlet opening is located in the center line, at the base of the front head, or in the bottom, adjacent thereto; or in the case of vertical tanks, at the bottom of the vertical side, or in the bottom, adjacent thereto.

2. Outlet valve mounting: The valve mounting is of compression type, close coupled, of stainless steel or white metal, and is designed and fitted to permit the use, if desired, of single service gaskets, so that the valve body may be removed for cleaning.

Public Health Reason: The outlet for purposes of cleaning and drainage, is located in the front of the tank or in the bottom immediately adjacent thereto. Close coupling avoids the formation of a pocket of milk in which bacterial growth may occur. Interchangeability of gaskets permits the removal of the valve for cleaning, and the minimum inlet size of 1½ inches has been found in practice to be the minimum which can be readily cleaned.

3. Valves: Valves are sanitary in construction, are readily cleanable, and comply with 3A Sanitary Standards for Fittings. Valves need not be of leak-detector type.

4. Inlets: Inlets are of the no-foam type, are sanitary in construction, and are equipped with a cap.

5. Air vent: A hooded air vent of not less than 3 square inches in free opening area is installed at the top, toward the front. The air vent is designed so that parts are readily accessible and easily removable for cleaning, and is provided with a punched metal screen having openings not greater than 1/16 inch in diameter.

Public Health Reason: Ease of dismantling and ready accessibility of all parts is essential to regular and effective cleaning. The purpose of the screen is to prevent ingress of vermin.

6. Gauge opening: The gauge opening is a stainless steel sleeve not less than 2 inches in diameter, located in the head and fitted with an approved 3A cap.

7. Thermometer opening: One or more standard 3A fittings are provided that will accommodate an indicating or recording thermometer interchangeably. The thermometer inlet is located in the front head sufficiently low to permit registering of temperatures when the tank contains not more than 10 percent of its capacity.

Public Health Reason: It is desirable to be able to ascertain the temperature of a partial tankful of milk or milk product.

8. Manhole: The manhole is located at the drainage end or side of the tank. The dimensions of the manhole opening are not less than 15 inches vertical and 20 inches horizontal.

The cover is of the inside-outside swing type, capable of ready removal and disassembly for cleaning, and may be provided with a 1 inch flush sanitary white metal or stainless steel sampling cock. The cover is provided with a continuous, sanitary, removable gasket.

The frame is so pitched that liquids accumulating on the exterior flange will flow away from the milk.

Public Health Reason: The location specified facilitates the replacement of the disassembled agitator, and observation of thermometer and valve mountings, etc., without complete entrance into the tank. The minimum dimensions prescribed for the manhole opening permit ingress and egress of personnel of average size. Continuous gaskets have no joints which may eventually open to permit the entrance of milk solids.

9. Sight and light glasses: Sight and light glasses are of such construction that interior surfaces drain inwardly and they are demountable for cleaning. The diameter of the openings into the tank is not less than 4 inches. Sight and light glasses are so placed that the opposite end of the tank, when empty, can readily be observed. The exterior flare of the opening is pitched so that liquids cannot accumulate.

10. Other openings: All openings other than those specified are of sanitary design and capped.

E. **Agitators:**

1. Agitators: The agitator shaft is demountable for cleaning, and has a packless bearing. The horizontal agitator has a sanitary rotary seal.

The blades are of sufficient size and so powered as to provide adequate agitation of the product.

(Adequate agitation for whole milk is that degree of agitation which, within 20 minutes, restores uniformity [plus or minus 0.1 percent] to the fat content, throughout the capacity volume, after storage for 24 hours at 40° F.)

2. Horizontal agitators: If the tank is provided with but one agitator, it is mounted in the front head close to the manhole opening.

3. Vertical agitators: If any agitator support at the bottom of the tank is provided, it does not interfere with drainage. The point of entrance to the tank shall be protected against dust and insects.

4. Alternate agitation: Compressed air may be used, in which event the air is filtered through single service filters from which position it is conveyed to the milk in sanitary pipe and fittings provided with sanitary check valves.

Public Health Reason: Agitation, after quiescent storage, is necessary to restore uniformity throughout the tank content. Mechanical agitators can be more effectively cleaned in a wash vat than in position; and packed bearings eventually become impregnated with milk solids and bacteria, which subsequently find their way back into the tank contents, and contaminate them. The location of the agitator in the front head reduces the amount of necessary passage through the tank in its removal and replacement.

F. **Tilt of Tank:**

The construction of the tank is such that complete drainage with water can be obtained with a pitch not greater than 1 inch in 100 inches.

Public Health Reason: Inability to remove the residue of tank contents or of washing solution, by complete drainage, increases the difficulty of effective cleaning, and nullifies bactericidal treatment to some degree. The foregoing standard assures a uniform gradient in the bottom of the tank, so that when it is installed with a slight pitch drainage will be complete.

G. Motors:

Motor mounting and drive are of sanitary construction and sufficient clearance is provided to permit easy cleaning.

If motor is mounted in an inverted position, provision is made for drainage of the frame.

Public Health Reason: Motor and its mounting are subject to accumulations of dust and milk solids, avoidance of which is facilitated by sanitary construction.

H. Access to Top of Tank:

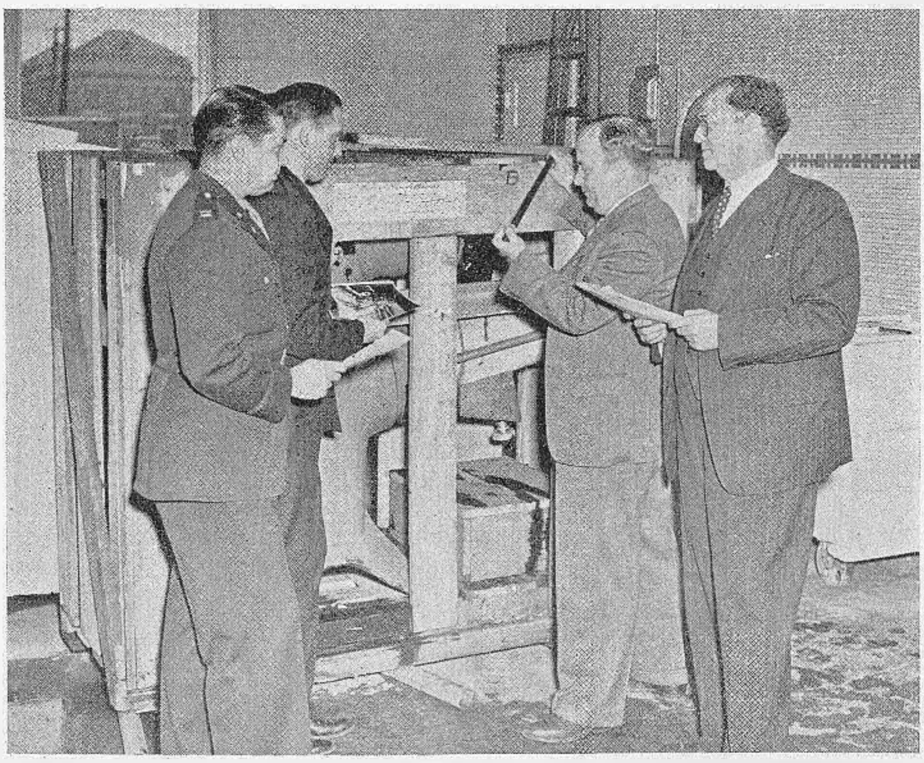
The tank is provided with ladder rungs or a platform if any openings are above the eye level.

Public Health Reason: Accessories or openings located in the upper portion of a tank head or side must be readily accessible for cleaning and routine use; the top of the tank must be cleaned from time to time. Unless ladder rungs or a platform are installed on the tank, a portable ladder must be used, or the agitator motor or thermometer may be damaged, or the valve mounting sprung by personnel using it or them as a footing.

[Dr. G. W. Grim has resigned from the Dairy Industry Committee.]

GERMAN CONTINUOUS BUTTER CHURN

(Continued from page 143)



Standing before the machine, left to right, are Capt. Edward Barrett, Administrative Officer, Quartermaster Food and Container Institute, Chicago; G. W. Shadwick, Chairman of Research Committee, American Butter Institute, Beatrice Creamery Co., Chicago; Wilbur Carlson, member of QMC Intelligence Team which captured churn, now with Kraft Foods Co.; and Dr. H. A. Ruehe, Department of Dairy Husbandry, University of Illinois, Champaign, Ill.

Report of the Committee on Frozen Desserts

THE frozen desserts industry like all other industries is in a transition period from a war to a peace time basis. War left its mark on this industry as it has on everything else in the world. Shortage of labor and materials and an increased demand for almost any kind of product created a mighty tempting situation for the unscrupulous manufacturer. A dearth of inspectors and other peace-time controls did not help matters. There were those who would have permitted the use of starch fillers to help stretch the gallonage. However, in general it can be said to the credit of the industry as a whole that they kept their product up to the standard required by the law during the emergency. That manufacturers of frozen desserts did do so well during this period despite almost insurmountable difficulties reflects great credit upon their training and integrity. Years of hard work and education by sanitary inspectors and the dairy departments in the various agricultural colleges had left its imprint on the industry to the extent that when the going got hard and temptations arose, their training told them there was only one thing for them to do—to make a sanitary, standard product of good quality despite the handicaps. In fact, the smart operator kept his quality at the prewar level regardless, knowing that it would be good business and his best advertisement.

Quality in Ice Cream

These days the theme song is "quality." Someone has aptly said that Quality Unlimited is the Post-War Gravy train. It is wonderful that so many people are becoming quality-minded all at once. It is a fine thing. It pays good health and economic dividends. The only trouble with such manufacturers is that they have no deep and abiding convictions regarding quality. Many of them do not really know what quality means, what it stands for. Quality is of such a nature that it is like a virtue. Most people recognize it even though they can not define it. Although the nature of quality is such that it is hard to define, yet practically all the elements that go to make up quality in a food such as ice cream are known.

The elements of quality in ice cream are:

1. Good clean, fresh, or properly preserved, disease-free ingredients such as milk, butter fat, milk solids, stabilizers, flavors, colors, sugar, fruits, and the like.
2. Proper mixing and blending of the ingredients.
3. Manufactured in sanitized, approved machinery by intelligent, clean, and healthy workmen.
4. Stored in clean refrigerator rooms until sold.
5. Stored and dispersed by the retailer in a sanitary manner and served at the proper consistency to the customers.

One could write a great deal on each of these five headings and upon the individual topics under each heading. As a matter of fact all the literature on ice cream deals with various aspects of ice cream comprised under these five headings.

Report of Other Committee Members

As usual, the report of the other members of the Committee make up the meat of this report. As we read Mr. Ghiggoile's report, we can not but admire the fine work which California is doing under his able direction. His reports from year to year should be an inspiration to other states to pass similar laws and regulations. The description of an automatic machine for making ice cream and other frozen dessert novelties indicates just how far we have progressed in the past twenty-five years. In 1919 in an article on ice cream sanitation, I described such an ideal machine. One of the readers taking the article too literally wrote and asked where such a machine could be bought. After writing to a great many manufacturers, I had to write him that no such machine was to be had.

In his report, Dr. Krog gives us the situation at the eastern end of the United States where dairy products are not as plentiful as in the mid-west, and a part of them must be shipped in. They are more concerned with plastic cream, butter-oil, milk powder, and the like since these products are more economical and convenient for them.

Dry mix for ice cream has also received some attention since it was made and used by our Armed Forces overseas. It was estimated that during one year they would use about 150 million pounds of dried mix which would make about 75 million gallons of ice cream. Dry mix for ice cream-making has future possibilities under certain conditions especially for those who are a long distance from the source of supplies. It must be competitive, equal to or superior in quality to fresh mix, have a keeping quality of from three to six months, comply with all health standards, and its use must be permitted by local or state laws. The same factors which affect the keeping quality of whole dried milk are operative in dry ice cream mix. The same procedures which produce a high quality, whole, dried milk likewise produce a high quality dry ice cream mix.

Mr. Scott's report is representative of the entire southern part of the country. Normally having only sufficient milk and dairy products for their own need, the great influx of people, civilian and military, completely upset the whole dairy picture in the South. The problems created were great but they had a fine group of leaders like Mr. Scott to solve them in the best possible way.

At the northern end of the continent Mr. Cameron reporting for Canada paints a picture very similar to that found in the United States, viz., shortage of materials and labor and a greatly increased demand for frozen dairy products. There was some lifting of restrictions such as substitutes for sugar but on the whole quality was maintained practically at the pre-war level. How different were the conditions in countries more directly affected by the war. Ice cream made in England during the war was but a mere shadow of what it was prior to the war. The following are typical formulae used by English manufacturers "A" before the defeat of Germany and "B" at the time of the defeat of Japan: [1]

Ingredients	*A Ounces*	*B Ounces*
Margarine	21.5	18.75
Sugar	20.0	18.00
Skim milk powder	21.0	5.25
Soya flour	2.0	7.00
Wheat flour	....	7.00
Gelatine	1.0	....
Manucol	....	0.50
Glycerin-monosterate	....	1.00
Salt	....	0.25
Water	116.5	122.25
Total solids	35.0%	31

So while the quality of frozen dairy products, especially ice cream, may have eased off slightly during the War, certainly they did not deteriorate to the point that they did in many other countries. As dairy products became scarce, one of the most notable changes which occurred was not so much the reduction in quality of ice cream as the switching to other frozen dairy products such as water ices and sherbets. However the shortage of sugar curtailed even their production.

[1] Skertchly, C. *The Ice Cream Trade Jour.*, p. 38, Dec., 1945.

Report of O. A. Ghiggoile

Chief, Bureau of Dairy Service, California Department of Agriculture

The public expected better ice cream after the war and they are receiving it. Almost overnight, with the lifting of governmental restrictions (except on sugar), the sherbet-ice cream mixtures and water ice substitute products used for milk shakes and in frozen bars, disappeared from the market. As a wartime measure the Director of Agriculture changed the citric acid requirement on sherbet from thirty-five hundredths to two-tenths of 1 percent. This permitted the production of a low acid sherbet which could be used in the preparation of milk shakes. The law requiring at least 10 percent of fruit was not changed however, and most manufacturers used apple puree to satisfy this standard. This product is now almost entirely replaced with ice milk of prewar composition.

The war taught us one important thing about food habits—they can't be changed overnight. G. I. Joe wanted ice cream and he wanted it no matter where he was—Italy, India, France, Iwo Jima—and to a large extent he got ice cream. This miracle was accomplished by the production of powdered ice cream mix. Millions of pounds of such mix were processed in California during the war. Many problems beset the production of dry mix but the most troublesome was that of rancidity development. Through research, both private and governmental, this difficulty was overcome by hermetically sealing the cans, withdrawing the air, and replacing with nitrogen. Recently an Army major told me that he had eaten some ice cream made from dry mix that had been stored in Alaska for two years. He pronounced the quality as good and received similar opinions from his men.

Just what the postwar market possibilities are for dry mix it is too early to state. Already small packages of the product are being put up for domestic use. Counter type freezers may turn to this product because it has the advantage of being non-perishable. The comparative price between liquid mix and dry mix may easily be the factor which determines its future.

The war has done something startling to the public. We have become conservative-minded. Victory gardens; can your own fruit and vegetables; freeze your surplus food; these things have brought forth a tremendous new industry—the frozen food locker business and the deep freeze home storage units. These things are with us to stay, and the sub-zero domestic freezing unit should serve to the advantage of the commercial ice cream manufacturer.

There have been many improvements in dairy plant construction during the past few years. Floors and walls are now of tile—easily kept clean and always attractive. Glass block walls are not only sanitary but are attractive, easily cleaned, and permit more inside daylight. Ceiling construction is now of such a design as to permit the steam and air rapid escape through overhead sky-light ventilators. This is accomplished by doing away with the right angle juncture between the wall and ceiling and providing a 45° angle slope on the upper part of the wall. Air-conditioning is making its introduction into dairy processing plants.

Dairy equipment manufacturers tell us not to expect anything that is much different from the present processing machinery. The continuous process for making butter, we are told, will probably be the most revolutionary. But we are promised continued production of equipment of sanitary design. The new homogenizer and viscolizer have shown amazing improvement in sanitary construction: no packing glands, easily taken apart, complete access to all working parts for ease of cleaning, stainless steel construction, and removable block are a few of the features that appeal to a sanitary-minded inspector. Pasteurizers equipped with flush type, leak detector valves are rapidly replacing the outmoded vats which had the old style coil stuffing-boxes, and dead-end valves. Stainless steel sanitary pipes and fittings are taking the place of the tinned copper type. In fact, one manufacturer has informed us that they manufacture stainless sanitary pipes to the exclusion of any other type.

The Armed Forces order their ice cream put up in quart bricks, sliced eight to the quart. It took millions of such slices to satisfy the Army's appetite for ice cream. The slice had almost disappeared from the market until the war came along. The old method of cutting and wrapping a slice of ice cream involved quite a bit of handling. Now a new automatic cutting and wrapping machine eliminates the touching of ice cream by hand. Those plants which do not have volume enough in slices to justify the investment in expensive packaging machines are taught to cut and wrap in a manner that allows no handling of the product.

We have devoted a great deal of time and study to the sanitary features involved in the production of ice cream and ice milk novelties: frozen coated or uncoated pieces on a stick. The process, until recently, consisted of filling the molds with soft ice cream, scraping off the surplus with a squeegee, freezing the molds in a brine tank, defrosting, and picking up the frozen pieces by hand and putting them in a bag. This method was sloppy and was full of instances where the hands came in contact with the product.

This old style method has been replaced with one of modern sanitary design. The ice cream is frozen in a continuous freezer, piped to an automatic filler which fills the mold cavity with a measured amount and makes scraping unnecessary; frozen in brine tank; defrosted but held in the stick holder; dipped automatically in chocolate coating; and mechanically bagged. The entire process, even to putting the sticks into the stick holder, is completed without a hand coming in contact with the product. Some manufacturers, at our suggestion, have converted case type bottle washers to the job of washing and sterilizing the molds used in making molded frozen products. This not only saves time but does an excellent job of cleaning and sterilizing. The members of our inspection staff, in cooperation with the frozen confection industry, have worked out many of these changes and have made a substantial contribution to progress in sanitation. One of our men has designed a mold scraper (for use in smaller plants) of one piece, stainless steel construction with rubber scraper blade, readily removable for easy cleaning. These scrapers are now in production and available to the trade.

The new model counter type freezers are now on the market and already several have been installed in California. These machines reflect many improvements in sanitary design. There is a tendency toward the elimination of troublesome packing glands and their replacement with a removable metal seal. The new dasher can be completely dismantled for proper cleaning. Some manufacturers provide metal legs to keep the equipment up off the floor so as to prevent any accumulation of moisture, slime, or dirt.

The dispensing of soft or semi-frozen ice cream or ice milk from these machines into cups or cones has become very popular. One equipment manufacturer has marketed a freezer with two freezing barrels of two and one-half gallons capacity each. While dispensing from one barrel the other is freezing a second batch. This makes for continuous operation and avoids any delay between batches.

In this State all counter-type freezers are required to be in a separate room having a floor of concrete, tile, or other non-absorbent material, and sloped to a trapped drain; non-absorbent lower walls; running water; lights; ventilation; and facilities for washing and sterilizing the containers and equipment. Our Department makes available, at no cost, a working blueprint which may be used as guide by those who plan to install freezing equipment. This plan covers such details as plumbing, floor, wall, window, and door construction, together with a list of the essential State requirements.

The United States Navy has just released a very interesting report concerning the use of penicillin in ice cream as a cure of certain throat infections. They have noted equal success in treating both children and adults and add that ice cream affords an ideal vehicle for conveying this miracle drug.

Vitamin-enriched ice cream has just been introduced to the consumer. This product is too new for any extensive report but does show that ice cream has joined the other food products in the general trend toward enriched food. No doubt we shall be called upon to enforce certain provisions relative to special labeling, having to do with these products.

Report of Andrew J. Krog

Health Officer, Plainfield, New Jersey

I. *Revocation of Food Distribution Order # 8*

The cessation of hostilities in the Japanese theater on August 14 immediately altered the program of the country with respect to its food resources planning, production, and distribution.

In March 1945, the restrictions of F.D.O. # 8, with respect to dairy solids other than butterfat, were removed. On September 1, 1945, F.D.O. # 8 restrictions on butterfat were also removed. M.P.R. # 577, which governs prices of ice creams according to their butterfat contents, still remains in effect. Although this pricing regulation did not warrant prime consideration before the revocation of the butterfat feature of F.D.O. # 8, it has provoked tremendous thought since that time.

The interpretation of the Department of Agriculture, made on September 6, was:

"The revocation of W.F.O. No. 8 does not obviate the escalator clause of M.P.R. No. 577. You will note that Section 2.5 specifically provides that where, pursuant to an order of W.F.A., or other agency of the Federal Government, the percentage of permitted use of total milk-solids or butterfat is 80 percent or more, there shall be no permitted reduction in total milk-solids or butterfat content."

"Therefore, since the Department of Agriculture is removing all restrictions effective retroactively as of September 1, 1945, the manufacturer of any of the products covered in M.P.R. No. 577 must now restore his formula to his base period one, and is required to maintain his established maximum prices. If a manufacturer does not revert to his base period formula, he must correspondingly reduce his maximum price."

Ice cream formulations should, therefore, revert quite rapidly to those of prewar products—at least as far as the dairy fat and serum solids percentages are concerned.

II. *The Sugar Situation*

The situation with respect to sugar is very much different from that of dairy fat and solids. The removal of restrictions on the manufacture of many items made with sugar has made the already short market even shorter. O.P.A. announced that sugar quotas for industrial users during the fourth quarter of 1945 are to remain at the same levels established for the third quarter. The sugar situation is too well known by everyone to require a detailed summary here. It is to be considered only as it affects the ice cream industry.

Experiments to determine the minimal percentages of sugar necessary in ice creams to impart sweetness satisfying to the normal palate have been performed recently. Similar determinations had been made years ago when sugar was plentiful, to determine the maximum which could be included in a mix before the consumer objected. (Sugar, from its price, is cheaper than dairy fat, or serum-solids, and is, therefore, the cheapest ingredient of the mix.)

Pyenson and Tracy found that the consumer will not object to sugar contents as low as 10.0 percent. Since normal prewar mixes contained an average of 15–16 percent of sugar, and highly sweetened mixes even went as far as 18 percent, it may be expected that the present postwar mix will not achieve the exact composition of the prewar article.

In prewar days, some manufacturers replaced a substantial quantity, frequently up to one-third of sucrose in their formulas, by other sugars—dextrose and/or sugar solids from high conversion syrups. The war-developed shortage of sucrose has made its replacement by these other acceptable sweetening agents a standard practice. Dextrose and high conversion syrup supplies have been absorbed so rapidly that they too are scarce items.

In many markets, the reduction of sugar content was accompanied by the introduction of cereal-derived protein to elevate total solids percentages. The excuse has been given that high conversion corn syrups solids were not all classifiable as "sweeteners."

Whereas the substitution of sucrose by other sweetening materials may be acceptable from the Food and Drug standpoint, the utilization of cereal proteins in the ice cream formula beyond the levels permitted for stabilizers constitutes "adulteration" and "misbranding" of the product, if it is called "ice cream."

III. *Sources of Dairy Solids*

The revocation of the restriction on heavy cream to consumers has tightened up the market with respect to fluid cream for ice cream manufacturing. The manufacturer has found it necessary, therefore, to continue using fat concentrates from the other sources which have become customary to him through the war period.

Sweetened condensed whole and skim milks have become much more popular in the past number of months of sugar shortage. Many condensing plants are capable of obtaining sugar for conversion into these products, and their purchase by ice cream manufacturers does not involve the transfer of sugar points. A properly manufactured sweetened condensed product is a desirable source of both sugar and dairy solids. Some plants whose equipment is not adequate have, however, flooded the market with much material which is substandard from both the chemical and bacteriological viewpoints.

Plastic cream is still the subject of much discussion. From the health aspect, plastic cream, though a concentrate, is not different from creams containing lower percentages of butterfat; the fat and serum-solids relationships are those of a normal cream. While it has been demonstrated that a good plastic cream can be made only from a good cream, there is no guarantee that all plastic cream will be good. Some health departments have considered that plastic cream, containing more than 80 percent of butterfat, is classifiable as "butter," and have not, therefore, enforced their fluid cream standards with respect to plastic cream.

Butter-oil use has been stimulated through its increased availability. Butter "set-aside" on Government order, which spoiled after inadequate warehousing, was salvaged primarily as butter-oil.

The situation with respect to serum solids was eased up at the beginning of the year, as was noted in the first section of these comments. The premium on warehousing space has permitted a high percentage of substandard materials to find its way into ice cream plants.

IV. *Other Mix Ingredients*

In addition to dairy fat and serum

solids and sweetening materials, ice cream mixes may contain egg solids, flavoring materials, and limited concentrations of "stabilizers."

The advertisements in ice cream trade journals show that egg solids, blended with materials of non-egg origin, are being offered by many suppliers. The only possible justification for these other materials is that they might possess stabilizing properties—in which case, their concentrations should be taken into account in determining the legality of the mix formulation. In many instances, the non-egg solids possess no stabilizing qualities and serve merely as fillers.

The ice cream trade journals list a tremendous assortment of "stabilizers." In some instances these preparations are recommended for use at concentrations well above the legally permitted maxima. The stabilizing merits of some of the preparations offered are not too well established.

In this connection, some of these products are offered to the trade, mixed with sweetener and neutralizer. The use of neutralizers is permitted in some areas, but not in others. The percentage composition of these combination materials are rarely disclosed on the label, and are very frequently not taken into account in calculating the mix. Some formulas credit the total dry contents of combination mixtures to the sweetener category.

The high cost of labor has made fruit products extremely expensive as well as short. Although most laws restrict the acids used in flavoring to those of true fruit origin, the advertisements again disclose that other organic acids, and some inorganic acids, are being offered regularly as substitutes.

V. *Bacteriological Control*

War-time shortages of personnel have, in many instances, caused health control officials to neglect the examination of ice creams. In some areas, the control of the processed product has consisted of mere phosphatase testing. Where it has been demonstrated that certain flavoring materials affected the phosphatase reaction, it was interpreted by some control officials that even phosphatase testing could be eliminated, and the entire problem of ice cream control ignored.

Since very few ice cream formulas involve the use of raw dairy products, the phosphatase test is hardly an adequate criterion. Where flavoring materials which affect phosphatase are involved, the laboratory pasteurization of the sample will yield the flavor effect to be subtracted from the unitage, to be ascribed to dairy ingredients.

From what has been detailed above, with respect to the mix formulation, adequate control of ice cream involves the careful checking of the individual ingredients before the mix-manufacturing operation. The proper control of the finished ice cream still requires the determination of total count, and of coliform level, as reviewed in earlier reports to this committee. The non-replacement of equipment during the war years and the rapid advancement of obsolescence through increased use during the war years require that the finished product be controlled more conscientiously than it ever had been before.

Reconversion by equipment manufacturers will be slow: first, because of the present labor situation; second, because of tremendous back-log of rated orders. Moral compulsion will require them being filled first, although rating has been discontinued by war agencies. This curtailment might lead to the replacement of new equipment or parts with makeshift materials. Care must be reserved in the selection of this equipment in order that difficulties of sanitation will not be experienced. Ice cream manufacturers will not be able to obtain equipment replacements of even 1941 models for a full year or more, since their orders were generally not even rated.

VI. *Carcinogenic Dyes*

Recent studies have revealed that certain dyes, which may be predisposing to cancer, have been used for lithographing or printing of ice cream containers. This practice should be discouraged inasmuch as it is particularly dangerous in those packages used to contain individual servings as children are prone to remove the adhering ice cream from the container by licking.

It is respectifully urged that the Committee bring to the attention of the members of its parent organization, the very great need for a resumption of control of the entire ice cream industry.

Report of John M. Scott

Chief Dairy Supervisor, Florida State Department of Agriculture
Gainesville, Florida

The past few years have been quite a trial to the ice cream manufacturers of Florida as we are sure they must have been to the manufacturers in many other states. Florida's population has been greatly increased by the influx of war workers and the large number of people visiting the military and naval personnel located here, as well as the personnel itself. All of these people wanted ice cream or some other frozen desserts, and our manufacturers made every effort to supply this enormous demand in spite of the wartime restrictions placed upon their operations.

The shortage of materials such as milk solids, fats, and sugar was an almost insurmountable problem, and they had the additional problems of shortage of labor in their plants and overworked equipment. The quality of the products manufactured naturally suffered to a certain extent, but on the whole the consuming public seemed satisfied and made very few complaints; it may have been, though, that frozen desserts were so scarce, as were many other items, that the consumer was glad to get anything.

The products manufactured complied in the main essentials with the standards established by the Florida Frozen Desserts Law, and Florida did not change any of its standards during the war. This law was enforced throughout the emergency, though sometimes it was difficult to convince the operators that products that did not come under the provisions of the law should not be sold during the emergency. Our Florida law contains a definition of imitation ice cream which takes in all frozen desserts not defined in the law; the law further states that, "No person shall sell, advertise or offer or expose for sale any imitation ice cream." This provision helped us materially to maintain the standards that we had worked for during the previous eight or ten years.

The majority of our ice cream makers will be glad when they can get back to normal conditions so that they can again put out only first-quality ice cream. When good ingredients are available once more, competition will be a dominant factor in improving the quality of the products sold. New equipment is badly needed in our ice cream plants, but it looks like it will be some time before the manufacturers can get replacements; it may even be a year or two before enough new equipment can be manufactured to relieve this situation. This problem is probably the major one facing the industry at this time.

Report of W. C. Cameron

Chief, Dairy Products, Grading and Inspection Service
Department of Agriculture, Ottawa, Canada

During the past year no changes were made in the Government orders respecting the composition of ice cream and the volume of mix manufactured. That is to say, ice cream must still contain from 9.5 to 10.5 percent milk fat; 34 percent total solids; and not less than 1.7 pounds food solids per gallon of which amount not less than 0.47 pound must be milk fat, and all ice cream must weigh at least 5 pounds per gallon. Manufacturers of ice cream and sherbet mix were still required to limit the volume made for civilian accounts during any quarter to the volume made during the corresponding quarter of the basic year commencing April 1st, 1941. Exemptions were still permitted for ice cream mix used to supply the armed forces, and military and civilian hospitals.

As in the United States, the amount of sugar available for the manufacture of ice cream was considerably lower than in the previous year. Substitutes such as glucose, cerelose, etc., have been more widely used, although their use has been restricted to some extent due to lack of adequate supplies. Existing legislation under the Food and Drugs Act restricting the use of substitutes for sucrose to 25 percent of the total sweetening agent was repealed, but in general practice manufacturers of mix have not used glucose and other substitutes to an extent greater than 30 percent of the total sweetening agents. The use of such substitutes caused some minor changes in plant procedure, such as a lowering of the freezing temperature by 2 or 3 degrees, and in some cases the holding temperature in retail cabinets was also lowered. Members of our field staff found that in many cases the percentage of serum solids in the mix was increased by 1 to 2 percent, and firms using egg yolk, either dry or frozen, increased slightly the amount used. Supplies of skim milk and buttermilk powders were generally more plentiful during the past summer.

Previous to this year, the volume of sherbet and water ice manufactured had increased. However, the reduction in sugar quotas this year caused many firms to lower the output of these products, and some discontinued the manufacture of same entirely in order to use their entire sugar quotas for the manufacture of ice cream. There has also been a decided decrease in the kinds of ice cream available to the consumer. In prewar years, ten or more flavors were available, but due to sugar restrictions, shortages of fruits, flavorings, including chocolate, firms are presently making three or four flavors only and some of the smaller operators have made only vanilla ice cream.

Owing to the shortage of commercial ice cream, dry "mixes" for the household manufacture of ice cream have become widespread and enjoy a popularity which we do not believe will remain when the supply of commercial ice cream is large enough to satisfy all consumer demands. These powders require the addition of milk or cream and are limited of course to those homes equipped with electric refrigerators. The finished product resembles a sherbet rather than smooth textured ice cream.

In conclusion, the over-all production of ice cream in Canada during 1945, has been slightly lower compared with the previous year, due largely to the closing of many army, naval, and air force camps and the demobilization of troops during the past few months. However, as more abundant supplies of raw materials occur and present restrictions on production are removed, the industry as a whole are confident that continued progress will be made both in quality and quantity of products manufactured.

L. C. BULMER
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Safe Milk Supplies of Cities and the Public Health Laboratory

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Suggested Code of Interpretation of Procedures of Department of Public Health of San Francisco

THE production of good milk is a technical procedure which requires experience. Maintenance of satisfactory standards has for years meant the use of control measures to keep within bounds milk from producers who lack experience, who are careless, or who are unscrupulous.

This has led to inspection systems in the various units of government. Inspectors are expected to keep within defined boundaries, the procedures of the producer, the transporter, the processing or pasteurizing plant, and the distributor. These four elements are usually combined into one or two units; e.g., one man owns the cow, milks it, and transports the milk to a depot, and another processes and distributes it. Processing plants have their own inspectors; they, too, are concerned with proper standards of production without which they fall under censure or yield to more careful processors.

Inspection presumes authority to demand that milk shall be produced under sanitary conditions and that it shall be safe. The constitutional rights of the producer are presumed to protect him from unreasonable demands. It is incumbent upon inspection services to demonstrate that anything they require for sanitation and safety is imperative toward that end. It is equally proper that producers be protected from improper requirements.

The evolution of this form of control has resulted in laws and ordinances fortifying inspection systems which deal with sanitation, safety and nutritional problems. Legal judgment is necessary to settle differences of opinion.

One service performed by the laboratory is the support, by objective evidence, of either side of these controversies. Such evidence has to be objective and the interpretation put upon it must be valid. Laboratory evidence does not necessarily fill either of these requirements.

A second service performed by the laboratory is the aid given to inspectors as evidence, which added to their observations, enable them to trace difficulties, to raise the standards of producers, and to check points which, from observation alone, are not possible to follow. Properly used, evidence from the laboratory may be a guide toward tangible results which inspectors hope to achieve. This is the basic service of the laboratory, for legal problems arise only over equivocal issues which, in an ideal sense, would not exist in a perfectly coordinated scheme.

Interpretations of results of laboratory tests are opinions. Exact methods for these tests are put down in writing and are generally followed throughout the United States. This is not done for the interpretations, though a degree of uniformity in this respect is perhaps as much needed as uniformity in the procedures of the laboratory tests.

It is the purpose of this article to establish, for the Department of Public Health of the City and County of San

Francisco, a code of interpretation of the results of laboratory tests of dairy products. Our goal is to promote understanding and coordination in the use of data from the laboratory.

The city is one of our larger cities. Its inspection service is backed by considerable experience and the standards and quality of its dairy products are reasonably high. It would be possible, by including some minority opinions, to establish on a wider basis a code of interpretation of data from the laboratory. Uninterpreted, reports are useless.

SAFETY OF DAIRY PRODUCTS

This is the *essential* feature of control. Unsanitary milk will sooner or later be unsafe and milk low in total solids or butterfat is substandard nutritionally, but there is no danger from it.

Tuberculosis and undulant fever may come from infected cows.

Directly or indirectly, human contamination of milk may cause cases of typhoid fever, paratyphoid fever, the dysenteries, food poisoning, diphtheria or streptococcus sore throat (tonsillitis, septic sore throat, and scarlet fever).

There are perhaps five tests, or sets thereof, pertinent directly to the safety of dairy products.

A. *Tuberculin test:*

This test, performed by veterinarians, is made by inoculating cows in the caudal fold near the base of the tail with small amounts of extracts of the bacilli of tuberculosis. Cows react to this substance provided they have a moderately well developed tuberculosis.

Reports of these tests are made by veterinarians. They are obliged to report that their opinion is that each cow tested is "positive" or "negative." They do not and cannot report for each cow that it has or has not tuberculosis; interpretation is necessary.

The accuracy is perhaps as high as 90 percent, meaning that perhaps as many as 90 of 100 cows are properly labeled as tuberculous or non-tuberculous. There are several reasons for this.

Some tests are uncertain so that the veterinarian may erroneously consider them positive or negative.

In the early stages or advanced stages the tests may give erroneously negative results.

Tests have under certain circumstances been masked by unscrupulous producers.

Infections can develop faster than tests can be performed. An animal can shift from negative to positive in two weeks or a month; tests oftener than once a year are burdensome. In a given herd with 20 tuberculous animals, several might be missed on testing and the number would rise toward 20 during the following year. With 2 infected animals, one might easily be missed and there might be 2 or 3 by the end of the year.

The tuberculin test is a means of reducing the number of tuberculous animals. The errors inherent in the test must be frankly recognized.

B. *Brucella agglutination test:*

This test is performed in the laboratory by mixing the blood serum of each cow with the organisms of undulant fever (in cattle, contagious abortion). With serum from most infected cows a reaction occurs.

Reports made by the laboratory indicate a positive or negative reaction with serum from the blood furnished through the veterinarian.

Interpretations, as with tuberculin tests, are useful in the control of undulant fever. Serum becomes reactive several weeks after injection. Reactions can be observed with fair accuracy in the laboratory.

Errors may arise in spoilage of specimens, improper containers, processing the serum, or in handling it. Some animals respond poorly in the production of reacting substances. The use of vaccines renders the test valueless.

Tests cannot be done frequently enough to catch new reactors.

This test is a means of reducing the number of infected animals. Its inherent errors must be recognized.

C. *Tests of personnel:*

Organisms causing the following diseases may originate with persons in contact with milk: typhoid and paratyphoid fevers; the dysenteries; food poisoning; streptococcus sore throat (scarlet fever, septic sore throat, and tonsillitis); and diphtheria.

There is no practical medical test, clinical or laboratory, suitable for recognizing routinely possible disseminators of the above organisms.

When epidemiologic evidence appears to incriminate some member of the personnel in a given producing or processing plant, concentrated studies may be made to find a person carrying typhoid or paratyphoid organisms. The only conclusive evidence is the identification of these organisms in the laboratory from certified specimens, though tests of the serum of the personnel may be suggestive and epidemiologic evidence may be presumptive.

Under provocation, the laboratory may undertake tests for carriers of the organisms of dysentery, streptococcus sore throat (cows are also suitably tested for these organisms), and diphtheria. Even concentrated effort is usually not helpful, partly because of the time elapsing between infection and the taking of specimens and partly because tracing a few organisms over a wide area is difficult. The effort may be worth while when epidemics are of particular significance, when the evidence requires support from the laboratory, and when the evidence is focused on a few persons sufficiently to give some chance of success.

D *Phosphatase test:*

This test is a color test demonstrating the degree to which an unstable substance has been destroyed by pasteurization. Since infection in neither cows nor employees can be more than partially controlled, the only solid safeguard for milk and dairy products is pasteurization.

This test is relatively simple and has few inherent errors. The results are rated as acceptable evidence, supporting inspection, to indicate failure to pasteurize adequately.

This is rated as the preferred test in control of failure in pasteurization through a break-down in machinery, impatience, carelessness, or lack of integrity.

E. *Tests for pathogenic bacteria:*

There are no practical methods whereby pathogenic bacteria in milk can be detected. The most delicate test is the drinking of milk by consumers; even then, with several glasses per consumer tested, not everyone is infected.

Sanitation in Dairy Products

The main emphasis in the control of dairy products is on sanitation rather than safety; that is, cleanliness and esthetics are given first consideration.

In the broad sense sanitation includes all moves which have to do with safety. The emphasis on sanitation is in this sense over and above the interest in safety; no reasonable precautions which have to do with safety are overlooked.

Furthermore, it is true that there is a close correlation between improved sanitation and increased safety in milk. Cleanliness will not eliminate tuberculous cattle; the operator of a clean dairy is more likely to reduce tuberculosis in his herd than the operator of a dirty dairy.

A. *Bacterial count:*

The laboratory is able to determine approximately the number of clumps of live bacteria of certain kinds in a given quantity of milk. The procedure is applicable to cream, ice cream, milk drinks, and rinse waters. Results are reported as the Official Colony Count. These figures are approximate indices of certain phases of sanitation. They should be neither overrated nor underrated.

The count is an index of three features of samples tested: (1) the extent of contamination from miscellaneous, not specific, sources; (2) the temperatures at which the milk has been held; and (3) the age of the milk when tested. The count does not give a clue as to which of these points is at fault, when this count is "high." A "low" count, however, indicates attention to all three of these features.

The index figures, or counts, cannot be rated as more significant than the accuracy of the test warrants. No significance should be attached to *single tests* in which the variation is under 100 percent; i.e., if Dairy A gave a test of 50,000 this week and another week showed a change to more than 25,000 or less than 100,000, no particular significance could be attached to it.

Multiple tests increase the accuracy. For yearly averages a number of figures can be used. Care is still necessary in interpretation. Series of tests, neither single nor numerous, find usefulness to inspectors in endeavoring to trace difficulties and overcome unsanitary practices. Consistent improvement in count, though not great, is useful to inspectors.

The count should never be considered the goal in sanitation, in which inspection is a matter of collecting specimens. It is rated primarily as an aid to the inspector. To make the count a collection of figures for the files is as bad as making the index a substitute for inspection.

B. *Breed count:*

This is a microscopic count of all bacterial cells, regardless of kind, clumping, or whether they are alive or dead. Pasteurization does not affect this count. Organisms such as thermophiles from dairy equipment, missed by the colony count, are caught by this method. The error inherent in the test is high. There is no correlation between the breed count and the colony count.

The method is not considered applicable to western milk, most of which has counts too low to take advantage of its benefits over the colony count.

C. *Coliform tests:*

The test is made by inoculating samples of milk into a broth which is selective for coliform organisms. The test is not perfectly selective and some errors occur. Furthermore, the coliform organisms, originating in manure and perhaps grain and dust, become widely distributed.

The significance to be attached to "high" or "low" figures for coliform organisms, again calling for judgment as to what may be called high or low, depends on empirical observations. Some unsanitary condition must correlate with high figures and this must improve when the figures go down.

Present opinion suggests a correlation between coliform counts and unsanitary pasteurizing equipment. This correlation is found often enough to make the test useful to inspectors, when and if they choose. It is insufficient evidence by itself for condemnation.

There is presumed to be some correlation between this test and adequacy of pasteurization. It is one of the less satisfactory means of determining adequacy of pasteurization and is therefore not acceptable for this purpose.

D. *Streptococcus tests:*

The most acceptable method of testing, a plating method with a medium containing blood, does not lend itself to routine work. The greater proportion of colonies which appear to be streptococci are not.

This test, or the Hotis test which is inferior to it, is sometimes used as a method for getting an index of mastitis. It could become the simplest method for this purpose, but it is not now satisfactory.

E. *Sediment tests:*

Sediment tests for visible dirt are not routinely applicable. They are in the nature of an inspector's test rather than a laboratory test.

Centrifugalization of warmed milk under proper conditions reveals blood and pus indicative of mastitis or other inflammatory injury. The procedure does not have the status of an official test but deserves consideration.

No definite stand is taken with regard to laboratory tests for mastitis. Support in this is needed, for the control of mastitis is a move in sanitation which is receiving increasing attention.

F. *Methylene blue and resazurin tests:*

Dye is added to samples of milk and, through the action of a bacterial by-product the quantity of which depends roughly on the number of bacteria, the color is reduced to a lighter color or white. The time consumed is a measure of the number of bacteria present at the start, in theory.

These tests are considered failures with good milk and with pasteurized milk. They are inferior to other counts and offer nothing additional in the way of information. They are wrong in theory. They are not accepted for any purpose.

G. *Taste, odor, etc.:*

There are tests of considerable value which are subjective in nature though they have the objective equivalence to laboratory tests. Experience is necessary and they are made by inspectors. Their significance and importance should be bolstered while the significance of laboratory tests is reduced in order to derive a fair appraisal of all means of testing.

H. *Tests of equipment:*

There are as yet only general official tests for "sterility" of equipment, all based on rinsing whole surfaces and making colony counts of rinse waters. The contact or spot plate procedure tests a given area but has the same principle. There is no official method for testing spots likely to be uncleaned, such as corners, junctions in pipes, or cracks. Swabs are permissible but are supposed to cover four square inches.

With judgment and experience in the selection and taking of specimens, bacterial counts can be definitely useful in improving sanitation. Their significance is in support of investigations by inspectors.

These tests, so adapted to surfaces primarily smooth, are not representative of areas most appropriately checked in examinations for cleanliness. This loophole in the tests deserves emphasis particularly in view of the increasing use of chemical disinfectants, which are blocked by dirt and milk deposits in corners where washing may be imperfect. With steam heat, penetration is better.

I. *Tests of disinfectants:*

There are no simple tests for chemical disinfectants. Only prolonged chemical and bacteriologic study under various conditions, both in the field and in the laboratory, can properly determine the properties of a chemical disinfectant. Some properties which must be known are: toxicity, detergent action, action on metals of various sorts, action in the presence of alkali, soaps, or acid, effect of milk whey or cake on it, stability, penetrating ability, variation in activity at different temperatures, and effect on various kinds of organisms. This partial list of properties indicates the impossibility of superficial evaluation.

NUTRITIONAL VALUE

All ingredients of milk have nutritional value. The elements may be considered as butterfat, solids not fat, and water (including dilution of milk or the addition of preservatives). The natural ingredients vary with the breed of cows and sometimes from other factors. This is not a matter of safety or sanitation but a problem of guaranteeing an article to be as represented.

A. *Butterfat:*

The standard Babcock test is virtually universally accepted as a satisfactory measure of butterfat as a basis for payment or for any other purpose.

B. *Total solids:*

This is likewise a chemical test in which the accuracy is adequate for any significance likely to be attached to the results.

Purchasers who pay the price of milk for water which is in excess, either as formed in the cow's udder or when added to dilute the milk, are cheated.

C. *Adulterants:*

Chemical tests for common adulterants are known and are regarded as unsatisfactory. The same is true of preservatives. It cannot be said that tests for all possible adulterants or preservatives exist, however.

The significance of tests for adulterants is clear. There are no circumstances in which adulteration is permissible barring recognized practices, such as manufacture of dairy products.

There are two fears from preservatives. That they are toxic is possible, though this danger is not great. The principal objection is to their action in masking improper sanitation.

The Rapid Ripening of Cheddar Cheese Made From Pasteurized Milk*

As a result of experimental work over a period of years before the war, the Bureau of Dairy Industry developed a time-schedule method of making Cheddar cheese which gave more assurance of uniformly high quality in the cheese than the methods previously used. The new method was adopted and used successfully by many cheese makers during the war years. One important way in which the new method differed from previous methods was that the milk was pasteurized.

Many cheese makers, however, have stated that Cheddar cheese made from pasteurized milk frequently does not ripen as rapidly as cheese made from raw milk and that it does not develop sufficient flavor to satisfy some consumers even when the curing period is relatively long.

Accordingly, extensive experiments have been carried out in the Bureau's laboratories in an effort to develop a method for rapidly curing Cheddar cheese made from pasteurized milk and for improving the flavor. This report presents briefly the experimental procedures and a summary of the results obtained on the influence of the curing temperature. A method is suggested for speeding up the ripening time and for improving the flavor of Cheddar cheese made from pasteurized milk.

During the past 4 years, 256 vats of experimental cheese were made, by the time-schedule method (1), from pasteurized milk of good quality and cured at different temperatures. Two vats of cheese were made daily from one lot of milk. Approximately 800 pounds of milk was used in each vat, yielding four "daisies" weighing 21 to 22 pounds each. Usually, one daisy from each vat was cured at 50° F. (10° C.) and one at 60° F. (15.6° C.), but in some instances one from each vat was cured also at either 40° F. (4.4° C. or 70° F. (21.1° C.). The remaining daisies from each vat were used in other experiments. In the curing-temperature studies, 14 daisies (from 7 lots of milk) cured at 40° F., 256 (128 lots) at 50°, 248 (124 lots) at 60°, and 10 (5 lots) at 70°, were tested and graded.

Another series of experiments was made in order to compare cheese made from raw and from pasteurized milks of different qualities. To obtain milks of different quality for this series of experiments, some of the raw milks were held for varied periods of time before they were cooled. The quality of these milks was judged, on the basis of bacterial counts and methylene-blue tests, as good, fair, poor, or very poor. For each of nine experiments, the raw milk was divided into two equal parts. One part was pasteurized and the other was not pasteurized. Each part yielded four cheeses, two of which were cured at 50° F. and two at 60°.

Samples of analyses were removed from the cheese in each series described above at the following ages: 1 day, 2 weeks, and 1, 2, 3, 4, and 6 months. During the early part of the experiment, the cheeses were tested regularly at each of the ages indicated. Later, however, the cheeses were tested less frequently, but in all instances at 3 and 6 months of age.

Approximately 1,600 samples of cheese were tested for chemical, bacteriological, and physical properties. The following tests were made: (a) *Chemical*—Extent of proteolysis, as measured by determining total, soluble, non-protein, and amino nitrogen; pH value and titratable acidity; relative amounts of lactose and biacetyl. (b) *Bacteriological*—Numbers and kinds of bacteria. (c) *Physical*—Plasticity, flexibility, and tensile strength.

Analyses were also made of samples from a considerable number of green cheeses to determine the moisture, fat, and salt content, and the results showed that they usually contained from 37 to 38 percent moisture, 50.5 to 52.5 percent fat in dry matter, and 1.65 to 1.95 percent salt.

Each cheese was graded at 3 and 6 months of age for flavor and for body and texture. In addition, many were graded at 1 year of age. Usually, the grading was done by three persons, but it was often done by four persons and in a few instances by two. The graders did not know the identity of the cheese when they graded it.

Results from Rapid Ripening

The influence of curing temperature, quality of milk, and pasteurization on the rate of ripening and on the flavor of the cheese was evaluated on the basis of differences noted in flavor and in body and texture at the time of grading, and also on the basis of differences in the rate of protein break-

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* A preliminary report of a cooperative investigation by George P. Sanders, chemist, Ralph P. Tittsler, bacteriologist, and Homer E. Walter, dairy manufacturing specialist, with the assistance of Oscar S. Sager, chemist, Harry R. Lochry, dairy manufacturing specialist, and Donna S. Geib, bacteriologist, Division of Dairy Research Laboratories.

down, in numbers and types of bacteria, and in physical properties as measured by the laboratory tests.

The cheese that was cured at 60° F. ripened faster and developed more flavor than the control cheese cured at 50°.

The cheese made from pasteurized milk of good quality was as fully ripened in from 3 to 4 months at 60° F. as that cured for 6 months at 50°, and that held at 60° also developed not only more but also better flavor than that held at lower temperatures. After being cured for 3 months at 60°, the cheese was never curdy or rubbery. It usually had slightly more firmness and a slightly more crumbly, shorter body, at 3 months, than that held at the lower temperatures, but the degree of shortness was not objectionable. In some instances, however, the body became too short, and also somewhat mealy, when curing at 60° was continued longer than 4 to 6 months.

On the other hand, when low-grade milk was used, either raw or pasteurized, the quality of the cheese cured at 60° F. was definitely inferior to that of the cheese cured at 50°. The inferior quality was especially pronounced when the low-grade milk was not pasteurized. Defects such as acid, sour, bitter, unclean, and rancid flavors, gassiness, and short, crumbly body developed to a greater extent at 60° than at 50°.

A curing temperature of 70° F. was found to be too high even when high-grade milk was used. The quality of the cheese cured at 70° was not as good as that of the cheese cured at lower temperatures, except during the first few weeks.

The cheese made from pasteurized milk was consistently better and more uniform in quality than the control cheese made from the raw milk, except when very high-grade milk was used. With high-grade milk, there was very little difference, either in the quality of the cheese or in the rate of ripening and flavor development, between the cheese made from raw and that made from pasteurized milk. However, with medium-grade and with low-grade milk, especially the latter, the raw-milk cheese ripened and acquired flavor more rapidly, but its quality, including flavor, was decidedly inferior to that of the pasteurized-milk cheese.

Gassiness did not develop in any cheese that was made from properly pasteurized milk.

The investigation of a higher curing temperature (as high as 60° F.) for the rapid ripening of Cheddar cheese is a continuation of earlier work in this Bureau (2) which demonstrated that pasteurization of the milk and the use of a controlled time-schedule which maintains the acidity within the proper limits during manufacture are important steps in producing cheese of uniformly high quality. When cheese is made from good milk and the milk is pasteurized and the cheese is made by the time-schedule method, it can be ripened safely and more rapidly at the higher temperature indicated.

It is important to emphasize that the higher curing temperature (as high as 60° F.) should be used only when the cheese is made from high-grade milk, effectively pasteurized. This conclusion is based on the observation that the defects in cheese resulting from the use of low-grade milk are accentuated by an increased temperature of curing.

The experimental results described here seem sufficiently convincing to refute the belief that Cheddar cheese made from pasteurized milk cannot be ripened rapidly and will not develop a sufficient amount of the characteristic Cheddar flavor.

All of the results are being tabulated and studied in detail so that the correlations among the various chemical, bacteriological, and physical characteristics, the rate of ripening, and the development of flavor can be detected and properly evaluated, and so that the findings can be summarized for publication.

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Dried Milk

The Bureau last year reported that the keeping quality of dried whole milk packaged in air could be at least doubled by evacuating the container sufficiently and filling with inert gas to reduce the oxygen content of the free space in the container to 3 percent. Further studies this year indicate that only slight reductions below 3 percent are necessary to increase the keeping quality even more markedly.

Some of the oxygen-containing gases in dried milk are occluded or adsorbed, however, and it is difficult to remove them sufficiently to obtain a final oxygen concentration of less than 3 percent. A study of the factors that may be concerned has shown that the fineness of the powder particles, the degree of vacuum used, the length of time the vacuum is applied, and the temperature of the product at the time of evacuation are involved. Of these, the degree of evacuation is of predominant importance. Aside from the fact that low pressures must be used for efficient gas removal, it has been found that a double evacuation between operations to allow for diffusion of occluded or adsorbed gases, greatly facilitates the attainment of a low final oxygen content.

Results with average commercial products indicate that to obtain a final oxygen content of 3 percent or less in the container, a vacuum of 3 to 5 millimeters or less for at least 3 minutes must be used. The use of a double evacuation under these conditions, with an intervening period of 4 to 7 days between evacuations and subsequent gas filling, will result in a final oxygen content of approximately 1.5 to 2.0 percent in the container.

With the use of approximately 23 millimeters of pressure for 3 minutes and a double evacuation as described, the final oxygen content of the containers will be approximately 2.5 to 3.0 percent.

Cheddar Cheese

During the past year the Bureau of Dairy Industry obtained sufficient evidence to show conclusively that it is possible to speed up the ripening of Cheddar cheese by curing it at 60° F. instead of at 50°, provided the milk is of good quality and is pasteurized. Experimental cheeses held at 60° were as fully ripened in from 3 to 4 months as those held at 50° for 6 months, and generally the flavor of those held at 60° was better.

The results of additional analytical experiments during the year confirm the Bureau's previous findings that pasteurization of high-quality milk has little or practically no significant effect on the rate of ripening of the cheese. When the raw milk has a high bacterial content, however, the rate of ripening of the cheese is retarded by pasteurization of the milk. But if such milk is not pasteurized, the resulting cheese is very inferior in flavor and quality and is abnormal in composition.

A Phosphatase Test for Cheddar Cheese

A practical method for testing Cheddar cheese to determine whether or not the milk used in making the cheese was pasteurized has recently been developed by the Bureau of Dairy Industry. The method is a modification of the phosphatase test commonly used in testing milk to determine the adequacy of pasteurization.

More than 350 samples of Cheddar

cheese, for which records of the milk treatment were available, were tested by the new method. All samples of cheese made from raw milk gave very strongly positive tests; some of these were more than 1 year old, and one was more than 5 years old. All samples made from underpasteurized milk gave results that were positive in varying degree. None of the cheeses made from milk that was pasteurized at 143° F. for 30 minutes, or at 160° or higher for about 15 seconds, gave positive tests regardless of the age of the cheese. A decrease of 2 degrees in the pasteurizing temperature or the addition of as little as 0.1 percent of raw milk to pasteurized milk, could be detected by testing the cheese.

CHEESE WHEY

About 4 pounds of whey-protein curd can be recovered from 100 pounds of separated whey and, when pressed, the curd contains about 77 percent moisture, 16.5 percent protein, and 2.5 percent milk fat.

Preliminary results indicate the feasibility of converting the whey-protein curd into a Roquefort-type of cheese and continued experiments have yielded some cheese of good quality. Preliminary results also indicate the possibility of converting whey-protein curd into a cottage-type cheese or into a suitable base for cheese spreads.

SPOILAGE IN EVAPORATED MILK

Fat separation in evaporated milk depends not only on the efficiency of homogenization, viscosity, and conditions of storage, but also on the physical state of the protein which was associated with the fat in the cream layer. Easily dispersed fat layers are less objectionable than layers which are held tightly together by adsorbed partially denatured protein. Such protein seems to exert a cementing effect on the fat globules. Undesirable changes in the protein took place in those milks which had received less than the normal amount of heat during processing.

ADDITION OF SUGAR TO POWDERED ICE CREAM MIX

Experiments by the Bureau of Dairy Industry to improve the manufacture of powdered ice cream mixes have shown the possibility, as well as the economy, of adding most of the sugar after the mix has been dried rather than before it is dried. As much as 90 percent of the required sugar can be added after the mix is dried, thus avoiding the necessity of dissolving it in water and removing the water later during the drying process. The freezing and whipping properties of ice cream mixes made from powders prepared in this way are entirely normal.

Some manufacturers are not homogenizing the mixes before drying them, but are relying instead on the nozzle of the sprayer to homogenize the mix. Experiments with unhomogenized mixes show that some homogenizing effect on the butterfat occurs in the vacuum pan and at the nozzle, but usually this is not enough to stabilize the butterfat sufficiently to the action of the beaters. Homogenization of the mix is recommended without reservation.

HOMOGENIZATION OF ICE CREAM MIX

Small commercial manufacturers of ice cream mixes, who ordinarily do not have homogenizers, can make a good product without homogenizing the entire mix if they buy and use cream that has been properly homogenized, according to experiments by the Bureau of Dairy Industry.

At the time homogenizers first came into use in ice cream plants, about 1910 to 1915, it was customary to homogenize the cream only. Later the manufacturers found it more convenient and also productive of better results to homogenize the entire mix, and this is the common practice today. But the homogenizer is a much better machine than it was some years ago and cream properly homogenized affords the smaller manufacturer a means of making equally good mixes. Besides improving the quality of the ice cream, the principal purpose of homogenization is to prevent the churning of the butterfat in the freezer.

The Bureau's experiments indicate that creams of from 20 to 30 percent fat content are most convenient to handle and that mixes made from such homogenized creams whip very satisfactorily, there actually being no trouble in obtaining overruns considerably in excess of the legal 100 percent standard. From the standpoint of "eating properties" identically proportioned ice creams made from homogenized creams and homogenized mixes are usually of the same quality.

New Type of Canned Milk Devised for Armed Forces

A new type of canned milk which is high in "quick energy" value and suitable for drinking directly from the container was developed during the year by the Bureau of Dairy Industry, with the cooperation of evaporated milk manufacturers, in response to requests by the Army Quartermaster Corps. The milk was wanted for use on invasion beachheads where the landing forces frequently need a "pick-up" for sluggish appetites.

The milk, which is a sterile product in sealed containers, has excellent storage life and it is only slightly more concentrated than ordinary fluid milk. It contains approximately 16 percent total solids, whereas ordinary fluid milk contains about 13. The extra solids are largely sugars of different kinds, although a little more milk fat is also included in the formula.

Both chocolate and caramel gave a product of satisfactory flavor, but caramel seemed the most promising from a commercial manufacturing standpoint. Small batches of caramel flavored milk were made commercially by an interested manufacturer of evaporated milk, and the new product is now available for use by the Quartermaster Corps.

Penicillin May Have Nonmedical Uses

Experiments by the Bureau of Dairy Industry during the year showed that penicillin, which is now used only in the medical field, has a destructive action against bacterial spores which may make it useful also in nonmedical fields, including food preservation.

Spores, which are a dormant form of germ life, occur widely in food materials and constitute one of the major problems of the canning industry. Their extraordinary ability to resist high temperatures and other destructive influences, combined with their inherent capacity to germinate and produce toxins and other forms of food spoilage, is responsible for the rigorous pressure sterilization now required in commercial practice.

In the medical field the use of penicillin is against the nonsporulating or vegetative bacteria, but even these forms of bacteria are not affected except when they are actively multiplying. Apparently, bacteriologists in general have assumed that penicillin would have no effect against spores because of their dormant nature. Earlier work in the Bureau of Dairy Industry, however, had shown that mild heating would stimulate spores to grow, and this knowledge led the dairy bacteriologists to believe that suitable growth conditions or prior stimulation of the spores might make them susceptible to penicillin.

Investigating their theory, the dairy bacteriologists found that penicillin causes a marked destruction of bacterial spores when the fluids in which they are suspended are suitably incubated with small amounts of the drug (5 Oxford units per milliliter). They found that after incipient germination occurs the spores assume some of the unstable characteristics of vegetative cells, at which time they are attacked by the penicillin present. This action arrests their further development before vegetation can occur. In the meantime degenerative changes take place in the cells as a result of the penicillin action, which leads ultimately to their death.

Ten different cultures representing five different species of the genus *Bacillus* were studied (*B. cereus, B. megathereum, B. stearothermophilus, B. brevis,* and *B. subtilis*). All but one species (*B. cereus*) were found to be susceptible to penicillin in varying degrees. Even in the susceptible species, however, a small fraction of the spores is relatively resistant to penicillin.

The remarkable effectiveness of penicillin in low concentration against spores of high heat resistance, together with its nontoxic nature and its rapidly decreasing cost, suggest its possible usefulness as a preserving agent. A suitable combination of penicillin and mild heating seems to offer the best prospect of success. The possible usefulness of penicillin in relation to the sterilization of evaporated milk and to the prolonged preservation of fresh milk is under investigation.

NUTRITION AND PHYSIOLOGY INVESTIGATIONS

VITAMIN A VALUE OF SUMMER BUTTER

Since 1941 the Bureau of Dairy Industry has been cooperating with some 20 State agricultural experiment station laboratories to determine (1) the average vitamin A potency of the creamery butter produced in the United States; (2) the effect of commercial methods of storage on the vitamin A potency; and (3) the vitamin A potency of the butter sold on the retail markets.

The results of the nation-wide survey, which were compiled by the Bureau during the year, show that about 64 percent of the creamery butter is produced in summer and about 36 percent in winter. The summer butter has averaged nearly 18,000 International Units of vitamin A per pound and the winter butter about 11,000, making the average potency of the total annual output approximately 15,000 International Units per pound.

The survey showed also there is practically no loss of potency during ordinary commercial storage and handling of the butter, and that butter sold on the retail markets also averaged about 15,000 International Units of vitamin A per pound. Butter of the average potency, when consumed at the prewar rate of 18 pounds per capita per year, furnishes about 15 percent of the daily vitamin A allowance for normal adults.

Butter containing as much as 23,000 International Units is frequently produced in summer, under very good pasture conditions, but there are large fluctuations in the vitamin A potency of the butter produced from month to month and from State to State. The difference in vitamin A potency is largely the result of differences in the carotene content of the roughage feeds available to the cows in different seasons and regions. Research by the Bureau of Dairy Industry and by other investigators has shown that it is possible, by proper feeding, to produce butter in winter with the same high vitamin A potency as the summer butter.

BETTER HAY-PRESERVING METHODS RESULT IN A HIGHER VITAMIN A CONTENT IN WINTER MILK

Dairy farmers can produce milk in winter which will be as high in vitamin A value as summer milk, if they include sufficient carotene in the winter ration.

Although increasing the amount of carotene does not in itself result in a greater yield of milk, it is possible to improve the ordinary methods of preserving the hay crops and thus not only bring about an increased milk yield but reduce the losses of carotene in such crops. The greater yield of milk should make it more profitable to improve hay preserving methods, and the increased carotene content would incidentally improve the vitamin A value of the milk.

During the year comparisons were made of the feeding value of alfalfa hay preserved as silage and a field-cured hay. The silage contained 21 percent protein and the hay about 15 percent per unit of dry matter. Cows on the silage produced 7.3 percent more milk than those on the field-cured hay. At the beginning of the feeding trials the silage contained 9 times as much carotene as the hay, and as the trial proceeded the hay lost more carotene until at the end the silage contained nearly 14 times as much per unit of dry matter as the hay. Preserving alfalfa as silage avoids the loss of feeding value in field-cured hay that results from exposure to various weather conditions during curing and in storage. The higher carotene content of the silage resulted in a higher vitamin A potency in the milk.

No Nutritional Deficiency in Milk from Cows on Grain and Corn Silage

Since the diet of the cow may alter the composition of her milk, experiments were conducted by the Bureau of Dairy Industry to determine whether there is any nutritional deficiency in the milk from cows limited to a ration of grain and corn silage. Such rations are frequently used in farm practice.

The milk produced by cows on this ration was tested for the unidentified growth factor which Bureau experiments have shown occurs in cows' milk, and the milk produced on this ration was found to contain as much of this factor as was found in milk produced either by cows on pasture or by cows that were getting a good grade of alfalfa hay.

Better Cheese

The Bureau's cheese manufacturing specialists traveled from factory to factory, usually in automobile-trailer laboratories, to demonstrate the Bureau's method of making high-quality Cheddar cheese and thus assist the factory operator in increasing the percentage of U. S. No. 1 cheese, which was so urgently needed by the Government for overseas shipment. Many factories that had previously been turning out less than 35 percent No. 1 cheese were able to increase the proportion to 80 percent, and more, by following the procedures advocated.

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Association News

Chicago Dairy Technology Society

The Chicago Dairy Technology Society had their monthly meeting on March 12th, 1946, at the Continental Hotel. The late comers were rewarded with a nice roast beef dinner. The good turnout of members was merited by two fine speakers, Col. L. L. Shook and J. C. Hening.

Ross Speicher, chairman of the Dance Committee, announced the Spring Party which will be held on May 4th, at the Continental Hotel. An excellent orchestra was engaged for that evening and there were lots of prizes as well as dinner and dancing, all for $3.50 per ticket.

The next meeting on April 9th brought Wilbur Carlson of Kraft Foods as the principal speaker. His talk was on observations of the Dairy Industry in Europe.

One of our members took the fatal step on March 16th, 1946, at the Roseland Presbyterian Church. After the ceremony, Mr. W. E. Rockwell and his bride left on a motor trip to New Orleans. Lots of good luck to the newly-weds from their friends in Chicago Dairy Tech.

News Flash—Dave Batchelor reported that he finally took an order for bottles and did not have to make a delivery promise.

News Flash—Wills Rayl was late for dinner, and so was the excellent roast beef. That is more than a coincidence.

F. E. Seyfried

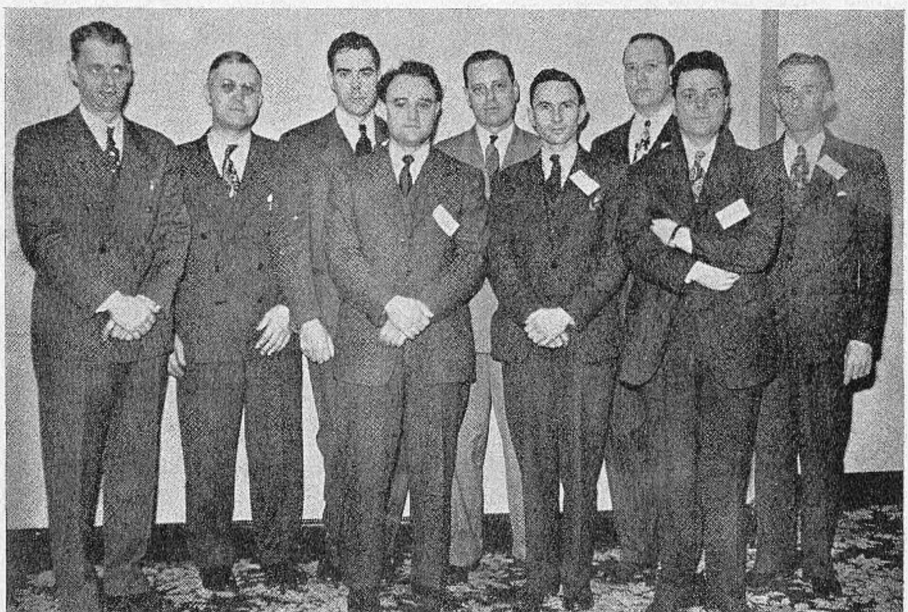
Industrial Notes

Wyandotte Chemicals Research Department Holds Seminar

The 61 technically trained staff members of the Wyandotte Chemicals Research Department recently held a three session seminar at the Detroit Book-Cadillac Hotel. One session was devoted to scientific activities within the department and one to corporation and management topics. At the dinner meeting, Walter J. Murphy of Washington, D. C., and editor of the American Chemical Society, reported on his tour of German chemical plants shortly after V-E Day.

An incidental part of the technical discussion was the disclosure that the Spectro-Chemical laboratory of the Wyandotte organization is able to make electron microscopic measurements of 1/100 of a micron, or 1/2,500,000 of an inch. The electron microscope and other spectrographic equipment is regularly used by the Wyandotte laboratories in both control and development activities. Technical papers presented by eight staff members of the department treated with problems prevalent in the several industries served by Wyandotte Chemicals with their various compounds and organic and inorganic chemicals. These papers included a wide range of subjects including "Application of Physical Techniques to Chemical Research," "Synergism," "Current Trends in Chemical Patents," and "Synthesis and Evaluation of Mildew-proofing Agents."

RESEARCH DEPARTMENT SUPERVISORS OF WYANDOTTE CHEMICALS AS THEY APPEARED AT THE SEMINAR RECENTLY HELD AT THE BOOK-CADILLAC HOTEL, DETROIT



Left to Right: W. R. Day, Patent; Dr. L. R. Bacon, Cleaning and Sanitation; E. F. Hill, Inorganic; A. W. Liger, Industrial; Dr. T. H. Vaughn, Director of Research; Dr. D. R. Jackson, Organic; C. F. Graham, Analytical; Dr. W. F. Waldeck, Chemical Engineering; Dr. P. E. Burchfield, Chemical Engineering.

Bowey's Announce Sale Executives' Promotions

Mr. Charles F. Bowey, Executive Vice-President, In Charge of Sales, officially announced today the following promotions:

Mr. W. C. Hutchinson, Vice-President, appointed National Sales Manager for the DARI-RICH Grocery Package Department. He will also continue his regular duties as Eastern Division Sales Manager of the DARI-RICH Dairy Department.

Mr. L. N. Johnson, Vice-President and Director of Bowey's, Inc., appointed National Sales Manager of the firm's Soda Fountain-Ice Cream Department, along with his present duties as Central Division Sales Manager of the DARI-RICH Dairy Department.

Mr. John R. Stafford has been appointed Assistant Sales Manager of the Soda Fountain-Ice Cream Department for the Central Division and will also continue as Chicago Territory Sales Manager for that department.

Mr. Paul G. Butz has been appointed Assistant Sales Manager of the DARI-RICH Dairy Department for the Central Division, assisting Mr. Johnson.

J. H. Remick, Jr., Now Vice-President of New England Firm

J. H. Remick, Jr., a former executive of the Detroit Creamery and until recently associated with Wyandotte Chemicals Corporation, is now Vice-President of E. & F. King & Company of Boston, manufacturers and distributors of heavy chemicals since 1834. Mr. Remick is a former director of the Dairy Industries Supply Association, and during the war was a member of the WPB Advisory Committee on solid carbon dioxide. With Wyandotte Chemicals he directed the sales of carbon dioxide, calcium carbonate, and calcium chloride.

FOOD INSTITUTE FOR THE ARMED FORCES

The QMC Subsistence Research and Development Laboratory has been designated as the Quartermaster Food and Container Institute for the Armed Forces. Col. Charles S. Lawrence, QMC, is assigned as its Commanding Officer. The missions of the Institute are:

1. To design, improve, develop, and evaluate food products and rations suitable for military use, the packaging and packing of these items and in addition, the packaging and packing of all other Quartermaster Corps supplies, except fuel and lubricants.
2. To prepare, revise, and amend Quartermaster Corps specifications for food products, rations, and the packaging and packing section of all Quartermaster Corps specifications, except those pertaining to fuel and lubricants.
3. To prepare for publication: manuals, bulletins, regulations, specifications and texts of a technical nature which pertain to food products, rations, and food preparation and the packaging and packing of all Quartermaster supplies other than fuel and lubricants.
4. To represent the Office of The Quartermaster General on Federal, military, and other specification boards, the National Research Council, the National Academy of Sciences, Military Testing Boards, the U. S. Department of Agriculture, the Federal Food and Drug Administration, and any other national or international research or scientific organizations in technical matters dealing with the products and supplies, mentioned in 1 above.
5. To establish procedures and methods for quality control and inspection of the products and activities mentioned in 1 above.
6. To administer a coordinated fundamental and applied research and development program with scientific institutions interested in the products and activities mentioned in 1 above.
7. To provide, at the Institute, supplementary indoctrination on latest developments in food and container research for instructors in the Bakers and Cooks Schools, food supervisors and inspector instructors. To provide further, a training program for other personnel intended for various subsistence assignments.

(Continued on page 185)

New Members

ACTIVE

Cooper, O. V., Senior Sanitarian, State Health Department, Route 7, Box 652, Phoenix, Ariz.

Donovan, Joseph J., Senior Sanitary Inspector, Health Department, 105 Sumner Rd., Brookline, Mass.

Engendorff, O. H., State Sanitarian and Dairy Inspector, State of Wyoming, Box 17, Worland, Wyo.

Harman, Thomas D., 325 S. Court St., Circleville, Ohio.

Kremer, Philip F., Food Inspector, State Dept. of Agriculture, Milwaukee 7, Wis.

Kucher, Dr. Paul C., Dairy and Meat Inspector, City Health Department, Fort Wayne. Ind.

Orth, Harper V., Sanitarian, Public Health Department, Shawnee, Okla.

Peebles, Harold E., State Bacteriologist, Department of Agriculture, State House, Des Moines 19, Iowa.

Russell, C. C., Director, Jefferson County Board of Health, Health Department, City Hall, Chattanooga 2, Tenn.

Tuttle, Eugene K., Chief Milk Sanitarian, City Health Dept., 2652 Quincy Ave., Ogden, Utah.

Weindel, Howard M., Chief Milk Sanitarian, State Board of Health, Topeka, Kans.

Young, Homer G., Laboratory Control, Isaly Dairy Co., Hoffman Rd., Glen Shaw, Penn.

Zobel, Edgar H., Milk Sanitarian, State Department of Agriculture, 603 Watson St., Ripon, Wis.

ASSOCIATE

Abraham, William, Owner, Sheboygan Sunshine Dairy, Inc., 2627 No. 15th St., Sheboygan, Wis.

Allen, D. L., P. O. Box 102, Monticello, Iowa.

Andersen, Carl C., Milk Sanitarian, State Board of Health, 718 Boston Bldg., Denver, Colo.

Arnold, W. M., Jr., c/o Memphis Branch Laboratory, 874 Union Ave., Memphis, Tenn.

Berge, Orrin J., Superintendent, Verifine Dairy, R. 1, Eisner Ave., Sheboygan, Wis.

Bersted, R. W., Asst. Sales Manager, Sediment Testing Supply Co., 20 E. Jackson Blvd., Chicago 4, Ill.

Blakelock, Edw. A., Keiner-Williams Stamping Co., 57 Foster Rd., Belmont, Mass.

Blish, Edwin J., Fieldman, 343 Delaware St., Sturgeon Bay, Wis.

Buker, Melvin A., Queens Farms Dairy, Inc., High St., Copenhagen, N. Y.

Buyens, Harold J., Laboratory Technician, Wheeler Cheese Co., 428 Harvard St., Green Bay, Wis.

Camp, L. D., Sanitation Office, Baldwin County Health Dept., Bay Minette, Ala.

Comegys, E. F., Jr., Manager, Beatrice Creamery Co., 2 N. E. 2nd St., Oklahoma City, Okla.

Corbett, W. J., Dean Milk Co., 1126 Kilburn Ave., Rockford, Ill.

DeHart, G. H., Milk Sanitarian, Macon-Bibb County Health Dept., 815 Hemlock St., Macon, Ga.

Deming, Dr. David F., 123 Andrews St., Massena, N. Y.

Deutsch, M. N., City Health Department, Sioux City, Iowa.

DuBois, Adrien S., Chemist, Onyx Oil and Chemical Co., 15 Exchange Pl., Jersey City 2, N. J.

Edwards, Robert L., Laboratory, Consolidated Badger Co-op., 508 Picnic St., Shawano, Wis.

Filcek, George R., Laboratory Technician, Luick Dairy Co., 2008 W. Fond du Lac Ave., No. 1, Milwaukee 5, Wis.

Fletcher, Chester W., District Manager, Mutual Products Co., 5409 W. Galena St., Milwaukee 8, Wis.

Fredbeck, Emmett O., City Milk Inspector, Waukegan Health Dept., City Hall, Waukegan, Ill.

Friday, Edward R., Dairy Inspector, Madison Board of Health, Madison 3, Wis.

Gardner, Paul R., Department of Health, 207 N. 24th St., Olean, N. Y.

Graham, Russell A., Solvay Process Co., Syracuse 1, N. Y.

Graves, Roy B., Borden Farm Products Co., Antwerp, N. Y.

Hammond, Gordon T., Microscope Sales, Bausch & Lomb Optical Co., Rochester 2, N. Y.

Hansen, Carl T., Mgr., Rantoul Sanitary Milk Division, Beatrice Creamery Co., Rantoul, Ill.

Hansen, John, Field Service, Klenzade Products, Inc., 206 North 3rd St., Ft. Atkinson, Wis.

Harris, F. W., Quality and Fieldman, East Dane Quality Co-op., Lake Ripley, Cambridge, Wis.
Herrick, R. E., M. H. Renken Dairy Co., 60–32 Woodbine St., Brooklyn 27, N. Y.
Hildebrand, Dr. G. J., City Health Commissioner, 1208 S. 8th St., Sheboygan, Wis.
Howes, M. E., Wm. Weckerle & Sons, Inc., 1001 Jefferson Ave., Buffalo, N. Y.
Keown, Robert M., Milk Sanitarian, Intercity Milk Control Council, Box 191, Elkhorn, Wis.
Kilpatrick, Wm. H., Apprentice La Sill Milk Co., 501 Ft. Sill Blvd., Lawton, Okla.
Knudsen, J. W., 1205 1st Ave., Spencer, Iowa.
Kobes, Thomas, Cheesemaker, Denmark, Wis.
Larrow, H. A., Waddington Milk Co., Inc., 10 Spring St., Ogdensburg, N. Y.
Lessly, J. E., Farm Production Supt., Sterling Meadow Gold Dairy, 316 North Western Ave., Oklahoma City 4, Okla.
Malin, Victor T., Jr., Manager, Kelsey-Malin Dairy, R. F. D. Box 152-W, Dickinson, Texas.
McClendon, Earl, Owner, Meadow View Dairy, 715 W. Cherokee St., Okmulgee, Okla.
McLaughlin, R. M., Westchester County Dept. of Health, 22 Grandview Ave., White Plains, N. Y.
McMorrow, B. J., Director, Bureau of Sanitation, Board of Health, Honolulu, Hawaii.
Meggitt, Wendell, Swaner Dairy, Iowa City, Iowa.
Miller, R. E., General Manager, Turtle Lake Co-op. Creamery Assn., Turtle Lake, Wis.
Morton, Douglas B., Asst. Milk Sanitarian, State Dept. of Public Health, 2129 S. Fourth St., Springfield, Ill.
Nadelin, Eugene Paul, Owner, Nadelin Dairy, 819 Wuinby Ave., Wooster, Ohio.
Osborne, A. V., Branch Manager, Jensen Machinery Company, Inc., 5305 Horton St., Oakland 8, Calif.
Page, Jim C., Manager, The Page Milk Co., Coffeyville, Kans.
Pireaux, L. B., Plant Superintendent, The Fairmont Creamery Co., Green Bay, Wis.
Polzin, Elmer W., Intake Inspection, Luick Dairy Co., 1018 W. Burleigh St., Milwaukee 6, Wis.
Razee, Arthur H., Manager, Chemical Service and Sales, Rumford Chemical Works, 131 West St., Mansfield, Mass.
Reed, Sam I., Chief, Div. of Sanitation, Bremerton-Kitsap County Health Dept., 6th and Marion St., Bremerton, Wash.
Rood, M. J., Schleuter Dairy Supply Co., Janesville, Wis.
Roundy, Zola Doyle, Research Chemist, Armour & Co., 17 McIntosh Ave., Clarendon Hills, Ill.
Smith, Ben, Laboratory Technician, Beatrice Creamery Co., 14th St. at Broadway, Mattoon, Ill.
Sontag, Clarence, Fieldman, Luick Dairy Co., 1126 N. 24th St., Milwaukee 3, Wis.
Tema, Mike A., Fieldman, Turtle Lake Co-op. Creamery, Turtle Lake, Wis.
Thomas, G. Hugh, Student, University of Wisconsin, 308 N. Orchard St., Madison 5, Wis.
Tovan, John, Eastwood Dairy, 146 So. Collingswood Ave., Syracuse 6, N. Y.
Vanden Borch, Oscar, International Harvester Co., 109 Van Bergh Ave., Rochester, N. Y.
Vinal, Harry L., Blue Ribbon Dairy, 533 South Ave., Syracuse, N. Y.
Youse, Arthur M., Plant Supt., Borden's Farm Products Co., 5999 Nottingham Ave., Detroit 24, Mich.
Zwirschitz, Louis W., Fieldman, Kraft Foods Co., Aniwa, Wis.

CHANGES IN ADDRESS

Bellin, Walter P., San Francisco, Cal., to Route 1, West Bend, Wis.
Boe, Robert H., Austin, Texas, to 300 North Crowdus St., Dallas 1, Texas.
Booth, Dr. L. E., Chicago, Ill., to Gardner, Ill.
Brooks, Dr. Paul B., Albany, N. Y., to 146 Western Ave., Altamont, N. Y.
Brooks, Paul L., Columbus, Wis., to 34 North St., Middletown, N. Y.
Brunner, 1st Lt. T. F., Denver, Colo., to Brunner, Capt. T. F., c/o Postmaster, Nora Springs, Iowa.
Coleman, Lt. Ed., Lebanon, Ind., to Coleman, E. J., 32331 Oscoda Court, Wayne, Mich.
Culver, Earl, Green Bay, Wis., to Spring Green, Wis.
Eisman, Leon P., Charleston, W. Va., to St. Louis County Health Dept., Clayton 5, Mo.
Evans, Merton P., 411 Church St., Newark, N. Y., to 314 Colton Ave., Newark, N. Y.
Flake, J. C., New Orleans 17, La., to Evaporated Milk Assn., 307 N. Michigan Ave., Chicago 1, Ill.
Gaylord, Clifford, Canisteo, N. Y., to 649 Woolworth Bldg., Watertown, N. Y.
Grant, Alister, Moncton, N. B., to 225 Dominion St., Glace Bay, Nova Scotia, Canada.
Halldorsson, Thorhallur, 1210 W. Dayton St., Madison 5, Wis., to 1218 Spring St., Madison 5, Wis.
Hansen, Nicolai T., 4445 Barry Ave., Chicago 41, Ill., to 4318 West Schubert Ave., Chicago 39, Ill.
Helmbrecht, M. F., Beaver Dam, Wis., to Hutchinson, Minn. Kraft Cheese Co.

Hillstad, A. C., 411 N. Ingersoll St., Madison 3, Wis., to 157 Dunning St., Madison 3, Wis.
Hollister, E. J., Madison 5, Wis., to 1 Mt. Hope Ave., Rochester 7, N. Y.
Houser, Leroy S., Chicago, Ill., to Borden's 8th Ave. at 12th St., Huntington 10, W. Va.
Hyde, Burt, 3 Slocum Ave., Granville, N. Y., to 22 Columbus St., Granville, N. Y.
Kehus, William R., Baltic, Mich., to R. 2, Box 84, Chassell, Mich.
Knight, Harold W., Chicago, Ill., to 427 Jefferson Ave., Elgin, Ill.
Lindsey, Robert, 505 S. Fifth St., Champaign, Ill., to 132 S. Market St., Beatrice Creamery Co., Champaign, Ill.
Little, Lawrence L., Chicago, Ill., to E. F. Drew & Co., Inc., Boonton, N. J.
MacMorran, W. F., 320 High St., Troy, Penn., to 157 W. Main St., Troy, Penn.
Mason, Karl M., Peoria, Ill., to Box 276, New Providence, N. J.
McAvoy, Harold E., 720 S. Fourth St., Springfield, Ill., to 1052 W. Calhoun St., Springfield, Ill.
Menefee, Harold C., 504 E. Sangamon Ave., Rantoul, Ill., to 310 E. Sangamon Ave., Rantoul, Ill.
McGuire, Howard, Gilman, Ill., to 107 S. Tanner St., Rantoul, Ill.
Milone, Nicholas, Middletown, N. Y., to 35 Market St., Poughkeepsie, N. Y.
Mott, Mrs. Janet H., San Francisco, to 1542 Hudson St., Redwood City, Calif.
Mowry, Merlin M., Middletown, N. Y., to New Hampton, N. Y.
Nutting, L. M., Syracuse, N. Y., to Board of Health, Territory of Hawaii, Honolulu, T. H.
Peterson, Dr. Oliver H., Fort Omaha, Neb., to Dr. Salisbury's Laboratories, Charles City, Iowa.
Piper, Perry E., Bloomington, Ill., to c/o Ramsey Laboratories, Lisbon Rd. and Evins Ave., Cleveland 4, Ohio.
Pletcher, L. O., Spring Mills, Penn., to Beech Creek Ave., Mill Hall, Penn.
Reiger, Herbert A., Syracuse, N. Y. to 5547 Lakewood Ave., Chicago 40, Ill.
Roe, Roscoe, 11 Sand St., Cortland, N. Y., to 119 Tompkins St., Cortland, N. Y.
Rowland, J. L., Dallas, Texas, to 314 North Folger St., Carrollton, Mo.
Shean, Harry R., Arkport, N. Y., to Greene, N. Y.
Shields, Fred S., Lebanon, Ill., to 322 North F St., Tulare, Calif.
Smith, Abraham, 225 W. 106th St., New York City, to 12 E. 41st St., New York 17, N. Y.
Smith, Harold J., 52 Second St., Belvidere, N. J., to 628 3rd St., Belvidere, N. J.
Springstead, C. S., Leroy, N. Y., to 510 Terminal Bldg., Rochester, N. Y., State Health Department.
Stober, James, Sioux City, Iowa, to Green, Iowa.
Strang, Dr. G. J., Glens Falls, N. Y., to 50 Brown St., Lewisburg, Penn.
Tetzlaff, Frank, Richmond, Va., to 2670 Cascade Rd., S. W., Atlanta, Ga.
Van Winkle, Fred A., Rochester, N. Y., to 166 Highland Ave., Middletown, N. Y.
Vorperian, John H., Freeport, N. Y., to Nassau County Health Dept., Mineola, N. Y.
Weber, Albert H., Millerton, N. Y., to P. O. Box 283, Oxford, N. Y.
Weinstein, Max, Washington, N. J., to 712 Avenue M, Brooklyn 30, N. Y.
White, H. G., Bellefonte, Penn., to R. D. 1, Spring Mills, Penn.
White, Herbert L., Canton, Penn., to Lock Box 825, Lancaster, Penn.
Widland, Myron A., Danbury, Conn., to 614 Dickinson St., Springfield 8, Mass.
Wilder, Orville, Peekskill, N. Y., to 29 Judson St., Canton, N. Y.
Woodman, M. J., 1250 Sedgwick St., Evanston, Ill., to 1806 Maple Ave., Evanston, Ill.

FOOD INSTITUTE FOR THE ARMED FORCES

(Continued from page 182)

8. To prepare and keep up to date plans to be used in time of national emergency, for the organization and expansion of activities relating to 1 above.

9. To maintain liaison with various agencies of the Armed Forces and to ascertain the status of current and proposed strategy, tactics, and logistics affecting the research and development of applicable products and supplies.

10. To maintain contact with industry, universities, government and other laboratories, and maintain a suitable advisory and technical information program relating to the items and activities mentioned in 1 above.

11. To maintain a current library and library service on appropriate technical information.

12. To maintain a current summary of national and world resources required for the development of rations and the packaging and packing of all Quartermaster supplies except fuels and lubricants.

13. To maintain and operate mobile subsistence laboratories.

"Dr. Jones" Says—*

This question of routine medical examination of food handlers: we were talking about it just recently. I said experience had proven that it didn't accomplish what it was supposed to and created a false sense of security. In short, you don't get "value received" for what it costs.

It occurred to me, afterward, that where we dropped the subject—it might leave the impression there's nothing to do about food handlers—that is, to protect the public. And that isn't so. There's at least two things that can be done—that they're doing in several places.

New people that're being taken on in these places—of course it's to the employer's interest to know that they aren't carrying any disease germs that might cause trouble. By arrangement with the health officer or with a private physician, a careful history can be taken to find out whether they've ever had any sickness that might have been typhoid fever or dysentery. Those are the most important things.

* *Health News*, New York State Department of Health, Albany, N. Y., Feb. 18, 1946.

If there's anything suspicious in their history, then they should go into it thoroughly: have enough specimens examined either to find the germs, if they're there, or to be sure they aren't. Typhoid carriers have been discovered that've been carrying the germs for twenty years or more and apparently never knew it. Of course they shouldn't be working in restaurants.

Probably the most practical thing they're doing: New York City is one of the places where they're putting on training courses for restaurant employees. They show 'em what the dangers are (like staphylococci getting into food from somebody with boils or a bad cold); what to do to avoid getting germs from their hands into food; about refrigeration to avoid food poisoning and all that. The bosses—they take these courses, too.

The system that'll discover everybody that's got disease germs in 'em or on 'em at all times don't exist. But the better they understand what they're doing, the less likely they are to be dangerous.

PAUL B. BROOKS, M.D.