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Improving the Quality of Oklahoma Butter

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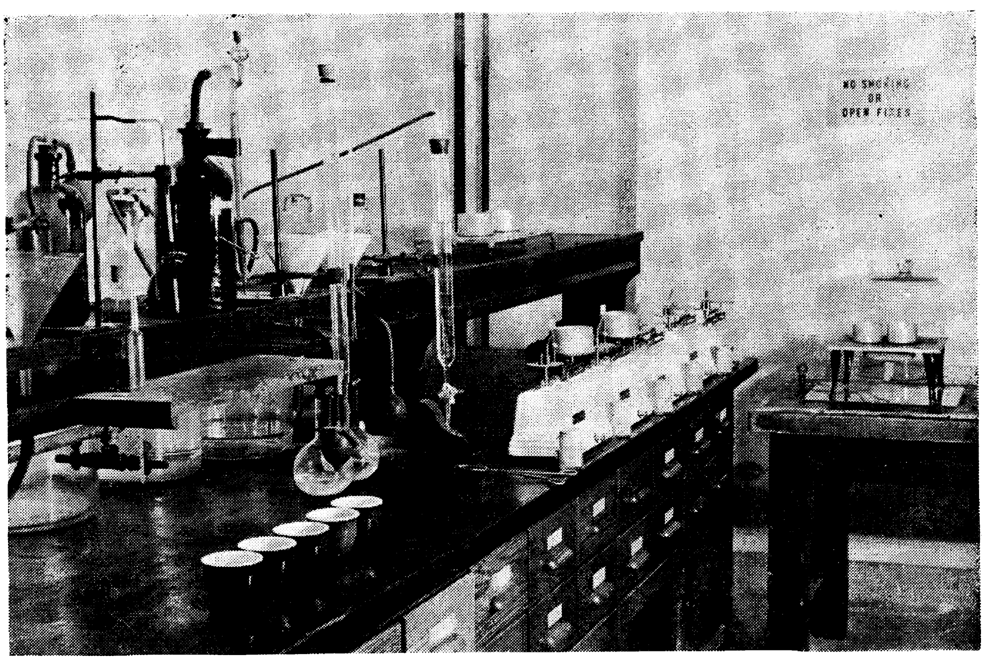

The laboratory equipped for analysis of butter samples.

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SUMMARY

I. A STUDY OF OKLAHOMA BUTTER..........Page 3

In 1932 the Dairy Department at Oklahoma A. and M. College began a service to butter manufacturing plants in the State, the purpose of which was to aid in standardizing the composition of, and to improve the quality of, Oklahoma butter.

In two and one-half years over 3,000 samples of butter from 26 plants have been analyzed by the Kohman method for moisture, salt, curd and fat. Results indicate that many of the plants which cooperated on the project enjoyed material benefits.

II. NEUTRALIZING HIGH ACID CREAM FOR BUTTERMAKING..........Page 8

Neutralizer flavor was found in a large number of the poorer quality butter samples, most of which had probably been made from high-acid cream. A study was made to determine the most suitable methods and materials to be used for neutralizing high-acid cream. Magnesium limes alone were found to be slightly better than calcium limes alone, and sodium carbonate was found to be better than sodium bicarbonate. Neutralizing two-thirds of the excess acid with magnesium lime and one-third with sodium carbonate proved to be a satisfactory procedure for standardizing high-acid cream.

III. METHODS AND EQUIPMENT FOR THE PROPAGATION OF STARTERS..........Page 14

Inexpensive yet adequate equipment for propagating and maintaining cultures of high quality at a cost within the reach of the smallest plant is described and explained.

IV. COOLING CREAM ON THE FARM AND IN CREAM BUYING STATIONS..........Page 22

Lack of adequate cooling facilities on farms is responsible for much of the poor quality cream marketed in Oklahoma. Cream stations are not equipped to care properly for cream while it is in their possession. Inexpensive and practical equipment for these needs is described in this bulletin.

V. TESTING FOR SEDIMENT IN CREAM..........Page 30

Out of efforts that are being made to improve the quality of cream in Oklahoma, a need for a suitable means of determining the amount and kind of insoluble foreign matter in cream has been recognized. A sediment test to accomplish this has been devised. Directions for performing the test and preparing the necessary solution are given.

IMPROVING THE QUALITY OF OKLAHOMA BUTTER

E. L. FOUTS and J. I. KEITH

I. A STUDY OF OKLAHOMA BUTTER

NEED FOR STANDARDIZATION

On January 1, 1932, the Dairy Department at the Oklahoma A. and M. College began a service to butter manufacturing plants in the state, the purpose of which was to aid in standardizing the composition and improving the quality of Oklahoma butter. The initiation of this plan was prompted by the analyses of thirty or forty samples of butter which had been sent to the college from a number of plants to be entered in a scoring contest. These samples were analyzed for water, salt, curd, and fat as an accommodation to manufacturers who had submitted them. The butters from different plants as well as individual churnings from the same plant were found to vary greatly in composition.

When informed about this serious lack of uniformity in their products, several plant owners requested that they receive aid from the Dairy Department in standardizing the composition and improving the quality of their products.

PROCEDURE IN THE PROJECT

In response to the request from plant owners, the Dairy Department inaugurated a project to afford analyses, scores, and bacteriological examinations of as many samples of butter as the plants wished to send in to the laboratory. This work was done by the college for the cooperating plants on a cost basis, which was about twenty cents per sample. In the two and one-half years the laboratory has been operating, more than 3,000 samples from a total of 26 plants have been received and examined.

All the plants represented in this study were owned either privately or as cooperatives. They ranged in production from 50,000 to 2,000,000 pounds of butter annually.

It was not possible nor desirable to continue indefinitely to analyze samples for all plants which began the service. Some stopped sending samples because of lack of interest, some because of failure of business, and others because they did not care to have the fact known that they were consistently manufacturing butter of low fat content. Several plants, after acquiring the necessary equipment, were able to control the composition of their butter to such a degree that they felt justified in discontinuing the service from the college.

THE STANDARD COMPOSITION SUGGESTED

It was suggested at the start of the project that all plants should strive to have 80 per cent fat in their product at the time of sale, this percentage complying with both State and Federal regulations. Practically all samples of butter submitted were churn samples, that is, they were taken at the churn while the butter was being removed. In studying the data this point should be borne in mind, as butter usually loses some moisture during packing, printing and storage. Each buttermaker was encouraged to study the moisture loss in his product due to these factors and to incorporate moisture in the butter accordingly. It was found that in the average plant .3 to .4 per cent moisture was lost between the churn and the final package. Considering this, the desired range of butterfat at the churn was established at 79.6 to 80.5 per cent. For safety, however, buttermakers were encouraged to maintain a fat content somewhat above the minimum.

RESULTS

Moisture

The data given in Table I reveal that most plants which sent samples regularly throughout a two-year period showed a slight increase in the moisture content of their butter in 1933 over 1932. This increase was advised in a number of instances because these plants had fat averages during 1932 which were somewhat higher than was considered necessary. The moisture increases in most cases were accompanied by the desired decrease in fat percentage.

Salt

The salt content of the samples was quite uniform throughout the entire State, ranging from 2.25 to 3.11 per cent in 1932 to 2.10 to 3.06 per cent in 1933. Since the desirable salt content is determined largely by local conditions, little has been said about it except that uniformity should be maintained and that the percentage should be increased if the trade will permit it. Generally speaking, a slight increase may be noted in the salt content of the 1933 samples over those submitted in 1932.

Curd

The curd content of the butter has been quite uniform. It has been suggested that this constituent be held below 1 per cent, and in most cases this has been accomplished. In 1932 four plants, and in 1933 three plants, exceeded this limit.

TABLE I. Moisture, Fat, Salt, and Curd Content of Butter from Twenty-Six Oklahoma Plants for 1932 and 1933.

Plant No.	Moisture		Fat		Salt		Curd	
	1932	1933	1932	1933	1932	1933	1932	1933
1	15.48		81.25		2.49		.71	
2	16.35	16.47	80.04	79.74	2.71	3.00	.87	.83
3	15.00		81.00		3.02		.97	
4	15.32		81.71		2.25		.71	
5	15.96		80.47		2.70		.85	
6	15.94	16.35	80.65	80.25	2.72	2.82	.66	.56
7	17.61	17.47	78.85	78.76	2.62	2.93	.96	.77
8	17.66		78.70	77.98	2.68	2.55	.94	1.13
9	16.31		79.91		2.68		1.09	
10	16.75		79.56		2.51		1.14	
11	16.57	16.74	79.54	79.56	2.98	2.99	.89	.69
12	15.56		80.44		2.95		1.01	
13	16.28	16.51	80.45	80.17	2.53	2.58	.71	.72
14	16.00		80.58		2.63		.78	
15	18.46		77.31		3.11		1.10	
16	15.10	16.40	81.42	79.88	2.76	2.94	.72	.76
17	16.65	16.33	79.68	80.66	2.86	2.10	.78	.89
18	16.97	17.10	79.62	78.94	2.80	2.90	.60	1.05
19		16.93		77.77		2.74		.60
20		16.26		80.08		2.85		.79
21		16.70		80.25		2.55		1.00
22		16.71		79.70		2.69		.88
23		16.25		79.76		3.06		.97
24		16.21		80.57		2.43		.77
25		17.47		78.90		2.87		.77
26		15.74		80.91		2.66		.73

Fat

Table I reveals that in 1932 four, or 22 per cent, of the eighteen plants then sending in samples, namely: Nos. 1, 3, 4, and 16, had fat averages exceeding 81 per cent for the entire year. Two of these plants, Nos. 1 and 4, had failed in business during that year. It may also be observed that during 1933 no plant had a fat average as high as 81 per cent. In a conscientious effort to standardize the composition of their butter some plants decreased the fat content of their butter below the point considered desirable; others knowingly decreased the fat content of their product to a point which was not only illegal but detrimental to the quality of their product. Most plants, however, brought their butter composition within the desired range.

TABLE II. Average Percentage Composition of All Samples of Butter Analyzed in 1932 and 1933.

	Water	Fat	Salt	Curd
1932	16.32	80.13	2.70	.83
1933	16.62	79.85	2.72	.79
Difference	+.30	—.28	+.02	—.04

+ indicates increase.
— indicates decrease.

Table II, showing the average composition by years of all samples of butter analyzed, reveals that a .3 per cent increase in moisture content was effected with a corresponding decrease of .28 per cent in fat content. The slight increase in salt and decrease in curd, while desirable, are not considered significant.

LITTLE SEASONAL VARIATION

Table III shows the average composition of all samples submitted by quarters during 1932 and 1933, revealing the fact that the composition of the butter throughout each year was quite uniform.

TABLE III. Average Percentage Composition of All Samples Submitted by Quarters for 1932 and 1933.

Qtr of Year	Water		Fat		Salt		Curd	
	1932	1933	1932	1933	1932	1933	1932	1933
1	16.10	16.63	80.22	79.76	2.82	2.75	.83	.86
2	16.34	16.61	79.99	79.81	2.73	2.76	.92	.78
3	16.22	16.76	80.33	79.76	2.63	2.72	.80	.72
4	16.63	16.38	80.07	80.19	2.62	2.60	.67	.81

During the spring months of 1932 a slight increase in moisture content was noted over the first quarter, while in 1933 the coming of the pasture season made practically no difference in the moisture content of the butter. It is conceded that unless special care is taken by a buttermaker during spring months the moisture content of the butter will have a tendency to increase somewhat. The fact that during the second year the samples remained quite uniform throughout the seasons is indicative of careful study by the buttermaker of the periodic analyses of his butter.

THE TENDENCY IN CONTROLLING FAT PERCENTAGE

In Table IV all samples analyzed were grouped according to their fat percentages and classified either as being within the desired range 79.6-80.5 per cent, or in the high-fat range over 80.5 per cent or in the low-fat range under 79.6 per cent. Each group was sub-divided into sections to show the deviation from the desired range. During the second year of the project the percentage of samples falling into the high-fat classification was reduced from 33.1 to 22.0 per cent. This reveals an actual reduction of about 33 per cent in the number of high-fat churnings. The samples falling into the desired range increased from 40.7 in 1932 to 43.2 per cent in 1933. The low-fat group increased from 26.1 to 34.7 per cent with the greatest increase in the group just below the desired range. In an effort to hold the fat content of their samples at a desirable minimum some plants slipped into the low-fat group during the second year.

TABLE IV. Number and Percentage of Samples From All Plants Falling into Each Classification Based on Fat Percentage.

		1932		1933	
	% Fat	No.	Percent	No.	Percent
High Fat	over 80.9	251	19.8	170	12.1
	80.6—80.9	169	13.3	140	9.9
TOTAL		420	33.1	310	22.0
Desired range	80.0—80.5	328	25.9	346	24.5
	79.6—79.9	187	14.8	264	18.7
TOTAL		515	40.7	610	43.2
Low Fat	79.0—79.5	177	14.0	260	18.4
	78.6—78.9	51	4.0	102	7.2
	under 78.6	103	8.1	128	9.1
TOTAL		331	26.1	490	34.7

Table IV, which is a summary of all samples from all plants, does not give due credit to the really progressive plants such as plants Nos. 2, 6, 11, 13, 16, and 17 that are shown in Table I, nor does it criticize the plants with fat consistently low such as Nos. 7, 8, 15, 18, 19, and 25. One of the chief aims of the project was to lend assistance to individual plants, and this has been accomplished very effectively in a number of instances.

Table V is of interest particularly to the individual plants in that it shows in percentage the distribution of samples by plants during 1932 and 1933.

TABLE V. Butter Samples Classified According to Fat Content, by Plants, 1932 and 1933.

Per cent of all samples from each plant.

Plant No.	Year	Fat content in per cent						
		over 80.9%	80.6 to 80.9%	80.0 to 80.5%	79.6 to 79.9%	79.0 to 79.5%	78.6 to 78.9%	under 78.6%
		per cent	per cent	per cent	per cent	per cent	per cent	per cent
1	1932	47.61	9.52	14.29		9.52	4.76	14.29
2	1932	11.30	11.88	31.88	20.86	15.94	3.47	4.63
	1933	7.27	7.27	27.27	21.81	18.18	10.90	7.27
3	1932	36.84	36.84	15.78	10.52			
4	1932	75.00				25.00		
5	1932	5.00	40.00	50.00	5.00			
6	1932	40.70	14.07	15.07	10.05	9.54	3.01	7.53
	1933	27.50	11.50	19.00	12.00	16.15	5.50	8.00
7	1932	13.04	7.60	14.13	10.86	7.60	2.17	44.56
	1933	4.16	8.33	33.33	8.33	4.16	4.16	37.50
8	1932	3.44	1.72	31.03	12.06	32.75	8.62	10.34
	1933			5.40	5.40	5.40	21.62	62.16
9	1932		20.00	20.00	40.00	10.00	10.00	
10	1932	4.76	14.29	19.04	9.52		14.29	38.09
11	1932	2.83	3.77	12.26	22.64	42.45	11.32	4.71
	1933	8.82	2.94	17.64	27.94	19.11	5.88	17.64
12	1932	31.37	9.80	25.49	13.72	13.72	3.92	1.96
13	1932	18.07	24.85	41.80	9.03	4.51	1.69	
	1933	8.20	13.43	42.53	29.85	5.22	.75	
14	1932	29.36	11.93	26.60	17.43	11.01	2.75	.97
15	1932				16.66	16.66		66.66
16	1932	66.66	20.00	13.33				
	1933	8.33	15.00	20.10	18.33	25.00	10.00	3.33
17	1932	11.11	11.11	33.33	11.11		22.22	11.11
	1933	39.28	10.71	23.21	7.14	8.92	1.78	8.92
18	1932	25.00		25.00	25.00			25.00
	1933	7.69	7.69	7.69	15.38	15.38	23.07	23.07
19	1933	2.04	4.08	26.53	22.44	34.69	8.16	2.04
20	1933	16.21	16.21	29.72	13.51	13.51		10.81
21	1933		25.00	50.00				25.00
22	1933	4.86	9.56	25.33	19.63	24.16	9.22	7.21
23	1933	6.25		18.75	43.75	18.75		12.50
24	1933	45.45	4.54	9.09	18.18	9.09	9.09	4.54
25	1933				33.33			66.66
26	1933	50.00	22.22	16.66	8.88	2.77		
All samples from all plants	1932	19.82	13.34	25.90	14.77	13.98	4.02	8.13
	1933	12.05	9.92	24.53	18.72	18.43	7.23	9.07

TABLE VI. Percentages of All Samples Falling into Various Classifications Based on Yeast and Mold Content During 1932 and 1933.

	1932	1933
Excellent	1	15
Good	25	30
Fair	33	40
Poor	41	15

Basis of Classification
(Molds and yeasts per cc.)

Excellent	0
Good	1-10
Fair	11-50
Poor	Over 50

YEAST AND MOLD

Table VI shows the marked improvements in the sanitary quality of the butter made, as judged by the total numbers of yeasts and molds present. It is significant that during 1932 only 1 per cent of the samples examined rated "excellent," while in 1933, 15 per cent fell into the same classification; 41 per cent were rated as poor in 1932 while only 15 per cent were poor in 1933. Here, again, the figures represent all samples from all plants but do not give credit due many plants which showed a very marked improvement.

Pumps, pipe lines and churns were the greatest offenders in causing the high yeast and mold contamination. When suitable washing and sterilizing methods were applied regularly, marked decreases in yeast and mold counts were noted.

II. NEUTRALIZING HIGH ACID CREAM FOR BUTTERMAKING

The project reported in the preceding section was devoted particularly to a study of the compositions of the samples of butter secured from Oklahoma creameries. Incidental to that project, however, a great number of the butter samples were scored and criticized in an effort to ascertain the causes of the off-flavors frequently encountered.

The most serious flavor defects occurring the greatest number of times in the lower scoring samples were those characterized as "old cream," "unclean," "cowy," and "feedy." This would indicate that most of these off-flavors have their origin on the farms and that clean production, proper cooling and frequent delivery of cream would improve the situation greatly.

Next in frequency among the serious flavor defects were the "neutralizer" flavors. These were described by the terms "neutralizer," "limy," "soda," and "burnt." A survey of the plants from which these samples were received revealed that the materials and methods used in standardizing the acid content of sour cream were many and varied. The literature reveals little if any research dealing with the neutralization of really high-acid cream. It was thought that since the acid content of much of the cream in Oklahoma is unusually high, a study to determine the most suitable materials and methods for the process would be of value to the butter industry.

EXPERIMENTAL PROCEDURE

Lots of cream with acid tests ranging from .35 to 1.20 per cent were obtained from a cream station. The cream was tested for acidity by weighing a nine-gram sample, boiling and cooling it and titrating with N/10 sodium hydroxide. The cream used was representative of that used in the manufacture of the various market grades of butter.

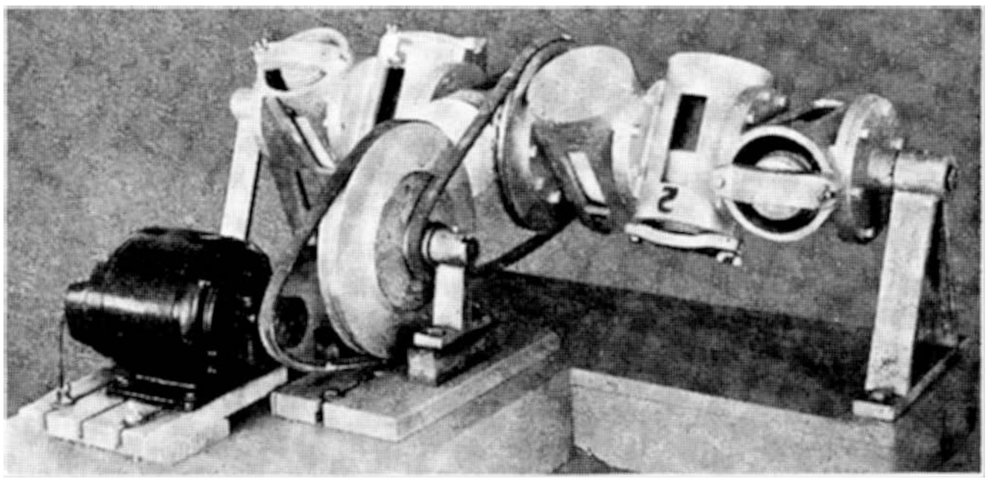

Figure 1. Laboratory churn.

The laboratory churn used is shown in Figure 1. It is made of cast aluminum in the form of a crankshaft and is perfectly balanced in any position. It is turned at 100 r. p. m. by an electric motor. Ordinary one-quart screw-top Mason jars are used and six lots of cream may be churned at the same time. One and one-half pounds of cream are used in each jar.

In each part of the experiment the lots of cream were forewarmed, pasteurized, cooled, and churned in exactly the same manner. The only differences in the entire procedure were in the variations in the materials and methods used in the neutralizing process.

NEUTRALIZING MATERIALS AND METHODS

The calcium lime used in this experiment was composed largely of calcium hydrate, the magnesium lime of magnesium oxide and calcium oxide or hydrate, and the sodas used were sodium carbonate and sodium bicarbonate.

The methods followed included single and double neutralization. Single neutralization as used here may be described as the complete reduction of the excess acid with a single alkali, all of the material being added at one time. Double neutralization as used in this experiment may be described as the partial reduction of the excess acid with calcium or magnesium lime and the reduction of the remaining excess acid with sodium carbonate or bicarbonate.

The cream was weighed into glass jars and warmed to 95°F., being agitated continuously. The amount of alkali required was determined, measured, and sprinkled into the cream in the form of a 10 per cent mix. In case of the limes a 15-minute period was allowed for the alkali to react with the acid before the heat was applied; a 5-minute period was allowed for the sodas. After the acid was standardized the cream was heated to 150°F., held for 30 minutes, and then cooled to 50° F. It was then held for 12 to 14 hours at this temperature before churning. After churning the butter was washed, 2.5 per cent salt was added, and the butter was worked until the salt was evenly distributed and the moisture well incorporated. The butter was scored fresh, packed in glass jars which were wrapped in brown paper to exclude light, and placed in storage at 10° F. At the end of 90 days the butter was removed from storage and scored again.

TABLE VII. Schedule for Neutralizing Experiments.

Method	Materials
	SERIES A
1	All calcium lime
2	Two-thirds calcium lime One-third sodium bicarbonate
3	Two-thirds calcium lime One-third sodium carbonate
	SERIES B
1	All magnesium lime
2	Two-thirds magnesium lime One-third sodium bicarbonate
3	Two-thirds magnesium lime One-third sodium carbonate
	SERIES C
1	All calcium lime
2	All magnesium lime
3	Two-thirds calcium lime One-third sodium carbonate
4	Two-thirds magnesium lime One-third sodium carbonate

DISCUSSION OF RESULTS

The results of the three trials which were run on each method are shown in Tables VIII, IX, and X. Since the results of the trials were quite similar for each method, only averages of the three trials are reported:

Series A

In tests reported in Table VIII, Method 1, in which high-acid cream was used, all of the excess acid was neutralized with a commercial neutralizer containing over 95 per cent calcium hydrate, all of which was added at one time. The average score of three lots of butter made from cream averaging 1.11 per cent acid and neutralized by this method was 87.8. These samples were all criticized as being "limy."

TABLE VIII. A Comparison of Butters made from High Acid Cream Neutralized by Different Methods.

	Method		
	1	2	3
Per cent acid in cream before neutralizing..............	1.11	1.11	1.11
Per cent acid in cream after neutralizing................	.22	.22	.22
Butter score (fresh)............	87.8	87.8	88.7
Butter score (ninety days)	87.4	87.3	88.5
Change in score after 90 days at —10° F...............	—.4	—.5	—.2

Method 1: All excess acid neutralized with calcium lime.
Method 2: Two-thirds of excess acid neutralized with calcium lime; one-third with sodium bicarbonate.
Method 3: Two-thirds of excess acid neutralized with calcium lime; one-third with sodium carbonate.

In Method 2, in which lots of the same cream were used, two-thirds of the excess acid was neutralized with the same lime as was used in Method 1, and one-third with commercial sodium bicarbonate. The average score of these churnings was 87.8, identically the same as Method 1. The butters in this group were all criticized as having a neutralizer flavor, particularly bicarbonate.

In Method 3, using lots of the same cream as in 1 and 2, two-thirds of the excess acid was neutralized with lime and one-third with sodium carbonate. The scores of this group averaged 88.7, which was .9 of a point better than the average of either of the other two methods. Since there was no significant difference in the keeping quality of the butter from cream neutralized by these three methods, it was concluded that Method 3 using calcium lime and sodium carbonate was superior to calcium lime alone or calcium lime and sodium bicarbonate.

Series B

In Series B (Table IX) high-acid cream was neutralized by three methods. In Method 1, all of the excess acid was neutralized with a commercial neutralizer composed of magnesium oxide and calcium oxide, all of which was added at one time. The average score of three lots of butter made from cream averaging 1.03 per cent acid was 88.4. All of these butters were criticized as being "limy."

TABLE IX. A Comparison of Butters made from High Acid Cream Neutralized by Different Methods.

	Method		
	1	2	3
Per cent acid in cream before neutralizing...............	1.03	1.03	1.03
Per cent acid in cream after neutralizing.................	.22	.21	.22
Butter score (fresh)............	88.4	88.3	88.8
Butter score (90 days)......	88.2	87.7	88.7
Change in score after 90 days at —10°F...............	—.2	—.6	—.1

Method 1: All excess acid neutralized with magnesium lime.
Method 2: Two-thirds of excess acid neutralized with magnesium lime; one-third with sodium bicarbonate.
Method 3: Two-thirds of excess acid neutralized with magnesium lime; one-third with sodium carbonate.

In Method 2, in the same experiment in which lots of the same cream were used, two-thirds of the excess acid was neutralized with the same material as was used in Method 1, and one-third with commercial sodium bicarbonate. The average score of these churnings was 88.3. These butters were all criticized as having a bicarbonate flavor. Bitterness was present in one sample.

In Method 3, using lots of the same cream as were used in Methods 1 and 2, two-thirds of the excess acid was neutralized with magnesium lime and one-third with sodium carbonate. The scores of this group averaged 88.8, which was about one-half point higher than either of the other two methods. Since there was no significant difference in keeping quality of the butter from cream neutralized by these three methods, it was concluded that the use of magnesium lime and sodium carbonate was superior to the use of magnesium lime alone or magnesium lime and sodium bicarbonate.

Tables VIII and IX reveal that better butter resulted when cream was neutralized with calcium or magnesium lime with sodium carbonate than when calcium or magnesium was used alone or with sodium bicarbonate. Trials were then run to compare calcium lime alone with magnesium lime alone and to determine the value of double neutralization when using (a) calcium lime and sodium carbonate and (b) magnesium lime and sodium carbonate.

Series C

Table X, Method 1, shows the results of tests in which all of the excess acid was neutralized with calcium lime, which was added all at one time. The average score for the three lots made from cream averaging 1.05 per cent acid was 88.2. All butters were criticized as having a "limy" flavor.

TABLE X. A Comparison of Butters Made from High Acid Cream Neutralized by Different Methods.

	Method			
	1	2	3	4
Per cent acid in cream before treatment	1.05	1.05	1.05	1.05
Per cent acid in cream after treatment	.22	.21	.21	.21
Butter score (fresh)	88.2	88.5	88.7	89.0
Butter score (90 days)	87.9	88.3	88.3	89.1
Change in score after 90 days at −10° F.	−.3	−.2	−.4	+.1

Method 1: All excess acid neutralized with calcium lime.
Method 2: Two-thirds of excess acid neutralized with calcium lime; one-third with sodium carbonate.
Method 3: Two-thirds of excess acid neutralized with magnesium lime; one-third with sodium carbonate.
Method 4. Two-thirds of excess acid neutralized with magnesium lime; one-third with sodium carbonate.

In Method 2, in which the cream was neutralized with magnesium lime, the average score for the three lots was 88.5. These butters were also criticized as being "limy."

In Method 3 two-thirds of the excess acid was neutralized with calcium lime and one-third with sodium carbonate. The average score of these butters was 88.7.

In Method 4 two-thirds of the excess acid was neutralized with magnesium lime and one-third with sodium carbonate. The average score of these butters was 89.0, which was from .3 to .8 point higher than the score of the butters made from lots of the same cream neutralized by the other three methods.

SUMMARY

Results of these experimental trials indicate that when high-acid cream (.60 per cent or above) is to be used for buttermaking purposes, it is desirable to double neutralize, using a magnesium lime and sodium carbonate. Neutralizing two-thirds of the excess acid with magnesium lime and one-third with sodium carbonate proved satisfactory. Other proportions of lime and soda also were found to yield satisfactory results. Calcium or magnesium limes alone often caused noticeable neutralizer flavor in the resulting butter. Sodium bicarbonate, when used with either calcium or magnesium limes, frequently imparted a bicarbonate flavor to the resulting butter. It has also been found desirable, particularly if the acid is .80 per cent or over, to add the lime mix in several installments to decrease the severity of the reaction.

Results of similar experiments using cream of medium and low acidities were as follows:

Cream with an acid content between .40 and .60 per cent may be satisfactorily neutralized by a single application of magnesium or calcium lime. The magnesium again showed a slight advantage over the calcium lime.

For cream with an acid content below .40 per cent treatment with either of the limes or sodas studied proved satisfactory with some advantage indicated for magnesium limes and sodium carbonate.

As the acid content of cream increases, the need for care in every phase of the process of neutralizing becomes greater. Too much emphasis can not be placed on the need for accurate acidity tests, selection and use of high grade chemicals, proper strength of mix, and correct method of adding. It should be realized that there are other causes for neutralizer flavor in butter besides simply adding too much neutralizer.

Only high quality neutralizing materials prepared especially for use in sour cream should be used. The neutralizing mix should be prepared exactly in accordance with the directions as set forth by the manufacturer. It should be added to the cream slowly from some sort of sprinkling apparatus so that it becomes thoroughly distributed immediately. Neutralizer mix should never be just poured into cream.

Neglecting any one of these points may cause a limy flavor or be responsible for some other serious defect in butter.

III. METHODS AND EQUIPMENT FOR THE PROPAGATION OF STARTERS

Many excellent bulletins are available describing the methods of propagating butter cultures and the equipment necessary for this purpose. Most of these publications leave the impression with the reader that in order to handle starters successfully much experience and expensive equipment are necessary. It is agreed that a thorough knowledge of the subject and wide experience are invaluable assets to the man handling starters, and, while it is highly desirable to have the most modern equipment for propagating them, it is not absolutely necessary to incur great expense in this connection. Generally speaking, the poor starters that are too frequently observed in many plants are the result of a lack of knowledge on the part of the person carrying them and of unsatisfactory or inadequate equipment. Many plants, especially the smaller ones, are unable to purchase the expensive equipment commonly recommended, and it is with these plants in mind that this work was inaugurated. Inexpensive home-made equipment for propagating and maintaining cultures of high quality is described.

NEW CULTURES

New cultures purchased from companies manufacturing them are quite uniformly good and are seldom responsible for poor starters commonly found in plants. During extremely hot weather, difficulty is sometimes encountered with new cultures due to the fact that the culture is exposed to adverse conditions during shipment. This is more especially true in the case of liquid cultures, although recent findings have made it possible to ship liquid cultures for long distances and have them in good condition on arrival at the plant.

Certain fundamental facts should be understood about the new cultures that are secured from supply houses. They are put up in two forms, liquid and powder, either of which is satisfactory if handled correctly. The liquid culture, due to the fact that the organisms are in an actively growing condition, starts more readily than the powder culture; therefore an active, usable culture usually can be obtained more readily from the liquid than from the powder type. The powder cultures, on the other hand, because the organisms are not in an actively growing condition, have keeping qualities far superior to the liquid cultures; but, after reaching the plant, they require a somewhat longer starting period, frequently necessitating several transfers before they become active and usable. As each type has definite advantages, the individual needs and preferences of the user will determine which type should be used.

MOTHER CULTURE

Mother culture is the term used to describe the small culture which is propagated in plants from day to day and from which the large batch of starter milk is inoculated. The milk to be used for mother cultures should be whole milk of the highest quality obtainable. Good clean skim milk is satisfactory, but skim milk is not usually recommended because it is often contaminated while passing through the separator. The milk should be placed in fruit jars with a piece of parchment and glass lid over the top or in ordinary milk bottles which should be double capped. These containers should be filled only about two-thirds full.

HEAT TREATMENT

The bottles containing the milk should then be placed in a water bath and heated to at least 180° F. for thirty minutes and longer for milk of doubtful quality. They should then be cooled to 70° F. by placing the jars in cold water. A thermometer in a bottle of water which is heated and cooled in exactly the same manner as the starter milk provides a satisfactory means of checking the temperature of the milk throughout the entire process without the danger of contaminating the heated milk by placing the thermometer into it. If the milk is heated early in the morning and the starters not transferred until evening, as is the usual custom, the heated milk should be cooled immediately and held below 50° F. When ready to inoculate it should be warmed to 70° F. by setting the bottles in warm water.

INOCULATING

In case a new culture is being started, the stopper should be removed from the culture bottle and the opening carefully flamed. Then cover should be removed from the bottle of properly prepared milk and the opening of that bottle also flamed. The entire shipment of the new culture, usually about one ounce, should be poured into two-thirds quart of properly processed milk, being careful that the new starter does not come into contact with the upper part of the bottle. The cover of the milk bottle should be quickly replaced and the milk agitated by a circular motion with care so that it does not splash on the lid.

INCUBATION

The bottle should be placed in an incubator at 68-70° F. for 12-14 hours, or until a firm, smooth curd has been formed. At this time it should be removed from the incubator and set in a cool place (45° F. or lower), preferably in ice water. The succeeding transfers should be made in a slightly different manner. Mother cultures should not be poured from one bottle to another when transferring, due to the chance for contamination in handling the larger containers. One very satisfactory method is to use a glass tube or a pipette which has been sterilized in a moderate oven of about 325° F. for at least one hour. These tubes or pipettes may be wrapped in paper and heated until the paper becomes a light brown, or they may be sterilized in a copper pipette case without wrapping. Another satisfactory method of transferring which is somewhat easier is by use of a spoon of suitable size. A long handled spoon such as is used at soda fountains is quite satisfactory. The spoon should be thoroughly cleaned and sterilized by holding it over a flame until quite hot or by placing it in boiling water for several minutes. Allow the spoon to cool, and then make the transfer by carefully dipping the desired amount of culture with the spoon and placing it in the prepared milk.

EQUIPMENT COST NOT PROHIBITIVE

Only a comparatively few plants are properly equipped to carry starters; this is due primarily to the cost of the necessary equipment which in the past has been prohibitive to the small plant. It has been found that satisfactory equipment can be constructed at a very reasonable cost by almost any one who is handy with tools. The following descriptions accompanied by photographs will enable any one interested to construct the equipment needed.

STERILIZER

Almost any tin shop will make a sterilizer (shown in Figure 2) suitable for heating the milk for starter cultures for $2.00 to $3.00 depending on the size required and the grade of materials used. A galvanized iron box to hold six quart bottles can be obtained at a cost of about $2.00. In time, however, this material will rust out. Copper, while costing more, is far superior to galvanized iron and will last considerably longer. The box should have a close fitting lid so that the steam will sterilize the portion of the bottles which is not in contact with the boiling water. It is advisable to have a metal rack about one-half inch from the bottom of the box to support the bottles and permit free circulation of the water under them in order to accomplish uniform heating of the milk.

Figure 2. An inexpensive sterilizer for culture milk. The sterilizer is made of sheet copper and has a tight-fitting lid.

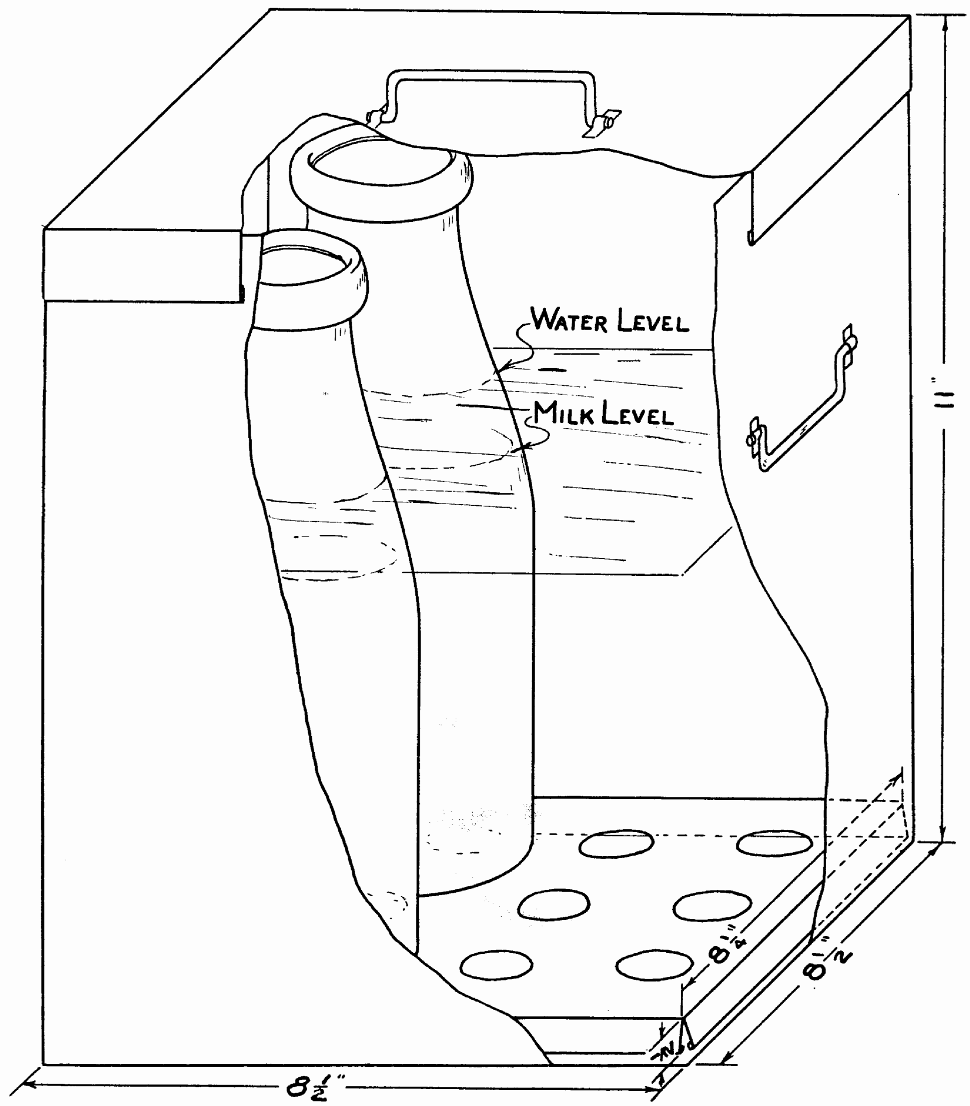

Figure 3. A cut-away and dimension drawing of the culture milk sterilizer shown in Figure 2.

If it is convenient, steam and water connections may be made through the top of the box to facilitate heating and cooling. If this is not convenient, the sterilizer may be set up on ordinary bricks and a small gas burner may be used to supply the heat. Cooling may be accomplished by the careful addition to cold water.

INCUBATOR

The incubator is a well insulated cabinet with a thermostatically controlled heating unit which maintains a uniform temperature between 68-70° F. It should be constructed of a good grade of lumber, white pine being very suitable. It should be carefully built and put together with screws. It should be insulated on the inside with one-half inch fiber board or other suitable insulating material, with a thin layer of pitch between the wood and insulation. The box should be painted to protect the wood from dampness to which it is continually subjected when in use.

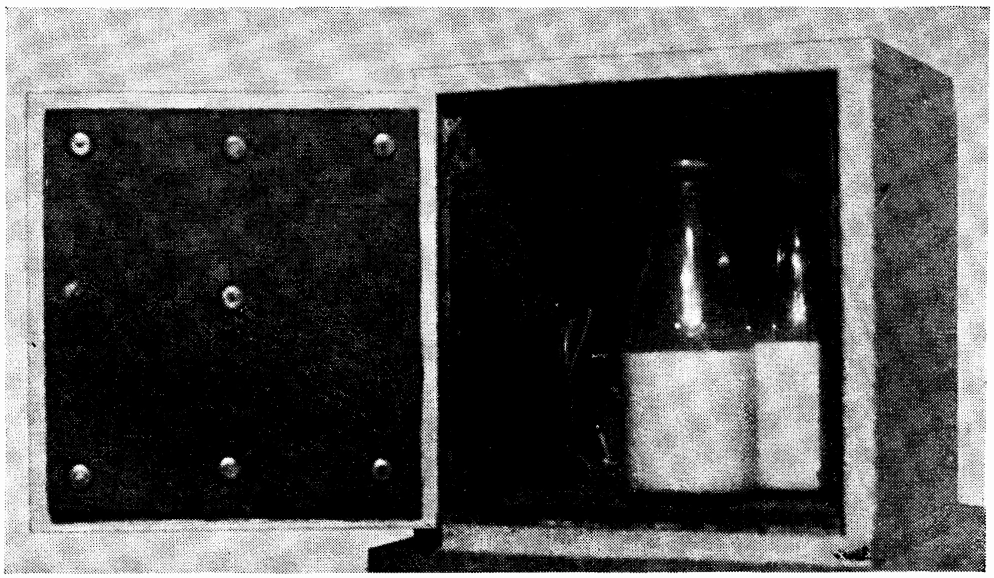

Figure 4. A small home-made incubator with automatic temperature control. Ideal for the small plant.

The thermostat should be placed on the side wall, as shown in Figure 5, so that it will be in no danger of getting wet in case a bottle should leak. A thermostat may be purchased from almost any scientific instrument company for about $3.00.

The lamp and flue should be located near the thermostat, so that short wires can be used for making the electrical connections. This part of the unit is made up of a keyless receptacle for open wiring with a 25 watt light bulb. The flue may be made of a No. 1 or 1½ tin can from which the top and bottom have been removed. This flue should be arranged so that the bottom will be off the floor at least 1½ inches to encourage free circulation of air. The flue should have a cover set about 1 inch above the top in order to distribute the warm air more uniformly.

When the incubator is completely assembled, it should be placed on a shelf in a convenient but out-of-the-way place, in a room which is held at all times below 68° F. The usual butter or milk storage room at 40-45° F. is a very satisfactory location. Connect the incubator to a 110-volt outlet which is independent of all switches, and then the thermostat is ready for adjusting. It should be adjusted by turning the regulating screw in the proper direction, so that it makes contact lighting the lamp at 68° F., and breaks contact turning it off at 70° F. In this manner the box being subjected to the cold air from the outside and the warmth from the light bulb on the inside and regulated by the thermostat maintains a constant temperature which is absolutely essential to

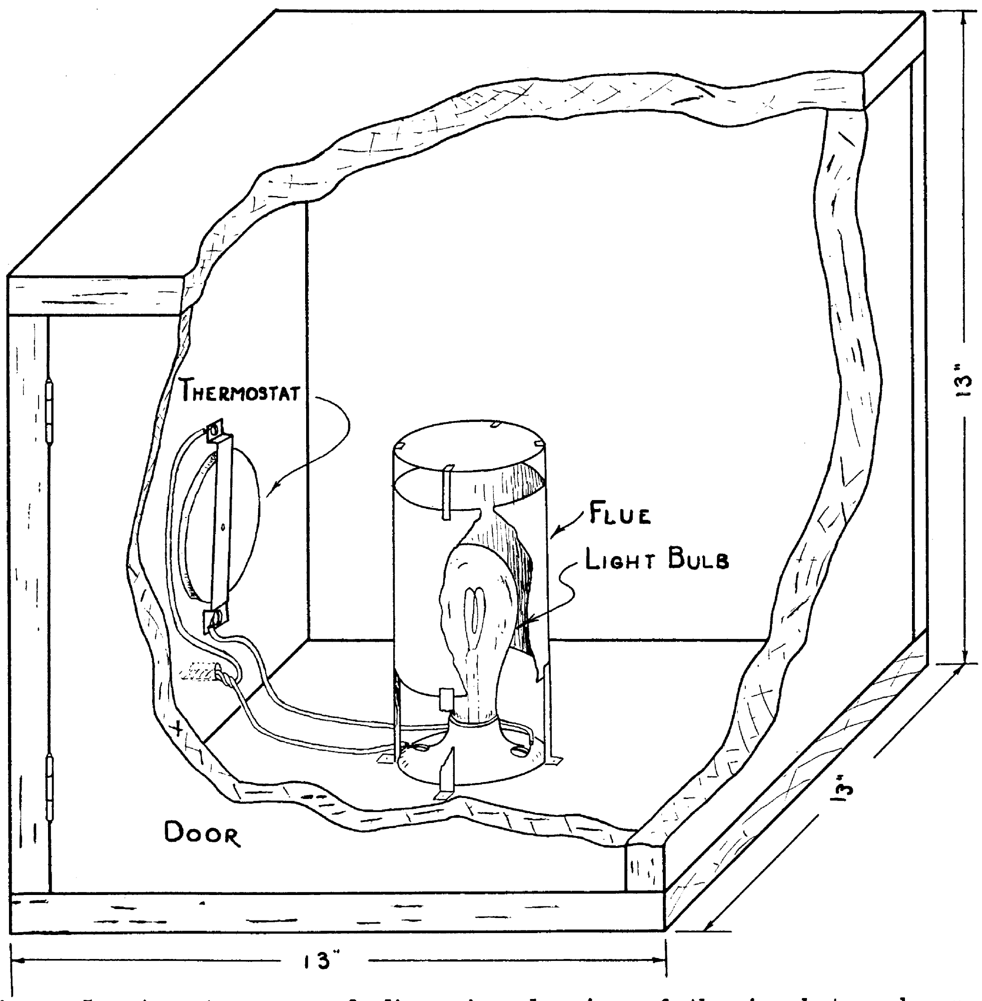

Figure 5. A cut-away and dimension drawing of the incubator shown in Figure 4.

the successful propagation of starters. It is a good policy to leave a thermometer in the incubator at all times, so that the temperature can be checked frequently.

This incubator can be made in practically any desired size, the only necessary change for larger sizes being to increase the heat by substituting a larger light bulb or adding an extra lamp and flue. The incubator shown in Figure 4 is a small one 13 x 13 x 13 inches with a maximum capacity of three quart bottles.

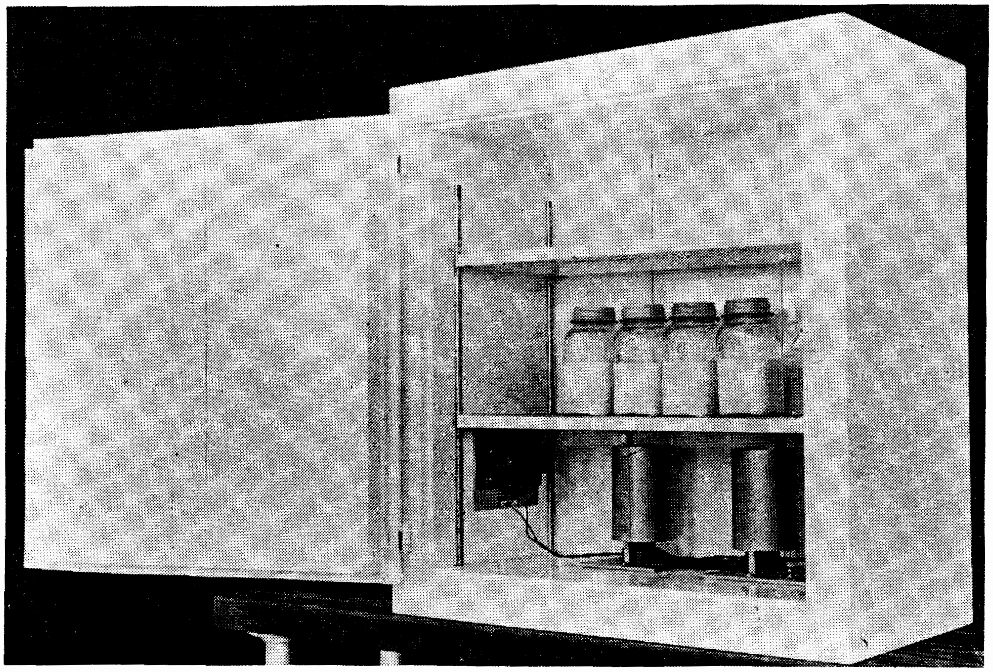

Figure 6. A home-made culture control cabinet of large capacity. This type of incubator must be kept in a room where the temperature is held below 68° F. at all times.

The incubator shown in Figure 6 is a home-made box 17 inches deep, 34 inches high and 31 inches wide. It is constructed of the best grade white pine lumber and is insulated with 1 inch of cork. It has adjustable shelves and will easily accommodate 24 quart fruit jars or milk bottles, which will take care of the requirements of the largest creamery. This incubator while costing considerable more than the smaller one shown in Figure 4 still is quite inexpensive.

The cost of a sterilizer made of copper by a tinsmith and the cost of materials needed to build the small incubator as described and pictured in Figure 4 are listed below.

Sterilizer	$3.50
Incubator:	
Lumber, paint and hardware	2.50
Thermoregulator	3.00
Electrical wiring and fixture	.60
Total Cost	$9.60

Figure 7 is an ordinary 50-pound ice box converted into an incubator by the installation of a thermostat and a heating unit. This arrangement provides a very satisfactory incubator with a capacity of 6 to 8 quart bottles.

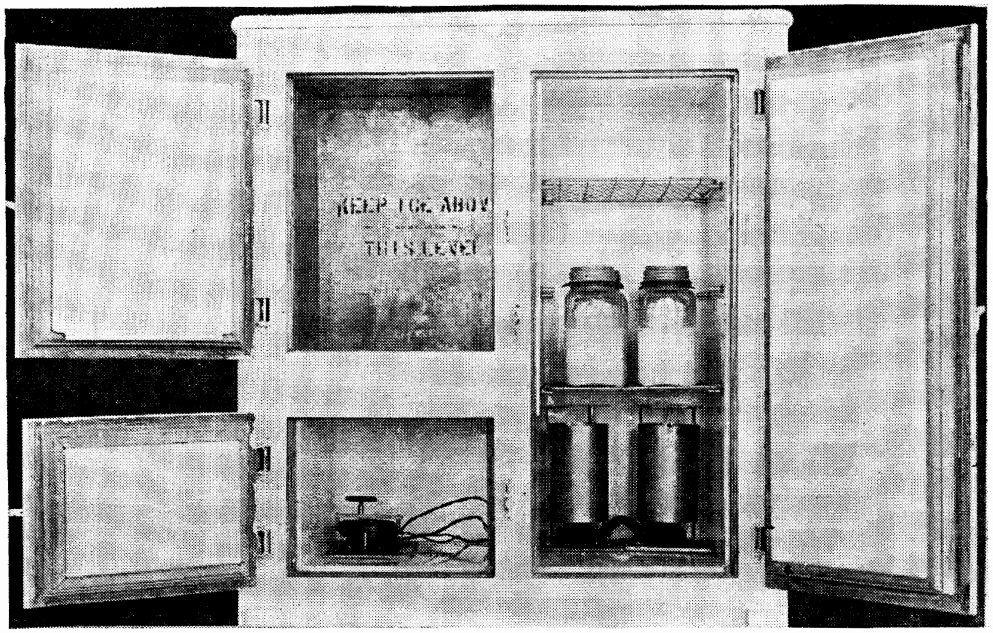

Figure 7. Culture control incubator made by placing a thermostat and a heating unit in an ordinary ice box.

The directions for locating either of these incubators are the same as those given for the small unit. If the ice box type is used, it may be kept in a warm room, provided ice is kept in the ice chamber. Otherwise the box should be located in a room where the temperature never exceeds 68°F.

IV. COOLING CREAM ON THE FARM AND IN CREAM BUYING STATIONS

The proper cooling of cream on the farm is one of the essential steps in the production of cream which will aid materially in the manufacturing of high quality butter. The failure on the part of many producers for various reasons to cool cream adequately is one of the primary causes of much of the low quality butter manufactured at the present time in the United States.

A SOUTHERN PROBLEM

In Oklahoma and in many other southern states, this situation is particularly due to the excessively high air temperature during the summer season coupled with relatively high water temperatures throughout the year. Due to the relatively small quantity of cream produced on the average farm, the use of ice or mechanical refrigeration is not economically justifiable. Therefore the farmer is confronted with the problem of doing the best he can with the materials at hand. Too many farmers have assumed the attitude that, since conditions are not particularly favorable, they are excused for not producing high quality cream. The cream grading programs now being conducted in various sections coupled with the activity of many state health departments will soon convince cream producers that they are not to be excused for the production of low quality cream because of local conditions. Bad cream will continue to be rejected; poor cream will receive a cut of several cents per pound of butterfat, and only high quality cream will receive a first grade price. Therefore it behooves all farmers to take every precaution to produce high quality cream, to cool it properly and to deliver it frequently.

The fact that it is impossible in the southern states to cool the cream with water to the extent that it is possible in northern states should not discourage any southern farmer from making full use of what cooling facilities are available. Even though completely satisfactory cooling cannot be accomplished economically at the present time on farms in the South, cream producers should realize that a little cooling is more to be desired than no cooling at all.

OFF-FLAVORS LOWER QUALITY

Because off-flavors lower quality, the following section of this bulletin will outline some of the most suitable and economical methods of cooling cream which is to be sold to creameries for butter-making purposes. First of all, however, it should be kept in mind that keeping cream sweet is not all there is to the production of high quality cream. Flavors which may be absorbed from the surroundings, flavors which may come from the feed the cow has consumed, and old flavors developed in cream from standing even though it may have been kept sweet may make the cream objectionable for use in the manufacture of high quality butter. Assuming that these facts are understood, a discussion of methods for cooling cream on the farm will follow.

Every farmer should equip himself with a floating dairy thermometer which may be obtained from any dairy supply house for about fifty cents. With this instrument the temperature of the cooling water can be determined as well as that of the cream. This will help a farmer decide which method of cooling cream is most suitable under his particular conditions.

FREQUENT DELIVERY AN ADJUNCT

Generally speaking, if cream is properly produced and free from off-flavors and is immediately cooled to 50° F. or lower and held at that temperature, it will be graded No. 1 if delivered twice each week; held between 50-75°F., it will be graded No. 1 if delivered three times each week; and held above 75°F. will likely be graded No. 2 unless delivered each day. The average temperature of water from wells on Oklahoma farms is between 58-60°F. The temperature of water from individual wells may vary considerably from this average; but if the temperature of the water from a well falls within this range, it means that during the season when the air temperature is above 60° F. cream held in this water must be delivered three times each week to assure the producer first grade price.

AIR POOR HEAT CONDUCTOR

During the seasons when the air temperature is lower than the temperature of the water direct from the well, cream should be allowed to stand in the water which has been drawn previously, in order that the water may be cooled down by the cooler air. In no case should cold air be depended on to remove heat from milk or cream. Air, being a poor conductor of heat, will not carry away the heat nearly so rapidly as will water at the same temperature. After the heat has been removed from cream by submersion in water, it may be kept cool satisfactorily by air, provided the air is cooler than the water.

A point which should be emphasized is the necessity of stirring the cream at frequent intervals to obtain quickest cooling. This is especially important during the first hour after the cooling has been started.

Fresh warm cream should always be set in cold water and stirred until cool before mixing with other cream. Failure to observe this precaution always results in cream of reduced quality.

THE BARREL COOLER

Where a considerable amount of cream is produced and a large quantity of well water of average temperature has to be pumped for stock, the barrel cooler (Figure 8) is perhaps the most satisfactory apparatus to use. It is easily constructed and very low in cost. It should be located between the pump and the stock watering tank, so that all water pumped will aid in keeping the cream cool. It is preferable to place the barrel in the milk house or other suitable building. In any case it should be inclosed to protect it from the direct rays of the sun and from dust.

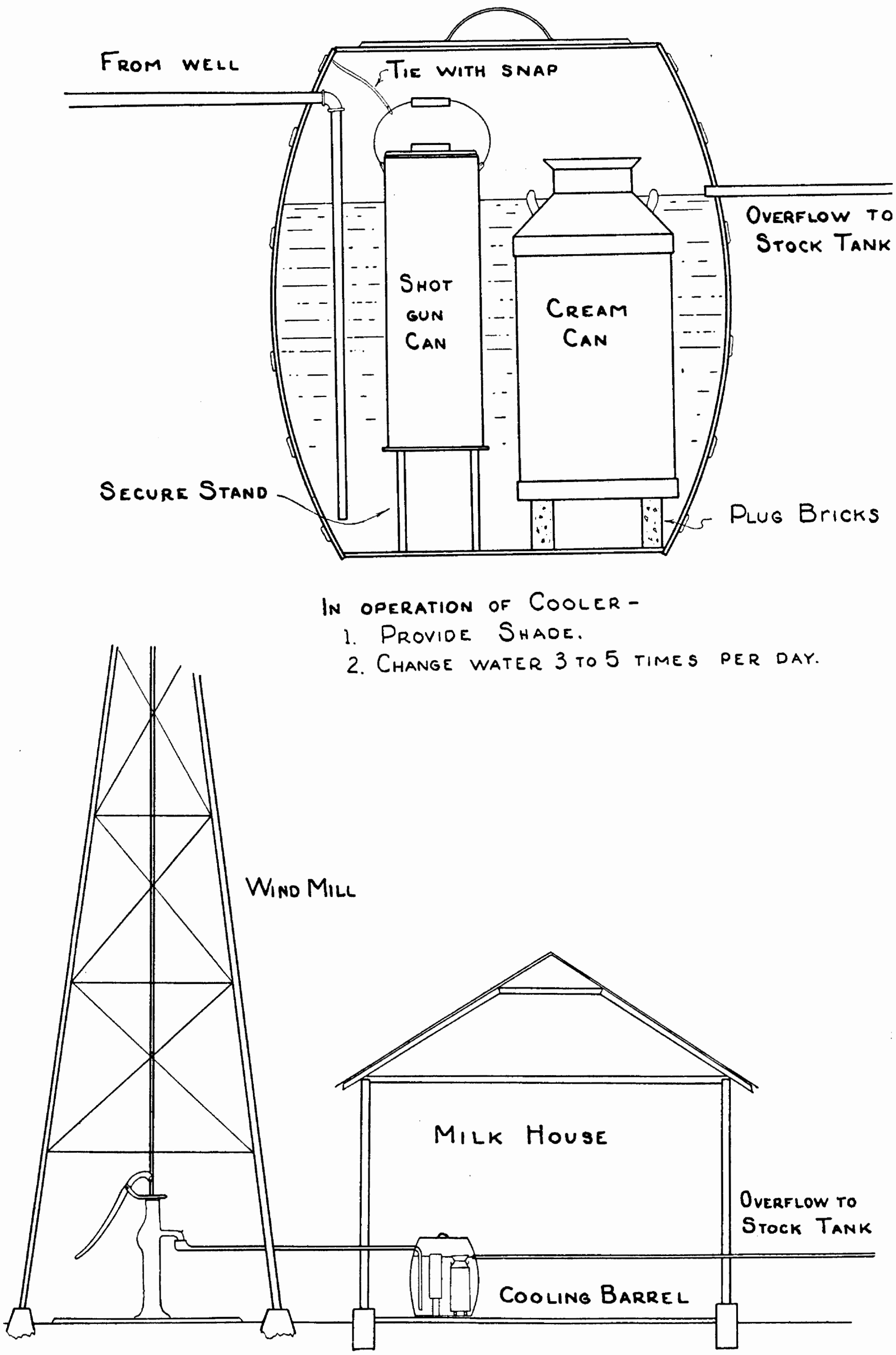

Figure 8. Details of construction and desirable location of a barrel cooler.

AN EVAPORATION COOLER

Where only a small quantity of cream is produced, or in cases where the water temperature is quite high, the evaporation cooler shown in Figure 9 has been found to be more suitable than the barrel cooler. For this cooler, two shallow pans are needed. One should be about six inches larger in diameter than a five-gallon cream can, and the other should be about the same diameter as the lid of the can. A piece of light weight muslin is also needed. It should be large enough to wrap around the can and cover it completely and long enough to extend into each pan.

After the cream has been separated, it should be pre-cooled in water for about an hour with frequent stirring before being placed in the evaporation cooler. It is advisable to have two cans for cream, one for the pre-cooling in water and the other one in which to hold the cream until it is ready to be taken to market.

After the cream is pre-cooled the storage can should have the cloth and top pan removed, the fresh cream should be added, stirred well, and the pan and cloth replaced. Both pans should be kept supplied with water in order that the cloth surrounding the can will stay saturated with water. During extremely hot weather it will be necessary to replenish the water several times during the day.

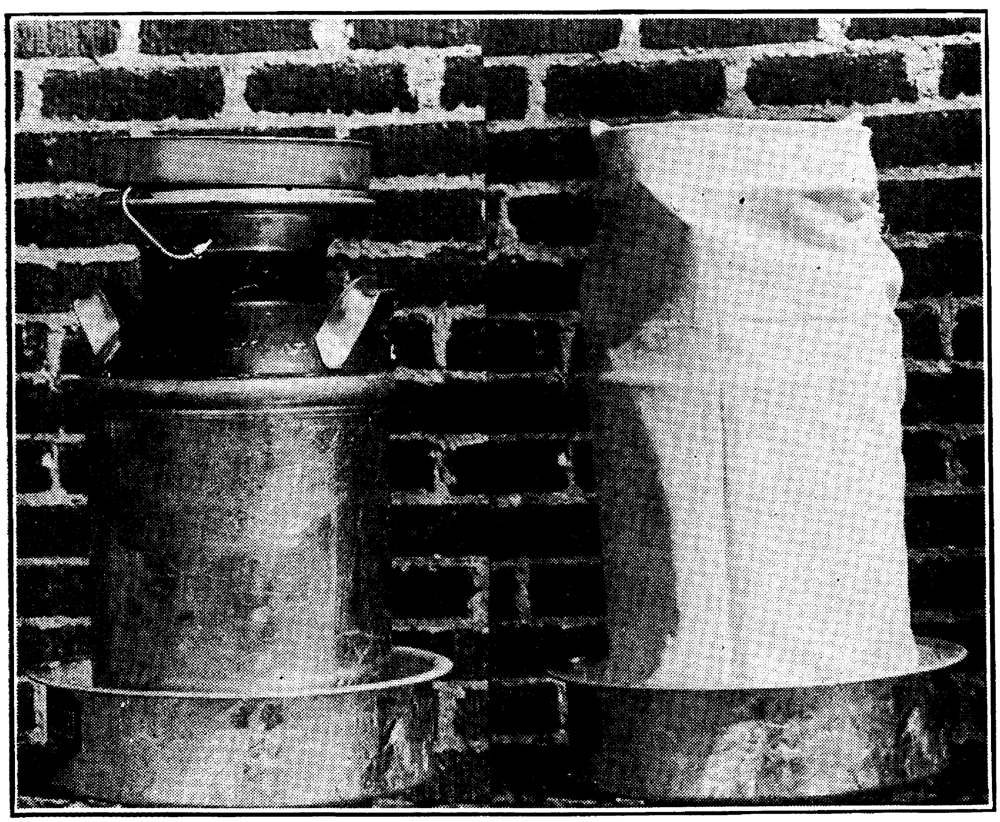

Figure 9. An evaporation cooler for cooling cream on farms where a plentiful supply of cold water is not available. Two views showing (a) cream can with water pans in place; (b) same as (a) except that the can is completely covered with a piece of light weight muslin which extends into both top and bottom pans. Almost any pan of suitable size may be used.

The can should be located in a convenient, shaded place where it will be subjected to any breeze that may be blowing. This cooler depends on the evaporation of water to reduce the temperature of the cream. It has been found that this cooler, while not perfect for its purpose, will provide a cheap, convenient means of aiding the small producer to sell good quality cream.

EVAPORATION COOLER FOR CREAM BUYING STATIONS

With the advent of cream quality improvement campaigns and the realization by creamery operators that the treatment cream has received in cream stations has been partly responsible for poor quality has come a need for a suitable method of cooling cream during the time it is held in the station. Here again, ice or mechanical refrigeration is at the present time thought to be economically not justifiable; so cheaper means have been sought.

Figure 10. An evaporation cooler recommended for use in cream station.

An application of the principle of the evaporation cooler described for farm use will aid considerably in reducing the temperature of cream in stations. Due to the larger scale of operation the pans and cloths are not well suited to cream station use. A spray system shown in Figure 10 has been developed which meets the requirements nicely. It is easy to build and very economical to operate. It consists of a framework of one-half inch black or galvanized iron pipe with nozzles at intervals suitable to the size of cans being used. The nozzles are similar to those used on vegetable racks in grocery stores, and when city water pressure is turned into the frame a very fine stream of water hits the can with considerable force. When this fine stream hits the curved side of the can, a fine mist is formed which completely covers the surface of the can. This mist evaporates readily, cooling the cream several degrees below the water temperature. The cans and rack should be placed in a position so that maximum evaporation will take place.

This type of cooler has advantages over the overhead sprinkler system in that less water is used and more cooling can be achieved because of the finer film of water and fine mist which is created.

The degree of cooling to be expected depends considerably on the atmospheric temperature, humidity, and air currents. To give some idea of the results to be expected from this apparatus in trials run during weather ranging from 100° F. - 105° F., using water for spraying at

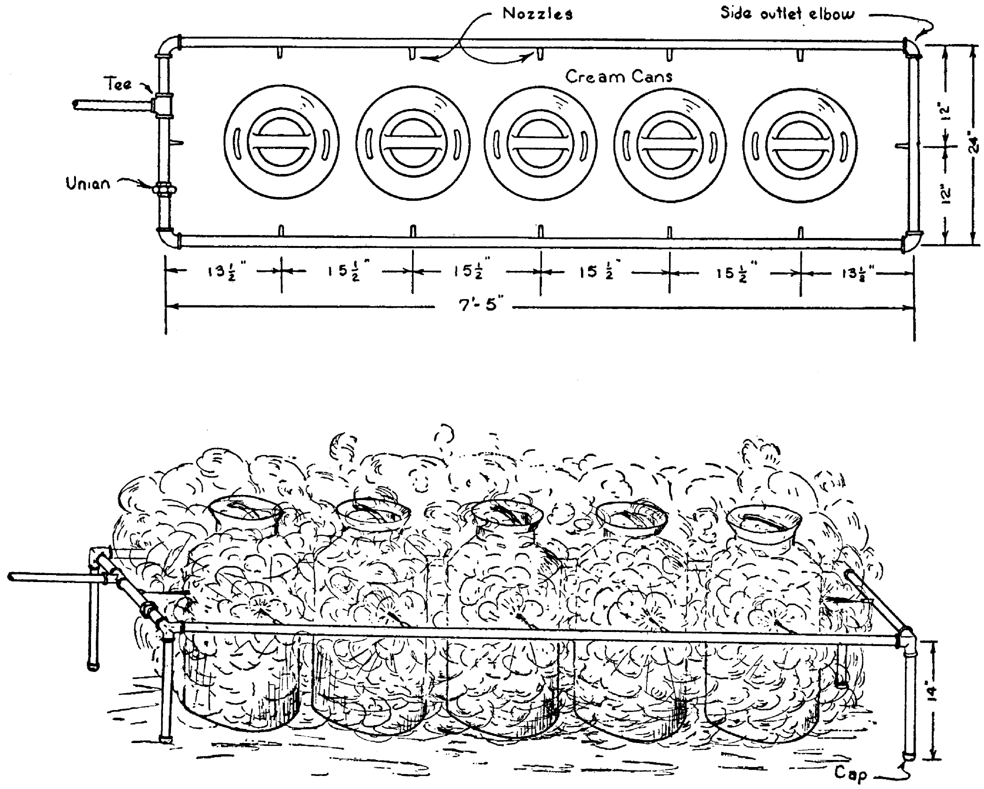

Figure 11. Diagrams showing the construction of the evaporation cooler for cream stations and the appearance of the cooler in operation.

90° F., it was found possible to cool cream to 75° F. On still, humid days the cooling efficiency was impaired somewhat. Lower air temperatures produced correspondingly lower cream temperatures.

In case cement floors and drains are not available on which to place the apparatus, a galvanized pan about four inches high should be used in which to set the cans to catch the water.

TOO MUCH WATER DETRIMENTAL

When the principle of the evaporation cooler is employed, care must be taken that an excessive amount of water is not used. During the summer while the tap water is quite warm, a coarse spray of water will tend to hamper the efficiency of the cooler. The smallest amount of water possible to keep the surface of the cans damp is the correct amount. For this reason a nozzle which creates a fine mist is more desirable than a coarse spray nozzle.

SPRAY FOR USE WITH SACKS

Wet sacks are satisfactory for reducing the temperature of cream in cans under certain conditions. Too much or too little water or poor distribution of the water impairs their usefulness. Since many of the large creamery companies in the South have already provided their operators with special sacks for covering their cream cans, it was thought desirable to devise a spray which would allow these sacks to be used in the most efficient manner possible.

A spray system shown in Figure 12 has been devised to meet this need. It is made from ⅜-inch pipe using standard fittings. It can be made in any desired size to suit the individual needs of station operators. It consists of a pipe of desired length with nozzles and diffusers as shown in Figure 13. A cross member at each end holds the device on top of the cans.

It is economical and easy to construct and operate; it is convenient and requires no floor space; it distributes water over a large area in adequate but not wasteful quantities; it cools the surrounding air through a radius of several feet; and it holds the temperature of the cream at a point considerably lower than can be obtained without the evaporation principle being applied.

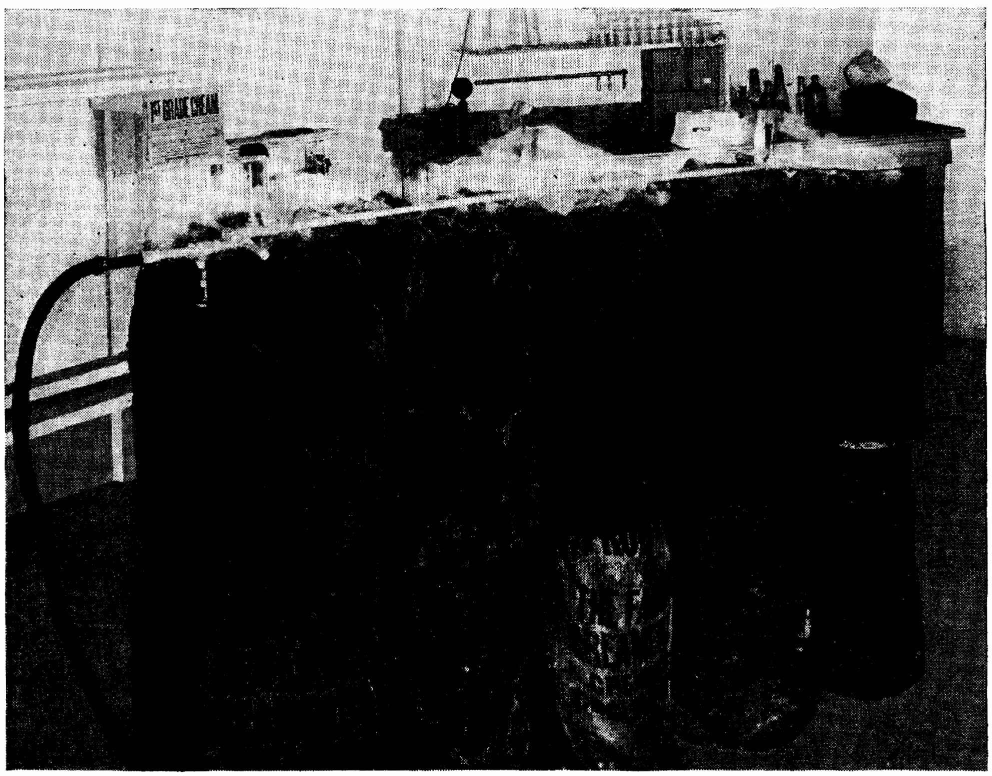

Figure 12. An evaporation cooler, for use in cream stations, of suitable size for cooling up to 200 gallons of cream.

Fittings and materials to construct one unit for a maximum of 24 ten-gallon cans are as follows:

4 ⅜″ caps
3 ⅛″ to ⅜″ bushings
1 ⅜″ nipple, 4″
2 ⅜″ nipples, close
2 ⅜″ pipe, 29″
3 nozzles ⅛″ thread, orifice approximately .025″ (Steel Products Co., Dallas, Texas)
6 ⅜″ tees
3 ⅜″ nipples, 6″
3 ⅜″ nipples, 1½″
1 ⅜″ valve
1 ½″ x ⅜″ reducer
3 diffusers (made from light strap iron mounted in such a manner that water jet strikes a flat surface at right angles.)

All materials used in the construction of these sprays should be galvanized. The apparatus should be covered with aluminum paint to render it more rust resistant.

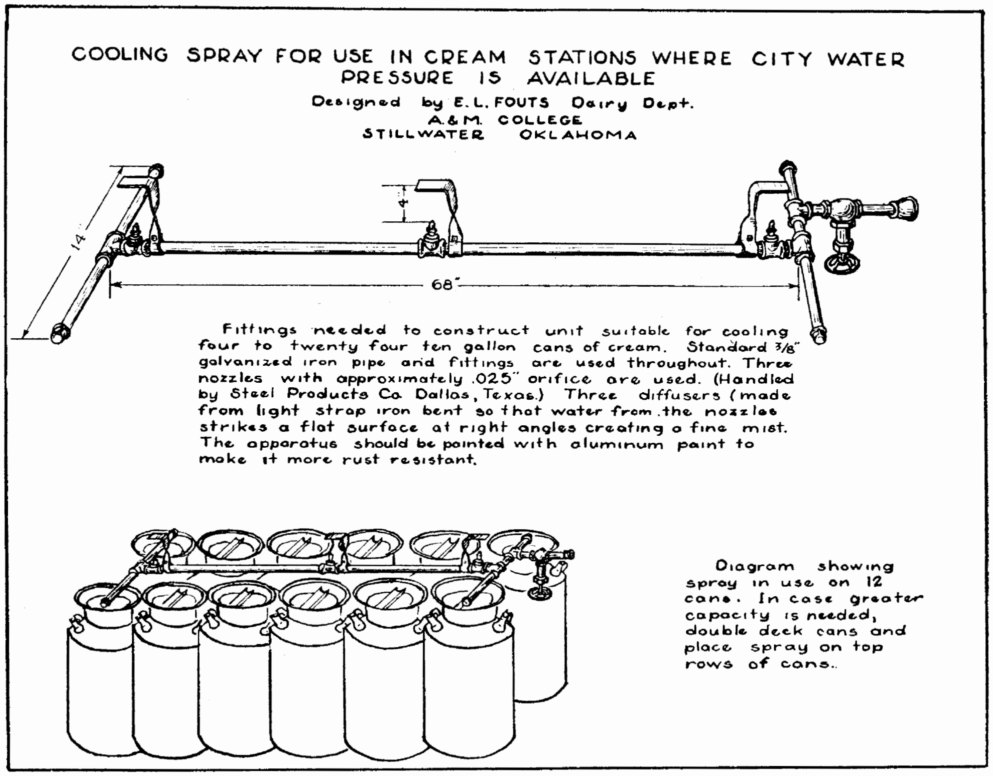

Figure 13. Diagrams showing the construction of a cream cooling device to be used in cream stations when burlap sacks are available.

V. TESTING FOR SEDIMENT IN CREAM

Several different pieces of apparatus have been used extensively for years in determining the amount and kind of sediment in milk. During recent months since the sediment testing of cream has received attention, some new equipment has been placed on the market for this particular use. Almost any apparatus which will conveniently permit the cream to be forced through a cotton disc will serve the purpose, although some sediment testers are more suitable for cream than others.

Due to the fact that flakes of precipitated casein will clog filter pads, it is frequently difficult to obtain a satisfactory sediment test on sour cream without first dissolving or partially dissolving the coagulated casein.

Various investigators have worked out methods and materials to accomplish this purpose which embody the use of sodium hydroxide (lye) or sodium bicarbonate.

SODIUM CARBONATE BEST SOLVENT

Repeated efforts in the dairy laboratory at the Oklahoma Experiment Station to perform the test using sodium bicarbonate of the strength recommended failed to give complete satisfaction, the pad frequently becoming clogged before the cream had completely passed through. Much undissolved casein frequently was left on the filter pad.

Trials with the procedure recommending the use of a weak solution of sodium hydroxide resulted in a satisfactory solution of the curd, but the sediment pads were left with a slightly yellow discoloration which obscured to some extent the finer particles of sediment.

These findings led to some experimentation with various reagents which are capable of dissolving coagulated casein. Those tried were sodium bicarbonate, sodium carbonate, sodium hydroxide and ammonium hydroxide. All except sodium bicarbonate dissolved the curd satisfactorily in most instances. Considering the cost of the material, ease of handling, and more particularly the fact that it yields a sediment test pad with a white background, sodium carbonate was considered the most suitable for use by cream station operators who desire to perform the test.

INSTRUCTIONS

To Prepare the Stock Solution

Weigh 321 grams (11.3 ounces) of commercial 58 per cent soda ash (sodium carbonate) and place in a clean gallon bottle. Add enough hot water (about 150° F.) to make up one gallon. Allow this to stand, agitating frequently until completely dissolved. Filter the solution through a cotton sediment disc to remove all sediment. Although the solution may be slightly cloudy, this condition will not interfere with the test in any way.

To Make the Test

Place 17.5 c.c. of the above stock solution in a small enamel-ware utensil. Add approximately 75 c.c. of boiling water which has previously been carefully strained to remove any sediment which may have been present in the water. Measure out two ounces of the cream to be tested and pour it into the dilute alkali solution which should be nearly boiling. Stir thoroughly while adding and allow the mixture to stand for two minutes, stirring occasionally. Pass the cream, water, and alkali mixture through a cotton sediment pad at about 170° F. Remove the sediment pad and observe the amount and type of sediment present.

A 17.5 c.c. acid measure or a 17.6 c.c. milk pipette may be used for measuring the desired amount of alkali. An ordinary two-ounce cream sample jar may be used to measure the desired amount of cream for the test.

In case chemically pure sodium carbonate is available and the operator desires to use it, the solution should be made by dissolving 430 grams (15.2 ounces) in enough water to make one gallon. Otherwise the test is performed exactly according to above directions. Apparently the impurities in commercial soda ash in combination with the sodium carbonate it contains produce a more powerful dissolving action than does pure soda ash, as it may be noted that more of the chemically pure chemical is needed to make a satisfactory solution than of the commercial product.

Commercial 58 per cent soda ash costs about ten cents per pound in small lots. At this price, the cost of enough solution for 100 tests is about two cents.

It should be recognized that no test so far devised will work perfectly on every sample of cream. Excessively sour, hand-skimmed cream presents a difficult problem because of the abnormally large amount of curd to be dissolved.

This test has been used successfully on a large number of samples just as they were delivered to a local creamery. No difficulty has been experienced in getting any sample of salable cream to pass through a filter pad, although in some cases a small amount of curd was left on the disc. This material is easily distinguishable from the undesirable foreign matter in cream. Many samples of cream seven days old were included in those tested.

In the interest of standardizing and simplifying the procedure and equipment the following recommendations are made:

1. Use a pressure-type sediment tester.
2. Use a two-ounce sample of cream.
3. Use sodium carbonate solution as directed.
4. Use the regulation 1¼-inch cotton sediment disc.