

The Butter Industry of Oregon

Factors Relating to the Quality of Butter



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INTRODUCTORY STATEMENT


By

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This report is the second of a series to be issued by the Oregon Agricultural Experiment Station on various phases of the butter industry. Circular 74 reporting on the initial survey of the industry called specific attention to the importance of giving further study to the problem of butter quality. With this in mind the cooperation of the Bureau of Dairy Industry, United States Department of Agriculture, was obtained and the second step, the study reported on herein, was undertaken. The present study was completed June 30, 1929.

Already as a result of the contacts made during this survey, visible improvement in butter quality has been made. Practical methods in farm refrigeration which will make possible the delivery of a much better raw product to manufacturing plants have been developed. Further studies of the relationship between the quality of raw cream and quality of finished butter suggested in this report have been approved and will be started shortly. All of these studies fit into the general scheme for finding what can be done to improve Oregon butter. There is every evidence that improvement in the quality is of as great importance as ever.

 THE quality of butter manufactured in Oregon can be improved. This can be done by using better manufacturing methods and by improving the quality of the raw product.

Butter made from first-grade cream to which has been added some cream of a lower quality will ordinarily score 90.0 to 91.0 when made under average conditions. By the churning of the first-grade cream separately and using the best manufacturing methods butter scoring 91.0 to 92.0 can be made.

Any further improvement in the quality of butter appears likely to come through improvement in the quality of the cream delivered to the creameries.

SUMMARY

1. 39.9 PERCENT OF THE MILK PRODUCED IN OREGON IN 1928 WAS USED IN THE MANUFACTURE OF BUTTER.

A larger amount of milk was used for butter than for fluid milk purposes or for any of the other manufactured dairy products. A considerable amount of cream was shipped to Washington and Idaho for butter manufacture.

2. THE AMOUNT OF BUTTER MADE IN OREGON PER YEAR HAS ALMOST DOUBLED DURING THE TEN-YEAR PERIOD 1919-1928.

The production of butter in Oregon in 1919 was 13,279,369 pounds; in 1928 it was 25,781,038 pounds.

3. THE NUMBER AND SIZE OF THE CREAMERIES HAVE INCREASED DURING THE PERIOD 1919-1928.

There were 80 creameries in the state in 1919 manufacturing an average of 165,992 pounds of butter per year per creamery. In 1928 there were 108 creameries which made an average of 238,713 pounds of butter per year per creamery. Although the total production in 1928 was almost 100 percent greater than it was in 1919, the percentage increase in the number of creameries had been only 44.

4. THERE HAS BEEN A DEFINITE TREND TOWARD GREATER PRODUCTION PER CREAMERY.

In 1924, the largest percentage of the creameries made less than 100,000 pounds, while in 1928 the largest percentage made 100,000 to 200,000 pounds. There was little change in the groups of creameries making more than 200,000 pounds per year. In 1928, 59.6 percent of all the creameries manufactured less than 200,000 pounds of butter.

5. THE WILLAMETTE VALLEY AND PORTLAND SECTIONS ARE THE MOST PROMINENT BUTTER-PRODUCING SECTIONS IN THE STATE.

Sixty percent of all the butter manufactured in the state was made in these sections. There has been a steady decrease, however, in the amount of butter made in the Portland area during recent years. This may be accounted for in part by the diversion of milk into other channels. The production in the Willamette Valley does not show any marked change during the past few years. The Southern and Eastern Oregon and Coast sections have shown increases in the amount of butter made. It is estimated that the cream shipped out of the state during 1928 contained 2,500,000 pounds of fat.

6. THERE IS A GREAT VARIATION IN THE AMOUNT OF BUTTER MADE EACH MONTH.

The percentage of butter made each month in 1927 varied from 4.0 to 14.2. The Coast section showed the greatest variation with a

SUMMARY (Continued)

production of only 4.0 percent in February and 14.2 percent in May and June. The Southern and Eastern Oregon sections showed a minimum production of 6.9 percent in February and a maximum of 11.7 percent in May. The production in the Willamette Valley and Portland sections varied from 6.0 percent in September to 12.0 percent in May. These variations have an unfavorable economic influence on plant operations.

7. BUTTER SCORINGS SHOWED A WIDE VARIATION IN THE QUALITY OF BUTTER MADE.

The scores of 265 samples of butter obtained in Portland retail stores and from representative creameries during the period January to June, 1929, inclusive, ranged from 87.0 to 93.0. Of these samples 20.8 percent scored below 90.0; 41.1 percent scored 90.0 and 90.5; 30.9 percent scored 91.0 and 91.5; and 7.2 percent scored 92.0 and above.

8. THERE WAS A PRONOUNCED LACK OF UNIFORMITY IN THE COMPOSITION OF 261 SAMPLES OF BUTTER ANALYZED.

There was a maximum variation of 6.9 in the percentage of fat, 5.4 in the percentage of moisture, 4.1 in the percentage of salt, and 1.0 in the percentage of curd, etc., present in the butter analyzed during January to June, 1929, inclusive. Not only was a great variation between the samples noted, but many samples showed variations from what is generally considered a standard composition of good butter.

9. SOME SAMPLES OF BUTTER HAD A HIGH YEAST AND MOLD COUNT.

The yeast and mold content of 232 samples of butter ranged from 1 to 5076 and averaged 225. Some of the samples showed counts of less than 10 per c.c., but the majority had counts of 50 and above. A low yeast and mold count indicates that the cream had been thoroughly pasteurized and that few organisms had been added by the equipment, wash water, wrappers, etc.

10. THE QUALITY OF CREAM RECEIVED BY THE 60 CREAMERIES VISITED SHOWED CONSIDERABLE VARIATION.

About 50 percent of the creameries visited were paying for cream on the basis of quality and used certain standards of cream quality as a guide. The majority of creameries were paying a premium of 2c to 5c for sweet cream over the price paid for first-grade sour cream, and made a deduction of 2c to 5c in the price paid for second-grade sour cream. The amount of sweet cream received by the plants which were paying according to a grading plan varied during the summer from 5 to 30 percent, and during the winter from 75 to 95 percent.

SUMMARY (*Continued*)

11. CREAM WAS NOT DELIVERED TO THE CREAMERIES AT FREQUENT INTERVALS.

The frequency of cream delivery varied from one or less to five deliveries a week. Much cream arrived at the creameries in a stale or sour condition on account of having been held too long on the farm under unfavorable conditions.

12. FEED AND WEED FLAVORS WERE PREVALENT IN THE CREAM AT CERTAIN SEASONS OF THE YEAR.

Wild onion and other weeds were responsible for undesirable flavors and odors in cream received at some of the creameries, especially during the spring, which resulted in a lowering in the quality of the butter. Undesirable flavors resulting from improper feeding of kale and turnips were also noted. Sticky and crumbly textured butter was noticed in the sections where the cows were fed on a restricted diet of alfalfa hay.

13. MANUFACTURING METHODS AT THE PLANTS SHOWED NOTICEABLE VARIATIONS.

In many creameries the cream was not graded before churning. Good and poor quality cream were mixed and churned together, with the result that there was considerable variation in the quality of butter made from day to day. Some creameries graded the cream before churning, even when it was not purchased on the basis of quality. This resulted in the production of standard grades of uniform quality. At one plant it was demonstrated that it was possible to improve the quality of the butter and make a more uniform product from day to day by keeping the off-flavored cream out of the usual first-grade churnings. It was found that no uniform methods of neutralizing and pasteurizing were used. The acidity to which the cream was neutralized varied from .14 to .30 percent. Pasteurizing temperatures varied from 140° F. for 30 minutes, to 165° F. for 10 minutes with the holding method, and from 170° F. to 200° F. with the flash method. Only four of the creameries visited were using a butter culture regularly.

14. MOST OF THE BUTTER MADE IN OREGON WAS SOLD IN THE STATE.

With the exception of a small amount, the butter made was sold within the state. Each creamery marketed its own output as much as possible in the form of prints and sold it to the retailers, or in some instances direct to the consumers. Surplus butter from Western Oregon was sold either in Portland, Seattle, or San Francisco. The surplus butter from Eastern Oregon was sold in Los Angeles.

15. BUTTER SCORING 91.0 CAN BE MADE UNDER PRESENT CONDITIONS.

Experimental churnings, field observations, and the study of manufacturing reports sent in with the samples to be scored indicate

SUMMARY (Continued)

that it should be possible to make a uniform 91.0-score butter from the first-grade cream now produced in the state, if proper manufacturing methods are used. In addition to this it should be possible, in most cases, by the proper use of a fine-flavored butter culture further to improve the quality to the extent of increasing the score from .5 to 1.0 point. This would mean that butter made in this way would score 91.5 to 92.0. All second-grade cream must be segregated and churned separately if the foregoing is to be accomplished.

16. A STILL HIGHER QUALITY OF BUTTER CAN BE MADE.

There was no plant in the state that made a 92.0-score butter from the average quality of first-grade cream received. It has been reported that occasional churnings of this grade have been produced from exceptionally good first-grade cream. There were a few plants, however, that manufactured butter scoring 92.0 to 93.0 from high-quality sweet cream, delivered to the plants or obtained from milk separated in the plants. If much improvement is to be made in the quality of the butter, it would seem that it must come about through a marked improvement in the quality of cream. Too few creameries are paying for cream on the basis of quality. Cream producers should be instructed in the methods of producing cream of fine flavor and in the caring for cream on the farm. The creameries should pay a differential in the price for the different grades of cream and churn them separately. Cream should be delivered with greater frequency under the present conditions of storage on the farms, and should be protected during transit. Where fresh, sweet cream is purchased, or where milk is received and separated at the creamery, the butter churned from such cream usually is of a 92.0- to 93.0-score quality. Butter culture having a fine flavor and aroma may be used advantageously in making butter of this quality. No evidence has been developed in this study to indicate that uniformly 92.0- to 93.0-score butter can be made except from sweet cream free from undesirable flavors.

The Butter Industry of Oregon

A Study of Factors Relating to the Quality of Butter

By

E. S. LARRABEE* and G. WILSTER

INTRODUCTION

There is a tendency generally throughout the United States to improve the quality of dairy products. The consumers are being educated to use butter of uniform flavor, appearance, and composition. Some work has been done in Oregon to improve the quality of butter, but still the largest proportion of the butter made is only of average quality.

The bulk of the butter made in Oregon is sold within the state by the individual creameries in the form of prints, and it is not subjected to any Federal or State inspection or certification which would serve to guide the consumers in regard to its quality. The selling of butter on local markets is chiefly a matter of satisfying the purchasers as to price, quality, and uniformity. The largest percentage of this butter is reported to be of medium quality, scoring from 90.0 to 91.0, a smaller percentage below 90.0 and very little above 91.0. There is a surplus of butter over that used for home consumption every year which must be sold on out-of-state markets. In order to receive the highest price, this surplus must be of the proper quality. This quality is not now generally produced.

The California markets offer the best outlet for the surplus produced in Oregon. Of the butter received on the San Francisco market from Oregon in 1927† only 10 percent scored 92.0. It was stated that some of the butter received from Oregon was very fine while some was very poor. In 1928, 35 percent scored 92.0 or above, 25 percent scored 91.0, 26 percent scored 90.0, and 14 percent scored below 90.0. It was also stated that there is likely to be an increasing demand for butter of high quality in California. The consumer demand is becoming more critical, and it will only be a short time when consumers' appreciation will be developed to such an extent that advantageous prices will be obtained for the higher grades of butter in comparison with those obtained for the lower ones.

The present study was made in order to determine:

- (1) The factors which have a bearing on the quality of butter made in the State of Oregon.
- (2) Whether higher grades can be made under present conditions.
- (3) What changes would be necessary to make higher and more uniform grades of butter.

The information obtained could then be used as a basis on which to build a program of butter standardization and improvement for the state.

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†Information to the authors from F. H. McCampbell, Bureau of Agricultural Economics, U. S. Dept. of Agric., San Francisco, California.

METHOD OF STUDY

In making the study the factors which received particular attention were:

- (a) Quality of cream received by the creameries.
- (b) Grade and composition of butter manufactured.
- (c) Manufacturing and marketing methods.
- (d) Market requirements as to quality and uniformity.

In the course of the investigation, observations and tests were made in the field, laboratory work was conducted, and marketing studies were made.

Field study. In making the field observations visits were made to 60 different creameries in the state, sufficient time being spent at each plant to permit becoming familiar with the quality of cream received, methods used in manufacture and marketing, and the managerial policy as it pertained to the problem of quality. These visits were made during different seasons of the year.

The flavor and aroma of each can of cream received during the inspection period were noted and the cream tested for acid by means of a rapid acidity test. This test consisted of using an 18-gram dipper for the cream and a 4-c.c. dipper for the alkali solution. A 20th normal sodium hydroxide solution containing phenolphthalein as an indicator was used. The 18-gram dipper was filled with cream from a well-stirred can and the sample placed in a white cup. Each dipperful of the alkali solution which was added to the cream represented .1 percent acid, calculated as lactic. The butter-fat test of the cream and the number of deliveries made each week were obtained from the creamery records.

Manufacturing practices and the sanitary condition of each creamery were noted. The butter made from the cream inspected was scored and tested for composition whenever possible at the time of each visit.

Laboratory study. Composition tests, yeast and mold counts, and quality scores of butter sent in by different creameries in the state were made in the technical dairy laboratory of Oregon State Agricultural College. Samples were also purchased on the Portland market for scoring and analysis. In order to ascertain where the contamination of the butter with yeasts and molds took place, samples of cream, buttermilk, and wash water were taken at different creameries during the manufacturing operation. As soon after taking as possible these samples were plated on malt agar in the laboratory at the College. Plates were incubated for five days at room temperature.

An attempt was made at two different plants to find out the effect of grading the cream in manufacturing on the quality of the butter. The use of butter culture with the object of further improving the quality of the butter was also studied.

Marketing study. The Portland Dairy Exchange was visited on different occasions to observe its operation and the methods used in determining the price of butter. In addition the quality of the butter received at the San Francisco market was observed as it was officially graded by the Federal-State Inspector.

SIZE OF THE BUTTER INDUSTRY IN THE STATE

A report issued by the United States Bureau of Agricultural Economics and the Oregon State Agricultural Extension Service on Oregon's Crop Production for 1928 lists the amount of milk produced and the dairy products manufactured for that year. Some of the figures given in this report were obtained from the State Dairy and Food Commissioner's report, while some were estimated from the best sources available. In computing the amount of milk used for the butter it was considered that one pound of butter was obtained from 20 pounds of milk. It is stated in the report that a very considerable amount of the milk and cream listed was produced in the State of Washington and disposed of in Portland. The data are given in Table I.

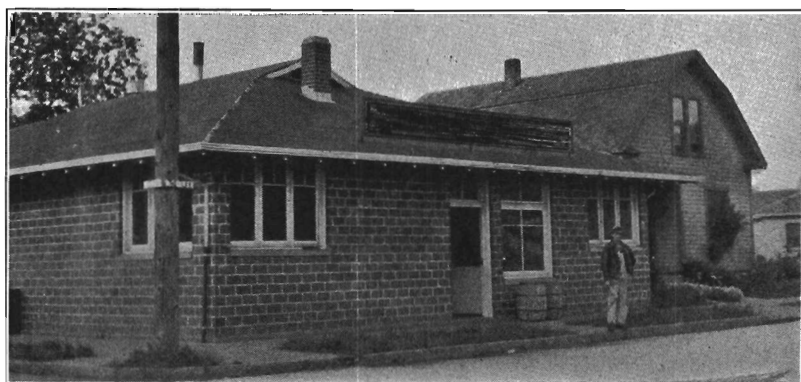


Fig. 1. A typical Willamette Valley creamery.

TABLE I. THE PRODUCTION OF DAIRY PRODUCTS IN OREGON FOR 1928

	Product made	Milk used	Percentage of total milk
	<i>lbs.</i>	<i>lbs.</i>	%
Butter	25,781,038	515,620,760	39.9
Cheese	12,968,412	118,906,264	9.2
Condensed milk	28,071,448	108,167,238	8.4
Powdered milk	2,035,164		
Cottage cheese	2,026,286	18,405,296	1.4
Ice-cream (gallons)	2,788,465	25,653,795	2.0
Market milk and cream .....	.....	365,000,000	28.3
Miscellaneous .....	.....	140,000,000	10.8
		1,291,753,343	100.0

The data show that 39.9 percent of the total amount of milk produced during that year was used for butter. A larger amount was utilized in this way than was used as market milk and for sweet cream, and it was about four times larger than the amount which was used in the manufacture of the next important product, cheese.

Number and size of creameries. There has been a gradual increase in the amount of creamery butter manufactured in Oregon. Table II gives the total yearly production of butter and the number of creameries in the state according to reports of the State Dairy and Food Commissioner for the ten-year period 1919-1928. During this period the production has increased 94 percent or almost doubled. The number of creameries has also shown an increase, but it is noteworthy that the ratio of the increase in the number of creameries is lower than that for the production. The yearly production per creamery was, therefore, greater during 1928 than during 1919. The average yearly output per creamery in 1919 was 165,992 pounds. In 1928 it was 238,713 pounds, which is an increase of 44 percent.

TABLE II. CREAMERY BUTTER PRODUCTION IN OREGON 1919-1928

Year	No. of creameries	Average production per creamery	
		Creamery butter	per creamery
		<i>lbs.</i>	<i>lbs.</i>
1919	80	13,279,369	165,992
1920	80	15,202,412	190,030
1921	84	17,111,671	203,710
1922	86	19,620,768	228,148
1923	97	23,230,301	239,488
1924	97	23,992,345	247,243
1925	98	23,770,807	242,559
1926	101	24,827,751	245,819
1927	98	26,205,783	267,405
1928	108	25,781,038	238,713

Some of the plants which reported a small amount of butter made were making it in connection with a market milk or other business.

The creameries which reported to the State Dairy and Food Commissioner their annual production of butter during the period 1924-1928 inclusive have been grouped according to their size. Table III gives the numbers and percentages of the creameries falling in each group. During this period the most noticeable change has been a decrease in the percentage of the creameries which manufactured less than 100,000 pounds and an

TABLE III. SIZE OF CREAMERIES IN OREGON*

Pounds of butter manufactured per year	1924		1925		1926		1927		1928	
	No. of creameries	Percentage of total.	No. of creameries	Percentage of total.	No. of creameries	Percentage of total.	No. of creameries	Percentage of total.	No. of creameries	Percentage of total.
		%		%		%		%		%
Less than 100,000	36	39.1	33	35.9	30	32.6	29	29.6	27	26.0
100,000 - 200,000	22	23.9	24	26.1	22	23.9	25	25.5	35	33.6
200,000 - 300,000	10	10.9	7	7.6	14	15.2	18	18.4	14	13.5
300,000 - 400,000	9	9.8	11	11.9	6	6.5	7	7.1	12	11.5
400,000 - 500,000	5	5.4	7	7.6	7	7.6	6	6.1	6	5.8
500,000 and over	10	10.9	10	10.9	13	14.2	13	13.3	10	9.6
Total	92	100.0	92	100.0	92	100.0	98	100.0	104	100.0

*Source: State Dairy and Food Commissioner.

Note: Only creameries reporting butter manufactured are considered in this table.

increase in the percentage of those which manufactured 100,000 to 200,000 pounds per year. In 1924, the largest percentage of creameries fell in the less-than-100,000-pounds group, while in 1928 the largest percentage was in the 100,000- to 200,000-pounds group. The other groups do not show any notable changes. It is significant that in 1924, 63.0 percent and in 1928, 59.6 percent of all the creameries manufactured less than 200,000 pounds of butter.

The size of the business has an important bearing on creamery costs, which are in turn reflected in the amount the creamery is able to pay its patrons for butter-fat. It is usually true that with a larger output a plant can be operated at a lower cost per pound of butter and more can be paid for butter-fat. The smaller creameries are able to compete successfully with the larger ones because the owner, often with some assistance from his family, does nearly all the work himself and has little money invested in buildings and equipment.



Fig. 2. A modern Southern Oregon creamery.

Types of ownership. Most of the creameries in the state are proprietary concerns or stock companies, the cooperatively owned plants being few. Of the 108 plants in 1928, 97 were privately owned or stock companies, and 11 were cooperatively owned. The creameries which are classed as cooperatives made 18.2 percent of the total amount of butter manufactured. At present there is no active organization of creameries for the purpose of marketing or improving the quality of the butter manufactured. For the years 1926-1928 there was an association of cooperatively and privately owned plants called The North Pacific Cooperative Creameries. This organization employed a man who worked with the butter-makers and patrons of the different creameries in the association in an effort to improve the quality of the butter manufactured by improving the cream quality and manufacturing methods. The organization was of much benefit in improving the quality of the butter manufactured. It did not enter the marketing field. Interest among the operators gradually decreased until the organization finally ceased its activity.

BUTTER-PRODUCING SECTIONS

Oregon has a variety of climatic conditions and systems of farming. The production of butter is grouped according to districts which have similar conditions. The Willamette Valley is the oldest agricultural district in the state and at present produces the most butter. This section comprises the counties of Washington, Clackamas, Yamhill, Polk, Marion, Benton, Linn, and part of Lane. Part of Douglas county is also included in the classification although it is not located in the Willamette Valley. Multnomah county is considered as a separate district because Portland has many creameries that draw their supply of cream from practically the entire state as well as from part of the state of Washington. The Coast section is considered to comprise the counties of Columbia, Clatsop, Tillamook, Lincoln, Coos, Curry, and those parts of Lane and Douglas counties that reach the Coast. Southern and Eastern Oregon include the remainder of the state.

TABLE IV. BUTTER PRODUCTION BY DISTRICTS FOR THE FIVE YEARS 1924-1928 INCLUSIVE

Section	1924	1925	1926	1927	1928	Number of creameries in 1928
Willamette Valley	7,780,772	8,258,628	9,165,886	8,807,923	8,301,183	35
Portland	8,591,857	7,402,906	7,059,839	7,455,091	7,111,733	22
Southern and Eastern Oregon	5,612,461	5,559,229	5,948,920	6,701,104	6,991,946	30
Coast	2,007,255	2,550,044	2,653,106	3,241,665	3,376,176	21
Total	23,992,345	23,770,807	24,827,751	26,205,783	25,781,038	108

Table IV shows that the Willamette Valley and Portland sections are the most prominent butter-producing sections of the state, since 57, or 52.8 percent, of all the creameries in the state are located in these sections. In 1928, 60 percent of the total amount of butter manufactured in the state was made in these two sections. The data indicate that there was an increase in the amount of butter made in the Willamette Valley section in the years 1925 and 1926 over 1924; since 1926 there has been a decrease, but

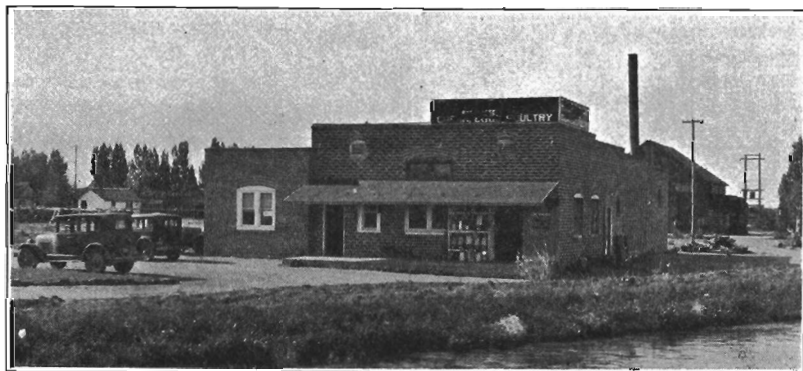


Fig. 3. A creamery in one of the growing dairy sections of Central Oregon.

the amount of butter manufactured in 1928 was still greater than it was in 1924. There has been a steady decrease, however, in the amount of butter made in the Portland district during the five years; for instance, in 1928, 1,480,124 pounds less were made there than in 1924. This may have been caused either by a decrease in production or by the diversion of milk into other channels, such as for market milk or by new plants in the sections which have been supplying cream to Portland. The Southern and Eastern Oregon and the Coast regions have shown increases, with the greatest increase in the Coast section. These increases reflect an increase in the amount of milk produced.

In addition to the butter manufactured in Oregon, large quantities of cream are shipped to creameries located in Idaho to be manufactured into butter. It is estimated that the cream shipped out of the state during 1928 contained 2,500,000 pounds of fat.*

SEASONAL VARIATION IN PRODUCTION

Table V gives the percentage of the yearly production of several creameries by months in each district. While the production of individual creameries may vary somewhat from this average, the table gives a general idea of the yearly spread. In the Willamette Valley and Portland districts the month of greatest production is May. It decreases rather rapidly during July and August to the low point in September. This is caused partly by methods of farm management and partly by the dry, hot summers and lack of adequate pastures. The amount of butter made in the month of greatest production is twice that in the month of lowest production.

TABLE V. SEASONAL VARIATIONS IN PRODUCTION BY MONTHS IN DIFFERENT AREAS

	Percentage of butter made (1927)											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Willamette Valley and Portland	7.7	7.3	8.3	9.4	12.0	11.1	9.6	6.8	6.0	6.8	7.2	7.8
Southern and East- ern Oregon	7.1	6.9	8.1	9.5	11.7	10.0	9.0	8.3	7.9	7.7	6.8	7.0
Coast section	4.1	4.0	5.6	8.2	14.2	14.2	12.4	10.6	8.1	7.6	5.5	4.5

The production in Southern and Eastern Oregon is a little more uniform throughout the year and does not drop so sharply from the high to the low point. May is the month of greatest production and November the month of the lowest. Dairy farming in most parts of this district is under irrigation, and summer production does not decrease as fast as in the Willamette Valley, where irrigation is not now practiced. In the Coastal section there is a wide variation between the amount produced during the season of lowest production and that of the season of the highest, being on the average three times more in the flush season than during the low period. The increase at some plants is sometimes still greater, being five times that of the lowest month. This variation causes difficulties in economical plant operation and has an unfavorable effect upon the quality, as the deliveries of cream are infrequent during the season of low production.

*Data furnished by county agents in Eastern Oregon and creameries in Idaho.

QUALITY AND COMPOSITION OF BUTTER MADE

A scoring of 56 samples of butter from the Portland Market in March and April 1926* showed scores ranging from 84.0 to 93.0 and averaging 88.6. During January and February of 1929 competent judges scored 104 samples of butter, 38 of which were purchased in Portland retail stores and the remainder were sent in by the creameries which cooperated in the present study. The scores of this butter ranged from 87.0 to 93.0 and averaged 90.3.

A monthly butter scoring and analysis was started at the College in March, 1929. During the first four months 161 one-pound prints of butter representative of the usual first-grade churnings of 54 different creameries have been scored and analyzed. The work of judging was done by men of recognized ability as butter judges. Three judges passed their opinion on each sample of butter. The scores showed a wide variation, ranging from 87.0 to 93.0 and averaging 90.4. Thus some butter was of second grade while some was of extra quality.

TABLE VI. SUMMARY OF QUALITY SCORES OF BUTTER EXAMINED DURING 1926 AND 1929

	March and April 1926		January and February 1929		March to June 1929	
	No. of samples	Percentage of total	No. of samples	Percentage of total	No. of samples	Percentage of total
	%		%		%	
Below 90.0	39	69.6	22	21.2	33	20.5
90.0 to 91.0	10	18.0	41	39.4	68	42.2
91.0 to 92.0	4	7.1	31	29.8	51	31.7
92.0 and above	3	5.3	10	9.6	9	5.6
Total	56	100.0	104	100.0	161	100.0

A summary of these three different scorings is shown in Table VI. There was little difference in the percentage of the samples falling in the various groups between the two scorings in 1929. A comparison of the 1926 and the 1929 scorings shows that there was a much greater percentage of the samples scoring below 90.0, and a lower percentage scoring from 90.0 to 92.0 in the 1926 than in the 1929 scoring. The percentage of samples scoring 92.0 and higher was quite similar for the three scorings. The greatest percentage of the samples examined during 1926 scored below 90.0, while during the 1929 scorings the largest percentages of the samples fell in the 90.0- to 92.0-score group. This would indicate that the quality of butter had improved during the three years.

Of the samples which, in 1929, fell in the 90.0- to 92.0-score group, 57.0 percent, or a little more than half of the samples, scored 90.0 to 91.0, and 43.0 percent scored 91.0 to 92.0. The improvement has consisted in the bringing of a large percentage of samples into the higher grades. Apparently there is still room for improvement in quality. It should consist in eliminating as far as possible the butter scoring below 90.0, and increasing the amount of butter which would score 91.0 to 92.0 and 92.0 and above.

*Oregon Agricultural Experiment Station Circular 74.

Analyses made for composition have totaled 261 samples, and 232 samples have been examined for their yeast and mold content. The minimum, maximum, and average percentages of fat, moisture, salt, and curd present, and the minimum, maximum, and average yeast and mold counts are shown in Table VII.

TABLE VII. MINIMUM, MAXIMUM, AND AVERAGE PERCENTAGE COMPOSITION AND YEAST AND MOLD CONTENT OF BUTTER

	Minimum	Maximum	Average
	%	%	%
Fat	76.6	83.5	80.53
Moisture	14.0	19.4	15.72
Salt .....	.7	4.8	2.77
Curd, etc. ....	.5	1.5	.96
Number of yeasts and molds per c.c.....	1	5076	225

These analyses show a pronounced lack of uniformity in the composition of the butter and indicate that greater care should be taken by the buttermakers in controlling the moisture, salt, and curd content. A large percentage of samples showed high yeast and mold counts, while a number of samples showed counts of less than 10 per c.c. of melted butter. A low count indicates that the cream used had been thoroughly pasteurized and that few organisms had been added during the churning and packing processes.



Fig. 4. Determining the score, composition, and yeast and mold content of butter in the technical dairy laboratory at the College.

A summary of the composition and yeast and mold counts of the butter received for the monthly scoring and analysis during the months of March to June, 1929, inclusive, is shown in Table VIII. The work has not proceeded long enough to indicate whether or not any improvement has taken place. It is noticeable, however, that there is great need for standardization in the composition of the butter. Many samples showed a great variation from the normal composition.

TABLE VIII. SUMMARY OF FAT, MOISTURE, AND SALT CONTENT, AND YEAST AND MOLD COUNTS OF SAMPLES RECEIVED FOR MONTHLY BUTTER SCORING AND ANALYSIS—MARCH TO JUNE, 1929

	March		April		May		June	
	No. of samples	Percentage of samples.	No. of samples	Percentage of samples.	No. of samples	Percentage of samples.	No. of samples	Percentage of samples.
Less than 80.0% fat.....	5	12.8	8	19.0	5	12.2	5	12.8
80.0 - 81.0% fat	22	56.4	28	66.7	31	75.6	28	71.8
More than 81.0% fat	12	30.8	6	14.3	5	12.2	6	15.4
Less than 15.4% moisture	10	25.6	8	19.0	3	7.3	6	15.4
15.4 - 15.9% moisture.....	17	43.7	16	38.1	23	56.1	21	53.9
More than 15.9% moisture	12	30.7	18	42.9	15	36.6	12	30.7
Less than 2.6% salt	10	25.6	11	26.2	12	29.2	9	23.1
2.6 - 3% salt	21	53.9	21	50.0	20	48.9	21	53.8
More than 3.0% salt	8	20.5	10	23.8	9	21.9	9	23.1
Less than 10 yeasts and molds per c.c. melted butter.....	7	17.9	3	7.1	2	4.9	2	5.1
10 - 15 yeasts and molds per c.c. melted butter	9	23.1	12	28.6	11	26.8	9	23.1
More than 50 yeasts and molds per c.c. melted butter.....	23	59.0	27	64.3	28	68.3	28	71.8
Total number of samples	39	.....	42	.....	41	.....	39	.....

FACTORS AFFECTING THE QUALITY OF BUTTER

The quality of butter manufactured in a plant is influenced more by the attitude of the owner of that plant toward quality and the ability of the buttermaker than by the size of the business. If the owner of a plant is interested in producing a high quality of butter he may work with his patrons to get a good grade of cream, refusing to accept poor and off-flavored cream. If on the other hand volume is his main consideration, little is said to the producer about cream quality, no matter what the size of the business may be. The smaller plants usually have a closer contact with the producer and are in a better position to work with him in an attempt to improve the quality of cream delivered, should they desire to do so. The smaller plants did not make more than one grade of butter and the lower quality of cream, if accepted at all, was either shipped to a larger plant or used with the rest of the cream with the result that the quality of butter was lowered. The larger plants were able to make two or three different grades of butter.

Quality of cream. The quality of the cream used in the manufacture of butter influences the quality of the butter more than any other factor. In order to investigate the quality of cream that the different creameries were receiving and to note manufacturing conditions, visits of two days' duration each were made to 60 different creameries in the state; creameries representative of their respective districts were selected. All of these plants were first visited during the summer and fall of 1928 and selected ones were visited during the winter and spring seasons of 1929 to note conditions at that time.



Fig. 5. Grading cream in the College creamery, an operation which is necessary if high-scoring butter is to be produced.

During the time spent at each creamery, the individual cans of cream received were inspected and graded by testing for acidity with the rapid acidity test and tasting for flavor, as previously described. Table IX shows the percentages of cream received which fell in the different groups based on acidity alone, the methods of gathering, and whether the plant used a grading plan in payment for butter-fat.

TABLE IX. ACIDITY OF CREAM RECEIVED AND METHODS OF GRADING AND GATHERING CREAM AT CREAMERIES

Date	Percentage of cream			Any grading plan for payment of butter-fat	Method of gathering cream	Average number of deliveries per week
	Less than .2 per cent acid	.2 to .6 per cent acid	.7 per cent acid or more			
7/9 and 10.....	22.0	53.8	24.2	Yes	Direct shippers	..
9/24 and 25.....	5.8	24.3	69.8	.....	Individual delivery	3
7/11 and 12.....	7.4	35.7	56.9	.....	Direct shippers	2
10/19 and 20.....	12.5	66.7	20.8	Yes	Individual delivery Route truck	Once on route truck
7/13-14.....	4.0	75.5	20.5	.....	Direct shippers	..
10/21-22.....	3.9	87.8	8.2	Yes	Individual delivery	2
7/16-17.....	17.2	72.1	12.7	.....	Route truck	..
10/29.....	32.7	61.4	5.9	Yes	Individual delivery	2
7/18-19.....	1.5	13.6	84.9	.....	Gathering stations	..
11/2-3.....	.....	84.9	15.1	No	Individual delivery	1
7/20-21.....	1.0	85.9	13.1	.....	Route trucks	..
11/1.....	3.3	96.7	.....	No	Individual delivery	2
7/25-26.....	3.0	63.2	33.8	.....	Route trucks	..
11/13-14.....	47.3	52.7	.....	Yes	Individual delivery	2
7/27-28.....	.....	64.8	35.2	.....	Route trucks	..
11/16.....	1.0	97.5	1.5	No	Gathering stations Individual delivery	1 ..
7/23-24.....	.....	10.1	89.9	.....	Route trucks	..
11/15.....	4.6	95.4	.....	No	Individual delivery	2
7/30-31.....	29.9	56.3	13.6	.....	Direct shippers	..
10/22.....	67.0	32.4	.6	Yes	Individual delivery	3
8/1-2.....	.1	61.6	38.3	.....	Route trucks	..
.....	1.7	96.1	2.2	No	Individual delivery	2
8/3-4.....	.....	54.9	45.1	.....	Gathering stations	..
10/26.....	2.4	97.6	.....	No	Individual delivery	2
8/6 and 7.....	11.5	71.2	17.3	.....	Individual delivery	..
11/29 and 30.....	59.2	40.8	.....	Yes	Gathering stations	3
8/8 and 9.....	.....	77.8	22.2	.....	Route truck	..
11/27-28.....	8.7	87.1	4.2	No	Gathering Stations Individual delivery	1 ..
8/14.....	.....	47.1	52.9	.....	Route truck	..
12/4.....	23.1	76.9	.....	No	Individual delivery	1
8/15.....	.....	26.3	73.7	No	Route truck	1
.....	.....	80.2	19.8	.....	Individual delivery	..
8/16-17.....	.....	80.2	19.8	.....	Route truck	..
12/5.....	64.1	35.9	.....	No	Individual delivery	2
8/20-21.....	19.7	42.5	37.8	.....	Direct shippers	..
12/11-12.....	70.6	29.4	.....	Yes	Individual delivery	3
8/22.....	11.9	61.9	26.2	.....	Individual delivery	..
12/13.....	52.3	47.7	.....	Yes	Route truck	2
8/23.....	20.9	42.3	36.8	.....	Individual delivery	..
12/14.....	11.2	88.8	.....	Yes	.....	2
8/24.....	5.7	37.5	56.8	.....	Route truck	..
12/15.....	63.1	36.9	.....	No	Individual delivery	2
8/28.....	.....	26.2	73.8	.....	Gathering stations	..
12/20.....	.....	91.7	8.3	Yes	Direct shippers	1
8/29.....	.....	31.5	68.5	.....	Direct shippers	..
12/21.....	5.1	94.9	.....	Yes	Gathering stations	1
8/30.....	88.1	11.9	.....	Yes	Route truck	..
.....	.....	.....	.....	.....	Individual delivery	3

TABLE IX. ACIDITY OF CREAM RECEIVED AND METHODS OF GRADING AND GATHERING CREAM AT CREAMERIES (Continued)

Date	Percentage of cream— Less than .2 percent acid			.2 to .6 percent acid	.7 percent acid or more	Any grading plan for payment of butter-fat	Method of gathering cream	Average number of deliveries per week
8/31	%	%	%	54.7	45.3	Yes	Route truck Individual delivery	.. 1
9/6	40.0	35.9	24.1	.....	.....	.....	Route truck	..
1/5	94.8	5.2	.....	.....	.....	Yes	Individual delivery Gathering stations	3 ..
9/5	14.6	57.8	27.5	.....	.....	.....	Route trucks	..
1/4	76.8	23.2	.....	.....	.....	Yes	Gathering stations Individual delivery	2 ..
9/10	28.1	58.1	13.8	.....	.....	Yes	Route truck Individual delivery	.. 2
9/7-8	38.5	48.3	13.2	.....	.....	Yes	Route truck Direct shippers	.. 2
1/3	73.7	26.3	.....	.....	.....	.....	Individual delivery	..
9/12-13 .....	.....	70.7	29.3	.....	.....	No	Route truck Individual delivery	.. 1
9/14-15	5.5	73.7	20.8	.....	.....	No	Individual delivery	1
9/18	12.1	67.1	20.8	.....	.....	.....	Individual delivery	..
12/26	40.4	59.6	.....	.....	.....	Yes	Direct shippers	2
9/20-21 .....	.....	77.8	22.2	.....	.....	No	Individual delivery	1
10/1	21.5	60.3	18.2	.....	.....	Yes	Individual delivery	2
10/2	21.7	75.8	2.5	.....	.....	Yes	Individual delivery	2
10/3	13.8	74.0	12.2	.....	.....	No	Individual delivery	1
10/4	48.7	51.3	.....	.....	.....	Yes	Route truck Individual delivery	.. 2
10/5	11.9	85.6	2.5	.....	.....	No	Route truck Individual delivery	.. 2
10/6-7	3.2	45.6	51.2	.....	.....	No	Gathering stations Individual delivery	.. 1
10/8	1.8	89.4	8.6	.....	.....	Yes	Route truck Individual delivery	.. 1
10/9	27.9	69.3	2.8	.....	.....	Yes	Gathering stations Individual delivery	1 and daily
10/10	18.7	69.5	11.8	.....	.....	Yes	Individual delivery Route truck	.. 2
10/11	7.2	89.5	3.3	.....	.....	No	Route trucks Individual delivery	.. 1
10/12 .....	.....	54.4	45.6	.....	.....	No	Gathering stations Route trucks	.. 1
10/13	95.5	4.5	.....	.....	.....	No	Route trucks Individual delivery	.. 3
10/25	8.1	91.8	.....	.....	.....	Yes	Route trucks Individual delivery	1 ..
11/20 .....	.....	92.1	7.9	.....	.....	No	Route truck	2
12/1	79.7	20.3	.....	.....	.....	No	Individual delivery	3
12/6-7	43.1	56.9	.....	.....	.....	No	Direct shippers	2
12/19	10.8	89.2	.....	.....	.....	Yes	Direct shippers	2
12/22	15.6	84.3	.....	.....	.....	No	Gathering stations Individual delivery	....
1/25	85.4	14.4	.....	.....	.....	No	Individual delivery	2
1/26	60.5	39.5	.....	.....	.....	No	Individual delivery	2

TABLE IX. ACIDITY OF CREAM RECEIVED AND METHODS OF GRADING AND GATHERING CREAM AT CREAMERIES (Continued)

Date	—Percentage of cream—			Any grading plan for payment of butter-fat	Method of gathering cream	Average number of deliveries per week
	Less than .2 percent acid	.2 to .6 percent acid	.7 percent acid or more			
1/28	64.0	35.9	.....	Yes	Individual delivery Direct shippers	2 ..
1/29	75.5	24.4	.....	Yes	Route trucks Direct shippers	1 ..
1/30	45.5	54.4	.....	Yes	Individual delivery Direct shippers	2 ..
1/31	40.4	59.6	.....	No	Individual delivery Direct shippers	2 ..
2/1	15.6	84.4	.....	No	Individual delivery	1
2/2	43.2	57.8	.....	No	Individual delivery	1
2/4	30.8	69.2	.....	No	Route truck	1

The quality of the cream at these different plants varied widely. It was influenced more by the attitude of the creamery management than by reason of any regional, climatic, or other conditions. One of the indications of interest in obtaining good quality cream was that 50 percent of the creameries visited were paying for cream on the basis of quality. This usually took the form of a premium for sweet cream over the sour cream price. To be classed as sweet, the cream had to have an acidity of less than .2 percent, calculated as lactic, and had to be clean to the taste. At one plant the acidity limit was placed at .3 percent. One of the rules for grading cream at the creameries using a grading plan for payment of butter-fat was as follows:

Sweet cream. Cream that contained not in excess of .2 percent lactic acid and free from all undesirable flavors or odors.

First-grade sour cream. Cream that contained not in excess of .7 percent lactic acid and was smooth, fairly clean to the taste, and reasonably free from pronounced objectionable flavors and odors.

Second-grade sour cream. Cream that was too high in acidity to grade as first, and that was yeasty, or contained undesirable flavors and odors in a moderate degree or that was somewhat stale.

Cream that was of a lower quality than the second grade as described above was returned to the producer.

The amount of premium paid varied somewhat between different creameries, ranging from 2c to 5c per pound of butter-fat, as is shown in Table X. Some of these creameries also made a distinction in paying for the sour cream, basing it on flavor. That is, if a can of cream was badly off flavor owing to bacterial action or some other cause, the price per pound of butter-fat for that cream was lowered from the standard price by 2c to 5c. A few creameries paid a lower price for the poorer quality of sour cream than for good-flavored sour cream but no premium for sweet cream.

TABLE X. DIFFERENTIALS PAID FOR DIFFERENT GRADES OF CREAM

Premium for sweet cream		Premium for sweet cream with deduction for No. 2 sour			Deduction only for No. 2 sour	
No. plants	Amount	No. plants	Amount premium	Amount deduction	No. plants	Amount
3	2c	4	2c	3c	2	5c
7	3c	2	3c	3c	1	2c
3	4c	2	3c	2c	--	----
2	5c	1	2c	5c	--	----
--	----	2	3c	5c	--	----
--	----	1	4c	4c	--	----

The amount of sweet cream received at plants paying a premium for this type of cream varied during the summer from 5 to 30 percent, and in the winter from 75 to 95 percent of the total amount of cream received. Where no premium was paid for sweet cream there was none of this quality received during the summer months and little during the winter months. Although a creamery might pay a premium for sweet cream, many of the patrons would not take advantage of this premium and did not deliver cream sweet. Most of the small producers believed that the extra care and attention necessary in cleaning utensils and cooling the cream, as well as more frequent delivery, were not worth while. The larger producers almost invariably made an effort to obtain the sweet cream premium when one was paid. The cream which was sweet when received at the creamery was delivered from two to five times per week, usually at least three times.

Nearly all of the creameries received some sour cream of poor quality which was high in acid, yeasty, or off-flavored. At creameries using a grading plan consistently, such cream was given a deduction of 2c to 5c per pound of butter-fat. But many of the operators would pay the regular price for this kind of cream for fear that the creamery would lose some patronage. If a producer, because of lower quality, received from a creamery a reduced price for a can of cream, he would be apt to send his next can to a different plant where he would receive the regular price even though the quality of the cream was not improved. Such competition makes it very difficult to pay for cream on a graded basis and has resulted in many of the plants being unable to follow the grading system consistently.

The frequency of delivery of the cream varied from one or less to five deliveries per week, and was closely associated with the method of gathering. There were four methods in use for gathering the cream:

- (1) Direct delivery by the producer to the creamery.
- (2) Gathered by truck, either weighed and sampled at the farm and dumped into larger cans, or brought to the creamery in the producer's cans.
- (3) Received at cream stations and shipped to main plant.
- (4) Direct shipment by rail or truck to creamery.

The creameries used a combination of two or more of these methods. Most of them furnished cans to the producers free of charge.

The direct delivery system gives a closer contact between the creamery operator and producer and offers a good opportunity for cream quality

improvement work with the producer. The frequency of delivery depends on the distance of the producer from the creamery and the size of his herd.

Where the cream was gathered by truck, the creamery usually owned the truck and made collections one, two, or three times a week. The cream was most commonly weighed and sampled at the farm and then emptied into larger cans for transportation to the creamery. The farmers' cans were not washed, spring scales were relied on for weighing, and grading was not usually practiced. Some of the creameries used the individual can system and brought the cream to the plant for weighing, sampling, and grading.

Cream shipped through a gathering station was usually sour when it reached the manufacturing point. The gathering station was made use of by small as well as by large creameries as a means of obtaining cream.

A large amount of cream was shipped direct to the creameries by truck or train. The cream was often sour or stale when it arrived at the manufacturing plants as the result of unfavorable conditions of producing and caring for it on the farms and the keeping of it for too long a time before shipping it.

There was intense competition for cream between different creameries in all sections of the state. This competition resulted in the sacrifice of quality in order to maintain volume.

There was some trouble with feed and weed flavors in the cream during certain seasons of the year. In the spring wild onion gave considerable trouble, especially in Eastern Oregon, and in the late summer when the pastures dried up bitter flavors were noticed in the cream because the cows were grazing on shrubs and weeds. In the winter time some trouble was experienced from the improper feeding of kale, turnips, or other strongly flavored succulent feeds. In certain sections of the state where the cows were fed on a restricted diet of dry alfalfa hay, difficulty has been experienced with sticky and crumbly texture of the butter. This trouble usually occurs during the winter months when the cattle do not have access to some kind of succulent feed.

Bitter flavors were observed during the winter in cream which was quite old when received. This defect was probably caused by bacteria.

Manufacturing methods. In nearly every plant visited some undesirable practices were noticed. The most common and noticeable of these was the lack of proper grading of the cream before churning by keeping out the old and off-flavored cream to be churned separately. It was customary for the buttermakers in many of the plants to include with the regular churning the poorer cans of cream received, in the hope that the defective flavors would be concealed. Where cream is not purchased on a quality basis this kind of cream costs the creamery as much as the good cream and the buttermaker hesitates to make a separate churning of it which may mean that the creamery would obtain a lower price for the resulting butter. Then, too, the amount of this cream is usually small so that it would take some time to get enough for a churning. But if this small amount of lower grade cream could be kept out, a marked improvement in the butter and a more uniform quality from day to day would result. At the larger plants where they have a greater volume of product, two and sometimes three grades of butter were made, particularly during

the hot weather. This made it possible to make uniform grades. The buttermakers sometimes lose sight of the fact that the quality of the butter will be largely determined by the quality of the poorest can of cream used in making that butter.

In an attempt to make an improvement in the quality of the butter at two of the plants in the state which were not grading the cream for manufacturing but did pay a premium for sweet cream, separate churnings were made of the different grades of cream. Since not enough sweet cream was available for separate churnings of this kind of cream, it was used with the first-grade sour cream. During this time it was possible consistently to make a 91.0-score butter from churnings of this nature. By ripening the cream with a fine-flavored butter culture the butter was further improved to a consistent 91.5 score, and an occasional 92.0. The lower-grade cream was also ripened with a culture, producing butter which scored 90.0 to 90.5. The score of the butter that had been made by mixing all grades of cream was 90.5 to 91.0.

It was found that there was no uniformity in the degree to which the acid was reduced before pasteurization. It varied from .14 to .30 percent, depending on the individual's experience and preference and whether or not a butter culture was used. Too often the cream was not accurately tested for acidity, making it impossible to add the correct amount of neutralizer to the cream before pasteurization. By making up the neutralizing solution correctly and by accurately testing the vat for acidity and knowing the amount of cream in the vat, the acidity can be reduced accurately. Very few buttermakers checked up on the acidity of the cream at churning time. This is the point where the acid content should be known to be correct.

In pasteurizing, the vat method was most commonly employed. The larger creameries used the flash method. As in the case of neutralization, there was no generally accepted procedure used in pasteurizing the cream; there was considerable variation in pasteurizing temperatures and periods of holding at the different plants. For the vat method temperatures were used ranging from 140° F. for thirty minutes to 165° F. for ten minutes. In the flash method temperatures of 170° to 200° F. were used. Some of the largest plants were the only ones using recording thermometers on the pasteurizers. Most of the plants used the ordinary dairy thermometer.

Very few of the creameries were using a butter culture regularly; only four of those visited were doing so. The culture was usually added at 70° F. after pasteurization, and the cream cooled down to the churning temperature, holding at this for at least one hour. If the cream was to be held overnight the culture was added just before churning.

The plants were as a rule fairly well equipped. Some had rather old churns and pumps. The condition of the cans at the different creameries was generally good, the cans were free from rusty spots, broken solder seams, etc. Where a mechanical can washer was used, the cans were washed, rinsed, steamed, and dried before being returned to the farmer. If hand washing was relied on the cans were often just washed and steamed but not rinsed or dried. Sometimes they were stored at the plant, inverted without the lids, and left to dry. On the gathering routes, where the cream was weighed at the farm, the cans were washed by the farmer.

The use of cream cans for buttermilk was not allowed by most of the creameries. Only eight of those visited permitted this misuse of the cream cans.

Not all of the creameries had the necessary equipment for making a composition test of their butter. The majority relied on the moisture test alone. Only 38 percent of them had a salt testing apparatus.



Fig. 6. An interior view of a clean creamery equipped with modern equipment.

Sanitary condition of creameries. The creameries differed in respect to their appearance, general cleanliness, and neatness. It would be hard to improve a few of the plants in these respects. The majority were good. A few were neither well painted nor attractive from the outside, were poorly ventilated, and were not kept in a good condition inside. The matter of absolute cleanliness and proper sterilization of the equipment was neglected in many of them. It is shown in Table VIII that many of the samples of butter analyzed had a high yeast and mold content. Although the yeast and mold content may not have an immediate effect on the quality of fresh butter, yet these organisms as well as bacteria present may cause the butter to deteriorate when held if it is kept at temperatures favorable for bacterial development, such as exist in retail merchants' places of storage or in home refrigerators.

In studying the relation of the yeast and mold content of the butter to the sanitary condition of the equipment, it was found that when the equipment was not properly cleaned and sterilized the butter was contaminated with yeasts and molds. To find out where this contamination took place,

samples were taken at different points in the process of manufacture at several different creameries. The results, summarized in Table XI, show that the churn, cream pumps, and pipes, as well as the parchment paper used for wrapping the butter, were all in some measure responsible.

TABLE XI. YEAST AND MOLD CONTENT AT DIFFERENT POINTS IN THE MANUFACTURE OF BUTTER

	Total yeasts and molds per c.c.—					
	Plant No. 1	Plant No. 2	Plant No. 3	Plant No. 4	Plant No. 5	Plant No. 6*
Cream from cooling vat after pasteurization....	1	0	0	0	0	33
Rinse water from churn	502	151	332	254	155	32
First cream through pump and pipe-line to churn	34	15	10,200	3	0	204
Last cream through pump and pipe-line to churn	1	0	0	0	0	8
Buttermilk from churn	1,410	455	1,750	4,145	272	1,776
Butter from churn	172	54	220	555	59	96
Water in which wrappers were soaking	1,632	426	502	6,280	901	5,800
Salt (per gram).....	0	0	0	0	0	0

*At Plant No. 6 the cream was pasteurized in one vat and then pumped to a cooling vat; the cream was contaminated by the pipe-line and pump leading to the second vat, the first cream through this line showing an excessively high count.

MARKETING

Each creamery marketed its output as much as possible in the form of prints and sold them on the local and neighboring markets. There is keen competition in the local markets among the country creameries as well as competition from the Portland centralizers which sell their product to some extent throughout the state. A few of the larger country creameries have established a print business in Portland also, but that market is fairly well supplied by the creameries operating in Portland. The surplus over what can be sold as prints was marketed as cube butter, either in Portland, Seattle, San Francisco, or Los Angeles, depending on the location of the creamery and the prices quoted on the markets.

Portland is the principal market for butter in Oregon, being the only large city in the state. Prices for butter are quoted on grades established by the Portland Dairy Exchange—namely, Extras, Standards, Prime Firsts, and Firsts. Standards is the grade primarily in demand at Portland and is supposed to correspond to a 91.0 - 91.5 score. Extras are comparable to a 92.0 score, Prime Firsts 90.0 - 90.5, and Firsts 88.0 - 89.5 score. There is some demand for the Extras during the storage season, but during the rest of the year there is no butter of this grade paid for at the price quoted on the Portland market.

Table XII shows the average monthly quotations for butter on the Portland and San Francisco markets for 1928. The Portland quotations are taken from the *Morning Oregonian*, and the San Francisco quotations are from the report of the Federal-State market news service at San Francisco. The prices on the San Francisco market were slightly higher than those on the Portland market.

The quotations of the Portland Dairy Exchange represent a small volume of transactions and do not take account of other sales which may be

above or below the quotation figure. They are, however, largely used as a basis for trading throughout the state. Print quotations are placed at 3c above cube standards.

Prices paid for butter-fat throughout the state are fairly uniformly based on the quotations printed in the *Oregonian*. The market reporter employed by the paper obtains this quotation from representative Portland creameries. In Southern Oregon the prices paid for fat in California must be given consideration.

TABLE XII. MARKET QUOTATIONS FOR 1928

	—Portland quotations—			—San Francisco—	
	Extras	Standards	Prime firsts	92 score	90 score
January	46.30	45.21	44.61	46.36	45.04
February	45.00	44.40	43.60	45.19	43.95
March	44.43	44.10	43.60	43.41	42.48
April	39.70	39.34	38.70	39.88	39.06
May	41.33	40.06	39.56	41.67	40.80
June	41.64	40.54	40.04	42.98	41.71
July	44.35	43.05	42.32	45.62	43.28
August	47.36	46.35	45.70	47.59	46.01
September	49.74	49.00	47.80	50.28	47.47
October	49.60	49.00	47.16	50.92	47.50
November	49.42	48.80	47.70	49.19	47.56
December	48.53	47.90	47.20	49.79	48.36
Average	45.62	44.81	44.00	46.07	44.43