7-1938

Cheese Production in Nebraska. University of Nebraska

Walter Kollmorgen
University of Nebraska-Lincoln

CHEESE PRODUCTION IN NEBRASKA

BY

WALTER KOLLMORGEN

Research Assistant

Conservation and Survey Division

The University of Nebraska

BULLETIN 17

CONSERVATION DEPARTMENT

OF THE

CONSERVATION AND SURVEY DIVISION

UNIVERSITY OF NEBRASKA

Printed by Authority of the State of Nebraska

Lincoln, Nebraska

July, 1938

CHEESE PRODUCTION IN NEBRASKA

BY

WALTER KOLLMORGEN

Research Assistant

Conservation and Survey Division

The University of Nebraska

BULLETIN 17

CONSERVATION DEPARTMENT

OF THE

CONSERVATION AND SURVEY DIVISION

UNIVERSITY OF NEBRASKA

Printed by Authority of the State of Nebraska

Lincoln, Nebraska

July, 1938

THE UNIVERSITY OF NEBRASKA

EDGAR A. BURNETT, Chancellor

BOARD OF REGENTS

HON. STANLEY D. LONG, Grand Island
HON. FRANK J. TAYLOR, St. Paul
HON. MARION A. SHAW, David City
HON. CHARLES Y. THOMPSON, West Point
HON. ARTHUR C. STOKES, Omaha
HON. ROBERT W. DEVOE, Lincoln

CONSERVATION AND SURVEY DIVISION

G. E. CONDRA, Dean and Director

As defined by law, the Conservation and Survey Division of the University includes the following state departments and surveys: Soil, Geological, Water, Biological, Industrial, Conservation, and Information Service. Its major purpose is to study and describe the state's resources and industries for use in development. Reports are published in three series, i.e., Nebraska Soil Survey, Nebraska Geological Survey, and the Conservation Department.

TABLE OF CONTENTS

Cheese Production in Nebraska

Cheese is more than a delicacy to be eaten occasionally; to millions of people it represents an essential part of the daily diet. The Swiss are the greatest consumers of cheese (Fig. 1), their consumption per capita being over three times that of the inhabitants of the United States. Cheese is a concentrated form of milk, containing an abundance of protein, calcium, and phosphorus in forms readily assimilated. We may hope, therefore, that this food will continue to find favor in our diet.

The modest consumption of cheese by Americans is in no small measure to be accounted for by the abundance of our meat supply. The United States is prominent in the production of pork and beef. As long as its per capita production of these foods remains high, its citizens will remain modest consumers of cheese, for cheese and meat are sources of the same element in our diet, viz., protein.

Traditions Concerning the Origin of Cheese

Cheese played an important part in the diet of man long before the discovery of America. Tradition has it that several thousand years before Christ the Arabs produced an edible curd, a form of cheese, by pouring milk into stomachs taken from slaughtered calves. Since such stomachs were and are commonly used by these people as bags for carrying liquids, it seems probable that this method of producing curd is very old. These ancient people never knew what properties of the stomach-container converted milk to curd and whey. It is now known that such stomachs still contain some of the dried digestive juices of the living animal. These juices contain, among other things, a digestive ferment known as rennet, a substance that promptly coagulates casein, which is found in milk. This casein is then drawn together into a semi-solid form known as curd; the more liquid, watery portion remaining is known as whey. Rennet, extracted from the stomachs of animals, is used to this day by cheese factories for rapid coagulation of milk in the cheese-making process.

Improvement in Cheese Making and Varieties of Cheese

The relatively simple method of producing curd, presumably discovered by the Arab, was but the beginning of what has become a highly technical process of cheese production. Curd, as cheese, is tasty and highly nourishing but spoils readily. The development of a cheese with keeping qualities was, therefore, desirable. Since all methods of cheese-making are dependent on the action of certain bacteria we can readily appreciate why the methods of perfecting cheese production in early times were largely accidental.

Tradition supplies us with another story which alleges to account for the discovery of the famous Roquefort cheese, a popular cheese to this

day. According to this story, a shepherd in France, some eight centuries ago, left some native cheese and bread in one of the cool, natural caves in the southern part of the country. A sudden storm caused him to direct all of his attention to his flock, and the food was temporarily forgotten.

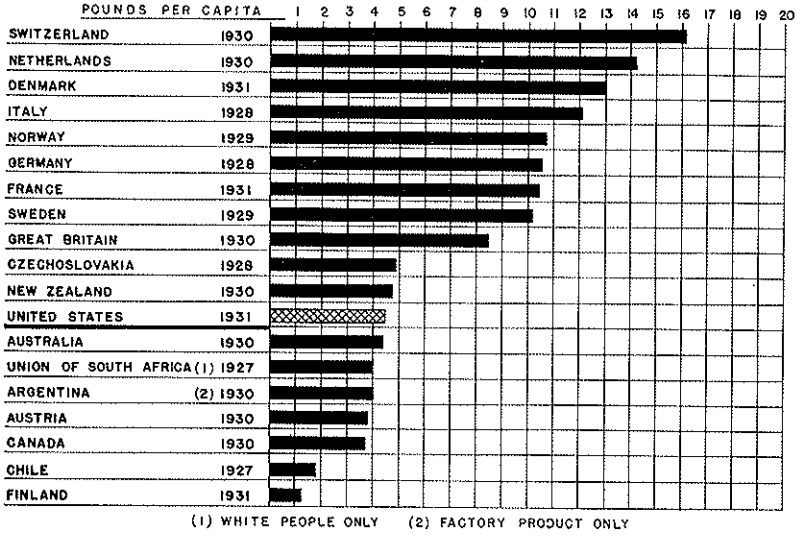

FIG. 1.—Yearly per capita consumption of cheese in various countries.
Source: Pirtle, T. R., *A Handbook of Dairy Statistics*, U. S. Dept. of Agriculture, Washington, 1933.

Several weeks later, the herdsman remembered his forgotten lunch. He fully expected it to be spoiled; nevertheless, he went into the cave to examine it. The bread was spoiled, but the cheese was covered with a curious green mold. He nibbled a bit and found that it tasted exceedingly good. He left more curd in this cave and found that it was similarly converted into a prized food.

Regardless of whether or not these stories about the Arab and the herdsman are true, we must concede that the accidental and the "trial-and-error" methods gave rise to many varieties of cheese centuries ago. Nor has the passing of time diminished the types of cheese produced. In a publication by the U. S. Department of Agriculture, entitled "Varieties of Cheese; Descriptions and Analyses," [1] there are 287 distinct varieties of cheese listed, and the comment is added that the local and provincial names for the same product run into the thousands. Although many of these cheeses are now produced in the United States, those of predom-

[1] C. F. Doane, *et al.*, *Bulletin 608* (1934).

inant significance are cottage, cheddar, Swiss, brick, and limburger. Of these the first two types are produced on a commercial scale in Nebraska.

Cottage Cheese

Cottage cheese, also known as Dutch cheese, is a sour-milk cheese, made extensively in this country. It is probably the same variety of cheese the Arab produced in bags made from the stomachs of calves. Nebraska housewives and commercial producers of this food obtain the same product in a different way.

Domestic Production of Cottage Cheese. The ease with which cottage cheese may be produced has always made it a popular item of food. In the domestic production skimmed or whole milk is set aside in a relatively warm place, preferably at a temperature of about 70° to 80° F. Under these conditions milk will sour as the result of the action of microscopic plants that find the milk to be an ideal medium in which to multiply. These plants consume the lactose, or animal sugar. After a number of hours, depending somewhat on the temperature of the milk, which must never be heated to a point sufficient to kill these organisms, enough lactic acid has been formed to sour the milk. The sour element in the milk coagulates the casein just as rennet does.

When the milk has thickened or firmly clabbered, it is cut into squares and thoroughly stirred with a spoon. The pan of broken curd should then be placed in a vessel of hot water with a temperature of 100° F. and cooked at this temperature for about 30 minutes. During this cooking process the curd should be well stirred at five-minute intervals to promote the separation of the whey from the curd and to increase the firmness of its texture.

Following the heating process, the whey is drained from the curd in a cheesecloth, a clean salt bag, or in a cloth-covered colander. The removal of the whey may be facilitated by stirring the curd when in a vessel or by applying pressure to it when it is drained in a sack. To prevent the curd from becoming too dry, draining should be stopped when the whey ceases to flow in a steady stream.

When the whey has drained properly, the curd should be placed in a strong vessel and worked with a spoon or butter paddle until it becomes fine in grain, smooth, and of the consistency of mashed potatoes. The addition of sour or sweet cream will add greatly to the smoothness and palatability of cottage cheese. Lastly, the cheese is salted according to taste; usually one teaspoonful of salt to one pound of curd is found satisfactory.[2]

[2] To obtain full particulars about making cottage cheese in the home and also tempting ways of serving this food, write for *Farmers' Bulletin No. 1451*, Department of Agriculture, Washington, D. C.

Cottage cheese has been produced in Nebraska as long as cows have been milked in this state. The limited purchasing power of our early pioneers induced them to utilize this home product rather extensively. Up to and during the period of the World War, the making of cottage cheese remained almost entirely a home practice. The amount of this food consumed up to that time, therefore, can only be conjectured. Since the World War cottage cheese has become a very popular commodity produced and sold by the dairies and creameries of the state. Its production has proved profitable, enabling these concerns to dispose of surplus milk, a certain amount of which is always essential to maintain a margin of safety for varying demands of fresh milk.

Commercial Production of Cottage Cheese. Cottage cheese may be made either from fresh or from surplus milk which was not disposed of as sweet, fluid milk. The milk is first separated and pasteurized, and the cream is used to make butter or ice cream or is used as fresh, fluid cream.

Setting the cheese.[3] The pasteurized skimmilk which is to be converted into cottage cheese is run into cheese vats at a temperature of about 80° F. Here it is tempered to the setting temperature, which should range between 80° and 85° F. during the greater portion of the setting period. Since the setting time lasts from 5 to 15 hours, 10 hours being a good average, the initial temperature of the milk should be varied somewhat to allow for slight heating or cooling of the milk from varying room temperatures during different times of the year. Thus temperatures as high as 90° to 95° F. are used in the winter setting, while during the hot months a temperature of 70° to 75° F. is adequate. The time available for the coagulating period will determine, within limits, the temperature used. When the milk has reached the proper temperature, from one-half to three or more per cent starter is added, the amount being determined by the length of the setting time, setting temperature, and the viability of the starter. In about 10 hours the milk should be properly coagulated, and the cheese-making process should proceed promptly.

Cutting the curd. The curd is ready to be cut when it tests between 0.7 and 0.9 per cent lactic acid. In the absence of a chemical test, this condition may be recognized when the curd is sufficiently firm to be cut into even cubes without shattering and when these have a clean, mildly acid flavor. The curd is cut with curd knives, first into horizontal strips or blankets parallel to the bottom of the vat and then into vertical strips lengthwise and crosswise of the vat (See Fig. 2).

[3] The details of the manufacture of cottage cheese presented herewith have been taken from E. L. Reichart and H. P. Davis, "Cottage Cheese Manufacture in Dairy Plants," *Bulletin 217*, University of Nebraska, College of Agriculture Experiment Station (1927).

Cooking and washing the curd. After the curd has been cut, it is heated by turning steam into the jacket of the vat. This causes the curd particles to expel the whey and to shrink. The heating or cooking temperature varies

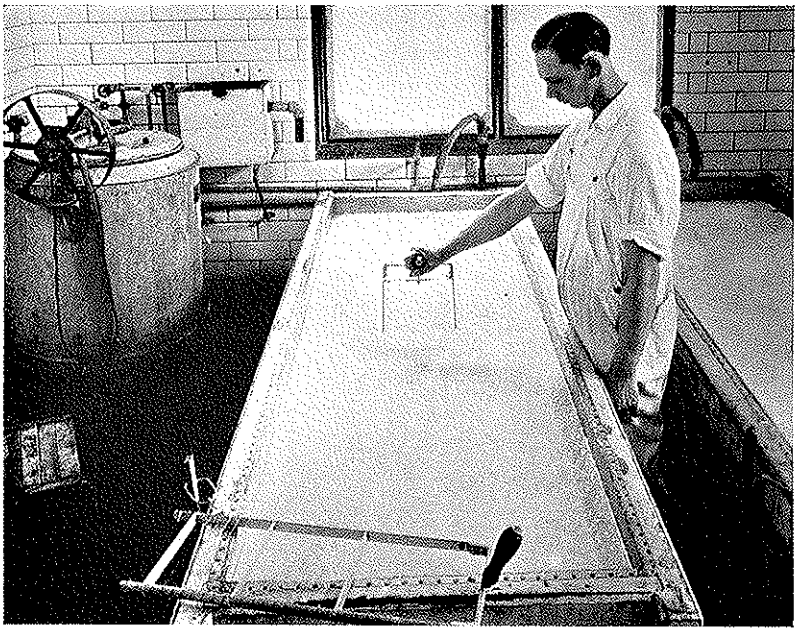

FIG. 2.—Cutting the curd. Notice the vertical curd knife in the hand of the cheesemaker and the horizontal knife lying on the front end of the vat. (Courtesy, Dept. of Dairy Husbandry, University of Nebraska).

from 110° to 140° F.; usually a temperature of 125° to 130° F. gives the best results. During this cooking process, which lasts from one-half to one and one-half hours, depending on the condition of the curd, the product is stirred with a fork or rake to insure even heating. Following this operation, the whey is drawn off.

The drained curd must now be washed and cooled. Since abrupt cooling with cold water shatters the curd, it is advisable to wash it three times with successively cooler water.

Thorough draining follows the washing of the curd. This is accomplished by banking it along the side of the vat and permitting the flow-off of the liquid to take place along the depressed center of the vat. When the water ceases to run freely, the curd is ready for salt and cream.

Salting and creaming the curd. Salt is added in the proportion of one pound to one hundred pounds of curd. This yields a lightly salted product and permits the addition of more salt by consumers of varying taste habits.

Varying amounts of cream are added to cottage cheese by different producers. According to E. L. Reichert and H. P. Davis,[4] the addition of one pound of cream testing 12 to 15 per cent to three pounds of curd makes a fine quality cheese.

Yield and production of cottage cheese. Ordinarily a good quality of milk will yield from 15 to 18 pounds of cottage cheese per 100 pounds of skimmilk. Variations result from the amount of moisture in the finished curd, the condition of the curd at the time of cutting, and the amount of curd lost in wash water as a result of shattering.

Cottage cheese is commonly marketed in small, paraffin-paper containers, in glasses, or even in butter tubs. The product is then retailed on milk delivery routes and in stores.

TABLE 1.—*Commercial Production of Cottage Cheese in Nebraska from 1922 to 1935*[5]

Year	Pounds	Year	Pounds
1922	167,000	1929	1,287,000
1923	209,000	1930	1,523,000
1924	273,000	1931	1,399,000
1925	401,000	1932	1,082,000
1926	446,000	1933	1,085,000
1927	676,000	1934	1,106,000
1928	965,000	1935	1,092,000

[5] Figures from 1922 to 1929 from *Nebraska Agricultural Statistics*, 1930, p. 86; from 1930 to 1935 from *Annual Reports on Dairy Products*, by states, U. S. Dept. of Agriculture.

The production of cottage cheese in Nebraska increased at an extraordinary rate during the 1920's. From 1922 to 1930 the production of this food increased from 122,000 to 1,523,000 pounds. During the more recent depression years, production of this cheese has declined to about 1,000,000 pounds. It seems reasonable to believe that cottage cheese will continue to find favor in the diet of Nebraskans, and that the annual production figure will continue to exceed the million mark by a considerable margin.

Cheddar Cheese

Cheddar cheese is by far the most popular cheese with keeping qualities made in this country. This cheese was first made in the village of Cheddar in Somersetshire, England. Today the term "cheddar" applies to the process of making the cheese rather than to any particular shape of cheese.[6]

[4] *Ibid.*, p. 9.

[6] The word "cheddar" is sometimes used to designate a cheese 14 to 16 inches in diameter and weighing from 60 to 100 pounds. Cheddar is made in a number of different standardized forms with distinguishing names, such as Flats, which have the same diameter as the cheddar size but weight only 30 or 40 pounds; Daisies, which are 12 inches in diameter and weigh 20 pounds; Young Americans, which are 8 inches in diameter and weight 8 to 12 pounds; Long Horns, which are 5 inches in diameter and weight 12 pounds; and Squares, which are of various sizes and usually 3 or 4 inches thick.

Both the popular cream-colored and the reddish cheese we purchase at the stores are cheddar cheeses. The former light-colored or cream-colored cheese is more technically known as New-York-style cheese, although most of it is at present made in Wisconsin. Generally, the New York-style cheese is aged longer before marketing, and this serves to temper its flavor. The latter, more reddish cheese, is plain American cheddar cheese. Its appearance results from the addition of color to the milk from which it is made. All of the commercially produced cheddar cheese in Nebraska is of the yellow type or American cheese.

Early Production of Cheddar Cheese in Nebraska. Prior to 1850 the making of cheddar cheese was a home industry. The machine age, which by this time had shifted the production of many commodities from the home to the factory, did not stop short of this home activity. In 1851 Jesse Williams of Oneida County, New York, began the purchasing of milk from his neighbors to increase the output of his popular cheese.[7] His represents the first cheese plant in this country. So popular was Mr. Williams' plan of cheese making, that within 15 years nearly 500 more cheese plants were established in New York.

The period marking the inception of cheese plants in the state of New York coincides roughly with the opening of the Territory of Nebraska. The limited number of cows in this territory precluded the establishment of cheese plants during the 1850's and nearly all of the 1860's. During this time some cheese was made in the homes by pioneer women. We have record of a modest beginning in commercial cheese making as early as 1860 by a certain Benjamin Whyte near Brownville, Nebraska,[8] but only small amounts were made and disposed of locally.

In the latter 1860's a cheese factory of considerable size was built by Dexter F. Woods at Palmyra, Nebraska. Mr. Woods milked from 60 to 80 cows every summer and converted the milk into cheese. Since his own cows furnished an inadequate milk supply the making of cheese had to be suspended in fall, winter, and early spring. The cheese was disposed of to supply local demand and was also sold to pioneers who were crossing the state in large numbers at that time. In 1881 the factory was dismantled.[9]

Cheese production in Nebraska reached its first high in the 1880's. In addition to a considerable production in the homes, four cheese plants pro-

---

[7] *Yearbook of Agriculture*, 1899, pp. 384-385.

[8] Notes of A. L. Haecker, formerly professor in the Department of Dairy Husbandry, University of Nebraska; at present secretary of Nebraska Creamery Butter Manufacturing Association; now Dairy and Food Commissioner of Nebraska.

[9] Information taken from letter written by Clayton F. Woods to Orlin M. Mervin, n. d. Letter now in files of A. L. Haecker, Lincoln, Nebraska.

duced cheese in this state in 1885 [10] (Fig. 3). By 1889 the state had nine plants, and its production of cheddar cheese exceeded one million pounds. In the early 1890's more plants were added, and by 1895 there were 15 cheese plants.

That the number of cheese plants increased up to 1895 may be attributed to a number of factors. The 1880's were essentially a boom period on the plains. A great many industrial plants were promoted successfully in Nebraska at that time because of the prevailing optimism that followed several successful crop years. Among these plants were the cheese-making establishments.

It seems probable that the absence of the cream separator (this appliance was generally introduced in Nebraska after 1900) and the severe drouth of the early 1890's also furthered the cause of the cheese factories in this early period. Prior to the advent of the cream separator the cooling,

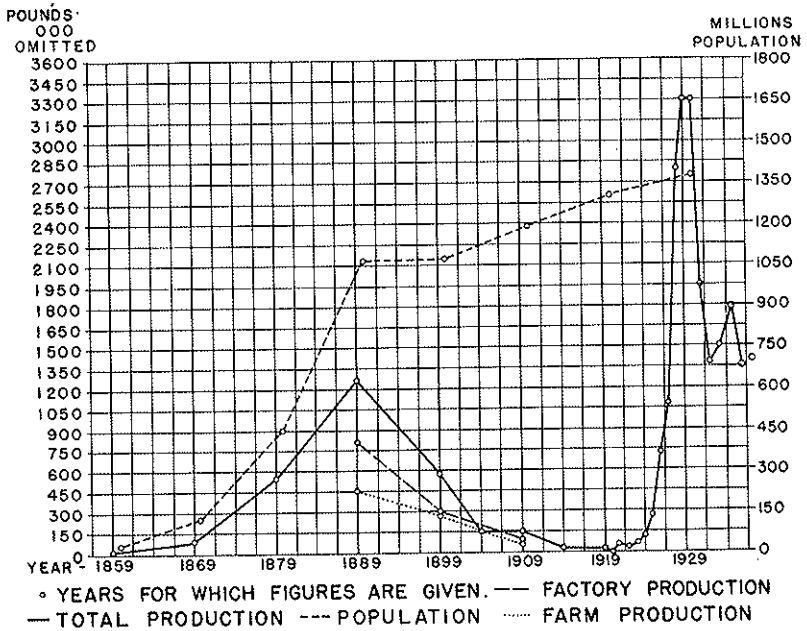

FIG. 3.—Cheese production in Nebraska, 1859-1936 (preliminary for 1936), and population increase, 1860-1930.
Source: Data on cheese production from 1859 to 1909 from *Statistical Abstracts of the United States,* 1920; for 1914 from 1920 census report; for 1919 to 1929 from *Nebraska Agricultural Statistics;* for 1930 and forward from the *Annual Reports on Dairy Products,* U. S. Dept. of Agriculture; population figures from census reports.

[10] *Annual Report of Nebraska Dairymen's Association,* 1885.

settling, and skimming of milk was tedious work; hence the willingness of some farmers to dispose of whole milk to cheese plants. The drouth gave further encouragement to the largely misplaced cheese industry in this state because an available supply of wild hay provided feed for milk production. Cereal crops were almost a complete failure during the early nineties. The sale of milk for cheese production provided a much needed income during these trying times.

In 1896 the drouth period ended. More prosperous conditions again prevailed on Nebraska farms, and there was less need for the marketing of milk to supplement the family income. During these years the newly perfected, home cream separator was also introduced in ever-increasing numbers. This new device made it possible to skim milk readily and easily. Instead of hauling milk to the cheese factory every day, it was now possible to accumulate the cream and make deliveries at weekly intervals. The skimmilk, then as now, was prized as excellent pig and calf feed. With the turn of the century these factors combined made for a great decline in cheese production in Nebraska. Not until the 1920's was the industry revived to a prominent position.

Cheddar Cheese Production in Nebraska since 1920. In 1920 very little cheddar cheese was produced in Nebraska (Fig. 4). By 1925 nearly 300,000 pounds of this cheese was produced in the state; and by 1929 production exceeded 3,000,000 pounds. From 1930-31 to 1935-36 the decline in cheese production is equally striking. The production of cheddar cheese was cut in half, being about 1,500,000 pounds during the last five years. (See Fig. 4). Weedy pastures and poor milk conditions combined with exceedingly low cheese prices to discourage the operation of cheese plants during recent years.

The spectacular rise in cheese production during the late 1920's is in keeping with a similar rise in the number of cheese plants in Nebraska during the same period. The census of 1920 does not list the number of cheese plants operating in Nebraska. Since cheese production was negligible in this state at that time, a statement of figures would have divulged to some extent the output of individual plants. It is likely that only a few plants operated, and these had a very limited output. For the fiscal year of 1929-30 Nebraska had 28 licensed cheese plants. Since then the number of cheese plants has been reduced to about one-half of the former number and the cheese output has declined proportionately. The number of operating cheese plants, however, is only a partial index of the number of plants actually financed and built. Many plants were built and operated only for a short time, if at all. In many instances these plants were promoted by civic groups that hoped to enrich and diversify the industrial activities of their respective towns.

The boom period of cheese production in Nebraska during the later 20's was part and parcel of the larger, national industrial boom. Investments were made with abandon in all sorts of industrial enterprises. Because of an expanded credit, money could be borrowed readily for purposes not necessarily sound or well planned. Promoters found a gullible investing public which could be induced to shoulder heavy debt burdens on promises not well founded. Promoters of cheese plants and cheese-making equipment, with other promoters, stood ready to profit by this situation.

The prospective customers for cheese plant equipment were not fully informed on all the essentials for the successful operation of a cheese plant. They were not informed on the required cow population necessary to produce an adequate milk supply; they were not told of the usual difficulty of changing the habits of cream producers to those of quality milk producers; they were not informed of the disinclination of Nebraska farmers to part with whole milk for only a modest increase in price returns over butterfat prices and of transportation cost of milk in our relatively thinly populated state; nor were they familiarized with selling difficulties frequently experienced by Nebraska cheese producers.

Distribution of Cheddar Cheese Plants in Nebraska, June 30, 1930, and May 15, 1935. Figure 4 shows the location and distribution of the 28 cheese plants in Nebraska on June 30, 1930. Five of these plants were located along the North Platte and belonged to the North Platte Valley Cooperative Cheese Company. The establishment of five cheese plants in such close proximity was inadvisable. Farming methods in the area did not suggest the availability of a sufficient quantity of good milk to operate all the plants on an adequate scale. The project was also handicapped by a heavy debt burden resulting from the construction of the plants. More modest equipment for cheese-making should have been obtained to start the program.

The newly established cheese plants of the North Platte Valley Cooperative Cheese Company promptly encountered the severe depression of the early 30's. Cheese prices sank to distressingly low levels. Interest payments had to be maintained on a large capital investment. Four of the plants discontinued operation. Additional funds were borrowed to maintain operation of the centrally located plant in Gering.

Several of the cheese plants noted on Figure 4 were operated in connection with creameries and other dairy processing plants. In such cases discontinuance in making cheese by 1935 may represent merely a postponement of operation until more favorable times and prices return. A number of plants however, failed and closed.

Figure 4 also shows that on May 15, 1935, only 15 cheese plants were

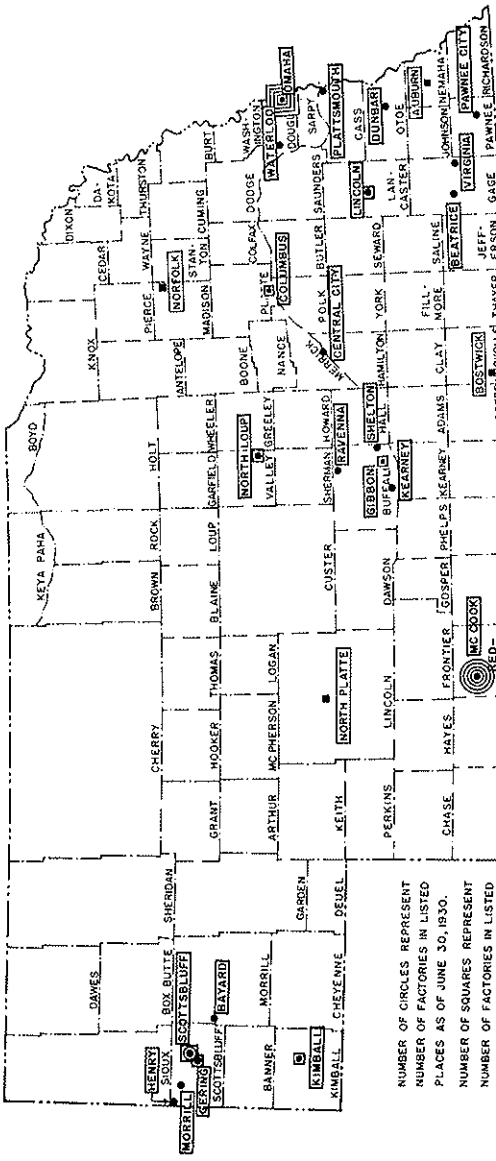

FIG. 4.—A comparison of the number of cheese factories licensed in Nebraska on June 30, 1930 with the number licensed on May 15, 1935 (According to duplicate license receipts in the Dept. of Agriculture, Lincoln).

licensed in Nebraska. By June 1, 1937, merely eleven plants were licensed to produce cheese and of this number only a few were actually in operation. Considerations relating to the drouth and the depression are largely responsible for this abrupt reduction in plants. It seems reasonable to believe that a number of factories will continue operation when more normal times obtain again.

Cheddar Cheese Production Difficulties in Recent Drouth Summers. A number of cheese plants in Nebraska failed to apply for a license to operate in recent years because of the severe drouth. A number of adverse factors made this expedient. The drouth suspended the growth of pastures, and in many instances only odoriferous weeds remained. The milk flow of cows in certain sections of the state was reduced as much as 50 per cent during the dry period. The weeds which the cows were compelled to eat imparted obnoxious flavors to the small amount of milk given. The poor quality of the milk was further aggravated by the unusually high temperatures which visited this section of the country as well as many other parts of the world. An unusual application of effort to cool the milk promptly would have solved this trouble in part. But many milk producers had always done this haphazardly, if at all, and failed to do so now. As a result, a very poor quality of milk reached the vats of the cheesemakers. Needless to say, the cheese produced was also of poor quality.

To all the other grievances of cheese production in Nebraska during the summer of 1934 must be added that of an all-time low price for cheese. The average New York wholesale price for No. 1 American cheese for 1932 was 12.8 cents per pound (Fig 5). Much Nebraska cheese went on the market at 11, 12, and 13 cents per pound. This low price is unparalleled in the history of the state. By 1935, the average yearly price for No. 1 American cheese on the New York market had risen to 16.8 cents, a price still distressingly low for Nebraska milk and cheese producers when feeding costs and difficulties are remembered.

The Manufacture of Cheddar Cheese. To produce a good cheddar cheese, milk of the best quality is necessary. The acidity of this milk should be as low as 0.14 to 0.15 per cent with a maximum of 0.18 per cent as an indication that undesirable bacteria have not become excessive. The milk should be clean and free from off flavors. Thus it is clear that the production of good factory cheese must begin on the farm.

The General Process of Manufacture. The milk is conveyed from the farm to the factory either by the farmer himself, or it is gathered by trucks. The great areas over which the milk must be gathered in this state has brought the truck into favor for hauling. Milk should arrive at the factory in the morning by 9:00 and not later than 10:00 o'clock. Here it is weighed, tested, and turned into huge vats holding up to 1,200 or

more gallons of milk. When the vat is filled, the first control test is taken, for the method of handling is in a measure dependent upon the condition of the milk.

To obtain good cheddar, the curd must be formed in the presence of lactic acid, and some of this acid must be left in the green cheese for proper ripening. Again it is necessary that the lactic acid must be formed by a particular kind of bacteria. The presence of many gas holes in finished cheese indicates that a wrong kind of bacteria became too active in the milk. Such cheese will also show other undesirable qualities. A starter consisting of milk soured by the right kind of bacteria is usually added to insure the proper amount and kind of lactic acid. When the proper acidity of 0.17 to 0.20 per cent has been reached, steam is passed through the walls of the huge vat until the milk it contains registers a temperature of 86° F. At this point cheese color is added. The cheesemaker now uses the same substance relied upon unknowingly by the Arab to coagulate the milk quickly. Rennet is added in amounts ranging from 2½ to 4 ounces per 1,000 pounds of milk. Within 25 to 40 minutes the milk coagulates and nearly all the valuable foodstuffs become enmeshed in the semi-solid curd.

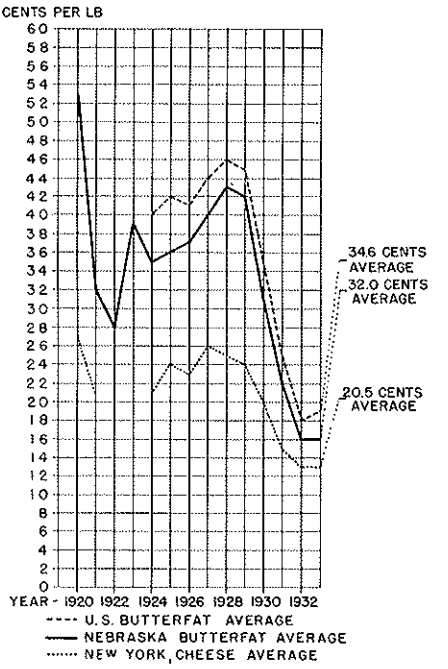

FIG. 5.—Average price per pound received by butterfat producers of the United States and Nebraska, and average wholesale price per pound of No. 1 American cheese, New York.

Source: Butterfat prices for the United States and cheese prices taken from *Yearbook* of Agriculture; Nebraska butterfat prices from the Nebraska Dept. of Agriculture and the U. S. Dept. of Agriculture cooperating.

The curd is then cut by curd knives. These knives do not consist of steel blades but of fine steel piano wires, separated by ⅜ of an inch and running perpendicularly in one instrument and horizontally in the other. Passing these knives through the curd results in uniform ⅜ inch cubes (See Fig. 6).

The cut curd is then heated to a temperature ranging from 98° to 105° F. with continued stirring. When the curd is sufficiently firm, the whey

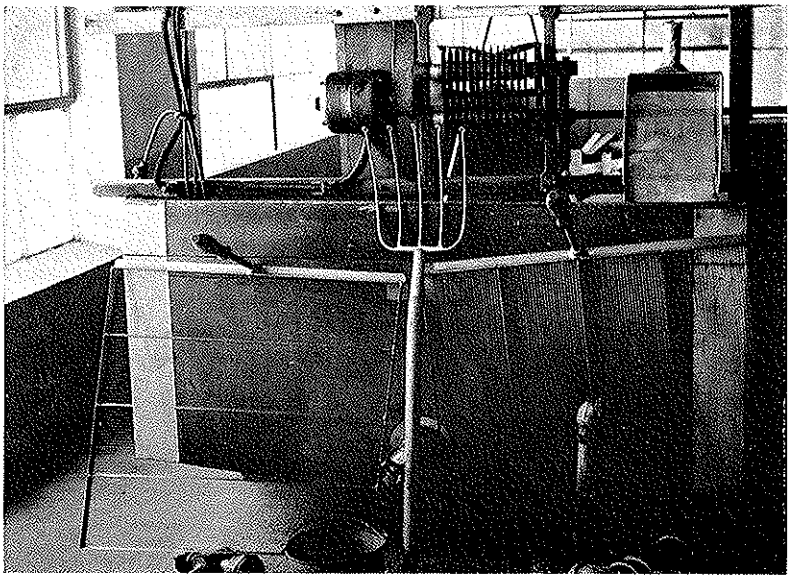

FIG. 6.—Curd mill (above), curd fork (center), large curd knives (lower left and right), curd scoop (upper right), strainer bucket (bottom center). (Picture taken in the Roberts Dairy Company plant, Lincoln).

is drawn off. The curd, which soon reconsolidates itself into a blanket form, is sliced into rectangular slabs which may easily be handled. The slabs are packed, turned, and repacked on the bottom of the vat at intervals ranging from 10 to 15 minutes until they are drained and the curd has the smooth feeling of velvet. This process is known as matting the curd. The matted curd is milled by a machine which cuts it into small sizes so that it may be uniformly mixed with salt. The small-sized curd pieces are then stirred (See Fig. 7) until they cease to run or drain, after which they are salted in the proportion of 2 to 2½ pounds of salt per 100 pounds of milk. After the salt has properly dissolved and has penetrated the curd particles to some extent, the cheese-in-the-making is ready to be placed in the press. Tinned-iron hoops of various sizes are lined with cheesecloth, the curd is placed within them, and pressure is gradually applied (See Fig. 8). The cheese is removed from these hoops the next day and permitted to dry from 3 to 12 days, after which it is paraffined.

Milk Quality and Cheddar Cheese Production in Nebraska. Cheese production, as has been previously stated, is not merely a matter of processing milk, any kind of milk. Milk used for this purpose must be clean and have a very low acidity score and bacteria count. To obtain such milk cows must be milked under clean conditions and sanitary vessels

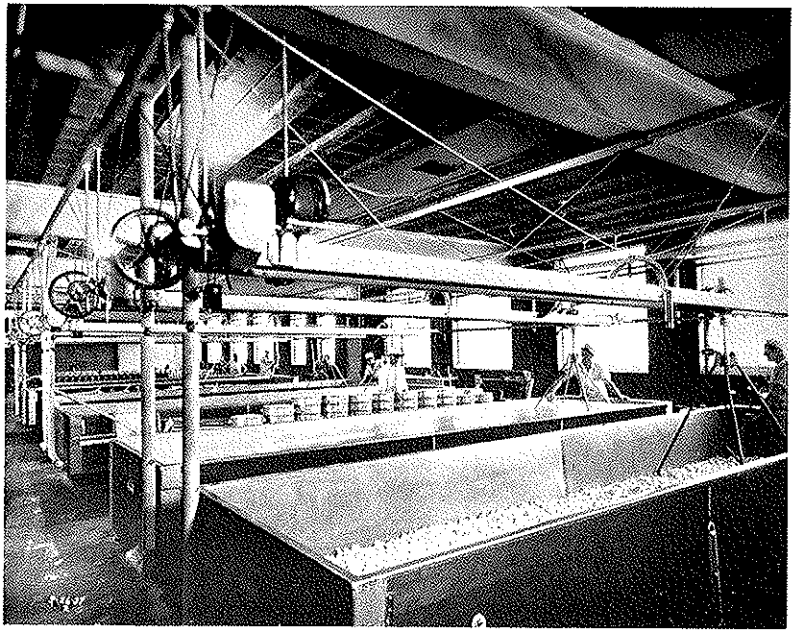

FIG. 7.—Interior view of a modern, well-equipped cheese plant. Each vat shown has a capacity of 10,000 pounds of milk. Milled curd is shown in the first vat, which is being stirred by a mechanical forker and by a hand curd fork. The second vat is filled with milk and is ready to be stirred. Tinned-iron hoops are shown beyond the second vat. (Courtesy, Roberts Dairy, Lincoln).

must be used. The milk must then be properly strained and promptly chilled. Ordinarily this chilling is accomplished most effectively and cheaply in fresh running water.

Many Nebraska farmers furnishing milk for cheese plants produce milk of excellent quality. It is equally true, however, that other farmers do not produce milk of this standard. Since the cow population in Nebraska is small, and since great distances must be covered to obtain sufficient milk, cheesemakers are usually compelled to accept the poor milk with the good milk. This means that the cheesemaker frequently, especially during hot weather, begins his work with a raw product that cannot be converted into good cheese. Milk in which the acid score is high produces a crumbly, inferior cheese.

Pasteurizing Milk for Cheddar Cheese. Whether the milk used in cheese making is to be pasteurized or not depends on the quality of the milk available. Most of the cheese made in the specialized cheese districts of Wisconsin is made from unpasteurized milk. As long as a high quality milk free from gas-forming bacteria can be obtained, it seems inadvisable

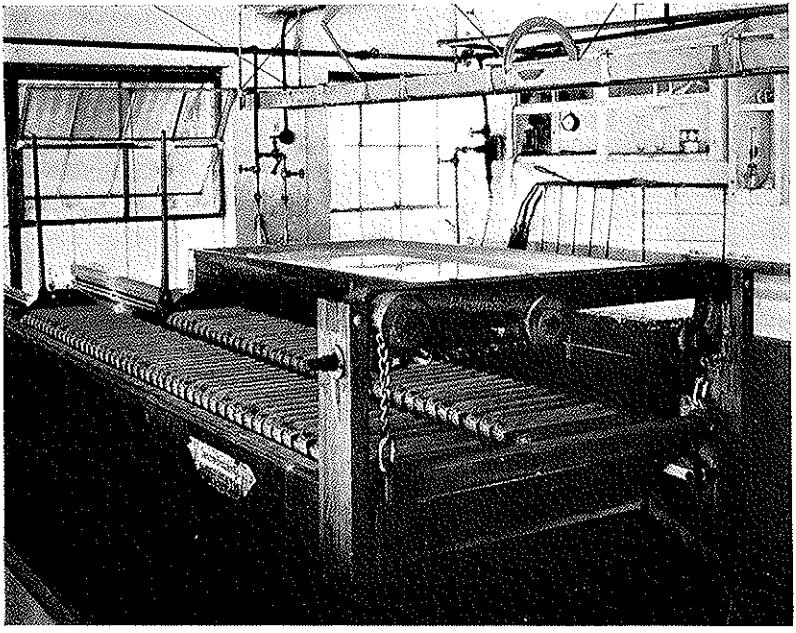

FIG. 8.—Cheddar cheese in tinned-iron hoops and in a cheese press. Notice cheese vat filled with milk in the background. (Picture taken in Roberts Dairy Company plant, Lincoln)

to pasteurize the milk. In the absence of such high-quality milk it is advisable to pasteurize. Besides destroying unwholesome bacteria, pasteurization also renders innocuous a host of germs which in some instances make for bad qualities in the cheese. It should be remembered, however, that neither pasteurization nor any other type of processing can completely overcome the bad effects which result from the use of poor milk in cheese making.

Most of the large cheese plants in Nebraska pasteurize milk before converting it into cheese. This is done to overcome the bad effects that follow the making of cheese from milk in which the aggregate bacteria count has become excessive. The large bacteria count in such milk results from improper milking methods, failure to cool milk promptly, and the long time such milk is in transit, particularly in summer. Unfortunately, most Nebraska cheesemakers cannot rely on a constant supply of high-quality milk.

Ripening of Cheddar Cheese. It was held until very recently that all good cheddar cheese must be ripened at a temperature below 50° F. from 3 to 6 months and even longer. Ripening at this low temperature was

gradual, and so a considerable period of time was consumed by this process of cheese perfection. More recently it has been found that the ripening process can be accelerated by placing the cheese in a storage place for two or three weeks where a temperature from 60° to 70° F. prevails. After this period of "hot-house" ripening, the cheese is placed in a storage room where a temperature of 40° F. or less prevails. Here it can be kept for a considerable period and be marketed at convenience.

Cheese that has been ripened by the hot-house method is not fully aged at the end of the first two or three weeks' period. Additional ripening at a lower temperature is desirable to temper the taste of the cheese properly.

It is believed by many students of the dairy industry that much of the cheese on the American market today is too green for consumption. It is difficult to know whether this is really true. Comparative data on the preference of consumers for green or aged cheese are lacking. Attempts that have been made in a few cities in the United States to learn the consumer's preference seem to indicate that cheese dealers are perhaps justified in marketing cheese before it is ripened to that degree of flavor which is so much desired by the connoisseur of cheese.[11] Only a small proportion of Wisconsin cheese is fully aged when retailed. Perhaps the bulk of cheese marketed in this country is seven or less weeks old. It has been suggested that producers and handlers of cheese stamp the date of production on cheese marketed. This practice would enable the purchaser to know if he is purchasing a green or well-ripened product.

The space and equipment necessary to ripen cheese properly has brought about the practice of dispensing green cheese to wholesalers and packers for proper curing. This is particularly true of smaller plants. Only one Nebraska cheese producer keeps the cheese he produces on his shelves until it is ready for consumption.

Yield of Cheddar Cheese per 100 pounds of Milk. The yield of cheese per 100 pounds of milk varies with the butterfat content of the milk. The yield may be calculated as follows:[12]

Butterfat Test of Milk	Cheddar Cheese Yield	
	Per 100 Pounds of Milk	Per Pound of Butterfat
3.0%	8.3 lbs.	2.76 lbs.
4.0%	10.6 lbs.	2.654 lbs.
5.0%	12.9 lbs.	2.580 lbs.

[11] According to a letter from Walter V. Price, Professor of Dairy Industry, University of Wisconsin, dated March 14, 1935.

[12] H. P. Davis and P. A. Downs, "What about Cheese for Nebraska?", University of Nebraska Agricultural College Extension Service, *Circular* 603, p. 5, (1924).

Cost of Making Cheddar Cheese. The cost of making cheddar cheese varies considerably with various production programs and situations. Within limits, the unit cost decreases with increased output. Since cheese must be made from fresh milk, it must, of necessity, be produced close to a dairying area. The output of any one plant, has, therefore, practical limitations. Small, one-man cheese plants predominate in the more specialized cheese producing areas to reduce to a minimum the distance between milk producer and milk processor. For profitable operation such plants should aim to produce about 100,000 pounds of cheese annually. This means the handling of about 1,000,000 pounds of milk per annum. According to *Miscellaneous Publication No. 42*,[13] issued by the United States Department of Agriculture, the average cost of making a pound of cheese varies from 3 to 5 cents, depending upon the volume of milk produced. Since the majority of cheese plants in Nebraska produced more than 100,000 pounds of cheese during the 1933-34 fiscal year, it is reasonable to assume that the cost of processing this food in these plants compared favorably with that of other plants in other states.

Whey Fat and Disposition of Skimmed Whey. Whey, drawn from the curd in the cheese-making process, is not all water. Unskimmed whey contains over 7 per cent solids, including from 0.20 to 0.35 per cent fat, 5 per cent milk sugar, 1.7 per cent albumin, some ash, and other substances.[14] Of these substances the butterfat is the most worth salvaging, particularly if the aggregate amount of handled whey is considerable. 100 pounds of whey contains sufficient fat to produce from 0.25 to 0.40 pounds of butter. A cheese plant processing 10,000 pounds of milk a day by separating the whey obtains sufficient butterfat to produce from 2 to 4 pounds of butter. It is for this reason that all of the well equipped cheese plants now separate the whey. Butterfat obtained in this manner is equal in quality to that obtained directly from fresh milk.

Whey is disposed of variously by different cheese producers. A few producers drain it off after separation as a waste product. Since, however, whey still contains some of the solids found in whole milk, it retains a fraction of its former food value. It is therefore frequently fed to hogs and in some instances to calves. Nebraska cheese producers who do not waste the whey either give it to hog feeders living adjacent to towns or return it to milk producers in the same cans in which milk is hauled to town. In the latter case, the return of the whey may be part of the selling agreement between the milk producers and the cheese-plant operator.

The return of whey in milk cans is not a satisfactory arrangement. Milk hauled to cheese plants should be sent in well-washed, sterilized cans.

[13] H. L. Wilson, "Points to Consider in Establishing a Cheese Factory," (1928), p. 4.
[14] J. L. Sammis, *Cheese Making* (1930), p. 115.

The plants have the facilities to clean the cans well and to sterilize them with steam. However, if whey is returned in the cans, it remains for the farmer to clean and sterilize them. Unfortunately, it frequently happens that farmers do not have the facilities or the inclination to clean the cans properly. As a result, the milk becomes contaminated in the containers. This, in turn, reduces the quality of the cheese produced.

Feeding Value of Whey. A great number of feeding experiments have been made to determine the feeding value of whey, particularly as its value compares with that of skimmilk. These tests have shown that whey is worth about half (perhaps slightly less) as much as skimmilk for feeding purposes.[15] Since it is considered that 100 pounds of skimmilk possesses one-half as much feeding value as one bushel of corn, it follows that 100 pounds of whey is worth about one-fourth as much as one bushel of corn. Where whey can be transported in good condition from cheese plants to feed troughs with a minimum of handling and transportation cost, it may profitably be used to supplement the feed of hogs and calves. It should be noted, however, that whey has been unbalanced as a feed by the removal of butterfat and certain other substances, particularly proteins. The latter substance is highly important in the diet of all animals, particularly growing animals. To overcome this unbalanced nature of whey as a stock feed, it is necessary to supplement it with protein-rich feeds, such as linseed meal, tankage, wheat middlings, or other similar feeds.

By far the greatest percentage of whey is fed to hogs. When so used, it should be pasteurized, unless it has passed through the pasteurizing process prior to cheese-making. Unpasteurized whey may readily transmit tuberculosis to growing pigs. It should also be fed under sanitary conditions, either sweet or sour. In a putrid state it is dangerous feed.

Whey is sometimes used as calf feed in prominent cheese-producing districts though rarely, if ever, in Nebraska. Calves fed on whey usually do not make as rapid gains as those fed on skimmilk.[16] Pasteurized whey may be used for calf feeding if it is obtained fresh from the cheese vat and is fed at blood temperature in addition to concentrated protein feeds.[17] Soured whey may also be fed to calves, provided it has soured under sanitary conditions. It is essential that either sweet or sour whey be fed consistently to calves without alternating between the two, because a change may cause scours in the young animals.

Methods of Paying for Milk Used in Cheese Production. The method of paying farmers for milk used in cheese production varies considerably.

[15] W. A. Henry, and F. B. Morrison, *Feeds and Feeding* (1923), pp. 648-49.
[16] *Ibid.*, p. 434.
[17] *Idem.*

The milk that is used in cheese production in the Lincoln and the Omaha areas is purchased on some form of the base-surplus plan.[18] Other plants use simpler methods based on the butterfat content of milk. A common method is to offer the local butterfat price plus an additional payment for the milk for each pound of butterfat. This "plus" payment may vary from a few to fifteen and more cents per pound. To illustrate this method, let us assume that the local butterfat price is 25 cents and the plus price is 6 cents per pound of butterfat. A farmer offering 100 pounds of 4 per cent milk for sale may compute his payment as follows:

100 pounds of milk containing 4 per cent of butterfat	25c x 4 =	$1.00
Plus price	6c x 4 =	.24
Total price		$1.24

In this instance the farmer is receiving the standard butterfat price plus 24 cents for 100 pounds of skimmed milk. In the summer of 1934 the more common plus price ranged from 5 to 7 cents.

The plus price offered for milk is usually computed on the basis of cheese prices. Since the price of cheese may sink so low that this plus consideration becomes negligible, the cheese producer may be compelled to offer a price that will net him a loss. It must be remembered that farmers may separate their milk any time and obtain standard butterfat prices for cream and this potential loss of milk producers usually compels the payment of a plus consideration by cheese factories.

Another method used by several Nebraska cheese producers is to pay for milk according to current cheese prices. Plants that operate under this plan and which are of a cooperative nature convert the daily milk supply into cheese and dispose of this product at regular intervals. The returns are then used to cover cost of production, and the balance is divided among the producers according to the amount of milk sold and the butterfat content of the milk furnished. The plus consideration which the farmers received for their milk under this plan has varied from 4 to 17 cents.[19] With cheese wholesaling for about 15 cents per pound and butterfat prices ranging around 30 cents, the plus consideration must approximate the lower figures. Cheese factories using this method of payment usually pay the farmer every two weeks. The plus consideration for milk bears a direct relationship to current cheese and butterfat prices.

Cost of Transporting Milk to Cheese Plants. The cost in Nebraska for hauling milk from farmsteads to cheese factories is a significant item in production cost. Nebraska's milk-cow population per square mile is

[18] See *The Milk Industry of Nebraska* by Walter Kollmorgen, *Bulletin 15*, Conservation and Survey Division, University of Nebraska (1937), p. 45.

[19] Range determined by interviews in the summer of 1935.

relatively low. Not all farmers within a cheese-producing district are willing to sell whole milk. In addition many rural roads are still in such condition that they must be avoided on regular milk-gathering routes. As a result, we find that milk-gathering routes of individual truckers range from 30 to 80 or more miles. The length of the average route seems to be 50 miles and over. The cost of transporting the milk, a cost that the producer of milk must bear directly or indirectly, ranges from 15 to 30 cents per 100 pounds of milk.[20] The average cost for this service seems to approximate about 20 cents per 100 pounds of milk hauled. In some instances this cost covers a return transportation of the whey; in others it does not. According to the plan used by one cheese plant, the farmer pays 20 cents for the hauling of the milk to the factory, and the factory in turn pays 10 cents per 100 pounds for the return transportation of the whey to the farmers. In either case, however the farmer pays for all hauling costs, directly or indirectly.

The hauling cost of Nebraska milk for cheese-making purposes places the producers of milk of this state at a tremendous disadvantage. Producers of milk for cheese plants in Wisconsin need not bear this expense, since nearly every farmer hauls his own milk to the plant. This is readily accomplished since 48½ per cent of the milk producers for the average cheese plant in Wisconsin live within one mile of the factory, and 86½ per cent live within a radius of 2 miles. In Nebraska producers of milk for cheddar cheese plants may live up to 50 and 75 miles from such plants. Since the average hauling cost in Nebraska approximates 20 cents per hundred pounds, the Nebraska farmer is "penalized" about 5 cents for each pound of butterfat in 4 per cent milk used for cheese production.

Marketing Nebraska Cheddar Cheese. Nebraska cheese is marketed in various ways. Most producers attempt to market locally as much cheese as possible. This method brings the greatest returns to the producer. Unfortunately, much cheese sold in this way may not be aged properly. At present, only one of the larger plants in this state has the proper facilities to age it satisfactorily.

Small cheese plants frequently obtain marketing agreements with wholesale houses and meat packers in large cities. Under such agreements the wholesalers and packers may purchase the complete output of certain cheese plants at prices comparing sometimes favorably and sometimes unfavorably with those prevailing in Wisconsin and New York. The firms may or may not age the cheese before it is resold to retailers.

The selling arrangement of producers with wholesalers and packers frequently determines the success of a cheese plant. Failure to obtain such an arrangement may precipitate marketing difficulties which threaten the

[20] Costs determined in interviews during summer of 1935.

success of the plant. Many Nebraska cheese plants have failed because of selling difficulties. Frequently wholesalers offer less than the standard price to Nebraska plants for their product. In offering a lower than standard price, wholesalers have pleaded a widespread prejudice against Nebraska-made cheese. It cannot be denied that Nebraska housewives have generally shown a preference for cheese made in other states, and so a local cheese may have to be offered for a lower price in order to be sold. It is maintained by some cheese plant operators that wholesalers of Nebraska cheese have at times taken an undue advantage of a real or alleged local prejudice against cheese made in this state, and that as a result producers have suffered unduly because of price handicaps and wholesalers', on the other hand, may have profited beyond a justifiable degree on Nebraska cheese handled.

Cheddar Cheese Production in Wisconsin and Nebraska

Cheddar cheese has been produced in what now comprises Nebraska ever since the territory was opened for settlement. In the early days of the state the production of cheddar cheese was a home activity. With increased settlement cheese plants were opened and operated. Such plants were and frequently are called into existence by promotion activities and by community organizations which hope to diversify the industrial activities of their respective communities. As a result, plants are brought into existence before the local cheese-making possibilities are properly understood. Prior to the truck and its milk-gathering possibilities, no cheese plant in Nebraska was successful that had to obtain milk from many producers. In certain instances, individually owned plants were reasonably successful, at least part of the year, if the cheese maker kept a great number of cows and so produced nearly all, if not all, of his milk. In a few instances, milk was obtained from a few selected neighbors who were willing to produce considerable milk of good quality. Some such plants operated for as long as 20 years, only to fall into disuse at the end of the period. The failure of the cheese industry to establish itself more thoroughly in this state has not noticeably daunted the advocates of this activity. New plants have been added about as regularly as others closed up. This study would not be complete without an examination of this adverse record.

Wisconsin stands in contrast to Nebraska in the cheese-making enterprise. In recent years it has produced about 60 per cent of all the cheese produced in the United States. In the light of this we may assume that conditions are highly favorable for cheese production in this northern state. Cognizance of the dairying activities in both states, as well as their respective environments, should reveal the clue to the marked differences in success with which cheese has been and is being produced in these two states.

Climate as Related to Cheddar Cheese Production. It is frequently asserted that the climate of Nebraska is inimical to good cheese-making. This is true only if properly understood. Prior to the advent of the automobile, it was difficult to gather sufficient milk in sparsely cow-populated Nebraska for cheese-making on an adequate scale. In warm weather the milk would frequently become unfit for this purpose before it arrived at the plant. The truck has somewhat overcome this question of distance, although in summer time the long hauls by truck still make for a deterioration of the milk.

The proper aging of cheese in the days prior to artificial refrigeration represented another serious problem. Until recently most Wisconsin cheese was aged in unrefrigerated buildings. In eastern Nebraska this could not be accomplished so readily, particularly in summer. High average and high maximum temperatures caused a certain amount of deterioration of the aging cheese. To avoid this problem, Nebraska cheese has usually been marketed in a rather green condition, even more so than Wisconsin cheese.

Figures 9 and 10 show some significant climatic conditions prevailing at places in Nebraska and Wisconsin. An eastern and a western point were selected in each state. With respect to location, Lincoln, Nebraska may be compared with Madison, Wisconsin, and North Platte, Nebraska, with La Crosse, Wisconsin. Since it is the warm temperatures that distress cheese producers, consideration of the climatic factor may be limited to the summer time as it prevails in these given places.

Most of the cheddar cheese of Nebraska is produced in the eastern part of the state. It is, therefore, of interest to compare the summer temperatures prevailing at Lincoln, Nebraska, with those of Madison, Wisconsin. The average monthly temperature at Lincoln in summer is from 4° to 5° F. higher than at Madison, Wisconsin (See Fig. 9). The average

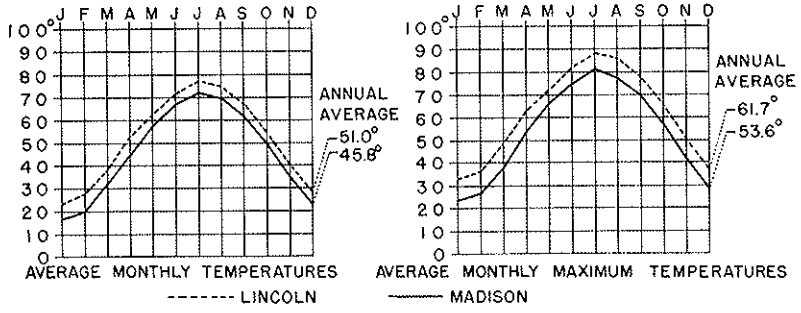

FIG. 9.—A comparison of average and maximum temperatures at Lincoln, Nebraska (1886-1930) and Madison, Wisconsin (1869-1930).
Source: *Climatic Summary of the United States,* Sectional Reports.

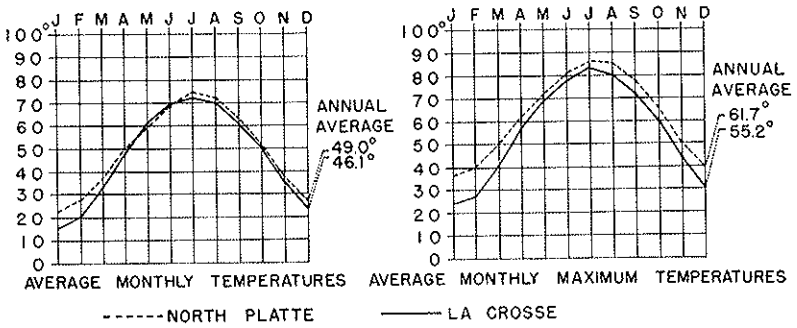

FIG. 10.—A comparison of average and maximum temperature at North Platte, Nebraska (1874-1930) and La Crosse, Wisconsin (1873-1930).
Source: *Climatic Summary of the United States,* Sectional Reports.

monthly maximum temperature, on the other hand, may be from 7° to 8° F. higher in Lincoln than at Madison. These higher temperatures undoubtedly increase the problem of getting fresh milk to cheese plants in Nebraska where the cow population is small.

In recent years, cheese plants have been established in western Nebraska, and it is interesting to note how the climate in this section of the state compares with a corresponding section of Wisconsin. Figure 10 shows the comparison. It will be noted that the average monthly summer temperature at North Platte, Nebraska, very nearly approximates that of La Crosse, Wisconsin. With respect to the average summer monthly maximum temperatures the difference is a little more pronounced, being 2° to 4° F. higher at North Platte. Generally speaking, however, temperature differences between these two places are slight and apparently inconsequential so far as cheese production is concerned.

The climate of Nebraska is not an insuperable problem today to the cheese industry of the state. Nebraska has an abundant water supply to cool fresh milk properly. Properly equipped trucks could maintain a low temperature for milk hauled to cheese plants. Moreover, nearly all cheese in the United States is now aged in artificially maintained temperatures.

Concentration of Dairy Activities in Wisconsin and Nebraska. The most striking difference between the dairying activities of Wisconsin and Nebraska is found in the cow populations of these two states. In 1929 Wisconsin had more than 1,800,000 milk cows, whereas Nebraska had only slightly over 600,000. Of the Wisconsin milk cows less than 100,000 were of dual-purpose breeds, whereas Nebraska had more than 300,000 in this class. This means that in the northern State one cow out of every eighteen was of a dual-purpose nature, whereas in our state every other milk cow was more or less a beef animal. Therefore milk production per cow in Wisconsin is considerably greater than in Nebraska. In 1929 the

average milk production per cow in Wisconsin was 5,710 pounds, whereas the Nebraska cow averaged 4,050 pounds.

The milk-cow population is concentrated in Wisconsin; the ten most thickly cow-populated counties in 1929 averaged 67.5 cows per square mile. In Nebraska the average for such counties was 18.5. These counties offer other interesting and significant contrasts. The average-sized farm in these ten Wisconsin counties was 102 acres, whereas those in the Nebraska counties averaged 166 acres. Therefore, the average-sized farm in the ten most thickly cow-populated counties of Wisconsin was more than a third smaller than the average farm in similar counties of Nebraska, yet on an average supported almost four times as many cows. Aside from all other considerations, it is apparent that this concentrated cow population in Wisconsin results in an abundant production of milk in a small area. Cheese production naturally profits by this arrangement.

It may also be assumed that the relative percentage of income which a farmer derives from the various products he produces may well indicate the interest and effort he puts into the various activities which net these returns. In this respect we also find a striking contrast between Wisconsin and Nebraska. From 1929 to 1932, the average Wisconsin farmer derived 52.1 per cent of his gross income from the sale of dairy products, whereas in Nebraska the average farmer derived only 11.6 per cent of his gross income from this same source. This means a great deal more specialization in dairying in Wisconsin and as much greater diversification of farming in Nebraska.

This contrast in relative income from dairy products has led to several known results. The average Wisconsin farmer treats his milk cows with greater consideration. They are fed with greater care. Most cows are housed in rather luxurious barns during inclement weather. A great effort is made to obtain and retain cows of superior qualities. Herds are bred in such a manner that the milk flow per head is sustained the year round.

The solicitude of the Wisconsin dairy farmer does not end with the care he bestows on the dairy cow. The production of good dairy products requires that equal if not greater care be given to the milk, which needs to be cooled promptly to arrest the rapid increase of bacteria. This is highly essential in order to produce good cheese, as well as other good dairy products. Cheesemakers of Wisconsin are very exacting in the quality of milk they purchase. Milk improperly cooled and defective is promptly rejected. Tests of each patron's milk are made frequently to maintain a high quality.

Contrasting Conditions in Wisconsin and Nebraska. There are other factors that make Wisconsin preeminent among the dairy states. Much of the southern part of the state, where the greatest concentration of dairy-

ing occurs, is characterized by land forms of minor relief interspersed with many lowlands and wet flats. On these land forms we find a relatively thick rural population. A maximum return must be obtained from a small area. Obviously, extensive farming is not possible with a large rural population. Power farming on a large scale is not practical, but the land is well suited for pastures and woodlands, and, naturally, for cows.

The pasture conditions in Wisconsin are, on the whole, favorable for good milk production. In the many lowlands of the state the water level is relatively near the surface and sustains profuse, luscious, nourishing grasses. Rainfall, which is not markedly greater during the summer in Wisconsin than in the eastern part of Nebraska, is much more effective because of lower temperature, less wind, and consequently, less transpiration and evaporation. Moreover, heavy dews in the low, moist land of Wisconsin encourage pasture growth to a higher degree than in Nebraska. These factors combined are conducive to good pastures in Wisconsin.

The transitional nature of the climate of Nebraska from east to west is commonly known. The average annual rainfall decreases from more than 30 inches in the southeastern part of the state to about 16 inches in the western part. Dry summers frequently arrest the growth of pastures, and the feed of stock is seriously curtailed, particularly in the more western pastures. Nor does the average Nebraska farmer supplement the feed of his cows during such periods by other greens or grains. This leads to a rather regular curtailment of milk production during the summer. Noxious weeds, which have usually grown to a fair size by this time, are frequently consumed by cattle, and the rather regular periods of ill-tasting milk that result are highly undesirable for cheese making.

Types of Farming in Nebraska not Conducive to Cheese Production

To be highly successful the making of cheese requires a specialized form of dairying carried on away from fluid-milk sheds. This condition is not found generally in Nebraska. Cheese makers in Nebraska usually procure their milk from farmers who have considerable interest in beef cattle, hogs, poultry, sheep, and grain production. We do have centers of corn production, wheat production, grazing, cattle feeding and hog feeding, but only in greatly restricted areas is there even a fair degree of specialized dairying. The milk cows in the state are usually of such color and build that they and their offspring may be transferred to the feed lot without serious loss in ultimate returns. During prosperous times fewer cows are milked, for no one milks for the fun of it. Cows become fresh at random times. The milk, in most instances, is separated and surplus accumulated cream is marketed. The incidental income which it provides comes in handy for the wife to purchase groceries and to supply her with pin

money. Diversified forms of farming enable the farmer to shift his major activity from one type of crop or stock raising to another. Changing prices of respective commodities and personal inclinations prompt such shifts. Obviously, few cheese plants can operate long under such conditions.

To produce good beef animals, calves should receive milk for several months. Hogs and poultry will also do markedly better if fed skimmilk. For this reason most of the farmers in the state part reluctantly with this product. With fair beef, pork, and poultry prices, skimmilk has considerable value in bringing stock to quick maturity. It must also be remembered that the Nebraska farmer, because of distance, pays a considerable price for the transportation of his milk to the cheese plant. A consideration of all these factors makes it highly doubtful that milking for cheese production has been or will be consistently more profitable in Nebraska than some other forms of farming enterprises.

It is not the purpose of this publication to discourage the making of all cheddar cheese in Nebraska. The food has been and is being made to good advantage under certain conditions. It is asserted, however, that these favorable conditions are not very widespread in the state at present.

Tariff Rates on Cheese

Cheese produced in Nebraska is largely consumed in this and surrounding states. Very little of it is shipped to distant markets. The price that Nebraska cheese brings on the market, however, is determined largely by the cheese prices that prevail in the important cheese markets of the United States as a whole. Since Americans ordinarily consume more cheese than they produce, the market price of cheese is also influenced by tariff taxes. Cheese producers as well as consumers are therefore interested in the extent of this tax, which has been set at amounts as follows:[21]

Payne-Aldrich tariff (1909) ..... 6 cents
Underwood tariff (1913) ..... 20 per cent ad valorem
Fordney-McCumber tariff (1922) ..... 5 cents
Hawley-Smoot tariff (1930) ..... 7 cents

The import taxes on cheese are considerable when it is realized that from 1920 to 1932 No. 1 American cheese wholesaled on the New York market at prices ranging from 13 to 28 cents a pound.

Foreign Trade of the United States in Cheese, 1909-35

With the exception of the period of the World War, the United States has exported but small amounts of cheese in the present century (Fig. 11). During the War the dislocations in Europe created a brief, profitable market abroad. Following this the sales abroad declined sharply, and less

[21] Compiled from the respective tariff acts.

than 2,000,000 pounds of this food have been exported annually in recent years. This is about equal to the total amount of cheese produced in Nebraska—which amounts to less than 0.3 per cent of the total produced in the United States.

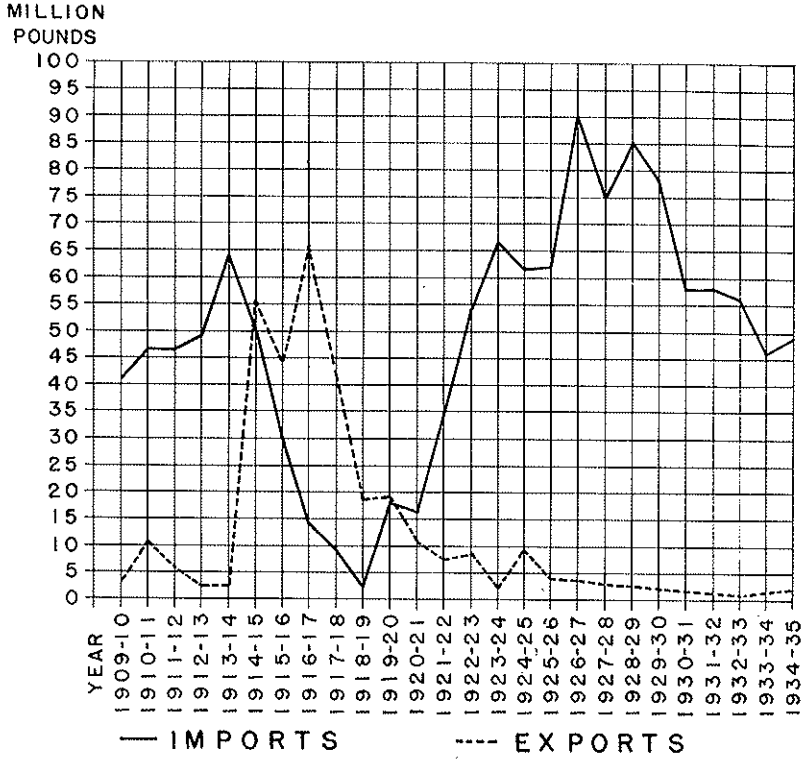

FIG. 11.—Foreign trade of the United States in cheese.
Source: *Yearbooks of Agriculture.*

Imports of cheese into the United States are considerably greater than exports. In the years immediately prior to the World War, from 40 to 60 million pounds of cheese were imported. During the War the imports declined radically, and less than 3 million pounds were imported during 1918-19. Following the War the imports have increased to such an extent that from 45 to 90 million pounds of cheese have been imported annually. Since the total production of cheese in this country has ranged between 400 and 500 million pounds in recent years, the imports equal from 12 to 20 per cent of the cheese consumed in the United States.

By far the greatest percentage of cheese imported comes from Italy, exceeding 50 per cent of the total since 1930. Next in importance are Switzerland, France, and the Netherlands.

Trend in Per Capita Consumption of Cheese in the United States

Table 2 shows the trend in per capita consumption of cheese as reflected by the census figures since 1849. In general, these figures show a decline from 1849 to 1879, and an increase in consumption from the latter year until 1929. The sustained and increasing program of cheese production seems to indicate that this food is increasing somewhat in popularity. The relation of factory cheese production increase in the United States is shown in Figure 12.

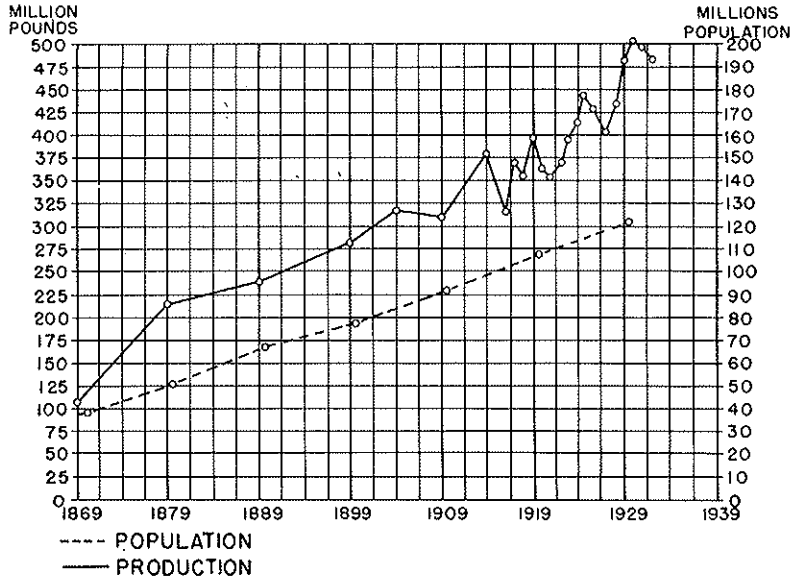

FIG. 12.—Factory cheese production and population increase in the United States since 1869 and 1870.

Source: *Statistical Abstracts of the United States.*

As population pressure increases in this country less meat may be produced, and a greater amount of food proteins will probably be derived from cheese. This, however, would be a long-time development and should not serve to prompt hasty promotion schemes for additional cheese plants at any time.

TABLE 2.—*Trend in Per Capita Consumption of Cheese in the United States* [22]

Year	*Pounds*
1849	4.0
1859	3.2
1869	3.3
1879	2.1
1889	2.9
1899	3.7
1909	3.85
1919	3.50
1929	4.62

Summary

Cheese is a highly nourishing, concentrated form of milk and, as a prized food, was known many centuries before the birth of Christ. Because of different methods of production in different areas, many varieties of cheese were perfected centuries ago. Cottage cheese, because of the ease with which it is produced, is to this day a popular home-made cheese and its commercial production has grown tremendously since the period of the World War. In recent years the average Nebraskan has consumed annually slightly less than one pound of commercially produced cottage cheese. Cheddar cheese is the most popular cheese with keeping qualities produced in America.

A large number of cheese plants were built in Nebraska during the 1880's and 1890's and again during the period following the World War. In many instances they were promoted and built by civic groups that hoped to enrich and diversify the industrial activities of their respective towns.

Prior to the advent of the auto truck, no cheese plant in Nebraska was long successful where milk had to be obtained from numerous farmers. Distances were too great for the horse and wagon. At present, cheese plants can usually obtain a sufficient amount of milk with the auto truck by collecting milk from considerable distances. Milk truckers for cheese plants in Nebraska cover exceedingly great distances in their milk-gathering activities. In some instances milk is acquired from producers living more than 50 miles from the cheese plants.

In a study made in Wisconsin it was found that 48½ per cent of the milk producers for cheese plants lived within one mile of such plants and 86½ per cent lived within 2 miles of the plants. In Nebraska the milk producer pays from 20 to 30 cents per hundred pounds of milk hauled to the cheese plants. The Wisconsin milk producer hauls his milk to the

[22] Includes all kinds of cheese except cottage, pot, and bakers. Data taken from census reports of the United States.

cheese plant, thereby reducing the transportation cost which the Nebraska producer has to meet.

Nebraska farmers, most of whom are stock raisers, part reluctantly with skimmilk because of its excellent feeding qualities. Transportation costs, the feeding value of skimmilk, and the price received for whole milk are factors that have not made the selling of milk to cheese plants consistently profitable in Nebraska. Compared with Wisconsin, Nebraska has a low milk-cow population of lower average production capacity. Diversified farming methods prevailing in Nebraska are not conducive to quantity and quality milk production. Few Nebraska milk producers cool their milk adequately before it is sent to cheese plants.

Many Nebraska cheese producers complain of a local prejudice against Nebraska-made cheese. The climate of Nebraska does not provide an insurmountable obstacle to good cheese production. Methods of feeding milk cows in Nebraska must be improved to sustain better milk production the year round as well as to prevent the production of off-flavored milk. Conditions favorable for the production of cheese in Nebraska are yet greatly restricted.

Acknowledgments

The writer wishes to express his appreciation of the assistance received from the following persons: Mr. A. L. Haecker, Chief of the Nebraska Bureau of Dairies, Foods, and Drugs; Dr. G. E. Condra, Dean and Director of the Conservation and Survey Division of the University of Nebraska; Mr. E. L. Reichert of the Dairy Husbandry Department of the University of Nebraska; Mr. John M. Buechel of the Roberts Dairy, Lincoln; and the many cheese-makers in Nebraska. Mr. J. D. Lytle drafted the charts and graphs used in this report and the photographs were taken by Mr. Richard Hufnagle. The late Dr. J. T. Link, Mr. E. C. Reed, Miss Grace Owens, and my sister Johanna Kollmorgen have read the manuscript and suggested improvements.