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THE FINCH DAIRY STATION

REPORT OF PROGRESS

BY
J. A. RUDDICK AND GEO. H. BARR

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ORIGIN.

The Finch Dairy Station was established in the year 1912, when the premises and good will of two small competing cheese factories located within a mile of each other were purchased by the department, and a new building erected in the village of Finch, Stormont county, Ontario.

OBJECTS.

The objects aimed at in establishing this Station were to provide facilities that would enable the Dairy Branch to,

(*a*) control and operate a model combined cheese factory, creamery, and milk and cream shipping station;

(*b*) demonstrate the advantages of a well-conducted factory, equipped to take advantage of the highest market for cheese, butter, milk or cream;

(*c*) encourage the production of winter milk;

(*d*) conduct experiments and investigations relating to the manufacture of butter and cheese;

(*e*) demonstrate new processes and to try out new appliances;

(*f*) demonstrate the value of the cool curing of cheese; and

(*g*) study the enonomics of dairy factory operation.

Being responsible for the successful operation of this factory conducted on strictly commercial lines, the Dairy Branch is brought into close contact with the problems which confront other manufacturers of cheese and butter throughout the country.

DESCRIPTION.

Figure 1 gives the floor plan and the original arrangement of the equipment.

The walls of the building are of hollow cement blocks throughout. The cheese-making room, used only during the summer months, is finished with a coat of paint on the smooth inside surface of the hollow blocks. The curing room is insulated with two courses of matched lumber, and a space of six inches between the sheathing and the inside surface of the cement blocks, which is filled with planer-mill shavings. The spaces between the joists in the ceilings are also filled with shavings. The ice chamber and the butter refrigerator are insulated with two courses of matched lumber, and a space of one foot between the lumber and the cement blocks, which is filled with shavings. The spaces between the joists in the ceiling are filled in the same manner.

The floors are of cement concrete throughout except in the ice chamber, the area of which is covered with coal cinders to a depth of one foot, on the top of which a layer of sawdust or planer shavings several inches thick is placed before the ice is put in.

There is no covering on the ice. Suitable openings are provided in the partitions between the ice chamber and the curing room and between the ice chamber and the butter refrigerator to provide for a circulation of air over the ice and though the rooms to be cooled. A steady temperature not exceeding 62 degrees F. can be maintained in the cheesecuring room.

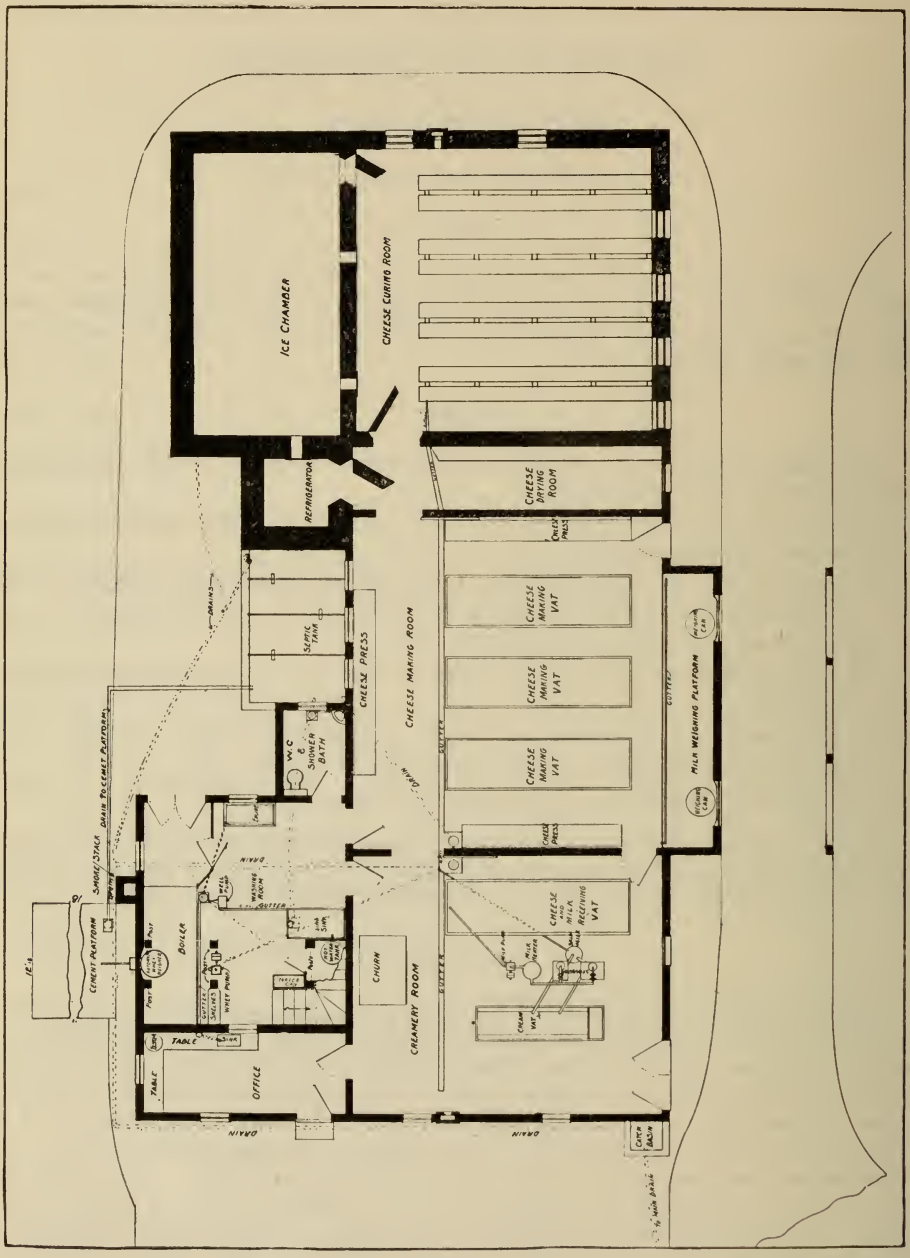

Fig. 1.

The floor of the butter refrigerator is constructed of a six-inch layer of concrete, three inches of compressed, impregnated cork board and finished with a layer of cement. Provision was made for the drainage of the area under the ice-chamber, as the site is one of rather impervious clay.

The building was so designed that the buttermaking, milk pasteurizing, and other apparatus pertaining to winter work, is located in a separate work room, the walls of which are specially insulated with two-inch Natco hollow tile and is, therefore, easily heated.

EQUIPMENT.

There are two weighing platforms for receiving milk and the cheesemaking room is equipped with four full-sized cheese vats and power agitators, three gang cheese presses, and an outfit for paraffining cheese. The buttermaking and milk handling equipment now consists of two 6,500 pound capacity cream separators, one milk heater and pasteurizer of 12,000 pounds capacity, two automatic pasteurizing and cream ripening vats, a combined churn and worker, one milk and cream cooler, and the necessary pumps for handling the milk and by-products. Buttermilk and skim-milk tanks and a steel whey tank are located above the boiler room on the second floor where there is no danger of frost during the winter months. The water supply is derived from a drilled well 85 feet deep. A hot water tank suspended from the ceiling of the boiler room is fed automatically from the cold water tank above. The exhaust steam from the engine passes through the hot water tank and provides a constant supply of hot water. The boiler feed water is drawn from the hot water tank, a special hot water plunger pump being used for that purpose. The exhaust from the separators is connected with the milk heater.

MILK SUPPLY.

There were sixty patrons of the two factories which were purchased in 1912. All of these patrons have continued to supply milk to the station and some new ones have been added. During the winter months several patrons from surrounding cheese factories, closed for that period, have brought milk to the station.

Table I shows the quantities of milk received during the calendar years 1912 to 1919. It will be observed that the quantity was practically doubled in two years from 1917 to 1919.

TABLE I.

Year.	Milk Received.	Net Return to Patrons per 100 lbs.	Total Amount Distributed to Patrons.
	lbs.	$	$
1912	2,069,281	1·11	23,304·49
1913	2,720,028	1·04	28,214·73
1914	2,356,202	1·19	28,108·74
1915	2,418,010	1·35	32,640·85
1916	2,486,380	1·60	39,779·88
1917	2,807,885	2·00	56,173·46
1918	3,859,217	2·14	82,785·69
1919	5,480,816	2·49	136,540·56

DISPOSAL OF MILK.

Finch is located at the crossing of the Toronto and Montreal line of the Canadian Pacific and the Ottawa and New York Branch of the New York Central Railways. Local trains pass the station about 10 o'clock every morning for Montreal and Ottawa, thus providing excellent shipping facilities for the milk or cream business. It is worthy of note that not a single patron of this factory has withdrawn his supply in order to make private shipments of either milk or cream. The management has been prepared at all times to take advantage of the highest market, either for butter, cheese, milk or cream, and a large proportion of the milk, as will be seen in Table II, has been sold to milk distributors in Montreal and Ottawa.

Table II shows the quantities of butter, cheese, butter fat, or milk sold during the years 1912 to 1919.

TABLE II.

Year.	Cheese.	Butter.	Fat sold as Cream.	Whole Milk Sold.
	lbs.	lbs.	lbs.	lbs.
1912	186,938	3,816	.....	.....
1913	129,811	43,268	5,351	.....
1914	131,906	21,247	14,207	60,800
1915	159,446	10,909	13,486	86,067
1916	153,574	117	16,317	334,703
1917	145,108	.....	23,718	577,472
1918	45,898	.....	86,572	890,970
1919	38,059	.....	149,665	983,867

MANUFACTURING CHARGES.

The manufacturing charges have been increased during the period of operation as follows:—

TABLE III.

Year.	For Manufacturing:		For Handling:	
	Cheese.	Butter.	Milk per 100 lbs.	Cream per lb. fat.
	c.	c.	c.	c.
1912	1¼	3	.....	.....
1913	1¼	3	.....	3
1914	1¼	3	10	3
1915	1½	3	10	3
1916	1½	3	10	3
1917	1½	3	10	3
1918	2	4	12	4
1919	2⅛	5	12	4

During the first years of operation the loss on manufacturing account during the winter months absorbed all the profit on the summer business, but since 1918 there has been an increasing profit on the whole year's operations after paying for all improvements, new apparatus and all other outlay.

HOW THE QUESTION OF PAYING FOR CHEESE MILK ACCORDING TO QUALITY WAS SETTLED.

The cheese money had always been divided on the "pooling" system, i.e., according to the weight only of the milk delivered, in the two factories which were acquired when the station was established. It was pointed out to the patrons that as they were now supplying a Government institution, which should be up-to-date in its methods and practices, they should consent to have the proceeds from sales of cheese divided according to the quality of the milk delivered by each patron.

This proposal was agreed to, but after one year's operation on this basis, about one-half of the patrons petitioned for a return to the old or pooling system.

The management then proposed to conduct the factory on both systems. It was advertised that on a certain day those who desired to have their milk pooled would deliver at one receiving platform and those who preferred to be paid according to quality would take their milk to the other one. It was intended to keep the two

deliveries of milk entirely separate, to sell the cheese separately and divide the proceeds according to the two systems. When the day arrived on which the division was to begin, not a single patron offered his milk at the pooling platform and the question has never been raised since.

WINTER DAIRYING.

The efforts to encourage winter dairying have been fairly successful.

During the winter of 1912-13 (December to March, inclusive) the total quantity of milk received was 208,937 pounds. During the same period in 1919-20 the total quantity delivered was 862,165 pounds. In the month of December, 1919, there was nearly four and half times as much milk delivered as in December, 1912.

THE SAVING OF FUEL.

With the increasing cost of fuel at most dairy factories, any saving in this direction has become much more important in recent years than it formerly was.

Two devices have been installed at the Finch Dairy Station which have affected a saving of approximately 25 per cent, or between $150 and $200 per year in the item of fuel alone.

The first consists of a 70-gallon copper pressure tank connected with the cold water tank, so that it is always full, and through which the exhaust steam from the engine passes in a series of coils. This affords an ample supply of hot water for washing purposes at all times. The boiler is also fed from this tank by means of a special hot water feed pump.

The other device is the connecting of the exhaust from the turbine cream separators with a Reid type milk pasteurizer used as a heater. The exhaust from the separators is sufficient to heat the milk for separating, except in very cold weather when the milk may be delivered partly frozen. An auxiliary direct steam connection is fitted to be used in such cases, but it is very seldom required.

The cost of installing these devices has been repaid several times over already.

This matter of the saving of fuel is one which deserve much more consideration on the part of factory owners than it generally receives.

THE MAKING OF SMALL CHEESE.

Recognizing the demand for cheese in small sizes for household use in Canada, provision has been made for turning these out in considerable numbers. The sizes adopted were 10-pound, 5-pound and 1-pound

An inquiry was received from England for 1-pound cheese and it was stated that there was a very ready sale for cheese of this size. A sample shipment was made and sent over, but the additional price offered was not sufficient to warrant the extra cost of putting them up.

Some tests were made to determine the loss in making 10-pound and twin cheese as compared with the standard 80 to 85-pound cheese, with the following results:—

AVERAGE LOSS IN WEIGHT ON CHEESE OF DIFFERENT SIZES MADE FROM 100 POUNDS OF CURD.

—	As Taken from Press.	7 days old.	14 days old.	21 days old.
	per cent	per cent	per cent	per cent
Standard Size	6·23	7·36	7·52	7·88
Twins	6·66	8·18	8·46	8·78
10 Pound	7·22	9·37	9·77	10·21

FIVE POUND CHEESE.

Five pound cheese are made by cutting a ten pound cheese in two after being in the press all night. A special device for holding the cheese while being cut consists of a hinged cylinder which opens to receive the cheese and then closes tightly around it. The cylinder is cut in two and a fine wire is drawn through the slot, thus dividing the cheese accurately and with neatness and despatch. The two 5-pound cheese are then replaced in the hoop with the freshly cut surfaces top and bottom and a cloth between the two cheese. The usual press cloths are put on and they are again put under pressure for 5 or 6 hours.

SMALL CHEESE WITHOUT BANDAGES.

The curd is filled into the hoops and put under pressure with only press cloths top and bottom. After about forty-five minutes the cheese are taken out of the hoops and wrapped with a light cotton cloth about two inches wider than the height of the cheese and long enough to overlap two or three inches at the ends. The cheese are then replaced in the hoops and pressed overnight.

In the morning the cheese are taken out, the cloths removed (to be used again) and the cheese put back in the press again for several hours. Press cloths should be used in this last operation. When the cheese are finally removed from the press, they are allowed to stand for a few hours until the surfaces have become quite dry, when they are paraffined and placed in the curing room.

Both 10 and 5-pound cheese are made without bandages and a considerable saving is thus effected.

It is doubtful if the cheese would stand up without the bandage except in a curing room where the temperature does not go above 65 degrees F.

THE USE OF PEPSIN IN CHEESE MAKING.

Early in the year 1916 it became evident that there would be an actual shortage of rennet extract in Canada before the cheesemaking season was far advanced.

To meet the situation, experiments were begun at the Finch Dairy Station with a view to find suitable substitutes for rennet. The use of hydrochloric acid mixed with rennet extract was tried with the idea of reducing the quantity of extract required. Fairly good cheese was made with this mixture as far as texture was concerned, but the flavour was very much inferior on account of the hydrochloric taint. This acid flavour was still very pronounced when the cheese were seven months old.

It has been a matter of common knowledge for years that pepsin, in its various forms, has the property of coagulating milk, but its cost compared with the cost of rennet extract, until the price of rennet was advanced by war conditions, made it prohibitive, except for experimental purposes. With the increased cost of rennet extract, this objection to pepsin was removed.

Between May 23 and June 2, 1916, five loss of cheese were manufactured by dividing the milk into two lots, using Armour's Soluble Powdered Pepsin in one and Hansen's Rennet Extract in the other. When the cheese were ten days to two weeks old, they were examined by leading experts in Canada and the opinion was unanimously expressed that from a commercial standpoint, there was no difference in the quality of the cheese made with pepsin and those with rennet extract. Pepsin was, therefore, recommended to the cheesemakers and full directions were issued for using it.

A quantity of pepsin was procured by the department and offered for sale to cheese factory operators, who found themselves unable to secure a supply of coagulant through commercial sources, at a slight advance over actual cost. This prevented

the price of pepsin from rising unduly as it undoubtedly would have done under the demand which was created if this check had not existed. A large quantity of pepsin was used by the factories from 1916 to 1919 and had it not been for this emergency supply of coagulant, the consequences would have been serious to the cheese industry.

A large number of different preparations of pepsin were put on the market, but cheesemakers were cautioned not to use any coagulant which had not been thoroughly tested by some competent authority. It was announced that the Finch Dairy Station was prepared to make thorough practical tests of all the different coagulants offered for sale. The results were published as soon as the information was available. A number of preparations were offered for sale which were unsuitable for the purpose and had it not been for this precaution, serious losses might have occurred in the cheese factories.

The supply of rennet is now nearly, if not quite, sufficient for all purposes, and as cheesemakers prefer to use rennet, the pepsin will probably go out of use. Full particulars regarding the use of pepsin will be found in Circulars 18, 19 and 21 of the Dairy and Cold Storage Series.

The establishment of the Finch Dairy Station was justified by this one piece of work alone.

PAYING FOR MILK ACCORDING TO QUALITY.

In view of the large number of cheese factories which still continue to receive milk on the "pooling" system and distribute the proceeds of the sale of cheese according to the weight of milk only, this question should still be a very live one in this country.

A large amount of experimental work bearing on the subject has been carried out by this Branch and at various Agricultural Colleges and Experimental Stations in the United States and Canada, since "paying by test" was first proposed in 1891, but it seemed to be advisable to emphasize the importance of the question by conducting some further tests with milk containing different percentages of fat at the Finch Station.

In 1913 and 1914 a great many samples of milk were tested with the Hart Casein Tester, but it was found very hard to get reliable results under ordinary factory systems. The Walker Casein Test was tried with somewhat better success in 1914 and 1915.

By selecting milk from various suppliers, quantities varying from 350 to 800 pounds were made up separately with a range of fat in the milk which averaged from 3·4 to 4·1 per cent. The yield of cheese from 100 pounds of milk averaged from 8·29 pounds to 10·75 pounds, or nearly 2½ pounds more cheese from 100 pounds of 4 per cent milk than from 100 pounds of 3·1 milk.

The yield of cheese per pound of fat varied from 2·55 pounds to 2·81 pounds.

The yield of cheese per pound casein varied from 3·47 pounds to 4·68 pounds.

The yield of cheese per pound of fat and casein combined varied from 1·47 to 1·73 pounds, or exactly the same variation as in the pounds of cheese per pound of fat.

The cheese were weighed to secure these figures when they were taken from the press.

With cheese selling at 15 cents per pound, milk testing 3·4 would return $1.41 on the pooling basis for milks of different quality.

Divided on the basis of the percentage of fat in the milk, 3·4 milk had a value of $1.31, or 3 cents per hundred under the actual cheese value, and the 4·1 milk yielded $1.58 per hundred or 6 cents above that of the actual cheese value.

Several different plans have been suggested on which payment for cheese milk might be made on a quality basis. Some of these plans are set out in the following table:—

TABLE IV.

ILLUSTRATING DIFFERENT METHODS OF DISTRIBUTING PROCEEDS FROM SALE OF CHEESE. PRICE 15 CENTS PER POUND.

Per Cent Fat in Milk.	Per Cent Casein in Milk.	lbs. Cheese per 100 lbs. Milk.	Value of 100 lbs. of Milk on Basis of:					
			Actual Cheese made.	Fat and Casein.	Fat only.	Fat + 2.	Fat + Calculated.	Pooling.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			$	$	$	$	$	$
3·40	2·30	8·95	1·34	1·36	1·31	1·34	1·32	1·41
3·50	2·00	9·02	1·35	1·31	1·35	1·36	1·35	1·41
3·50	2·20	9·19	1·38	1·36	1·35	1·36	1·35	1·41
3·60	2·10	9·00	1·35	1·36	1·38	1·39	1·38	1·41
3·70	2·20	9·39	1·41	1·41	1·42	1·41	1·42	1·41
3·70	2·30	9·73	1·46	1·43	1·42	1·41	1·42	1·41
3·70	2·35	9·64	1·45	1·44	1·42	1·41	1·42	1·41
3·80	2·00	9·57	1·43	1·39	1·46	1·44	1·45	1·41
4·00	2·30	9·83	1·47	1·50	1·54	1·49	1·51	1·41
4·10	2·10	10·17	1·52	1·48	1·58	1·51	1·54	1·41

The results in the foregoing table are based on the experimental work at the Finch Dairy Station with milks containing different percentages of fat and casein, as set forth in columns 1 and 2.

Column 3 gives the actual yield of cheese per 100 pounds of milk.

Column 4 shows the net return per 100 pounds of milk according to the actual quantities of cheese made.

In column 5 the division of the proceeds is based on the fat and casein content of the milk.

In column 6 the division is based on the fat content of the milk only.

In column 7 the division is made according to the fat plus 2 basis.

In column 8 the division is based on fat and calculated casein according to a formula proposed by Dr. L. L. Van Slyke.

Column 9 shows the value per 100 pounds of milk on the pooling system, provided all the milks with the different percentages of fat had been made up as one lot.

It is evident from a study of these figures that any of the plans proposed come very much nearer to the actual yield of cheese from the milk than the pooling system does.

The straight fat basis pays a slight premium to the richer milk. It has been held that the man who produces the richer milk, and thus raises the general average percentage of fat in all the milk supplied, is entitled to some consideration, but that view has not met with much favour in the minds of patrons generally.

The fat and casein basis seems to be impracticable on account of the amount of testing required, and the difficulty in securing accurate results in the testing for casein. In any case, the results are not as close to the actual yield of cheese as the fat plus 2 basis, or any closer than the straight fat basis.

The fat plus 2 basis has been adopted at the Finch Dairy Station. It involves a minimum of testing, is simple in application, and gives results which agree for all practical purposes with the actual yield of cheese.

SUMMARY.

The operation of the Finch Dairy Station has demonstrated the following points:—

1. That a Government institution may be operated at a profit.

2. That it is advisable in many localities, where there is competition for the milk supply for other purposes, to have factories equipped in such a manner as to permit of the manufacture of cheese, butter, or the sale of milk and cream at a moment's notice, in order to take advantage of the best market available. In this way, the patrons of the factory are not so likely to be induced to dispose of their milk through other channels.

3. That there is a large and unsatisfied demand in Canada for cheese for family use of 5 and 10 pound sizes.

4. That the patrons of factories appreciate a good service and are willing to pay a reasonable rate for manufacturing if they get value.

5. That a large saving in fuel expense can be effected by utilizing exhaust steam for heating purposes.

6. That the operation on commercial lines of a cheese factory and creamery is a decided advantage to the Dairy Branch in its work of advising the manufacturers of butter and cheese and outlining policies for the improvement of the manufacturing end of the dairy business.