The University of Minnesota

AGRICULTURAL EXPERIMENT STATION

SPECIAL REPORT
NORTH CENTRAL EXPERIMENT STATION
GRAND RAPIDS 1904-1914

DAIRYING AND GENERAL FARMING FOR THE TIMBERED SECTION

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UNIVERSITY FARM, ST. PAUL
FEBRUARY 1919

CONTENTS

ILLUSTRATIONS

SUMMARY

Dairying, with potatoes as a cash field crop, is believed to be the most profitable system of farming for the average farm of the timbered section of Northern Minnesota.

Common cows may be used under pioneer conditions as foundation stock for building up a profitable dairy herd.

With good feed and care, average common cows may be made to produce about 200 pounds of butterfat a year.

Daughters of common cows from a purebred dairy sire average 250 pounds of butterfat a year under the same conditions.

There is a wide variation in production. One cow may produce only 150 pounds of butterfat a year and another cow 250 pounds under practically the same conditions of feed and care.

Dairy type indicates production to a considerable extent, but the keeping of records of the milk and butterfat production of each cow is necessary to determine the real difference in value.

A production of 200 pounds of butterfat a year is necessary for a cow to be profitable from a business standpoint, even on moderately priced land.

From a business standpoint, 40 per cent of the common cows on the Experiment Farm were unprofitable. Only 10 per cent of the cows with dairy blood were unprofitable.

Through the use of purebred dairy sires, a dairy herd that will be quite equal to purebred animals in appearance and production may be built up from common cows, and this improvement may be brought about in ten years' time.

A dairy herd may be kept reasonably free from disease by starting with a disease-free herd and guarding against the frequent purchase of outside animals, and by the use of easily applied sanitary methods.

The crops found most profitable for the average farm of the timbered section of Northern Minnesota were oats, clover, fodder corn, potatoes, and rutabagas.

A three-year crop rotation of grain, clover, and cultivated crops was found the best system of cropping for large yields.

The growing of clover on each field once every three years and the application of stable manure were found necessary to keep up the fertility of sandy soil. This system improved sandy soil to a marked degree.

Clover seeded among the stumps on cut-over land produced excellent pasture. Dairy cows on the Experiment Farm produced as much as 40 pounds of butterfat for the pasture season, from an acre of cut-over land pasture that was the result of clover seeding.

Stump land pastured for several years is much more easily cleared.

Only potatoes should be sold from the farm, other crops should be fed and sold in the form of butterfat and other finished products.

Potatoes should be the chief market crop of the timbered section. Late potatoes give larger yields than early varieties. Carmen No. 1, or Green Mountain, proved the most satisfactory variety on the Experiment Farm.

All kinds of roots and vegetables were grown successfully. Plums, raspberries, currants, and strawberries were grown with continued success but apples were a failure.

Swamp land known as "muskeg" was tile-drained and thoroly tilled, but proved unsatisfactory for crop production.

Pig-raising was found profitable in connection with dairying. Poultry on a small scale was profitable. On a large scale it was not so profitable. Sheep gave fair returns.

The timbered section of Northern Minnesota is still largely undeveloped, but there is no longer any question as to its future possibilities in agriculture and especially in dairying. A part of the land is unfit for agriculture and should be devoted to forestry. The iron mines, the greatest in the world, will continue to occupy a considerable section, but the greater part of its seventeen million acres is for farmers.

SPECIAL REPORT OF THE NORTH CENTRAL EXPERIMENT STATION, 1904-1914

By A. J. McGuire

The eighteenth year of work at the experiment station at Grand Rapids, Minnesota, was completed in 1914. During this time 300 acres of land were logged off and 150 acres were brought under cultivation. Tile drains were put in for the low areas, including a muskeg swamp. Buildings were erected at a cost of $21,000. The number of dairy cattle was increased to 100 head, 60 of which were cows in milk. A special poultry plant was added with capacity for 1,000 hens. The total valuation of livestock and equipment other than buildings was estimated, August 1, 1914, at $16,000. The valuation of the land, 455 acres, was estimated at $75 per acre, or $34,125.

OBJECT OF THE WORK[1]

The object of the work at Grand Rapids has been for the most part to find the most practical and profitable system of farming for the timbered section of Northern Minnesota. The facts that the land must be cleared before it can be farmed, and that there is but a small acreage under the plow, make farming here different from that in the older settled sections of the state. The problem has been, and still is, to a great extent, to make a living from twenty acres or less under cultivation and at the same time to continue the clearing and development of the land to a point where the farm can be made most profitable.

SYSTEM OF FARMING FOLLOWED

The results of the work at the experiment farm as well as that of hundreds of successful farmers throughout the timbered section, show that for general conditions dairying is without any question the most profitable system of farming, and is entirely practicable for the greater part of the timbered section. Hog raising to a limited extent and poultry raising can be carried on with dairying. Where there is much natural meadow or where more feed is produced than is required for the number of cows necessary, beef cattle and sheep may

[1] The data given in this bulletin were published for the most part in press bulletin form at the time the work was done.

be raised to advantage. In locations near cities and under certain conditions, farmers may specialize in growing vegetables and small fruits, but as yet the field for this is very limited.

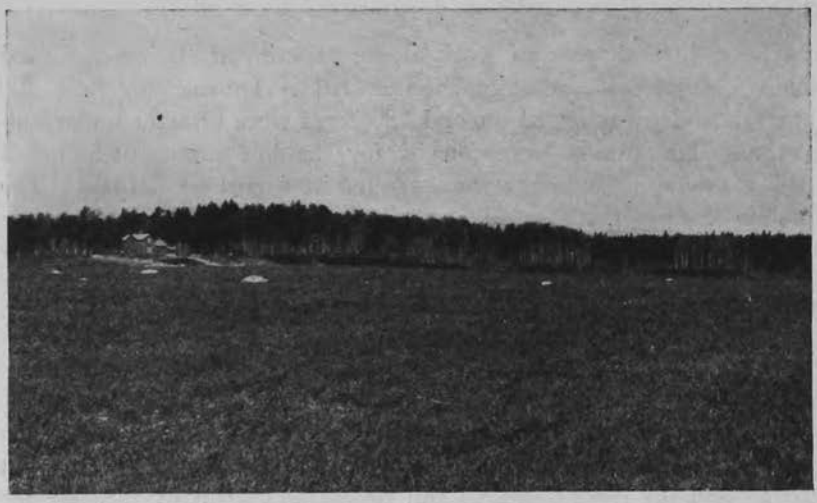

Fig. 1. Experiment Farm at Grand Rapids When Purchased, 1896

WORK IN DAIRYING

From 1904 to 1914 dairying was given special attention. The work was begun with a small herd of common cows, the kind kept by the average farmer of Northeastern Minnesota at that time. A purebred dairy sire was used, and the heifers were raised to replace the common cows. The feed and the care of the herd were simple and in keeping with what would be practicable for the average farmer. Butter was made and sold at the local stores until a creamery was established in the community.

The first object sought in the dairy work was to find if dairying could be made profitable in this section of the state, and with common cows, or the kind the pioneer farmers use. The second object was to find what improvement could be made through the use of a purebred dairy sire in building up a dairy herd, with common cows as foundation stock.

RESULTS OF DAIRY WORK

The results of the dairy work show that dairying is the most profitable branch of agriculture for the average condition of the timbered section of Northern Minnesota, and that good common cows may be used to advantage where the land is cheap, and especially as

foundation stock for building up a dairy herd, through the use of a purebred dairy sire.

The improvement made in the herd through the use of a purebred dairy sire was most marked. The heifers of the first cross, or the half-bloods, produced fifty pounds more butterfat a year than their mothers, the common cows. In the second and third cross there was not only increased production, but the breed of the sire showed so pronouncedly in the offspring that many of them would have passed for purebred animals.

Fig. 2. Experiment Farm, 1914

PROFIT IN DAIRYING

The common cows produced an average income of $54.88 per cow a year, for butterfat. The grade dairy cows averaged $68.90 per cow. The whole herd averaged $63.30 per cow a year throughout the ten years, the average price of butterfat being 28 cents.

In addition to the butterfat sold, 4,600 pounds of skimmilk per cow per year was fed to the calves, pigs, and chickens. This amount of skimmilk for feeding made it profitable to raise a calf and two pigs and to keep ten hens for every cow milked.

The manure was sufficient to manure each field on the farm every third year. Through the use of stable manure and the growing of clover, the crop yield was greatly increased, especially on the sandy soil. It was particularly noticeable that the crop yield increased as the number of cows on the farm increased. The yield on some of the fields was practically doubled in the ten years.

COMMON COWS

The work with common cows gave evidence of two things: (1) That the common cow is often better than the feed and care she receives; and (2) that she is not good enough for profitable dairying, with high-priced land and high-priced feed and labor.

The production from many common cows is only about 100 pounds of butterfat a year. This is mostly the result of poor feed and lack of care. With the best feed and good care, however, the production of the common cow will not average more than 200 pounds of butterfat a year. This is not sufficient to make dairying profitable on land worth $100 an acre and with high-priced feed and labor.

Fig. 3. Guernsey Sire at the Head of the Dairy Herd, 1914

GRADE DAIRY COWS

The grade dairy cows kept averaged 50 pounds more butterfat per cow a year than the common cows. After deducting the cost of feed, they brought an income of $11.82 more per cow a year than the common cows. Of the fifty-six grade dairy cows tested, thirty-three were half-bloods, or heifers from common cows and a registered dairy sire.

THE COWS TESTED

Records were kept of thirty-seven common cows or cows without dairy blood and fifty-six grade dairy cows or cows that were half dairy blood or more. The grade dairy cows were mostly daughters of the common cows and a purebred dairy sire.

The records as given in this bulletin show the production of every cow, both good and poor, in the herd and milked for a year or more during the ten years. They represent production under actual conditions, with nothing added or subtracted for any abnormal condition.

Table I shows the different factors that influence the profit or loss in dairying. The total number of cows given was never in the herd at one time. At the beginning there were ten cows in the herd and at the close, sixty. The herd was built up chiefly by raising the heifers. Some of the cows were in the herd the entire ten years, while at the close there were heifers with only one year's work.

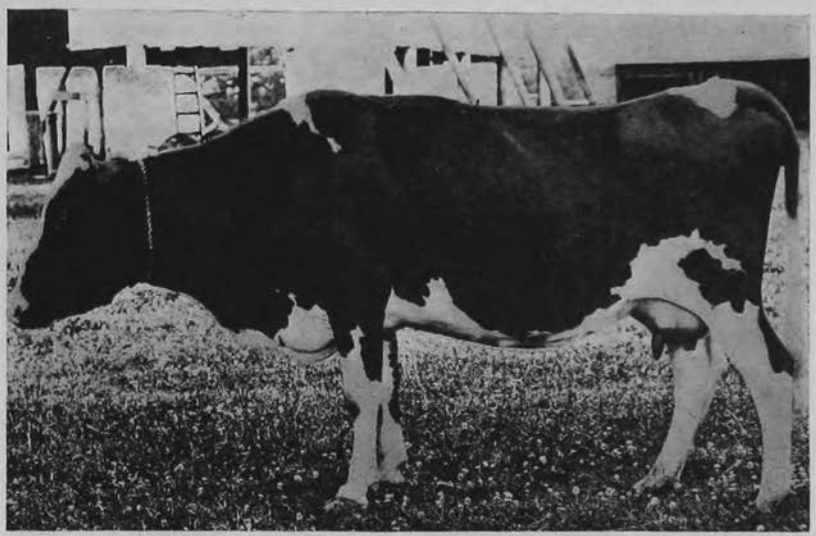

Fig. 4. Grace, a Common Cow (See daughter, page 10.)
Average yearly production: Milk, 5,532 pounds; Butterfat, 223 pounds.

TABLE I

SUMMARY OF WORK IN DAIRYING, 1904 TO 1914

Total number of cows (Common 37; Grade dairy 56)	93
Average pounds of milk per cow per year	5,158.8
Average pounds of butterfat per cow per year	226.1
Average value of butterfat per cow per year at 28 cents per pound	$63.30
Average cost of stall feed per cow per year	$31.75
Average return above cost of feed per cow per year	$31.55
Average record years per cow	4.17
Average time between freshenings (months)	17
Average age of cows at beginning of record (years)	3
Cows died from disease	6
Cows died from accident	1
Cows disposed of on account of non-breeding	9
Cows disposed of on account of unsatisfactory production	21
Cows disposed of on account of old age	1
Total number calves born	215
Calves died as result of abortion	6
Calves died from goiter	5
Calves died from scours	2
Calves died from all other causes	5
Calves lost, all causes, per cent	8.3
Feed Record per Cow per Year*	
Grain, pounds	1,300
Hay, pounds	2,000
Corn silage, pounds	6,000
Average pasture season for cows in milk, months	5
Average price of butterfat, per pound	$0.28

* Cost of feed figured at $25 a ton for grain, $8 for hay, and $2.50 for silage. Pasture, cut-over land, no charge.

In Table II a comparison is made between the common cows and those with dairy blood. The most important information in this table is the number of cows disposed of on account of unsatisfactory production. It was found that a production of 200 pounds of butterfat a year was necessary from a cow, to pay for her feed and the labor and other expenses in connection with her keep. Note that 40 per cent of the common cows failed to meet this requirement. Only 10 per cent of the grade dairy cows failed to produce more than 200 pounds of butterfat a year.

Fig. 5. Grace 4th, a Half-Blood Guernsey
Daughter of Grace and from a registered Guernsey sire. Average yearly production: Milk, 5,706 pounds; butterfat, 286 pounds.

TABLE II
COMPARISON OF COMMON COWS AND GRADE DAIRY COWS

	Common cows	Grade dairy cows
Number of cows	37	56
Average pounds of milk per cow per year	4,737.7	5,436.9
Average percentage of fat in milk	4.13	4.56
Average pounds of butterfat per cow per year	196.0	246.1
Average value of butterfat per cow per year	$54.88	$68.90
Average cost of feed per cow per year	$30.65	$32.85
Average returns above cost of feed per cow per year	$24.23	$36.05
Increased returns per cow per year in favor of dairy blood	.....	$11.82
Average record years per cow	4.9	3.66
Average time between freshenings, months*	15.3	18.9
Average age at beginning of record, years	3.12	2.77
Number of cows died from disease	4	2
Number of cows disposed of on account of non-breeding	3	7
Percentage of cows disposed of on account of non-breeding	8.1	12.5
Number of cows disposed of on account of unsatisfactory production	15	6
Percentage of cows disposed of on account of unsatisfactory production	40.5	10.5

* The difference in time between freshenings of the common and grade dairy cows is due to the fact that when a common cow failed to breed regularly she was disposed of, while several dairy cows that did not breed regularly were kept while there were prospects of getting them to breed again.

For the production and profit of different cows, a comparison of mothers and daughters gives the most reliable data. Where there is a difference it must be caused by the blood of the sire in the daughter. The value of a registered dairy sire is shown most clearly in Table III. An increase of 50 pounds of butterfat with the first cross places a value upon purebred dairy sires that is much greater than their cost.

TABLE III
COMPARISON BETWEEN COMMON COWS AND THEIR DAUGHTERS FROM A REGISTERED DAIRY SIRE

	Common	Daughters from registered dairy sire
Number of cows	21	19
Average pounds of milk per cow per year	4,569.8	5,027.9
Average percentage of fat	4.28	4.98
Average pounds of butterfat per cow per year	195.8	250.8
Average value of butterfat per cow per year	$54.82	$70.20
Average cost of feed per cow per year	$30.04	$31.25
Average returns above cost of feed per cow per year	$24.78	$38.95
Increased returns per cow per year in favor of dairy blood	.....	$14.17
Average record years per cow	5.8	3.16
Average time between freshenings, months	14.4	18.0
Average age at beginning of record, years	3.3	2.2

Classifying all the cows according to their type as they would be judged in the show ring, the records show that the best dairy type cows were the most productive and the most profitable. This was not true with each cow, but with the average of each group. The best common cow in the herd was a very good dairy type cow. The cows classified as poor dairy type, were shallow and narrow bodied. In this group of ten there were but three that made more than 200 pounds of butterfat a year. In the group of beefy type cows, only two out of fourteen made over 200 pounds of butterfat a year. In the group of very good dairy type cows there was not a poor animal. In the group of good dairy type cows there were but four cows out of thirty-three that made less than 200 pounds of butterfat a year.

A knowledge of type is a guide in selecting cows, but weighing and testing the milk is the only absolute method of knowing the profitable and unprofitable cows and the degree to which they are profitable or unprofitable.

Table V gives the individual record of every cow in the herd. To judge a cow's record certain other things need to be known aside from her production. Her breeding, type, age, the number of years tested, and the number of times she freshened, are all important factors, as well as the feed and care she received.

The years in each cow's record are consecutive and her production is the average per year for the total number of years.

TABLE IV
COMPARISON OF COWS OF DIFFERENT TYPES

	Very good dairy type	Good dairy type	Fair dairy type	Poor dairy type	Beefy type
Average number of cows	17	33	19	10	14
Average pounds of milk per cow per year	6,062.6	5,155.1	5,018.0	4,026.9	4,246.2
Average pounds of butterfat per cow per year	286.4	237.6	215.8	172.8	170.0
Average value of butterfat per cow per year	$79.99	$66.52	$60.42	$48.38	$47.60
Average cost of feed per cow per year	$34.60	$31.74	$31.33	$28.19	$28.91
Average returns above cost of feed per cow per year	$45.39	$34.78	$28.05	$20.19	$18.69
Average record years per cow	4.4	3.8	4.8	2.7	4.1
Average time between freshenings, months	17.0	17.0	17.0	15.9	14.3
Average age at beginning of record, years	3.3	2.6	3.0	2.4	4.1

Fig. 6. Bell, a Cow Without Dairy Blood (See daughter, page 16.)
Average yearly production: Milk, 5,898 pounds; butterfat, 233 pounds.

TABLE V—Record of Dairy Herd, 1904-1914

Name	Breeding	Average yearly production			Years in record	Age at beginning of record	Times fresh	Type
		Milk	Test	Butterfat				
		Pounds	Per cent	Pounds		Years		
Ada	Common	4,500.0	4.28	192.8	2	7.0	2	Fair dairy
Ada 2d	Common, daughter of Ada	4,122.3	3.86	159.2	4	2.0	4	Good dairy
Ada 2d 2d	Half Guernsey, daughter of Ada 2d	4 320.0	4.46	193.0	3	2.0	3	Good dairy
Bell	Half Red Poll	5,898.1	3.95	233.2	10	2.5	8	Beefy
Bell 2d	Three fourths Red Poll, daughter of Bell	4,032.0	4.24	171.2	5	2.5	4	Beefy
Bell 3d	Half Guernsey, daughter of Bell	7,146.8	4.52	323.2	3	2.0	2	Good dairy
Bell 4th	Half Guernsey, daughter of Bell	4,479.3	5.17	231.5	2	2.0	2	Good dairy
Black and White	Common	5,922.1	3.99	236.1	3	3.0	2	Fair dairy
Brindle	Guernsey-Jersey	5,638.2	4.71	265.8	5	2.5	3	Very good dairy
Brindle 2d	Three fourths Guernsey, daughter of Brindle	6,471.5	4.76	308.2	2	2.5	2	Very good dairy
Bud	Half Guernsey	5,606.0	3.63	205.2	3	2.0	2	Poor
Cherry	Common	3,775.3	4.53	171.2	2	2.5	2	Poor
Daisy	Common	3,857.8	4.24	163.7	5	4.0	4	Beefy
Dido	Common	5,937.8	3.77	224.0	1	3.0	1	Fair dairy
Distant	Half Red Poll	5,194.8	4.46	236.9	10	2.0	8	Good dairy
Distant 2d	Half Guernsey, daughter of Distant	5,242.4	4.92	258.0	3	2.0	3	Fair dairy
Exelda	Guernsey-Jersey	6,314.8	5.03	317.5	5	2.0	3	Very good dairy
Four	Guernsey	4,658.7	4.76	222.0	7	4.0	3	Good dairy
Four 2d	Guernsey, daughter of Four	5,877.7	4.56	268.4	3	2.0	2	Very good dairy
Four 3d	Guernsey, daughter of Four	5,706.8	4.61	263.4	2	2.0	1	Very good dairy
Five	Guernsey	4,837.6	4.38	211.8	4	3.0	3	Poor
Garden	Half Guernsey	4,577.0	5.08	232.8	5	2.0	3	Fair dairy
Garden 2d	Three fourths Guernsey, daughter of Garden	8,072.8	5.29	427.0	1	3.0	1	Very good dairy
Gilbert	Jersey	5,366.7	4.87	261.4	4	6.0	3	Very good dairy
Grace	Common	5,532.1	4.04	223.7	10	7.0	8	Fair dairy
Grace 2d	Half Red Poll, daughter of Grace	4,857.1	3.94	191.3	7	2.5	5	Fair dairy
Grace 3d	Half Red Poll, daughter of Grace	5,856.0	4.39	257.0	3	2.5	2	Good dairy
Grace 4th	Half Guernsey, daughter of Grace	5,706.8	5.02	286.4	6	2.0	4	Good dairy
Grace 5th	Half Guernsey, daughter of Grace	5,133.9	5.23	268.5	5	2.0	3	Good dairy
Grace 6th	Half Guernsey, daughter of Grace	3,838.9	5.41	208.7	4	2.0	2	Poor
Grace 7th	Half Guernsey, daughter of Grace	3,708.5	4.60	170.6	3	20 Mo.	1	Fair dairy

TABLE V—RECORD OF DAIRY HERD, 1904–1914—*Continued*

Name	Breeding	Average yearly production			Years in record	Age at beginning of record	Times fresh	Type
		Milk	Test	Butterfat				
		Pounds	Per cent	Pounds		Years		
Grace 3d 2d	Half Guernsey, daughter of Grace 3d	5,032.4	4.82	244.5	1	2.5	1	Fair dairy
Grace 4th 2d	Jersey-Guernsey, daughter of Grace 4th	6,020.1	4.56	274.5	3	2.5	2	Good dairy
Holstein	Guernsey-Holstein	6,033.9	3.88	234.3	2	3.0	2	Good dairy
Ida	Common	4,821.0	3.93	189.5	4	10.0	3	Good dairy
Ida 2d	Half Red Poll, daughter of Ida	5,678.0	3.87	219.6	7	2.5	5	Good dairy
Ida 2d 2d	Three fourths Red Poll, daughter of Ida 2d	5,229.5	4.61	241.3	6	2.5	4	Fair dairy
Ida 2d 3d	Half Guernsey, daughter of Ida 2d	4,059.0	4.80	194.9	3	2.5	1	Good dairy
Ida 2d 4th	Half Guernsey, daughter of Ida 2d	4,321.4	5.46	237.3	3	2.5	1	Good dairy
Jersey	Guernsey-Jersey	5,555.2	4.73	262.9	5	2.0	2	Very good dairy
Judy	Half Guernsey	5,293.0	4.09	216.7	1	5.0	1	Good dairy
Judy 2d	Half Red Poll, daughter of Judy	4,688.8	4.01	188.3	3	2.5	2	Beefy
Judy 2d 3d	Half Guernsey, daughter of Judy 2d	5,327.2	4.91	261.6	5	2.5	3	Good dairy
Lou	Half Red Poll	2,982.1	3.77	111.0	3	2.5	2	Poor
Lou 2d	Half Guernsey, daughter of Lou	4,605.0	4.73	218.0	3	2.0	2	Fair dairy
Lucy	Half Red Poll	4,359.8	3.99	174.0	6	2.5	5	Beefy
Lucy 2d	Three fourths Red Poll, daughter of Lucy	5,731.3	3.73	214.0	6	2.5	4	Fair dairy
Mary	Grade Jersey	5,249.0	4.11	216.0	7	4.0	5	Good dairy
Mary 2d	Half Red Poll, daughter of Mary	5,403.7	4.25	229.9	6	2.5	4	Good dairy
Mary 3d	Half Guernsey, daughter of Mary	4,011.0	5.13	206.0	2	2.0	2	Good dairy
Mary 4th	Half Guernsey, daughter of Mary	5,416.0	4.45	241.4	4	2.0	3	Good dairy
Mary 5th	Half Guernsey, daughter of Mary	5,775.0	4.23	244.3	3	2.0	1	Good dairy
Millie	Half Red Poll	5,079.4	3.98	202.3	9	2.5	7	Fair dairy
Moose	Common	5,587.8	4.47	250.1	2	3.0	1	Fair dairy
Mully	Common	3,277.8	4.39	143.8	2	2.5	2	Poor
Nellie	Half Guernsey	7,020.2	3.77	267.0	7	8.0	5	Very good dairy
Nellie 2d	Three fourths Guernsey, daughter of Nellie	4,896.0	4.94	242.1	2	3.0	2	Good dairy
Nellie 3d	Three fourths Guernsey, daughter of Nellie	4,928.5	4.62	227.9	3	2.0	1	Good dairy
One	Guernsey	4,073.8	3.99	162.8	6	8.0	2	Beefy
Price	Half Guernsey	5,427.8	4.53	246.1	5	2.5	4	Good dairy
Price 2d	Half Guernsey	3,506.7	4.86	170.4	4	2.5	3	Beefy
Price 2d–2d	Three fourths Guernsey, daughter of Price 2d	3,489.3	4.44	154.9	3	2.0	1	Fair dairy

TABLE V—RECORD OF DAIRY HERD, 1904-1914—*Continued*

Name	Breeding	Average yearly production			Years in record	Age at beginning of record	Times fresh	Type
		Milk	Test	Butterfat				
		Pounds	Per cent	Pounds		Years		
Price 4th	Half Guernsey	4,415.4	4.33	191.1	4	2.5	2	Poor
Queen	Common	4,073.8	3.99	162.8	3	10.0	2	Good dairy
Rose	Common	5,711.8	4.07	232.6	5	2.5	3	Fair dairy
Roxy	Common	5,836.7	4.25	248.1	10	4.0	8	Very good dairy
Roxy 2d	Half Shorthorn, daughter of Roxy	4,209.0	4.18	176.2	3	2.5	2	Beefy
Roxy 3d	Half Red Poll, daughter of Roxy	4,826.3	4.23	204.5	6	2.5	5	Good dairy
Roxy 4th	Half Guernsey, daughter of Roxy	4,263.5	5.72	244.2	5	2.0	2	Very good dairy
Roxy 3d 2d	Half Guernsey, daughter of Roxy 3d	5,259.1	4.98	262.1	3	2.5	2	Good dairy
Roxy 3d-3d	Half Guernsey, daughter of Roxy 3d	5,673.8	5.29	300.1	2	3.0	2	Very good dairy
Sawyer	Half Guernsey	4,829.6	5.48	264.9	5	2.0	3	Good dairy
Sawyer 2d	Three fourths Guernsey, daughter of Sawyer	5,700.7	4.85	276.9	1	2.0	1	Good dairy
Sella	Grade Red Poll	3,836.1	4.00	153.4	6	5.0	6	Beefy
Sella 2d	Common, daughter of Sella	5,550.1	3.81	211.4	5	2.5	5	Fair dairy
Sella 3d	Half Red Poll, daughter of Sella	5,777.1	3.80	219.9	7	2.5	5	Fair dairy
Sella 5th	Half Guernsey, daughter of Sella	6,505.9	4.73	308.2	3	2.5	3	Very good dairy
Shorthorn	Grade Shorthorn	5,299.9	4.14	219.8	3	3.0	2	Beefy
Six	Guernsey	5,693.6	4.32	246.2	7	4.0	5	Good dairy
Spot	High Grade Guernsey	7,581.3	4.06	308.2	4	3.0	3	Very good dairy
Spotty	High Grade Guernsey	5,259.4	4.23	223.7	4	2.0	2	Fair dairy
Star	Grade Shorthorn	5,302.7	4.34	230.2	2	3.0	1	Beefy
Stuffy	Half Red Poll	5,081.8	3.82	194.1	10	2.5	9	Beefy
Stuffy 2d	Three fourths Red Poll, daughter of Stuffy	2,315.2	4.19	97.0	1	2.0	1	Beefy
Stuffy 4th	Half Guernsey, daughter of Stuffy	4,936.7	4.99	246.3	2	2.0	2	Good dairy
Stuffy 5th	Half Guernsey, daughter of Stuffy	5,970.4	5.18	309.5	1	2.0	1	Good dairy
Swift	Half Red Poll	2,634.0	5.31	139.9	2	2.5	2	Poor
Three	Guernsey	4,703.0	4.93	232.0	7	5.0	4	Fair dairy
Three 2nd	Guernsey, daughter of Three	3,086.2	4.53	140.0	2	2.5	2	Beefy
Two	Guernsey	5,062.5	4.61	233.7	7	6.0	3	Very good dairy
Two 2d	Guernsey, daughter of Two	6,827.8	4.91	339.6	1	2.0	1	Very good dairy
White Face	Common	2,518.7	4.42	121.3	2	2.5	2	Poor
Wild Eyes	Half Guernsey	4,490.0	4.65	208.8	4	2.0	3	Fair dairy

BUILDING UP THE DAIRY HERD

A REQUIRED PRODUCTION

In beginning the dairy work, a standard was set of 200 pounds of butterfat per cow a year, and any cow that could not come up to this requirement was disposed of as unsatisfactory.

When the herd was started, in 1904, it was found necessary from a business standpoint to sell $50 worth of butterfat per cow a year in order that the cash sales from the cow would pay for the feed, labor, and all other expenses. In 1914 the required amount had increased to $60 per cow.

Fig. 7. Bell 3d, a Half-Blood Guernsey
Daughter of Bell and from a registered Guernsey sire. Average yearly production: Milk, 7,146 pounds; butterfat, 323 pounds.

It should not be understood that a farmer who is not getting this production from his cows is losing money. The value of the skim-milk, the calf, and the manure, even with an income of $30 per cow a year for butterfat, makes the farm far more nearly self-supporting than if cows are not kept. Almost any kind of cow will help make a living for the family, but in order to pay for the farm, especially if the land is high priced, and to improve the farm with first-class buildings and labor-saving machinery, the income from the cows must be considerably more than the cost of their feed.

MEANS EMPLOYED

Feed, care, records, and breeding were the means employed in building up the dairy herd on the experiment farm. In starting out with a herd of common cows, the aim was to build up a herd in a way that any farmer would be able to do. The feed used could have been provided on the average farm. The work of caring for the herd was done by young men hired from the farms of the northern part

of the state. The milk from each cow in the herd was weighed every milking and tested once a month, and the feed was weighed, so that the production of each cow was known and the cost of her production. Guernsey sires were used, but any of the leading dairy breeds might have been used with equally good results.

The important thing in breeding is to select some one breed that is adapted to the work, to stick to that breed, and to procure sires that are truly representative of the breed, especially in production.

Feed.—Clover hay and corn silage were the chief feeds during the winter and cut-over land pasture was depended on during the summer. Some grain was used, an average of 6 pounds per cow a day during the winter. The grain feed consisted almost entirely of bran, shorts, and wheat middlings. This is the feed most commonly used in the northern section of the state. The pasture, which forms a very important factor in profitable production, was cut-over land from which the brush had been cut, and clover, timothy, and bluegrass seeded between the stumps. The cows were on pasture from about May 15 to October 15, the young stock sometimes remaining until in November, depending on the weather.

The average daily ration for the cows during the winter was 10 pounds of clover hay, 30 pounds of silage, and 6 pounds of grain. The rule for feeding was 1 pound of hay and 3 pounds of silage per 100 pounds of live weight, and 1 pound of grain for each 3 pounds of milk produced. According to this rule a cow weighing 1,000 pounds and giving 30 pounds of milk a day, was fed 10 pounds of hay, 30 pounds of silage, and 10 pounds of grain. A cow of the same weight, but giving only 10 pounds of milk a day, was fed the same amount of hay and silage but only 3 pounds of grain. The day's ration was given in two feeds; morning and evening.

The first year there was no silo on the farm. The fodder corn was cured in the shock and fed in the bundle. Some roots were used to supply succulence. Satisfactory results were obtained, except for the waste of part of the fodder. A farmer without a silo may use fodder corn dry, feed with roots in addition, and have very good results. Good clover hay, that may be grown on every farm, is the most important part of the ration.

Rations used.—First year: Clover hay 10 pounds, fodder corn 10 pounds, roots 10 pounds, shorts 6 pounds.

Following years: Clover hay 10 pounds, fodder corn silage 30 pounds, mill feed 6 pounds (bran, shorts, and middlings).

Ration without grain: Clover hay 15 pounds, fodder corn 12 pounds, roots 24 pounds. This ration was used occasionally when there was a considerable supply of roots on the farm and no good market for them. Roots may be substituted for grain.

These rations represent the average amount fed for the average production of milk through the winter months, or for a production of 18 pounds of milk a day testing 4.3 per cent fat, which was the average daily production of milk for all the cows during the winter months throughout the ten years. Cows giving a larger quantity of milk were fed the same kind of feeds but in proportion to their production.

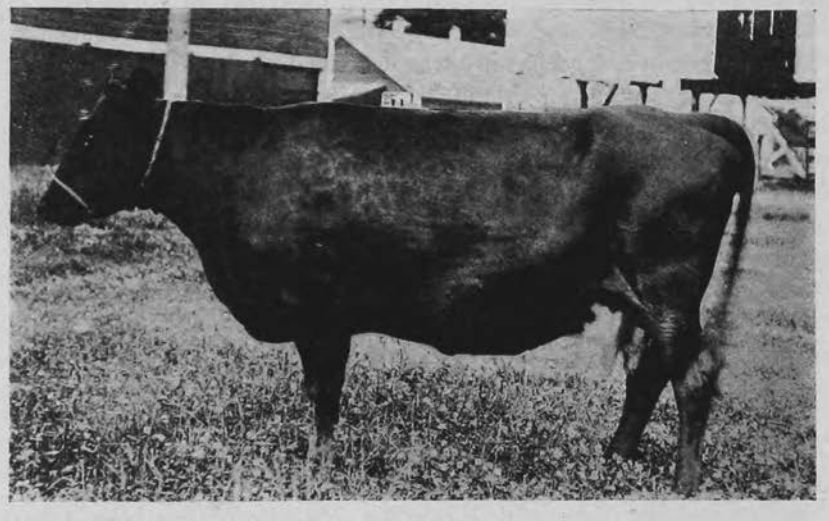

Fig. 8. Sella, a Cow Without Dairy Blood (See daughter, page 19.)
Average yearly production: Milk, 3,836 pounds; butterfat, 153 pounds.

Raising young stock.—All the heifer calves were raised. The bull calves were disposed of either as veal or as yearlings and never carried through the second winter.

The feed for the calves was whole milk the first week; whole and skimmilk, half and half, the second week or ten days; and then all skimmilk. This was generally continued until they were six months old or longer. Old process oilmeal was fed in the skimmilk, beginning with half a teaspoonful and slowly increasing to a tablespoonful at a month old. Half a handful of grain was fed to the calves when they were a week old. The amount was gradually increased to a double handful, or a pound a day, when they were a month old. The kind of grain fed to the cows was generally fed to the calves, altho a mixture of whole oats and corn, half and half, was found very satisfactory. Silage was also fed to the calves, beginning when they were a month old. They had access to hay when a week old and to water and salt when a month old. The quantity of milk fed was from four to five pounds twice a day the first week, with a gradual increase to six or seven pounds when the calves were a month old.

Not more than 8 pounds, or 4 quarts, was ever given and only two feeds a day. The second winter, when the heifers were a year old, they were fed chiefly on clover hay and silage and from 1 to 2 pounds of grain a day.

The calves were generally turned to pasture when from six to seven months old, and received no other feed during the summer months. Calves under six months old were kept in the barn during the summer, except with a run to a small pasture, and were fed practically the same as during the winter.

Fig. 9. Sella 5th, a Half-Blood Guernsey
Daughter of Sella and from a registered Guernsey sire. Average yearly production: Milk, 6,505 pounds; butterfat, 308 pounds.

Care of herd.—The care of the dairy herd was so planned as to have each cow produce all the milk she was capable of producing, economically; to have the milk and cream pure and wholesome; to keep the herd free of disease; to raise heifers that would be profitable cows; and so to organize the work that it could be done agreeably and well.

Most of the men employed had had no previous training in dairying, and when first employed they would have preferred to do other work on the farm rather than the dairy work, but not a man objected to the dairy work or disliked it after being on the place for two months.

Comfort.—To keep the cows comfortable was the first order of business. The milk record sheet (which cost very little to keep) showed that the cows were always down in their milk whenever they were uncomfortable. For example, if the cows were outdoors at night in May or September, when there was a frost, every cow would be down in her milk from 1 to 3 pounds in the morning, and it might be several days before they would regain their normal production. For this reason the cows were kept in the barn after the weather

began to get cold in the fall. They were turned out once or twice a week for exercise, but were always put back in the barn after an hour or two. The barn was so constructed that the temperature did not reach the freezing point in the coldest weather.

The milk record sheet also showed that the cows were uncomfortable when affected with any kind of skin ailment, mange, or parasites. To avoid these troubles a supply of coal tar dip was always kept in the barn and used freely. It was used in the comb and brush in grooming the cows, and as a spray for disinfecting the barn.

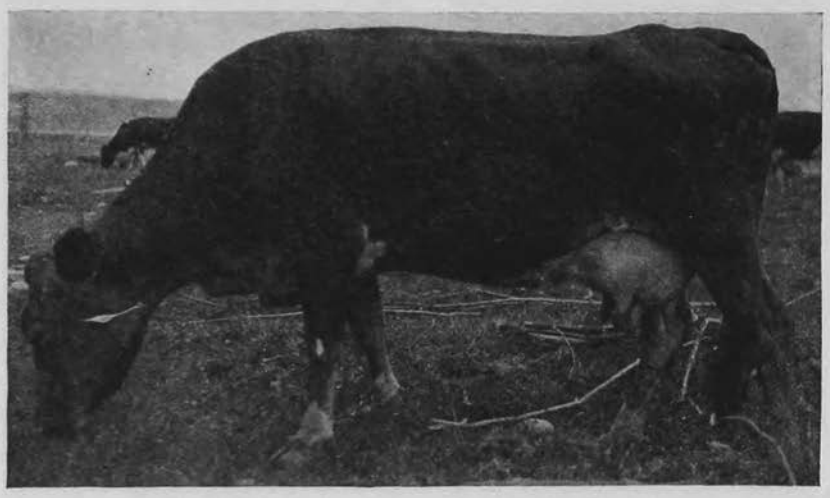

Fig. 10. Garden 2d, a Three-Quarters Blood Guernsey
Production first year: Milk, 8,072 pounds; butterfat, 427 pounds.

Regularity and system.—Regularity in feeding and milking and system in all the work was found to increase the milk flow without added expense. The feeding and milking were begun at a certain time every day the year round. Each man had certain work to do and was expected to do it every day without being told. The milking was begun at 5:15 in the morning and at 4:30 in the evening and all the dairy work was done in regular order. System brought harmony, and not only resulted in the cows' giving more milk from being regularly milked and fed by the same person, but the men found the work more agreeable and interesting.

Combating disease.—The dairy herd was tested for tuberculosis every year. In the ten years less than half a dozen animals gave evidence of the disease. These were promptly disposed of. There was not a single bad case of tuberculosis discovered in the herd during this time. This record is probably due to the fact that the herd was healthy at the beginning and few animals were purchased thereafter except the sires.

OTHER FARM ANIMALS

PIGS

Pigs were raised profitably on the experiment farm, but only to a limited extent. It was found that skimmilk was the controlling factor in the number of pigs that could be raised profitably, or in other words, the number of cows milked determined the number of pigs that could be kept profitably. One brood sow for every three or four cows milked, is about the right number for the average farm of the timbered section.

Fig. 11. Grade Dairy Calves at Experiment Farm

The plan was to have the sows farrow in the spring (April) and to raise only one litter a year. The pigs were grown largely on skimmilk and clover pasture. When there were too many pigs for the amount of skimmilk available, grain had to be purchased to raise them, and the profit was greatly reduced. Some grain may be purchased to fatten pigs if necessary, but they must be grown largely on skimmilk and clover pasture to be profitable.

Barley was the grain generally used for fattening, and this was grown on the farm. Some roots were also used and to good advantage. The sows were wintered on skimmilk, second crop clover hay, roots, and a small amount of grain, generally oats.

The uncertainty of maturing corn and the small amount of grain grown on the average farm of the timbered section makes pig raising a side line of dairying.

SHEEP

A flock of western ewes that had been purchased a few years before were on the experiment farm in 1904. They were not in a very thrifty condition. The lambs were affected with goiter and the ewes lacked in general vigor. The whole flock was sold and a flock of high grade Shropshire ewes was purchased from Central Minnesota. These did very well and gave a fair profit. It was found that the wool of the ewes would just pay the cost of their feed and care during the year and the lambs were profit. A ewe that did not raise her lamb gave no profit. While sheep require considerably less work than dairy cows, they do nevertheless require care and particular care at certain times of the year to insure profit. A careless farmer has no more chance to succeed with sheep than with any other kind of livestock.

POULTRY

Chickens were raised on both a small and a large scale. The small flock (100 hens) was kept under conditions similar to those on the average farm. They had the run of the farm yard, much of their feed was table scraps and other waste material, and they were cared for in connection with the chores of the farm. Under these conditions they paid well. Later a special poultry department was built up, consisting of a poultry house with a capacity of 1,000 hens. A poultryman's residence and separate grounds were provided and a special poultryman was put in charge. This did not prove a financial success.

The large poultry department was built up to determine whether poultry raising on a large scale and as a separate enterprise would be profitable or not. Fair returns were secured but not entirely in keeping with the outlay and the salary of a competent poultryman. The results indicate that poultry raising on a large scale should be undertaken as a separate and special enterprise only by a poultry expert who can give the work personal attention.

FARM CROPS

LARGE YIELDS AND HOW THEY HAVE BEEN OBTAINED

The farms of the timbered section of Northern Minnesota have on an average less than 25 acres under the plow. When a living must be made from this amount of cultivated land, large yields are necessary, and for this reason special attention has been given on the experiment farm to the production of large yields in field crops.

USE OF MANURE

The first fact worthy of note is that as the number of cows has been increased the yield of the field crops has increased. Through feeding all the crops produced on the farm except the potatoes and considerable purchased grain feed in addition, and carefully applying all the manure to the fields, the soil has been enriched. There have been 100 acres in field crops for ten years. The dairy herd has been increased from 20 to 100 head in the same time. Sixty of the animals are cows and heifers in milk. This number of dairy cattle, with the horses, pigs, and poultry has made the supply of manure such that each field has been manured at the rate of 12 tons per acre every third year for the last few years. Manure has been hauled to the field practically every working day in the year.

Fig. 12. Oats, the Most Profitable Grain Crop in Connection With Dairy Farming on the Experimental Farm

TABLE VI

SUMMARY OF CROP PRODUCTION, 1904-1914, INCLUSIVE

Crop	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	Average
Wheat, bu	18.0	17.0	19.3	17.0	15.0	Mowed	17.5	12.3	22.0	17.3	6.1	16.55
Oats, bu	39.7	37.9	39.0	31.4	17.0	26.7	43.5	40.0	58.0	67.0	28.7	38.99
Barley, bu	20.0	26.0	21.0	23.4	12.0	13.5	29.7	29.0	25.4	60.0	18.7	25.33
Rye, bu	16.0	*	*	15.0	*	*	15.5	*	*	*	*	15.5
Peas, bu	*	10.0	8.5	8.0	7.0	*	11.5	*	*	*	*	9.0
Flax, bu	*	11.0	*	10.0	*	*	*	*	*	*	*	10.5
Hay, first crop, tons	2.1	2.1	2.5	2.7	2.1	1.6	2.9	2.0	1.9	2.5	2.1	2.22
Hay, second crop, tons	Pastured	1.2	1.2	1.5	1.6	1.5	1.7	1.5	Pastured	1.8	1.1	1.45
Total hay, tons	.....	3.3	3.7	4.2	3.7	3.1	4.6	3.5	.....	4.3	3.2	3.67
Fodder corn, silage, tons	*	7.5	6.5	10.4	7.8	9.25	8.8	14.3	10.75	9.66	9.6	9.45
Ear corn, bu	*	25.0	*	28.0	28.0	*	30.0	*	*	*	*	27.8
Per cent mature	.....	77	50	60	60	80	60	.....	.....	60	.....	64
Potatoes, bu	150.0	198.0	196.0	213.0	254.0	205.0	270.0	274.0	330.0	279.0	309.0	243.4
Stock roots, tons	*	13.0	13.5	10.5	14.0	12.6	14.0	14.0	18.0	19.0	17.0	14.56
Rainfall, inches	22.66	37.76	26.27	20.97	24.94	24.73	21.25	28.55	16.97	32.43	21.52	25.47
Last frost in spring†	June 15	May 28	May 8	June 14	June 14	June 10	June 5	May 12	June 8	June 8	May 23	June 1
First killing frost in fall	Aug. 29	Sept. 13	Aug. 31	Aug. 20	Sept. 28	Sept. 1	Sept. 9	Sept. 3	Aug. 7	Sept. 22	Oct. 13	Sept. 7

* Indicates years crops were not grown under field conditions, or records of yield were not made.

† The last frost in the spring was not generally injurious to any great extent.

CROP ROTATION

The second factor in obtaining large yields has been growing clover on each field every third year, or in a three-year rotation. In this rotation, or system of cropping, one third of the plowed land of the farm is in grain, one third in clover, and one third in cultivated crops. Grain is grown but one year. Clover is sown with the grain making a clover hay crop the second year. The third year the clover sod is plowed under and the field grown to cultivated crops, corn, potatoes, and roots. A field that is too low or too hilly or too stony could not be worked in this rotation with profit. This frequent growing of clover in addition to the manure has greatly built up the humus of the sandy soil on the experiment farm. A cultivated crop on each field every third year has greatly helped to keep out the weeds and the frequent change of crops has lessened the loss from diseases.

CROPS GROWN

Oats, clover, fodder corn, potatoes, and rutabagas were the most profitable crops grown. Practically all the crops common to Minnesota were grown, but those mentioned were found most satisfactory for general conditions in the timbered section where the average farm has 40 acres or less under the plow.

OATS

Oats produced larger yields per acre than other grains and proved better adapted to new land, and the better quality of the straw for feeding gave them an added value. The Improved Ligowa, a variety of Swedish oats, was the main field variety. It is a white oat, medium in time of maturity and in length of straw. For land that is very rich and where there is danger of lodging, an early variety known as Kershon has proved satisfactory. This is a yellow variety. It has short straw and matures about as early as barley. Oats under normal field conditions have yielded from 35 to 70 bushels per acre.

Oats gave best results following a cultivated crop—on corn or potato ground. They were grown in a three-year rotation. The best time for seeding oats in the spring in the latitude of Grand Rapids is about April 20, or as soon after that as the soil is in condition.

OTHER GRAINS

Wheat, barley, rye, peas, speltz, flax, and buckwheat were all grown with success, but none proved so satisfactory as oats. When there is sufficient land under the plow to grow all the grain that is required on the farm, wheat may be grown to advantage for poultry feed or for milling purposes if there is a mill in the community.

Barley and field peas may be grown for fattening pigs. Peas do not yield so well on sandy soil as on clay soil. Speltz never gave as large a yield as barley. Fall or winter rye may be recommended for soil that is so sandy that there is danger of other grains failing. It should be seeded the latter part of August. But little rye was grown on the experiment farm because the soil was kept in a condition of fertility that produced a good crop of oats, and oats produced a larger yield per acre and a more satisfactory feed for all kinds of livestock.

CLOVER

Clover was grown with continued success. It was seeded with a grain crop of any kind. It has been grown to greatest advantage in a three-year rotation; that is, by seeding down with grain, growing clover for hay the next year (two cuttings), and then plowing up for a cultivated crop. Grown with fall rye, it was seeded on the rye in the spring as soon as the frost began to go out of the ground. If grown with oats or other spring grain, it was mixed with the grain in the drill box and seeded at the same time.

Fig. 13. Clover, an Excellent Hay Crop
Its roots enrich the soil. It is generally grown on each field every third year.

Clover is perhaps the most important forage crop for the farmers of Northeastern Minnesota. It may be grown among the stumps for pasture and hay before the land is cleared. It produces a valuable feed for all classes of livestock, and especially for dairy cows. It builds up and enriches a sandy soil, it mellows and makes more productive a clay soil. No season is too late or wet or cold greatly to lessen its abundant yield, and no hay crop gave so great a yield in seasons of light rainfall. Properly made into hay, it provides a winter feed for milk production or for the growing of young stock that is

almost a balanced ration in itself. On the experiment farm, clover hay was fed with good results not only to the cattle and horses, but to the pigs and chickens. Second crop clover was fed in winter to the brood sows and to the poultry in a limited way with good results. On rich land, clover seeded in the grain has given considerable pasture in the fall without injury to the next year's hay crop. For several years the value of the butterfat produced from pasturing the clover in the fall more than paid for the clover seed. Care must be used, however, not to pasture too close or too soon after the grain is cut.

Clover grown in a three-year rotation has given two cuttings of hay each year, yielding from 2.5 to 4.75 tons of hay per acre.

Seeding clover.—Clover was seeded with grain at the rate of about twelve pounds of seed per acre. Medium red clover was most commonly used. A mixture of medium red, alsike, and timothy was frequently used, at the rate of 6 pounds of medium red, 2 of alsike, and 4 of timothy.

The mixture used for seeding down cut-over land for pasture was medium red clover 1 pound, alsike 1 pound, white clover 1 pound, timothy 1 pound, and bluegrass 1 pound, making a total of 5 pounds per acre. This was seeded in the early spring as soon as the frost began to go out of the ground. The cut-over land was seeded down the spring following the removal of the timber. The cattle were turned on it the same season for pasture. This helped to keep down the second growth. After seeding, the land was harrowed with a spring-toothed harrow where it was possible to use one, but for much of the seeding the ground had no preparation either before or after, except to remove the timber, and the brush when the growth of brush was very heavy.

Most of the cut-over land treated in this manner has developed into first-class pasture, practically as productive of feed as tho there were no stumps on it.

Clover hay.—In making clover hay it was the practice to begin mowing when the crop was just about in full bloom, or a little earlier. In the latitude of Grand Rapids, this was generally from July 1 to 10. It was found that the early clover made a finer quality of hay, and the second crop was generally better when the first crop was cut early. The second crop was generally cut about September 15.

Growing clover for seed.—But little clover was grown for seed, owing to the need of hay for the large dairy herd. What was grown proved quite satisfactory. Alsike clover was found to seed much better than medium red. In growing medium red clover for seed, the first crop was cut for hay from about June 20 to June 25 and the second crop was cut for seed.

ALFALFA

Alfalfa has been grown only in a small way, but its yield as a permanent meadow has not been nearly so large as that of clover in a three-year rotation. Further experiments are needed to determine its value for land that is too hilly or too stony for a rotation.

Fig. 14. Fodder Corn
Corn was profitably grown for fodder and for silage.

FODDER CORN

Fodder corn (corn grown so thickly that few ears are formed) has been found of particular value in producing a large amount of feed on a small area of land in a single season. Corn planted for fodder from May 20 to June 1 produced a crop ready to harvest the first of September. The yield has been from 3 to 5 tons per acre of cured fodder or from 9 to 15 tons per acre, green weight, for silage. Corn drilled in rows three feet apart, for fodder corn, and at the rate of one bushel of seed to three acres, has produced more feed per acre than when planted in hills for the production of ear corn. As feed for dairy cows, fodder corn has proved very satisfactory and when fed in connection with clover hay has given excellent results.

Fodder corn has been grown chiefly for silage, the farm having two silos, but if a silo is not available, fodder corn may be cured in the shock and fed with excellent results. When fed as cured fodder it is desirable to seed more thickly than when grown for silage, as the stalks will then be finer and there will be less waste. A grain drill has been used for planting corn for fodder and is made to seed in rows 3 feet apart by stopping up all the cups but those 3 feet apart.

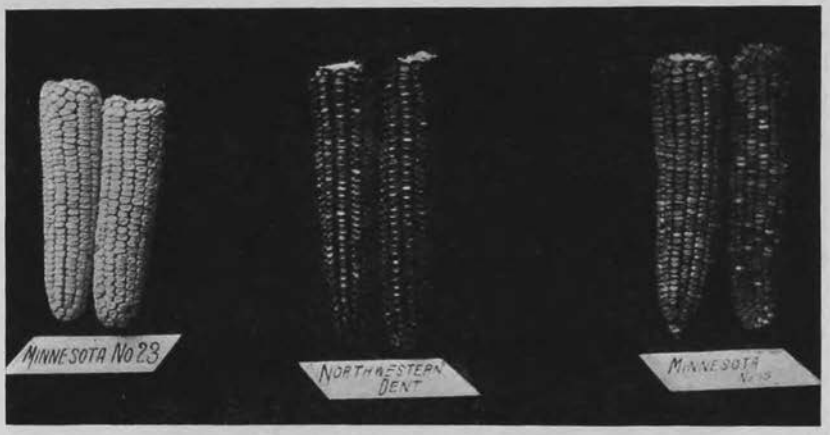

Fig. 15. Varieties of Corn Grown
Minn. No. 23 and Northwestern Dent were the earliest maturing varieties of corn tested. Minn. No. 13 and Northwestern Dent were grown for fodder and for silage.

Minnesota No. 13 has been grown with most satisfactory results for fodder corn. It is the largest variety that will reach a sufficient degree of maturity in Northern Minnesota. Northwestern Dent has also been found satisfactory for fodder. It matures earlier than Minnesota No. 13 but does not produce quite so much fodder per acre. For the growing of ear corn, Minnesota No. 23 has given best results, with Northwestern Dent a close second. The two varieties mature about the same time. Minnesota No. 23 has a smaller stalk than Northwestern Dent, but more ears. The average date for planting corn under favorable weather conditions was May 26. Fodder corn has been planted as late as June 15 and a fair crop obtained, but planting as soon after May 20 as weather conditions were favorable has always given best results. The date for harvesting fodder corn has been the first week in September. It is important to cut corn that is to be fed as fodder, before frost, as its feed value is greatly lessened by freezing.

POTATOES

Potatoes have proved the most profitable field crop to market from the farm. The average yield of potatoes on the experiment farm for 10 years was 243 bushels per acre. From 1910 to 1914 the yield was

306 bushels per acre. The soil and climatic conditions of the timbered section of Northern Minnesota are particularly favorable to the growing of potatoes. The large yield that it is possible to secure makes potatoes an especially desirable crop for a farm with but few acres under cultivation. In a year of normal prices it is easily possible to make $100 from an acre of ground planted to potatoes.

Carmen No. 1 (Green Mountain) were grown continuously from 1898 to 1914 on the experiment farm and as the main crop potato after 1904. It has been tested with 60 other varieties, and no variety has been found of greater value. From 1908 to 1914 the seed for the entire potato crop was carefully selected at the time of digging, so that the high quality of this variety has been vigorously maintained.

Carmen No. 1 is a white potato, oval in shape. It has a white sprout and white blossoms and a very heavy growth of light green vines. It is medium to late in maturing. It is a good keeper and of excellent cooking quality.

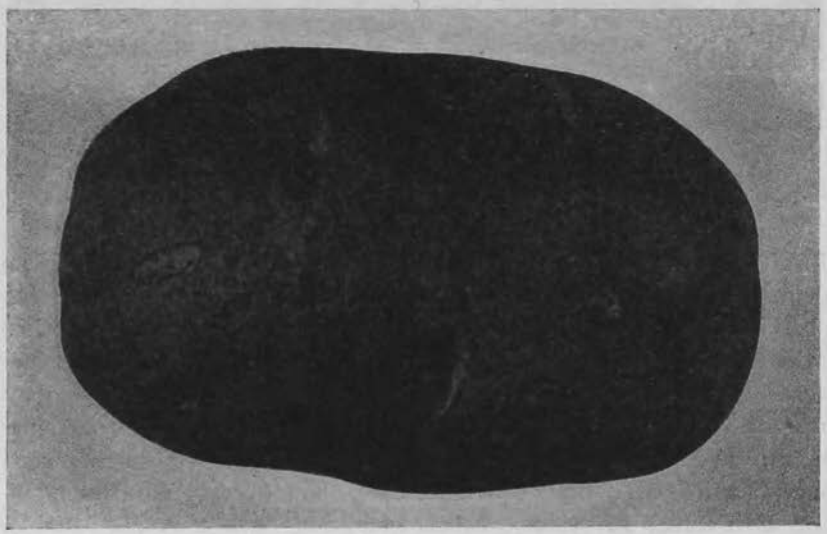

Fig. 16. A Good Type Carmen No. 1 (Green Mountain) Potato
Potatoes proved the most profitable cash crop.

The early varieties of potatoes tested did not yield nearly so well as Carmen No. 1, and are not recommended except to farmers who grow potatoes for an early market or in a limited amount for early home consumption.

Potatoes were grown with the best results in a three-year rotation: grain, clover, potatoes. Manure has been applied every third year, on the clover sod preceding the potato crop. The seed has been particularly free from disease, blight appearing but two years out of ten

and then not with serious results. Modern potato machinery has been used and found very satisfactory. Practically the entire potato crop for the ten years preceding 1914, except what has been used on the Farm, has been sold to the farmers of Northeastern Minnesota for seed.

The time for planting late potatoes was generally from May 20 to June 1. They were planted in drills 30 inches apart, about 15 inches apart in the row, and one piece in a hill. The seed potatoes of medium size were cut in four pieces. From fifteen to eighteen bushels were planted per acre. The late crop was harvested from September 25 to October 10. It was not considered safe to have potatoes in the ground after October 15 on account of danger of freezing. In digging the potatoes they were left on the ground two or three hours to dry before picking up when conditions would permit, and then were hauled direct to the root cellar.

ROOTS

All varieties of roots commonly grown for stock have been grown with continued success, mangels, stock carrots, sugar beets, and rutabagas. Rutabagas, all things considered, have been the most satisfactory of the root crops, in that they generally give a greater yield, will produce a crop under poorer conditions of soil and climate, and are commonly in demand on the market, and at a price that makes it profitable to sell them and replace them with grain as feed.

The yield under normal conditions has been from 12 to 15 tons per acre—from 350 to 550 bushels. Under especially favorable conditions as much as 20 tons (700 bushels) were grown per acre.

Roots may be termed the silo of the small farm. They may be used in place of silage and to a considerable extent in place of grain.

The objectionable flavor of the rutabagas was overcome by feeding the roots immediately after milking.

The time of planting was from May 20 to June 10 altho they may be planted later. They were planted in drills two feet apart. A garden drill was used for planting and a wheel hoe for the first cultivation. After that the horse cultivator was used. In 1913 and 1914 they were planted with the grain drill by closing the cups except those two feet apart. When the grain drill is used, care must be taken to keep from seeding too great an amount of seed. This was accomplished by putting only a small amount of seed in the cups at one time.

From 2.5 to 3 pounds of seed was used per acre. When the plants were about an inch above ground they were thinned to a foot apart with a hand hoe. In pulling the roots in the fall they were laid even

in the row with the tops all one way. The topping was then done with a corn knife. It can be done in this way almost as fast as a man can walk along the row.

The experiment farm has a root cellar in connection with the dairy barn which is very desirable for convenience in feeding the roots. The roots were fed whole.

In storing roots in a cellar for winter it is important to remove as much of the soil as possible from them, as a considerable amount of earth thrown in with the roots will cause them to heat.

Roots may be fed raw with good results to all kinds of livestock—cattle, horses, sheep, pigs, and chickens.

Fig. 17. Plums and Small Fruits Were Very Successfully Grown. Apples Were Not a Success

GARDEN AND ORCHARD

Vegetables of practically all kinds were grown with continued success.

Among the small fruits, strawberries, raspberries, and currants did especially well.

Plums were grown very successfully but apples were a complete failure. Over 500 trees were set out, at different times and under different conditions, but not a single tree lived to fruit. Just why apple trees will not live on this land is yet to be determined. It was supposed to be due to the severity of the winters, but that is evidently not the entire cause. Special investigational work by an apple expert is needed. Apples are grown successfully in a few locations in the vicinity of Grand Rapids but not generally.

FERTILIZER EXPERIMENTS ON UPLAND SOIL

In the spring of 1914 long-time experiments on the effects of phosphates and manure upon the sandy loam soil of the farm were started in coöperation with the Division of Soils at University Farm. Fifty-four one-tenth-acre plots, in three series of eighteen plots each, were laid out as shown in Figure 18, the series being separated by roadways one rod wide, and the plots by paths two feet wide. The plan provides for a three-year rotation of oats, clover, and cultivated crops; and six soil treatments, each of the latter appearing three times with each crop. The object of the repetition is to reduce the unavoidable errors of experiment due to variations in soil from place to place in the same field.

Plots 1, 7, and 13 are to be treated with neither manure nor commercial fertilizer. Plots 2, 8, and 14 receive one ton of finely ground raw rock phosphate the first season and are to be given a similar application at the end of six years, this being applied when preparing the land for the cultivated crop. The plots treated with either acid phosphate, manure, or both, will receive these every third year while the land is being prepared for the cultivated crop.

Plots 1- 7-13 No manure or commercial fertilizer.
Plots 2- 8-14 Rock phosphate, 2,000 pounds per acre every sixth year.
Plots 3- 9-15 Rock phosphate, 2,000 pounds every sixth year, and manure, 10 tons every third year.
Plots 4-10-16 Manure, 10 tons every third year.
Plots 5-11-17 Manure, 10 tons, and acid phosphate 360 pounds, every third year.
Plots 6-12-18 Acid phosphate, 360 pounds every third year.

All the rock phosphate and manure plots received the initial applications of one ton and 10 tons per acre, respectively, in the spring of 1914, but the acid phosphate was pro-rated, except on Series I, planted to corn, which received 360 pounds per acre. Both crops and treatment in that year are indicated on Figure 18. The yields in 1914 are reported in Table VI. The manure caused increased yields while the phosphates showed no distinct effect.

The much lower yield of the oats on all the plots in this experiment than on the field lots (Table VI) is to be attributed to a very late seeding, which was made necessary by the delayed arrival of the rock phosphate.

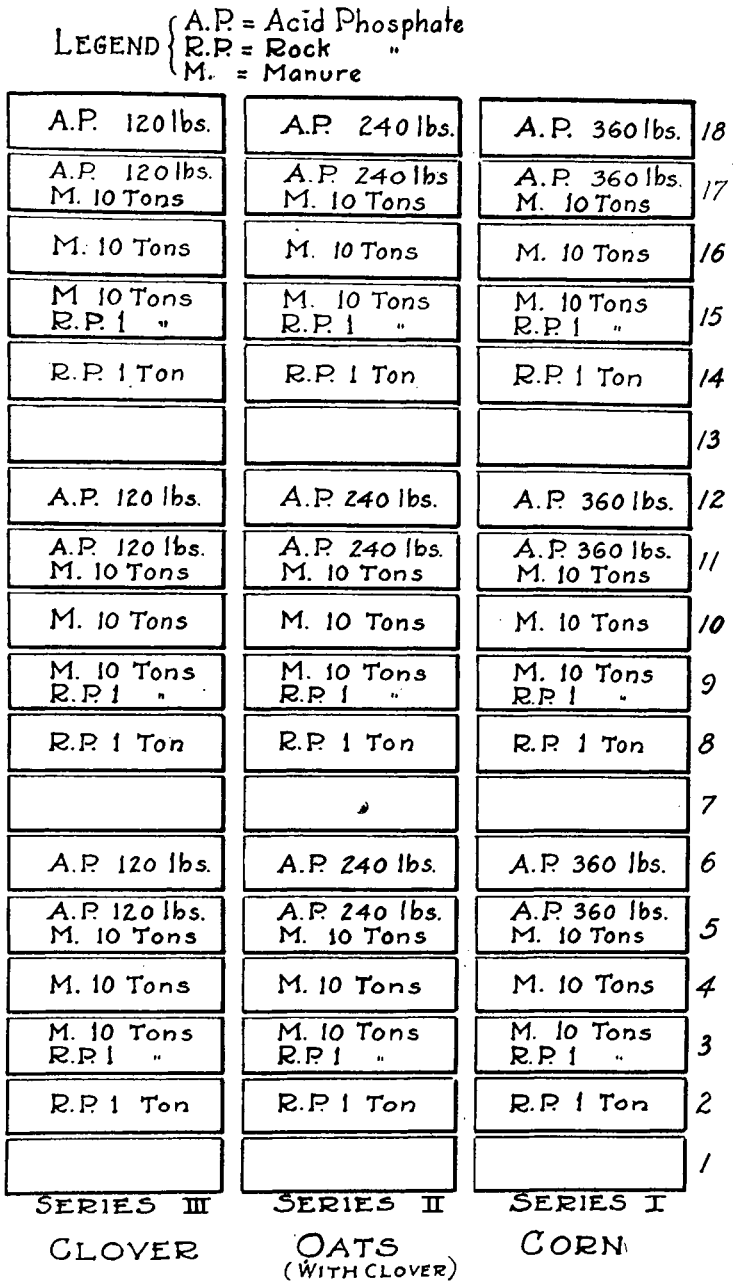

Fig. 18. Fertilizer Plots on Upland Soil

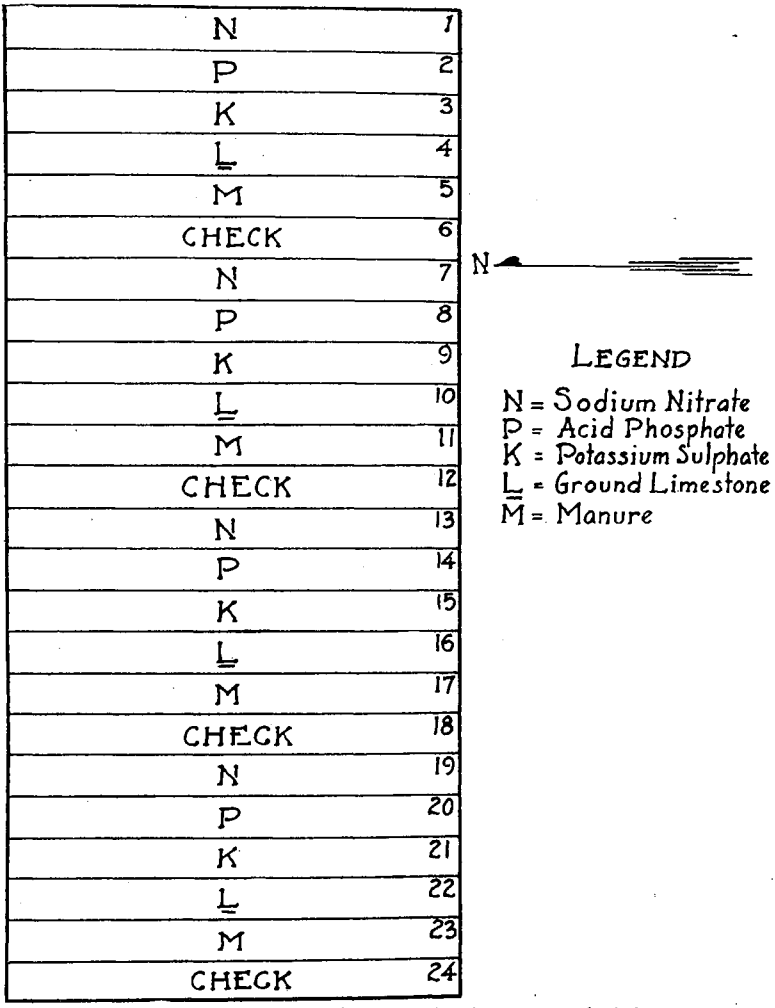

Fig. 19. Treatment of Plots on Muskeg, 1911 and 1912

MUSKEG SWAMP LAND

There is a considerable area of swamp land known as "muskeg" in the timbered section of Northern Minnesota. This swamp land is of moss or peat formation and varies in depth from a few inches to several feet. It is generally open or without timber. Where trees are growing on its surface they are generally small and of scrubby growth. The surface generally is covered with a growing moss underlaid with peat.

The experiment farm at Grand Rapids has a muskeg swamp of about 15 acres, a part of which has been brought under cultivation. This swamp is of deep formation varying in depth from 12 inches

to 15 or 20 feet. H. H. Chapman, who was superintendent from February, 1898, to March, 1904, conducted work on a part of this muskeg swamp and gave a very unfavorable report of its use for general farming or even for the successful raising of hay.

In 1910 the muskeg swamp was tile-drained and put under cultivation. Crops of various kinds were seeded in 1911, 1912, and 1913. Plots were laid out and treated with stable manure and other plots treated with different commercial fertilizers and these were compared with plots that received no fertilizer of any kind.

Where no fertilizer was used, no crop was produced, and none of the fertilizer treatments caused a satisfactory growth. Even after tile drainage, the ground was very soft in wet seasons and very susceptible to frost. In 1912 the entire crop on the muskeg was killed with frost when the crop on adjoining land was not injured. In 1911 and 1913 the crop on the muskeg could not be harvested on account of the softness of the ground, though it had been well drained in 1910. The preparation of the muskeg swamp for crop, not including the drainage, was fully as expensive as the clearing of high land of stumps.

In Figure 18 are shown the treatments applied in 1911 and 1912. In 1914 much more elaborate experiments were started in coöperation with the Division of Soils, the results of which will be reported in a separate publication.

GENERAL CONDITION OF AGRICULTURE IN NORTHEASTERN MINNESOTA

Twenty years ago the agriculture of the timbered section of Northern Minnesota was an experiment. There were few farmers and the region was little known by the people of other parts of the state. To-day the timbered section of Northern Minnesota has some of the most prosperous farms in the state and many of the most hopeful and happy farmers. The possibilities of its greatness in agriculture and especially in dairy farming, have been demonstrated beyond any question, not so much by the work of the experiment farm, but by men and women who went there with small means and by hard labor cleared away the remains of the forest and through intelligent farming built up beautiful homes. The work attempted at the experiment station at Grand Rapids has always been given much respect by the farmers and the success or usefulness that may be credited to the experiment station there, is in no small measure due to the sympathy and coöperation of the farmers of the region.

The work thus far is little more than that of the pioneer, little more than a showing of what can be done. The country as a whole is largely undeveloped. Here and there are communities that have been fortunate in having a sufficient population to make public improvements, good roads, consolidated schools, and other advantages, but the majority of the farmers still have few neighbors and poor roads, and have to play the discouraging part of waiting for civilization to come to them. Many of them are of foreign birth and can scarcely speak the English language but they possess sterling qualities for good farmers.

During the last few years there is a great influx of farmers from other sections of Minnesota and from neighboring states. Not uncommonly they buy land in undeveloped sections and being unacquainted with conditions and having to undergo temporary hardships, many become discouraged and leave the country and in so doing frequently leave the greatest opportunity of their lives. There is need of organization for settlement, of some means for looking after the new settlers and getting them started right.

The development of the timbered section of Northern Minnesota, the settling and clearing and proper farming of the land that should be farmed, and the reserving and reforesting of the land that is unfit for profitable agriculture is a work that will require the best effort that it is possible to give.