

NINETEENTH ANNUAL REPORT
OF THE
AGRICULTURAL EXPERIMENT STATION
OF THE
UNIVERSITY OF MINNESOTA,
Fiscal Year, July 1, 1910, to June 30, 1911.



UNIVERSITY OF MINNESOTA

The Board of Regents.

GEO. E. VINCENT, LL. D.	Ex-Officio
The President of the University.	
The HON. JOHN LIND, Minneapolis	1914
The President of the Board.	
The HON. ADOLPH O. EBERHART, Mankato	Ex-Officio
The Governor of the State.	
The HON. C. G. SCHULZ, St. Paul	Ex-Officio
The State Superintendent of Public Instruction.	
The HON. W. J. MAYO, Rochester	1913
The HON. MILTON M. WILLIAMS, Little Falls	1913
The HON. HENRY B. HOVLAND, Duluth	1914
The HON. A. E. RICE, Willmar	1915
The HON. CHARLES L. SOMMERS, St. Paul	1915
The HON. B. F. NELSON, Minneapolis	1916
The HON. PIERCE BUTLER, St. Paul	1916
The HON. CHARLES A. SMITH, Minneapolis	1916

The Agricultural Committee.

The HON. A. E. RICE, Chairman	The HON. H. B. HOVLAND
The HON. MILTON M. WILLIAMS	The HON. PIERCE BUTLER
The HON. B. F. NELSON	President GEO. E. VINCENT

University Experiment Station.

Station Officers.

A. F. WOODS, A. M.	Director
T. L. HAECKER	Dairy and Animal Husbandry
M. H. REYNOLDS, B. S., M. D., D. V. M.	Veterinary Science
ANDREW BOSS	Agronomy and Farm Management
FREDERICK L. WASHBURN, M. A.	Entomology
E. M. FREEMAN, Ph. D.	Botany and Plant Pathology
JOHN T. STEWART, C. E.	Agricultural Engineering
RALPH HOAGLAND, B. A.	Agricultural Chemistry, Soils
E. G. CHEYNEY, A. B.	Forestry
LEROY CADY, B. S. in Agr.	Horticulture
C. P. BULL, B. Agr.	Plant Breeding
H. R. SMITH	Animal Husbandry
R. M. WASHBURN, M. S. A.	Assistant in Dairy Husbandry
CLYDE BAILEY	Flour and Grain Testing
J. M. DORSEY	Fruit Breeding
L. B. BASSETT	Assistant in Farm Equipment
C. C. LIPP, D. V. M.	Assistant in Veterinary Science
A. G. RUGGLES, M. A. 2	Assistant in Entomology
J. P. WENTLING, A. M.	Assistant in Forestry
R. H. WILLIAMS, M. S.	Assistant in Animal Husbandry
A. C. ARNY	Assistant in Farm Crops
W. L. BOYD, D. V. S.	Assistant in Veterinary Science
W. H. FRAZIER, B. S.	Assistant in Soils
H. P. HOSKINS, V. M. D.	Assistant in Veterinary Science
DE FOREST HUNGERFORD, B. S.	Assistant in Soils
CORNELIA KENNEDY, B. A.	Assistant in Agricultural Chemistry
A. R. KOHLER, B. S. A.	Assistant in Horticulture
P. R. McMILLER, B. S.	Assistant in Soils
J. L. MOWRY	Assistant in Agricultural Engineering
W. L. OSWALD	Assistant in Agricultural Botany
H. B. ROE, B. S. in Eng.	Assistant in Agricultural Engineering
E. C. STAKMAN, M. A.	Assistant in Pathology
G. W. WALKER, B. S. in Chem.	Assistant in Soils
R. M. WEST, B. A.	Assistant in Agricultural Chemistry
F. W. WHITE, B. S. in Agr.	Assistant in Animal Husbandry
L. E. WILLEY, D. V. M.	Assistant in Veterinary Science
WARREN WILLIAMSON, M. A.	Assistant in Entomology
STEPHEN ANTHONY	Chemist, Animal Nutrition
MILDRETH HAGGARD, B. A.	Chemist, Animal Nutrition
W. H. CANTWELL, B. S. in Chem.	Assistant Chemist, Animal Nutrition
AGNES ERICSON	Assistant Chemist, Animal Nutrition
GRACE B. ANDREWS	Assistant in Animal Nutrition
A. J. McGUIRE, B. Agr.	Superintendent Grand Rapids Sub-Station
E. C. HIGBIE, M. A.	Superintendent Morris Sub-Station
C. G. SELVIG, M. A.	Superintendent Crookston Sub-Station
CHAS. HARALSON	Superintendent Fruit Farm, Excelsior

LETTER OF TRANSMITTAL.

MINNEAPOLIS, MINN., July 1, 1911.

To His Excellency, A. O. Eberhart, Governor of Minnesota:

I have the honor to transmit to you herewith the annual report of the Agricultural Experiment Station of the University of Minnesota for the fiscal year ending June 30, 1911.

JOHN LIND,
President Board of Regents.

List of Publications Published During the Fiscal Year Ending June 30, 1911.

	Pages.
Bulletin 121—Orchard and Garden Spraying.....	1-32
Bulletin 122—The Smuts of Grain Crops.....	33-64
Bulletin 123—Cutworms, Army Worms and Grasshoppers...	65-84
Bulletin 124—The cost of Minnesota Dairy Products.....	85-188

The Bulletins of this Station are mailed free to all residents of this State who make application for them.

**The Minnesota Agricultural Experiment Station in Account With
the United States Appropriations, 1910-1911.**

Dr.

To receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1911, as per Act of Congress approved March 2, 1887.....	\$15,000.00
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Cr.

By Salaries	\$ 9,933.33	
Publications	1,524.11	
Postage and Stationery.....	190.48	
Chemicals and Laboratory Supplies.....	642.50	
Seeds, Plants and Sundry Supplies.....	637.47	
Fertilizers	14.97	
Feeding Stuffs	313.60	
Tools, Machinery and Appliances.....	589.57	
Furniture and Fixtures.....	179.57	
Scientific Apparatus and Specimens.....	876.20	
Traveling Expenses	40.11	
Buildings and Land.....	58.09	
	\$15,000.00	\$15,000.00

Dr.

To receipts from the Treasurer of the United States as per appropriation for the fiscal year ending June 30, 1911, under Act of Congress approved March 16, 1906..	\$14,997.99
To balance from appropriations for 1909-1910.....	2.01

Cr.

By Salaries	\$12,339.94	
Labor	1,270.03	
Postage and Stationery.....	67.00	
Freight and Express.....	.15	
Chemicals and Laboratory Supplies.....	138.19	
Seeds, Plants and Sundry Supplies.....	92.26	
Feeding Stuffs	6.34	
Tools, Machinery and Appliances.....	66.91	
Furniture and Fixtures.....	175.65	
Scientific Apparatus and Specimens.....	677.23	
Live Stock	61.10	
Traveling Expenses	50.42	
Buildings and Land.....	54.78	
	\$15,000.00	\$15,000.00

FINANCIAL STATEMENT.

Statement of Receipts and Disbursements, Exclusive of Buildings, of the Department of Agriculture for the Fiscal Year
1910 - 1911.

General Support.

	Station.			School and College.			
	Receipts.	Disbursements.	Net Cost.	Receipts.	Disbursements.	Net Cost.	Dept. Total.
Agriculture	\$478.32	\$16,031.07	\$15,552.75	\$181.80	\$4,586.99	\$4,405.19	\$19,957.94
Agriculture Engineering.....		3,688.40	3,688.40		7,235.82	7,235.82	10,924.22
Botany		2,126.50	2,126.50		1,486.15	1,486.15	3,612.65
Chemistry		3,544.56	3,544.56	43.51	3,727.49	3,683.98	7,228.54
Dairy and Animal Husbandry....	3,091.05	10,574.14	7,483.09	9,366.81	26,018.63	16,651.82	24,134.91
Entomology		137.93	137.93		2,303.65	2,303.65	2,441.58
Horticulture	718.73	4,093.27	3,374.54		4,805.99	4,805.99	8,180.53
School				20,162.55	57,602.70	37,440.15	37,440.15
Station	531.26	24,740.24	24,208.98				24,208.98
Veterinary	72.59	2,316.45	2,243.86		3,013.11	3,013.11	5,256.97
Totals	\$4,891.95	\$67,252.56	\$62,360.61	\$29,754.67	\$110,780.53	\$81,025.86	\$143,386.47
Grand Rapids	5,019.36	12,730.32	7,710.96				7,710.96
Crookston	3,309.30	13,452.01	10,142.71	1,434.79	20,089.36	18,654.57	28,797.28
Morris				1,744.64	26,857.99	25,113.35	25,113.35
Totals	\$13,220.61	\$93,434.89	\$80,214.28	\$32,934.10	\$157,727.88	\$124,793.78	.....
Total General Support including Sub-Station.....							\$205,008.06

Special Appropriations.

Eradication of Noxious Weeds.....	\$ 763.86	
Field Crops	3,513.57	
Tobacco Investigation	1,381.56	
Total Agriculture		\$ 5,658.99
Drainage Problem	\$ 1,487.10	
Repairs	8,688.22	
Total Agricultural Engineering.....		\$10,175.32
Plant Diseases	\$ 347.13	
Total Botany		\$ 347.13
Alcohol Investigation	\$ 5,960.03	
Grain Laboratory	936.01	
Soil Investigation	1,179.11	
Total Chemistry		\$ 8,075.15
Campus Improvement	\$ 1,143.99	
For Breeding Farm	2,339.44	
Horticultural Crops	1,080.83	
Total Horticulture		\$ 4,564.26
Dairy Extension	\$ 2,449.16	
Live Stock	4,138.01	
Poultry Extension	2,399.43	
Total Dairy and Animal Husbandry.....		\$ 8,986.60
Investigation Injuries by Insects.....	\$ 751.63	
Total Entomology		\$ 751.63
Forest Expenses	\$ 3,855.02	
Forestry School Support.....	4,779.15	
Forestry School Institute.....	6,222.96	
Purchase of Forest Lands.....	2,653.49	
Timber Preservation	1,575.04	
Total Forestry		\$19,085.66
Hog Cholera Investigation	\$ 3,138.52	
Total Veterinary		\$ 3,138.52
Library		2,741.72
Agricultural Extension		30,850.33
Total University Farm Specials.....		\$94,375.31

Federal Funds.

	Hatch.	Adams.	Nelson.	Total.
Agriculture	\$1,735.13	.....	\$1,645.00	\$3,380.13
Agricultural Engineering	25.98	.....	4,176.19	4,202.17
Botany	569.04	2,354.42	2,667.17	5,590.63
Chemistry	2,594.59	1,700.00	1,531.32	5,825.91
Dairy and Animal Husbandry.....	2,570.10	5,470.00	1,001.71	9,041.81
Entomology	1,789.43	2,011.25	814.46	4,615.14
Horticulture	244.49	1,650.00	1,778.00	3,672.49
School, General .....	.....	.....	4,884.08	4,884.08
Station, General	3,678.48	63.25	.....	3,741.73
Veterinary	1,792.76	1,751.08	1,499.65	5,043.49
Totals	\$15,000.00	\$15,000.00	\$19,997.58	\$49,997.58

General Summary.

	Gen. Sup.	Special.	Federal.	Total.
Agriculture	\$19,957.94	\$5,658.99	\$3,380.13	\$28,997.06
Agricultural Engineering	10,924.22	10,175.32	4,202.17	25,301.71
Botany	3,612.65	347.13	5,590.63	9,550.41
Chemistry	7,228.54	8,075.15	5,825.91	21,129.60
Dairy and Animal Husbandry	24,134.91	8,986.60	9,041.81	42,163.32
Entomology	2,441.58	751.63	4,615.14	7,808.35
Horticulture	8,180.53	4,564.26	3,672.49	16,417.28
School, General	37,440.15	.....	4,884.08	42,324.23
Station, General	24,208.98	.....	3,741.73	27,950.71
Veterinary	5,256.97	3,138.52	5,043.49	13,438.98
Library .....	.....	2,741.72	.....	2,741.72
Forestry .....	.....	19,085.66	.....	19,085.66
Agricultural Extension .....	.....	30,850.33	.....	30,850.33
Total University Farm.....	\$143,386.47	\$94,375.31	\$49,997.58	\$287,759.36
Grand Rapids	\$7,710.96	.....	.....	.....
Grand Rapids, Drainage.....	.....	\$4,492.74	.....	\$12,203.70
Crookston Station	10,142.71	.....	.....	.....
Drainage .....	.....	235.56	.....	.....
School	18,654.57	.....	.....	29,032.84
Morris	25,113.35	.....	.....	25,113.35
Grand Totals	\$205,008.06	\$99,103.61	\$49,997.58	\$354,109.25

REPORT OF THE DIRECTOR OF THE EXPERIMENT STATION.

To the President of the Board of Regents:

SIR: I have the honor to hand you herewith the Nineteenth Annual Report of the Agricultural Experiment Station of the University of Minnesota, for the fiscal year ending June 30th, 1911.

We have included a somewhat more detailed account of the expenditures of funds appropriated by the State for station purposes. Heretofore only the money allotted from Current Expense funds of the University has been included. Many of the special appropriations, however, are strictly for station purposes, and should be shown for the purpose of making just comparisons between Government and State appropriations.

Very little change has been made in the work during the year; as this was the second year of the biennium, and the work is planned on a biennial basis. There have been no important changes in personnel.

New Buildings.

The old swine-barn was remodelled into a denatured-alcohol plant, and equipped for making fifty proof gallons per day, the full extent allowed by law. Plans for the additions to the Dairy Barn were completed and approved.

Plans for a new hog-house and horse-barn for the workhorses, also for a new Mechanics Arts building—to be constructed in connection with the Agricultural Engineering laboratory, for which an appropriation was obtained two years ago—were prepared and approved for presentation to the Legislature, and appropriations secured. A request was also made for a bull-barn, which was not granted by this Legislature. Requests were also presented to the Board for an additional laboratory building for Forestry, Entomology and Plant Pathology. The Plant Pathology work is crowded into the third story of the Horticultural Building, in space needed for the horticultural work and not well suited for the pathological work. A suitable space is also needed for bacteriological work. The Forestry College has no suitable rooms for laboratory work. A special building for the accommodation of these branches is necessary.

A request was presented to the Board for a fireproof seed-house; but it was not deemed wise to ask the Legislature for this at the last session. There are stored at present in the south wing of the barn, which is a building of wood construction, valuable nursery-bred varieties of grain, and the increase stock which is to be distributed among the farmers of the State. In addition to the danger of loss by fire, much trouble is encountered through the mixing of grains by rats and other vermin. It is almost impossible to handle the seeds properly in the building now available. Some of the more valuable strains have been brought into the Main Building, and stored in a room which should be available for class purposes, and which is not suitable to seed-storage. A fireproof building, which can be constructed for approximately \$25,000, should be furnished at the earliest possible opportunity. Improved seeds have been distributed, in the past, to over five thousand farmers, and through these to many thousands more. The average increase in yield from the use of the improved varieties has been from eighteen to twenty-five per cent. The value of our breeding-stocks could hardly be expressed in money.

The Station is very much in need of an improved greenhouse plant, containing enough space under glass to meet the requirements of the horticultural work, the investigation work of the various laboratories, which in the winter-time must be conducted largely under glass, and for the special experiments in vegetable-growing. At the present time, no greenhouse space is available, with the exception of that comprised within the structure used for class purposes; and this structure has reached a point where it cannot be repaired satisfactorily.

At Morris and Crookston, quite extensive changes in the buildings were planned, and general working plans for each station and farm were prepared and were approved by the Board.

More Investigators Needed.

Attention should also be called to the urgent need of more men to conduct the Station investigation work. At present, too much of the time of the various investigators is required in connection with teaching. The investigation work needs to be greatly enlarged in every division. Many problems of the greatest importance cannot effectively be handled with the men and facilities now available. Money for increasing the salaries of our investigators is also urgently needed. The government bureaus and other experiment stations are taking our men by reason of their higher salary scale. A Division of General Bacteriology is greatly needed. At the present time the work of this kind is scattered through several divisions. The work is especially needed in connection with the crop rotation investigations, soil fertility studies, dairy investigations, and home sanitation.

Poultry Work.

Estimates for the enlargement of a poultry plant were approved by the Board of Regents, and an increased appropriation for this work secured; and arrangements have been completed to secure Prof. Frederick H. Stoneburn, in charge of the poultry work at the Connecticut Experiment Station, and one of the leading experts along this line in the country.

More Land Required.

Additional land is urgently needed, at or near University Farm, in order to properly arrange demonstration plots and crop rotation systems; and also for use for pasture in connection with the animal husbandry investigations. Heretofore, the stock has been sent out to various places to pasture; and, owing to the difficulty of looking after it, considerable loss has resulted, especially to the experimental work. To make this work of the greatest value to the State, sufficient land should be available close to the station. We need, as shown in the table below, to purchase the 124 acres now rented; and, in addition, 170 acres, or a total of 294 acres. At the present time this could be secured contiguous to our present farm. At the present time, the use of the land at University Farm—419 acres including 124 acres rented—is distributed as follows:

	Present Farm.	Ad'tional Needed.	Rented.
Campus	58 acres	25 acres	
Septic tank	2 acres		
Dairy pasture (Lagoon district) available part of time	52 acres	50 acres	
Barns and paddocks	17 acres	10 acres	
Poultry-yards	5 acres	15 acres	
Horticultural trial gardens.....	5 acres		
Horticultural trial orchards.....	7½ acres		
Vegetable trial grounds.....	6 acres		
Forestry plantation	5 acres		
Plant pathology test plots.....	3 acres		
Swine paddocks and pastures.....	10 acres	10 acres	
Animal Husbandry pasture.....	42 acres	60 acres	
Crop rotation plots.....	20 acres		
Field crop nursery plots.....	18 acres		
Field crop seed-growing land.....	46 acres		
Fodder and ensilage crops for stock.....	19 acres	77 acres	77 acres
Investigations in agronomy and farm crop production	103½ acres	47 acres	47 acres
	419 acres	294 acres	124 acres

THE DAIRY AND ANIMAL HUSBANDRY DIVISION.

T. L. HAECKER, Chief.

In the Dairy section, the data secured in the investigation in economic feeding for milk production is being prepared for publication in forms suited for both popular and scientific use. A new series of experiments in Dairy Husbandry will be formulated for work in the future.

In the Animal Nutrition section, the fifth group of steers is being fed from birth to block, with periodic analyses of feeds, and analyzing a representative steer at each period of 100 pounds gain in body-weight. Also a group of steers is being fed from birth to block under ordinary farm facilities, to show rate of growth or gain in weight, and cost of production of steers, to any age up to thirty months.

In the Animal Husbandry section, the cost of pork-production is being investigated, and the influence of different rations on gain and weight determined.

The breeding and development of milking Shorthorns, in co-operation with the U. S. Department of Agriculture, is being continued. Two additional animals have been added to the herd, and careful records are being kept of feed consumed and milk and butter-fat produced. The heifer-calves are retained, and the bull-calves are sold to farmers who will use them in improving the milking qualities of their herds. Records are being kept of three other herds of milk Shorthorns, in co-operation with their owners.

Dairy Extension Work.

Extension work in dairying has been carried on during the year. Many samples of feed have been analyzed for farmers, milk and cream tested in the dairy laboratory, and butter and cheese scored. Aid has been given in various parts of the State, in the organizing and equipping of creameries, the holding of dairy meetings and the promotion of cow-testing enterprises. During the month of September and part of October, the whole staff in the Division assisted in judging live stock and giving addresses at county, district and street fairs. The large number of students attending the College and School of Agriculture, and the Summer School, greatly interfered with extension work.

Barns and Pastures.

Mention might be made of the fact that lack of barn and pasture-room has hindered the carrying out of feeding experiments in meat-production, planned along lines adapted to farm conditions. During the ensuing year, proper barn facilities will be provided, but no provision is made for adequate pasturage for our live stock. This is

greatly needed in demonstration and experimental work in economic meat production, under conditions that obtain on the average farm.

For lack of housing accommodations and pasture, little progress could be made during the year in experimental work looking to the promotion of the swine industry. A little money will be available, the coming season, for providing some shelter for the swine; but there is no provision for quarters this winter, and only enough stock for class-work can be kept.

Poultry Work.

The poultry industry has not received the support that the great importance of this industry demands. Minnesota is specially adapted to poultry-production, and this branch of endeavor should receive more attention at the Experiment Station, but on account of the limited funds available, only enough stock can be kept to provide for class-work. A poultry-house is greatly needed.

The development of the live-stock interests in the State is a matter of prime importance, for the restoration and maintenance of soil fertility. The people look to the station for demonstration work in the various branches of animal production, along practical and economic lines; and, to meet this demand, more means and better facilities should be provided.

THE VETERINARY DIVISION.

M. H. REYNOLDS, Chief.

Work during the past year has been continued in this Division as outlined in our report for 1910.

A large correspondence has been conducted with owners of stock, seeking veterinary help on account of infectious and other diseases. It has been the aim to make this correspondence as helpful as possible, even though it interferes with other lines of work.

The health of our farm stock has been unusually good during the past year. There have been no outbreaks of infectious disease, or unusual losses from any similar sources. In past years there has usually been some loss from cholera, among University Farm hogs; but, with the perfection of our vaccine work, this has been successfully prevented during the year.

Anti-Hog-Cholera Vaccine Work.

This section has continued, on a much larger scale than heretofore, the production and distribution of hog-cholera serum. During

the calendar year of 1911, fully twice as much serum will have been produced and distributed as during the previous year. Our records for 1910 show a production of 150,000 cc. During 1911 we will probably reach 300,000 cc. or over. We hope to nearly or quite double the production again in 1912, as our present facilities and supply are still inadequate for the demonstrated need.

The uniform potency of serum produced, our freedom from septic contamination, and the uniform satisfaction expressed by owners, have been gratifying.

Improved methods, given a practical working trial during the latter part of the year, promise a very considerable saving in cost of production. We hope to furnish serum to owners, next year, at a much lower figure than during the year now reported.

Educational demonstration tests have been held in various parts of the State, in accordance with a new line of work. These demonstrations have given good satisfaction to the people of the neighborhoods. They have also served, in a most satisfactory way, to secure public interest and to disseminate information concerning hog-cholera and serum work.

Our serum work has been self-supporting, and has accumulated something of a balance, for additional equipment and for a reserve to provide for the work during the years when there is slight prevalence of cholera and small demand for serum.

V. B. Vaccine.

Work has been continued, during the year, with a new and original method of immunization, with even better results and greater encouragement than were won in 1910. By this new method, we hope in the future to immunize young pigs against cholera, at a fraction of the cost of the serum method. This may easily prove to be one of the most important developments, in our knowledge of hog-cholera, that has occurred in recent years.

Ventilation.

This work has been continued since 1904. For special problems, see report of 1910. A bulletin giving a preliminary report was published in 1906. Since that time the work has been regularly continued; but the manuscript was withheld from publication in order to give us opportunity to repeat and verify some unexpected and surprising results. The work has been entirely in the line of physiological research; i. e., studies of the physiological effects produced by the confinement of animals under various conditions of ventilation. Earlier reports and statements concerning the unimportance of any probable stable increase of carbon dioxide gas, or decrease of oxygen, have been fully sustained by later work.

Valuable data have been accumulated by clinical studies of confined animals. Elaborate studies have been conducted concerning the effects of insufficient ventilation, as indicated by the blood. Tissue metabolism has been carefully studied in the urine of confined animals; the urine being used as an index as to the nature and extent of tissue metabolism.

Work has been prosecuted with reference to effects on the disease-resisting power of confined animals, as measured by phagocytosis and the opsonic index.

Work done during the past several years, in this project, shows plainly that ordinary lack of ventilation does not always or necessarily produce important injury to confined animals. It shows also that, when such injury does occur, it is due to causes other than those usually given, referring to carbon dioxide gas, volatile poisonous matters, etc.

Anti-Tuberculosis Vaccination.

Active field-work in connection with this project was finished during the year. Future work will consist in testing experimental animals with tuberculin, from time to time, as long as they are available.

Several trips have been made during the year, for purposes of test and inspection. Our work supports the view that the immunity given by von Berhing's vaccine is not of a sufficient degree of permanence to be of practical utility.

Swamp Fever.

Studies have been continued (in co-operation with the Bureau of Animal Industry, U. S. Dep. of Agr.) in efforts to define the virus. Some work has been done with methods of infection, excretion, and dissemination.

Lines of treatment, that have been successful with diseases similar as to origin and nature, have been tried with results that are, as yet, uncertain. The greatest obstacle to a successful study has been lack of certain diagnosis. Laboratory work has been started, with a view to perfecting some method of positive diagnosis.

Publications.

Data have been compiled, and are ready to be used at any time, for a bulletin on our new method of vaccination (V. B. Vaccination); which bulletin we hope to submit for publication in the near future.

Ventilation project data secured since the publication of Bulletin 98 in 1906, are now being prepared for the printer. It is our plan to publish this in the form of two technical or research bulletins which will cover our work up to September, 1909.

Needs.

The need is apparent for a larger hog-cholera vaccine plant. A small farm, with suitable equipment, is needed for this work. Black-leg vaccine, tuberculin, mallein, etc., could be economically produced at such a farm, in connection with a large hog cholera vaccine plant.

Work Planned for 1911-1912.

PROJECT NO. 1—*Ventilation*. The work of the coming year will be largely with the studies of disease resistance, as varied by free or imperfect ventilation. Work will be continued in the study of the urine of confined animals. Urine is used as an index of tissue changes as varied by abundant or imperfect ventilation.

PROJECT NO. 2—*Anti-Tuberculosis Vaccination*. But little more remains to be done with this project. During the year our experimental cattle will be kept under observation with a view to seeing whether the immunity has been lost and infection has occurred.

PROJECT NO. 3—*Hog Cholera Vaccine*. We have planned to continue the work of introducing hog cholera vaccine, and will make a special feature of educational demonstrations of actual vaccination, at suitable points in the State.

Our new method of vaccination (V. B. Vaccination), original with this Division, has progressed to a point where we feel justified in giving it an extended field trial during the coming year. V. B. Vaccination seems to promise results of unusual importance.

PROJECT NO. 4—*Swamp Fever*. Emphasis will be put during the next year on diagnosis. The greatest obstacle to satisfactory progress in this project has been the difficulty of certain diagnosis. Work is now under way looking to the development of a positive laboratory diagnosis.

THE DIVISION OF AGRONOMY AND FARM MANAGEMENT.

ANDREW BOSS, Chief.

The investigations in Agronomy and Farm Management are carried forward under the same lines as formerly; namely, (1) plant breeding; (2) farm crops; (3) crop rotation; (4) cost of production of farm products; (5) weed eradication, and (6) farm management. No new lines of investigation have been taken up this year, as our entire force is fully occupied in conducting the work already in hand.

(1) Plant Breeding.

The plant-breeding work has been carried forward under several sub-projects; namely, (1) wheat-breeding for an increased production

and better milling qualities, and also for rust-resistance; (2) breeding winter wheats for hardness; (3) breeding oats for increased protein content; (4) breeding oats for increased yield and stiffness of straw; (5) breeding barley for improvement in yield and quality; (6) breeding corn adapted to various localities in Minnesota; (7) improving Nos. 13 and 23 corn as to quality and type, as well as yield; (8) breeding flax for length of fiber and for increased seed-production; (9) breeding sugar-beets for increased sugar content; (10) breeding hardy alfalfa; (11) breeding clover for hardiness; (12) breeding cow-peas and soy beans for early maturity and increased yield; (13) breeding bromus for pasture and hay crops, and to develop a variety of bromus without a tendency to spread rapidly by root stalks; (14) improving timothy by selection, for greater leafiness.

Progress is reported in each of these sub-projects, and all will be continued during the ensuing year. The work in plant-breeding during the past year has been satisfactory on the whole; though the severe winter of 1910-11 seriously injured many of the winter-wheat stocks and some of the clover and alfalfa. Sufficient of the important varieties have been produced, however, for the continuation of the stocks, and no serious loss has been suffered, except that the work of developing large stocks has been delayed for a year. The spring-wheat breeding has been continued on about the same scale as heretofore; though an experiment, carried on for the purpose of forming new varieties by hybridizing and by different methods of selection, has been completed and the various stocks have been carried into increase-plots, to furnish seed which will be used next year in field-tests of new varieties. Special efforts have been made to push the corn-breeding work, with a view to securing types and varieties of corn that are better adapted to the northern part of the State. The corn-breeding stations at various points have served a useful purpose in this matter, and the indications point quite strongly to the rapid increase of corn-growing in northern Minnesota. No. 13 corn is being improved, and an attempt is being made to develop a new and somewhat larger variety of corn, by crossing No. 13 with a Missouri corn. In the third generation from the cross, the corn is maturing quite satisfactorily and promises to be of value. The Minnesota No. 529 wheat, which was distributed last year for trial, has proved only fairly satisfactory in hardness; and further tests will be made, during the coming year, before advocating its use extensively. Minnesota Nos. 261 and 295 oats, distributed a year ago, have proven satisfactory; and the No. 295 especially is being called for to quite an extent by the farmers of the State. No new varieties will be offered this year, though there are a few varieties of spring wheat which promise to be especially good yielders.

(2) Farm Crops.

The farm-crops work, including variety tests of all of the important cereals and farm crops, is continued. Tests have also been conducted, comparing the newly-originated nursery varieties with the standard commercial varieties. This feature of the work, while not perhaps strictly scientific, is necessary to determine which of the new varieties are desirable for general use by the farmers of the State. No new crops have been introduced during the year; though the investigations in tobacco-growing, in Sherburne County, are again carried forward in accordance with the provision of the Act of the Legislature, appropriating money for the work. Mr. Charles Lien, tobacco expert, has been retained for the year, and the area planted to tobacco has been somewhat enlarged. During the coming year a study will be made of Bokhara as a forage crop, to determine whether or not it is suitable for food for live stock. This work will be taken up as a sub-project, in co-operation with the Animal Husbandry Division, to determine its value.

(3) Crop Rotation.

No new rotations have been organized during the year, at University Farm. In connection with the Field C rotation plots, extensive studies of the humus and moisture content have started. The Field T rotation plots, organized two years ago, are affording an excellent study of methods of tilling soil, and of the application of manures and fertilizers. The work has been somewhat interfered with by the killing out of the clover crop last year; making it necessary to substitute field-peas, or a mixture of field-peas and oats, for the clover crops in rotation. The effectiveness of this line of work has been increased this year by taking soil-samples for analysis, and inaugurating the policy of analyzing the soil, the manures as applied, and the crops removed; thus determining the additions to fertility, and the fertility removed, by the various rotations. The results of former years have been used in completing the manuscript for a bulletin on Farm Management, to be published soon by the U. S. Department of Agriculture, and simultaneously as an Experiment Station bulletin.

(4) Cost of Production.

The Cost-of-Production studies, as carried out on a number of Minnesota farms, have been continued on two of the routes. On account of lack of funds, the third route was dropped in July, 1911. The work is still being carried forward at Northfield and Halstad. Data are also being secured from some of the demonstration farms, and from other farms that are under the special supervision of the statistical office.

(5) Weed Eradication.

The studies in quack-grass eradication, at Monticello, have been continued with very satisfactory results. Quack grass is yielding to persistent cultivation and crop rotation schemes; and at the close of this, the second year of cropping, we have the grass well under control. In the course of the next year or two, unless indications are misleading, we shall see the complete eradication of the quack grass on this farm, without the loss of a crop. Trial of spraying solutions, and of cultural methods, for eradicating both quack grass and the Canada thistle, is being continued, and the field of investigation somewhat enlarged. Studies will be taken up, during the year, of methods of eradicating the sow thistle; and additional tests will be made of the various spraying solutions offered on the market.

(6) Farm Management.

Farm management studies have so far been planned to include an investigation of the operations of the farm as a whole, in a number of places in the State. It is our purpose to learn the actual conditions existing, as regards cost of operation and net profit per farm, under different types of farming which are followed. Problems in organization will be taken up when these conditions are known, and new methods of operating farms, or of carrying on certain lines of production, will be promoted. This work is carried on in co-operation with farmers in various parts of the State, in the belief that the results will be more satisfactory and better reflect the best farm practices. The Division is still supervising the management of the farm of Mr. George Olson, of Belle Plaine, and of the Meadowlands Farm, at Meadowlands, Minnesota. Investigations are also being conducted in connection with the demonstration farms supervised under the Extension Division. Farm-management work will be enlarged during the year, by the employment of Mr. L. B. Bassett as expert in farm equipment. It is proposed to study the equipment of buildings, machinery and stock required by farms of different types, with a view to determining the amount of equipment best suited to profitable operation. Ten or twelve farms have already been inventoried, and work started which will be continued through the year. The number of farms will probably be increased to twenty-five or thirty, and a complete study made of the amount and cost of equipment on farms of various types. The work is conducted in co-operation with the Office of Farm Management, U. S. Department of Agriculture.

Future Development.

More help could be used, to decided advantage, in the plant-breeding work. One or two experts, devoting their entire time to the

study of the development of varieties of crops, would be profitably employed. They could at the same time compile and make available much scientific knowledge which is applicable alike to plant- and animal-breeding, and which at present cannot be brought out. We have the foundation for an extensive statistical study of results in plant-breeding, and should make provision at an early date to put this material in available form. We are still in need of a bacteriologist, who could give some of his time to the study of bacterial influences affecting the growth of crops in the various rotations. Soil bacteria play an important part in crop-production; and we should know definitely just what the effect of various soil-treatments is, as related to bacterial growth. An analyst for the Division is also needed, to make more effective our investigations in crop-production, especially that part of the work connected with the crop rotations and plant-breeding. Clerical help is needed also, both in the Farm Management and in the Agronomy offices, to compile and get ready for publication the mass of material that has been gathered on Plant-Breeding, Farm Crops, and the Cost of Production.

Publications.

The division has prepared and published Minnesota Bulletin No. 124, a report on the Cost of Minnesota Dairy Products. Extension Bulletin No. 18, on Alfalfa Growing in Minnesota, has also been prepared for publication.

THE DIVISION OF ENTOMOLOGY.

F. L. WASHBURN, Chief.

Grasshoppers.

Grasshoppers were so bad in the western part of the State that it was deemed advisable to ask the legislature for a special appropriation for carrying on work with a view to discovering some practical methods of control. We were fortunate in being able to secure an appropriation of \$6,000 for two years' work, and four men are already in the field, assisting farmers in experimenting against this insect, which is so materially reducing our yield of grain.

Cutworms.

Cutworms of various species were extremely injurious in the spring of 1910, and noticeable devastation has occurred through the work of the Wheat Army Worm. In every case in which this army worm has proved injurious we have traced its origin to old timothy fields, that have been allowed to remain in sod, without feeling the

plow for many years. Many letters have been written and visits paid to farmers over the State, and we have urged them not to allow timothy fields to stand more than four years at the utmost.

We have also been appealed to for various remedies which will control shade tree pests, notably the Elm Tree Borer, and Buprestid borers in maples.

Typhoid Fly.

In the fall of 1910, a typhoid epidemic having broken out on the iron range, the Entomologist was asked to visit the locality and determine how far the house fly was responsible for the spread of the epidemic. His report, made to the State Board of Health, and later printed in *Popular Science Monthly*, was to the effect that this insect was in a great measure responsible for the epidemic.

General Studies.

Work against the Clover Seed Chalcis is progressing, and Mr. Warren Williamson has been obtained from the University of Illinois to carry on this work. He has established field quarters near Duluth, and has already added valuable points to our knowledge as to the life history of this destructive insect.

In the insectary 214 experiments have been carried on the past year, along the line of rearing pests, parasites, etc.

The crop of apples and plums was practically a failure in 1910, and spraying experiments were, therefore, delayed.

Lectures.

Outside of the Short Course to Farmers, given at the Agricultural College, the Entomologist has given lectures as follows: January 14th, 1910, Duluth; December 6th, 1910, State Horticultural Society, Minneapolis; December 12th, Boy Scouts, Minneapolis; December 21st, Short Course, Crookston; December 28th, American Entomological Society of America, Minneapolis.

Special Publications.

Nineteen-ten has seen the establishment in this Division of a monthly pamphlet, *Minnesota Insect Life*, issued the first of April, May, June, July and August of each year. This is mailed to any resident of Minnesota asking for it.

In April there were delivered to us 9,000 Insect Charts, prepared as a result of the appropriation for this purpose made at the preceding legislative session, and a large number of these were distributed according to law to the district schools of Minnesota. This chart has been

most highly spoken of, and demands are being received for it, not only from all over Minnesota, but from all parts of the United States as well; and it is a work of which we are justly proud.

Nursery Inspection.

In 1910 fifty-eight nurseries were inspected, and certificates issued. The sum of \$263.73 was received from nursery inspection, and deposited with the State Treasurer to be added to the fund for combating injurious insects. We were obliged to refuse a few nurserymen their certificates until they had destroyed a large amount of crown gall on raspberry plants, which, if not so destroyed, would have disqualified them. We also inspect all foreign stock which comes to us from Holland, Belgium or France, and the present year has seen 11,000 such plants so examined. These plants consisted largely of Hydrangeas, Rhododendrons, Palms, Lilacs, etc.

Insect Collection and Exhibit.

Our insect collection has been materially increased in number of specimens and species, particularly in Hymenoptera.

At the State Fair in September, 1910, we made, as usual, an exhibit from this division, which attracted much attention.

THE DIVISION OF PLANT PATHOLOGY AND BOTANY.

E. M. FREEMAN, Chief.

The experimental work of this Division is grouped under eighteen projects. The principal investigations, with plans for the future, are as follows:

I. Cereal Rust Investigations.

ADAMS' FUND—(TWENTY-SIX SUB-PROJECTS).

Especial attention has been given to the examination of the aecidial stage and to spore physiology. Long-time infections of the springtime have been explained, and the occurrence of periodical rust epidemics has been given a satisfactory explanation. The chief work has been in the resistance of cereals to rust. A foundation has been laid for an anatomical and physiological study of resistant and susceptible varieties. It is planned to continue this line of work, in order to get at the basic nature of resistance; and especially to correlate this with the development of rust-resistant varieties. The work of breeding—with a large number of crosses and hybrids already made—has been con-

tinued, and new crosses have been made. The rust-plot has proven very successful, as a tremendously heavy epidemic of rust was obtained. Hybrid varieties, and durums crossed on bearded Fife, have given exceedingly promising results. Plants with large, unshriveled grain and fairly clean straw, in the midst of a whole field of considerably rusted plants, have resulted. The work will be continued along this line; and some help will be needed, not only in the laboratory but in the field, in order to make profitable and more useful the results of the crosses.

II. Smuts of Cereals.

The work has been confined largely to a comparison of treatments, and especially to the most efficient strength of formaldehyde solution. Experiments have been continued with hot-air and short-time treatments. It will be necessary, in the near future, to devise some sort of machinery for the modified hot-water treatment. Plans are being laid for this work.

III. Flax Diseases.

Fundamental work has been done for two years in building up a flax-sick soil. Work has also been done on flax-rust; and this work will be continued with a view to the development of resistance to both diseases.

IV. Garden Truck.

Cabbage brown rot investigations have been begun; and a large number of varieties of beans have been tested for bean bacteriosis. The diseases of potatoes are also under survey, and spraying experiments with early blight, and with brown rot, have been carried on. Particular emphasis will, in the next few years, be laid on potato experiments in the way of preventing any disastrous introduction or growth of potato diseases in the Minnesota seed-potato and other potato districts. Considerable work has been done on cucumber tubercular disease. The disease was not, however, bad this year. Mr. A. G. Tolaas, who was formerly student-assistant in the Division, and who is now Shevlin Fellow in the Department of Agriculture, has been assigned to the investigation of this problem.

V. Orchard Diseases.

Extensive spraying experiments, with a view toward the comparison of various sprays for Minnesota conditions, indicate for this year the superiority of commercial lime-sulphur to Bordeaux. Co-operative experiments in apple sprays have given excellent results. Brown rot of

apple, a serious branch canker, and apple rust, are being investigated, and work will be continued on them.

VI. Dendropathology.

Experiments were begun and carried on in the use of solutions for the damping off of coniferous seedlings, without, however, very successful results. The work will be continued with more susceptible varieties of conifers. Inoculation experiments with tree-wound parasites have been inaugurated at Itasca Park.

VII. Seed Card Work

has been continued and extended. Series II has been completed and is being distributed. This work is bringing excellent results. The weed-seed survey of the State is being continued, and also a survey of the weeds of the State.

Considerable difficulty is experienced on account of cramped quarters, and also on account of insufficient help.

It would be well to assign the Adams' fund work entirely to one, or not more than two men. There are numerous plant-disease questions which demand investigation, and it is especially desirable that facilities be provided in the way of additional help to bring the work of the Division in closer contact with the farmers of the State.

Publications.

Bulletin No. 121, entitled "Orchard and Garden Spraying." Bulletin No. 122, entitled "The Smuts of Grain Crops." Bureau of Plant Industry Bulletin No. 152, entitled "The Loose Smuts of Barley and Wheat." Bureau of Plant Industry Bulletin No. 216, entitled "Rusts of Cereals."

THE DIVISION OF AGRICULTURAL ENGINEERING.

JOHN T. STEWART, Chief.

Drainage Operations.

In the early part of the year, the tile drainage system on the Northeast Experiment Farm was completed. This system, consisting of 5.8 miles of tile drain, thoroughly drains 125 acres of land; the main being of sufficient size to furnish an outlet for a large area lying west of the State lands, which naturally drains through this farm. Approximately twelve acres of peat land, varying from eight to twenty feet in the depth of the peat deposit, was underdrained; the object being to determine the effect of tile on lands of this character, and later to

determine their value for agricultural purposes, by planting them in various crops.

Late in the season of 1910, the Hickory Island Demonstration Farm, of ninety acres, near Austin, was thoroughly underdrained. In the spring of 1911, the Osakis Demonstration Farm, of 160 acres, was underdrained. An experimental tract of ten acres of peat land at Meadowlands, Minnesota, was underdrained, partly by the use of tile, partly by the use of wooden boxes. The object of this experiment was to determine the cost of reclaiming such lands, and their value for farm purposes.

All the above drainage systems were put in in accordance with surveys and plans furnished by this office free of cost; the construction was superintended by this office; but the actual cost of construction was paid by the land owners.

Peat and Muck Lands.

For three months, during the summer of 1910, an assistant gave his time to a study of the cultivation of peat and muck lands in various parts of the State; the object being to determine to what extent lands of this character are being farmed, the methods of cultivation, and the results.

Surveys and plans for the underdrainage of several other tracts have been made; but construction work has not begun.

Tile Curves.

A practical experiment has been made to determine the minimum radii for the economical laying of tile curves, with tile of from four to thirty inches in diameter—the object being to find how much cutting of the end of the tile is required to make good joints on curves, and not have the curve so short as to interfere with the flow of water. On flat lands, the above is not important, but in rolling lands, in laying large tile, it is often necessary, in order to avoid deep cutting, to reduce the length of curve to a minimum, and still not affect the efficiency of the drain. It was for this purpose that the experiment was carried on. A sufficient number of tile of various sizes were actually laid, in curves of varying radii, to determine this point.

Irrigation Experiments.

A half-acre plot has been set aside, on University Farm, for irrigation experiments. In the latter part of June, a Skinner Over-head Spray System was installed. Irrigation Investigations, U. S. Office of Experiment Stations, and the Division of Plant Pathology of this Station, are interested in this experiment. The intention is to irrigate one-half the plot and leave the other half unirrigated, and to determine

the value of irrigation by comparing the yields of the two. The effect of irrigation on plant diseases will be studied by the Division of Plant Pathology.

Future Experiments.

During the coming year, it is intended to experiment some in the cost of digging tile-trenches of various widths and depths; to determine the necessary strength of tile of large diameter; to continue so far as practicable the investigation of peat lands; and to proceed with the construction of the underdrainage systems on farms where work has not been completed.

On August 1, 1910, the blacksmith-shop and power-station on University Farm were combined with the Division of Agricultural Engineering. This places in this Division practically all lines of work in any way relating to engineering. The administration of this division naturally requires a large amount of time, and interferes somewhat with the carrying out of experimental work. While there are nine assistants in the Division, the large amount of routine work in teaching and other required Station work takes practically all their time. The legislature of 1911 appropriated \$160,000 for the erection of a new building for this Division. With the appropriation made by the 1909 legislature, there became available on August 1, 1911, \$260,000 for the construction and equipment of the new building. The plans for the building are well under way. This building is badly needed, and will greatly facilitate the opportunities of the Division for doing experimental and Station work.

THE DIVISION OF CHEMISTRY.

RALPH HOAGLAND, Chief.

The investigation work of this Division is on a project basis; and, in addition, more or less general work, such as analyses of feeds, water, soils, fertilizers, etc., is done for farmers of the State. Following is list of projects:

PROJECT No. 1—Industrial Alcohol—General Project.

Sub-Project 1.—Relative lighting efficiency of alcohol and kerosene.

Sub-Project 2.—Composition of different varieties Minnesota potatoes.

PROJECT No. 2—Human Nutrition Investigations—General Project.

Sub-Project 1.—Economy of the fireless cooker, and effect of cooking upon the composition of cereal breakfast-foods.

PROJECT No. 3—Cereal and Flour Investigations.

Sub-Project 1.—Study of the composition and milling value of Minnesota wheats.

PROJECT No. 4—Increasing the Protein Content of Oats—Co-Operative with the Division of Agriculture.

PROJECT No. 5—Soil Fertility Investigations—Adams.

PROJECT No. 6—State Soil Survey.

Sub-Project 1.—Fertilizer experiments—University Farm.

Sub-Project 2.—Fertilizer experiments—Grand Rapids.

PROJECT No. 7—Special Soil Investigations.

Sub-Project 1.—Composition and Agricultural Value of Peaty Soils.

PROJECT No. 8.—Wheat—Effect of climate and soil upon its composition and milling value.

PROJECT No. 9—Commercial Feeding Stuffs—Composition of.

In brief, progress on the above projects has been made as follows:

Industrial Alcohol.

PROJECT No. 1—In 1909 the State Legislature appropriated \$6,000 for the establishment of an experimental industrial alcohol plant at this Station. Owing to the resignation of Prof. Harry Snyder, chief of this Division, at about that time, work on the plant was somewhat delayed. During the past summer the plant has been installed in a remodeled building of substantial brick, on the campus, and is now practically ready for operation. The total cost of the equipped plant is approximately \$6,500, some other funds having been available for the purpose, in addition to the original appropriation.

The plant has a capacity of about fifty gallons of absolute alcohol per day. The equipment is all modern, and such as is used in large distilleries.

Owing to the present high price of potatoes, corn only will be used during the coming winter. Later, an equipment to handle potatoes will be installed; and, when prices warrant, that product will be used for making alcohol.

Sub-Project No. 1.—Work on this sub-project has been completed, and results submitted for publication as a bulletin entitled, "Relative Lighting Efficiency of Alcohol and Kerosene."

Sub-Project No. 2.—Ninety-three samples of potatoes, representing thirty varieties, have been analyzed. In addition, a study has been made of the composition of potatoes at different stages in their

growth. The purpose of this work is to determine the value of Minnesota potatoes for alcohol manufacture.

Human Nutrition.

PROJECT NO. 2.—For the present, all work on this project has been dropped. After doing some preliminary work on Sub-Project No. 1, results did not seem to warrant its continuance. The Human Nutrition work is of importance, and ought to be carried on; but, for the present, pressure of other work prevents its continuance.

Cereals and Flour.

PROJECT NO. 3.—The 1909 legislature appropriated \$1,000 for establishment of a flour and grain testing laboratory at the Station. This laboratory has been completely equipped, and Mr. C. H. Bailey, formerly in charge of the Grain Testing Laboratory, U. S. Dept. Agr. at Fargo, N. Dak., has been secured to take charge of this line of work. All work submitted by the State Board of Grain Inspection is being promptly taken care of.

Sub-Project No. 1.—In addition to the work noted above, a study is being made of the composition and milling value of the varieties of wheat grown in the principal wheat-producing counties of the State. The results of this work will probably be ready for publication in the spring of 1912.

The Protein in Oats.

PROJECT NO. 4.—Nitrogen determinations were made on 124 samples of oats.

Soil Fertility.

PROJECT NO. 5.—The work on this project has consisted chiefly of a study of the amount and composition of humus from a series of forty-four rotation plots started in 1895. Soil samples were taken from each plot at that date, and again in 1905. The different methods of cropping followed have produced very interesting changes in the amount and composition of the humus. In addition to this work, the total plant-food in soils in 1895, and again in 1905, is being determined. All crops removed are analyzed for nitrogen, phosphoric acid and potash.

The results of this work will probably warrant publication in the spring of 1912.

State Soil Survey.

PROJECT NO. 6.—An accurate and detailed survey is being made of the soils of the demonstration farms and sub-stations, and the

field-work will be completed this fall; but a large amount of analytical work remains to be done on the soil samples collected.

Pot-culture tests have been carried on this summer on soils from a part of the demonstration farms; and this work will be continued next summer.

Soil samples are being collected from those sections of the State from which no samples had previously been taken.

Sub-Projects Nos. 1 and 2.—These experiments are being continued, but it is too early to expect decided results.

Special Soil Investigations.

PROJECT NO. 7. *Sub-Project No. 1.*—This project is in co-operation with the Engineering, Pathological and Agricultural Divisions, on a study of peat soils. The co-operative experiment this year is being conducted on a muskeg swamp at Grand Rapids. In addition to this experiment, Mr. Hungerford made an extended trip over the State, examining peaty soils and collecting soil samples and information. A part of the analytical work has been completed and the remainder will be finished this winter.

Fertilizer experiments on peaty soils have been conducted this past summer, in co-operation with a number of farmers.

Wheat.

PROJECT NO. 8.—This project is in co-operation with the Division of Agriculture, and consists of a study of the effects of soil and climate on the composition and milling value of the principal varieties of wheat, which are to be grown for four or five years in the principal wheat-growing sections of the State. Seed is being grown at the Station this year, and the experimental plots will be started next spring.

Commercial Feeding Stuffs.

PROJECT NO. 9.—In co-operation with the State Dairy and Food Commission, samples of commercial feeding-stuffs are being collected from all parts of the State, and will be analyzed this winter. The purpose of this work is to furnish the farmer with information as to the composition of such feeds.

In addition to work on the projects above outlined, considerable routine analytical work has been done for other divisions, and for farmers throughout the State.

The investigation work for the next year will be very largely, if not entirely, along the projects above outlined.

A large number of requests have been received for analyses of soil samples. The analysis of individual soil samples is of doubtful

value and the gain therefrom so small as to be out of all proportion to the actual cost of analysis. As far as possible, advice as to the agricultural value of soils submitted has been furnished, and analyses have been made when necessary.

One bulletin, on "The Relative Lighting Efficiency of Alcohol and Kerosene," by R. M. West, has been submitted for publication.

THE DIVISION OF HORTICULTURE.

LEROY CADY, Chief.

The past season has been exceptionally good for the development of a great many horticultural crops. The tree fruits especially have done exceptionally well throughout the State. The orchard at University Farm gave a satisfactory yield, nearly all varieties bearing at least a few apples. Those doing the best were Wealthy, Patten's Greening, Anisim and Duchess; and, among the crabs, Sweet Russet, Shields, Florence and Lyman's Prolific. The Russian orchard, which was originally planted with Russian varieties, a large number of which had died out, was entirely done away with this spring. The land on which this orchard stood was made a trial plot for seedling potatoes, and for a few variety tests. Plums were an exceptionally good crop. A large number of seedlings at University Farm fruited for the first time, and several hundred bushels of plums were gathered. These, as well as the apples, found a ready market at the Station, at good prices. The grapes did not yield as well as in some other seasons, although there was a fair crop. There seemed to be less winter-killing this season, among the ornamentals and fruits, than would reasonably be expected on account of the poor conditions last year.

On the Campus.

The oaks on the campus, as well as throughout a large part of the State, were injured by the oak borer, and a good many have been cut out and burned.

Peonies, among herbaceous ornamentals did not blossom as heavily as usual, possibly owing to the drouth last season. They are, however, going into the winter in good shape, with every indication of good growth next season. More additions have been made to the hedge plots and a few additions to the ornamental planting. Much more work should be done along this line next season.

Mr. Kohler has had charge again, this year, of the potato and vegetable work, and has made studies in potatoes seed degeneration

and has conducted experiments in breeding, spraying and variety tests of both potatoes and vegetables. Careful notes on these various lines have been kept, and will be available for use in the future.

The Minnetonka Fruit Farm.

The fruit-breeding farm has made rapid growth in the last year. A large number of strawberry and raspberry seedlings fruited; among them some of considerable promise. About three or four hundred of these have been saved for further testing. Some 600 seedlings of the Beta grape fruited for the first time; and, in a few cases, the second time, this year. About a dozen of the best of these have been selected for further testing and propagation. Some of these are better than the original Beta in quality, and fully as hardy. About 8,000 plums were fruited, and a hundred or so of these have been selected for further trial. Among these are a number of crosses of Japanese and Americana types, which give indications of being valuable. A large number of these have been carefully propagated, and will be further tested before they are distributed.

An addition was made to the greenhouse at the fruit-farm, practically doubling the capacity of the house. This will give room for more accurate breeding-work. Mr. M. J. Dorsey began work the first of August along the lines of research in fruit breeding, under the Adams Fund.

Members of the Horticultural Division have, as usual, attended a number of county fairs, and farmers' and civic meetings throughout the year.

The Station Greenhouse.

The greenhouse has been partially repaired, but is in an unsatisfactory condition at the present time. The building has settled considerably in places, and the wood-work has so decayed that it cannot be repaired to advantage. A new building, of improved construction, is much needed.

Among other needs of the Division is more land for potato and vegetable work.

THE DIVISION OF FORESTRY.

E. G. CHEYNEY, Chief.

The Preservative Treatment of Fence-Posts.

Three years ago some experiments along this line were carried on at the Zumbro Heights Fruit Farm, in co-operation with the U. S. Forest Service. They are of interest more particularly as an example

of what can be done with partly-seasoned timbers; for subsequent experiments in other places would seem to indicate that it is inadvisable to treat anything but well-seasoned posts.

Posts of red oak, white oak, soft maple, ash, cottonwood, birch, elm and basswood were treated with creosote, by the open tank method, with varying lengths of hot and cold baths. The results ranged from a mere coating to a penetration of half an inch, with an absorption of from one and one-half to six pounds of oil per post.

Water-gas tar proved unsatisfactory, on account of its excessive frothing and high water content.

Owing to the large amount of extra labor expended in the weighing and measuring of the posts and treating material, the cost of these experiments is not a fair test for commercial practice. It ran as high in some cases as eighteen cents per post.

Only a progress report can be made at this time, because an examination of the posts last summer showed that practically all of them were as yet perfectly sound.

An experimental plant is now being equipped at the Station, and the experiments for the coming year will be directed toward the adaptation of a cheap and efficient treating-plant and method of treatment for use on the farm. It is probable that a co-operative plant for the community will prove to be the most satisfactory and the most economical.

Sylvicultural Experiments.

All the sylvicultural experiments have been started in the past three years—most of them in the past year. As many of these experiments will cover a series of years, few definite results have as yet been obtained.

Time of Sowing Coniferous Seed in Nursery Beds.

A series of sowings were made at Itasca Park, three years ago, to determine the best time for sowing coniferous seed. The spring was cold and wet.

Seed planted the first of May required five weeks to germinate, on account of the cold, and it finally came up, at the beginning of a series of wet days, only to damp off. The sowing was almost a total failure.

The remainder of the series, sowed two weeks apart through May and the first half of June, germinated in a little shorter time, but shared almost the same fate as the first.

The last sowing, made on July 5th, with seed which had been soaked in the lake for forty-eight hours, yielded almost a perfect stand. Damping off scarcely touched them. The most significant point is

that they matured sufficiently, with the aid of a straw mulch, to withstand the winter cold. It proves that late planting need not be feared in that section.

This last spring, beds of Norway pine, sown by the Forest Service at Cass Lake about the first of June, produced a splendid stand. The season was a month earlier than two years ago. Early plantings may work, in a particularly favorable year, but are open to great risk if the season happens to be late. The late planting is much safer, and apparently as good as the earlier ones.

Treatment of the soil with sulphuric acid and lime proved useless to prevent damping off with the earlier plantings.

No treatment with red lead proved efficient in protecting the seed from birds. Treatments with tar oil delayed, and in some cases entirely prevented, germination.

At the Cloquet Station.

The following experiments were started at the Cloquet Station last spring:

Comparison of nursery beds with high and low screen.

With lath screen and brush screen.

Unprotected beds and beds tightly enclosed in fly-screen.

Broadcast sowing were made with seed of white pine, Norway spruce, and Douglas fir, in unprepared cut-over land, harrowed ground, ground harrowed and covered lightly with cut brush after planting. Sowings of white pine were also made on recent burns.

Underplantings of white pine, limber pine, and Norway spruce were tried in dense stands of young jack pine.

White pine was sowed in seed-plots on open cut-over land recently burned.

Sample plots were laid out around single seed-trees, and in dense stands of mature Norway.

Satisfactory results of any value cannot be obtained from these plots before next spring, and some of them will not show up for several years.

THE DIVISION OF AGRICULTURAL EXTENSION AND FARMERS' INSTITUTES.

A. D. WILSON, Superintendent.

Demonstration Farms.

A marked feature of our work in co-operation with farmers has been in conducting, in the State, nineteen demonstration farms. An agreement is entered into between each of these farms and the Agri-

cultural College, under which the farmer agrees to use his farm and equipment as per directions received from an expert from the Extension Division. The Extension Division representative assumes the directions of all the farm business and operations, and directs the work by visits to each farm; when possible, twice each month, and, if necessity arises he makes more frequent visits. The work has been in operation but about a year; consequently there is little to report in the way of results, except to say that each one of these farms, during 1911, has a net profit to show above the operating expense. The form of contract entered into between the Department, of Agriculture and the owners of the demonstration farms is as follows:

THIS AGREEMENT, Made and entered into in duplicate this.....day of....., 19....., by and between the College of Agriculture of the University of Minnesota through its Dean, A. F. Woods, party of the first part, and.....in the County of....., party of the second part.

WITNESSETH, Whereas, the parties hereto are mutually interested in advancing and developing the agricultural interests of the community in which the second party resides, and to that end have determined upon the carrying out of certain demonstration work in said community, and

Whereas, the second party is the owner and proprietor of.....acres of land, more or less, viz:....., heretofore selected for use in the carrying out of said demonstration work, and

Whereas, the first party is willing to furnish expert advice in the carrying out of the demonstration work to be done upon said land, and

Whereas, the second party is willing to furnish all of the necessary work, seed, machinery and other things in the performance of said work, and

Whereas, said second party is also willing to co-operate with first party in the premises, and

Whereas, the second party is to have all of the rent, income, crops and profit from said land, with the understanding that all necessary reports concerning such crops and income from said premises may be prepared and used by first party in the furtherance of the agricultural interests of Minnesota, and

Whereas, it is the understanding of both parties hereto that this agreement and the provisions hereof shall be for the advancement of the agricultural interests of said community and the State of Minnesota, and said work shall be of a public nature, and aside from the profits and income to be derived by second party from said land, said demonstration shall be for the public good.

NOW THEREFORE, It is agreed between the parties hereto as follows:

1. That this agreement shall continue for a period of five years from the.....day of....., 19.....
2. Second party is to cultivate, care for and manage said land and all crops and live stock thereon in a husbandlike manner and in accordance with the advice and instructions of the first party and its employees; to furnish all seed, machinery, labor and material necessary to the operation of said farm, and to at all times keep a complete record and account of all seed, machinery, live stock, produce and other things derived from the operation of said farm; which record and account shall at all times be under the direction and subject to the supervision of the first party.
3. The first party, its agents and servants shall have the right to go upon

said premises at any time they may desire for the purpose of carrying out the provisions of this contract and of exhibiting said farm and the work being done thereon to others, with the understanding, however, that no crops or things upon said farm shall be damaged or in any manner interfered with by this going upon or so inspecting said farm and the work being done thereon.

4. Second party further agrees to allow the public to enter upon and examine said farm and all stock, crops and produce thereon at any time, with the further understanding that the public and persons entering thereon shall not in any manner damage or interfere with any crops, stock or property thereon.

5. It is further agreed that first party, its agents, servants and employees shall at all times furnish ample and sufficient attention to the progress of the work being done upon said farm; to lay out plans for the operation thereof and the care of the live stock thereon; to at all times furnish expert advice and directions to second party, to the end that the results expected to be obtained may, if possible, be attained at the earliest possible time; to aid the second party at all seasons of the year by way of counsel and advice in the performance of all work thereon, so that without unnecessary delay scientific and better methods of agriculture may be used in carrying on the said farm and in the production of grains, grasses and live stock thereon.

6. It is understood between the parties hereto that in order to advance the business of agriculture in said community a system of crop rotation is to be arranged for and carried out and that to furnish to the public by the cultivation of said farm valuable demonstrations and object lessons, it will be necessary to carry on and cultivate said farm under the supervision of first party for the period aforesaid; and that from the date hereof the second party shall abide by the directions of first party in the laying out of said farm and the establishment of a system of crop rotation thereon.

7. It is further agreed and understood between the parties that in as much as the best results may be obtained from the carrying on of said farm for demonstration purposes by having the attention of the public frequently directed thereto, and to that end the parties agree that they and each of them will at all times put forth their best endeavors to interest the public in said farm and the work being done thereon, and the parties hereto co-operate in that regard.

8. It is further understood and agreed that further than herein indicated the parties hereto shall assume no obligation one to the other; and for the services of second party and for all things which he hereby agrees to do he shall be fully compensated by receiving the crops, income and products of said land and the live stock produced thereon.

9. It is further agreed that the first party shall be the sole judge as to the method which shall be adopted for disseminating the results of the demonstration work done upon said land, and the placing of such results and reports before the public shall at all times be at the expense of the first party.

IN WITNESS WHEREOF, Both parties have hereunto set their hands and seals the day and year first above written.

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Signed, sealed and delivered in Presence of

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Industrial Contests.

Rural School and Industrial Contest work, as outlined in Extension Bulletin No. 3, has been promoted as rapidly as possible. Mr. George F. Howard has devoted his entire time to this work, and has received considerable assistance from other Extension workers.

During the year, 338 sessions of rural school teachers' and rural school officers' meetings have been addressed by Mr. Howard and others. The total attendance at all of these sessions has been 17,876. At least forty counties have taken some part in the Industrial Contest work, beside a large number of high and graded schools.

Educational Exhibits.

Educational tents were sent, during the fall of 1910, to seventeen county fairs. In these tents, charts and models were used to illustrate improved farm methods. In forty-two days in attendance at fairs, 31,375 people were met in these tents.

Lecture Courses and Short Courses.

Our regular Extension workers held Lecture Courses and Short Courses, in seventy-two different towns; the Lecture Courses consisting of from three to eight lectures; usually giving one lecture every other week. The series included lectures in General Agriculture,—Live Stock and Home Economics. In some instances general Short Courses were held for a week; in others special Short Courses. Several one-week courses in Home Economics were held. In this work were held a total of 419 sessions, with a total attendance of 31,615 people.

Special Schools.

Four Poultry Schools were held in the State. These schools were continued for one week. Classes in these schools were regularly enrolled, and a small fee charged. The amount of the fee, however, was returned to each student in the form of books and record-blanks of use in the Poultry industry. In these four schools, forty-seven sessions were held, with a total attendance, at all sessions, of 1,935.

Two special Corn Schools were held, under the same arrangements as were the Poultry Schools. At these two schools there were twenty sessions, with a total attendance of 1,385.

Farmers' Clubs and Other Gatherings.

Considerable effort has been devoted to the organization of Farmers' Clubs, as outlined in Extension Bulletin No. 1. Fifty-four meetings of this kind were held by Extension Division men, with a total attendance of 4,359.

Through the year, addresses were given at miscellaneous meetings, such as County Fairs, Teachers' and School Officers' meetings, special farmers' meetings, etc., in 145 different places, with a total attendance of 17,034.

Publications.

A Press News sheet is published twice each month, and sent to the papers of Minnesota and adjoining States. This sheet gives timely items of agricultural information regarding the work done at this and other agricultural institutions, and by successful farmers. Thirty-five hundred copies are published of each issue.

Every three weeks a page of illustrated agricultural matter is furnished to the American Press Association. The page is sent in plate form, at \$1 per page, by the Press Association, to sixty or more papers in the state.

A popular bulletin, consisting of from eight to twenty pages, and presenting in a practical and concise way some timely agricultural subject, is published each month. These bulletins are sent free to anyone in the State desiring them. There are now over 35,000 names on our mailing list, and the list is growing rapidly.

In addition to these publications, special posters and circulars are published when necessary.

The 1911 Legislature increased our annual appropriation from \$25,000 to \$40,000. They allowed us, in addition, \$2,000 annually for prizes to be offered in the State Industrial Contest.

THE NORTHWEST EXPERIMENT FARM.

C. G. SELVIG, Superintendent.

The Northwest Experiment Farm, University of Minnesota, is situated two miles north of Crookston, Polk County, Minnesota. It was established in 1895, in response to the demand made by the farmers in this section of Minnesota, for a farm where trained experts could sift out the methods of farming that would be the most beneficial to the people of this part of the State. The Red River Valley embraces a large area of valuable land. This farm is located in the heart of that valley, and bears a peculiar responsibility in trying to solve the problems that arise here.

Drainage.

The farm is located in a low part of the country, and up to 1908, it did not produce crops consistently, on account of the lack of drainage. In 1908 a complete drainage-system for the farm was established.

This system of drainage, including both tile drainage and surface drainage, has been successful, as results that have been achieved already indicate. A drainage bulletin was published in 1908, giving in detail the plan pursued in installing the drainage system upon this farm. (Minnesota Experiment Station Bulletin No. 110). Last fall the system was thoroughly inspected. The open ditches were cleaned out. This did not prove to be a very expensive work, as very little sediment had been deposited in them, due to the fact that last year was a dry year in this section of Minnesota. The tile drains were found to be open and in good condition. There was no noticeable difference in the condition of the various kinds of tile used in the tile drains. This year it was noticeable that the fields drained by open ditches or by underground tile could be used after rains more quickly than the undrained or untiled fields. The indications point clearly to the fact that the system of drainage installed here is proving of the greatest value, and that farms similarly located in Northwestern Minnesota will have their value increased greatly when such drainage is installed. It is too early to give definite results of the system.

Crop Rotation.

One of the most important things done during the past year on this farm was the plotting out of the farm fields into two practical major farm rotations. These embrace, in the aggregate, about four hundred and thirty acres. On account of the lack of drainage, no systematic and regular crop rotation had been practiced in the past on the farm proper.

Crop Report.

This year's crop, as a whole, was a very successful one. The yields of oats and barley were considerably above the average. The weather conditions, on the whole, were favorable. Following is a table of yields:

CROP REPORT FOR 1911.

Field.	Crop.	Variety.	Date Sown.	Rate Per A.	Previous Crop.	Grass Sown.	Manure.	Date Harvested	No. Acres.	Total Yield.	Yield Per A.
A1	Pasture.....										
A2	Barley.....		4/21	2 bu.	Oats	Clover and Tim.			8.9	320 bu.	36 bu.
B1	Fodder.....	No. 13	5/29	18 lbs.	Oats		8 ton		25.7		
B2	Rye.....	No. 2	9/10	1½	Oats				11.9	212 bu.	17.8 bu.
B3	Corn.....	No. 13	5/20	8 lbs.	Rye and Oats		8 ton		5.		
B4	Alfalfa.....										
C1	Wheat.....		4/19	1¼	Rye and Oats	Clover and Tim.	6 ton	8/11	33.4	761 bu.	22.8 bu.
C2	Barley.....		4/19	2 bu.	Oats	Clover and Tim.			7.1	238 bu.	33.5 bu.
C3	Meadow.....										
D	Oats.....	Early Roosevelt..	4/25	2¾	Follow			8/7	42.	2859 bu.	68.2 bu.
D2	Corn.....	No. 23	5/19	8 lbs.	Hay				5.		
E	Hay.....										
E2	Millet.....	Siberian		2 bu.	Wheat				10.		
F1	Oats.....	Early Roosevelt..	4/22	2 bu.	Hay	Clover and Tim.	8 ton	8/2	14.1	830 bu.	58.8 bu.
F2	Oats.....	No. 281	5/8			Clover and Tim.		8/11	13.1	454 bu.	34.6 bu.
G1	Oats.....	Swedish Select...	5/6	2 bu.	Oats	Clover and Tim.		8/2	6.5	204 bu.	31.4 bu.
G2	Barley.....		5/8	2 bu.	Barley						
					Sheep Past.	Clover and Tim.		7/28	30.	1014 bu.	33.8 bu.
H1	Oats.....	No. 261	5/15	2½	Millet			8/7	6.4	335 bu.	52.3 bu.
H2	Waste.....								5.6		
H3	Millet.....	Siberian	6/12	½ bu.	Flax			9/10	12.4		
I	Flax.....		6/16	½ bu.	Pasture			10/8	25.7	196 bu.	7.6 bu.
J, K, L.	Pasture.....										
Hog	Pasture.....	Barley									
	Corn.....	N. W. Dent		8 lbs.					2.9	112 bu.	36 bu.
Exp.	Barley.....		4/21	2 bu.		Clover and Tim.		7/28	3.5	170 bu.	48.0 bu.

From various experiment plots:—

Wheat	64 bushels
Barley	100.5 bushels
Oats	44.5 bushels

Total Crop:—

	Averages.
Rye— 212 bushels	17.8 bushels
Wheat— 761 bushels	22.8 bushels
Barley— 1854.5 bushels	35.3 bushels
Oats— 4681.5 bushels	59.0 bushels
Flax— 196 bushels	7.6 bushels

Experimental Work.

The experimental work with field crops was reorganized in April, 1911. A series of plots was laid out, and experiments along the lines of crop-rotation, variety-testing, and work with corn and alfalfa, were outlined and started. Most of the land devoted to this work is fairly well drained naturally, as well as tile-drained. Eighteen half-acre plots are devoted to the following rotations: A three-year rotation of wheat, clover, and corn; a seven-year rotation of wheat, barley, grass, grass, flax, oats, and corn; a five-year rotation of wheat, grass, grass, oats, and corn; wheat continuously; wheat continuously with clover added; and corn continuously.

Various other experimental work is under way, including tests of various crops, methods of seeding, preparation of seed-bed, time of seeding, etc.

The work with alfalfa has demonstrated that this crop is adapted to Red River Valley conditions, so far as indicated by tests from 1908 to 1911 inclusive. The following table gives the yields:

ALFALFA SEEDED IN 1908—YIELD IN POUNDS PER ACRE, THREE CUTTINGS.

Plot.	Variety.	1909	1910	1911	Average.
1	Dry Land.....	4000	3700	2770	3490
2	French	5100	3630	4025	4251.6
3	Montana	6000	4700	6095	5598.3
4	Grimm	6150	6000	5470	5873.3
5	Utah	3150	1300	3095	2515
6	Grimm		1300	4210	2755

Dairy and Animal Husbandry.

The work in the Dairy Department during the past year has consisted of feeding balanced rations and keeping accurate record with each cow. The milk of each cow is weighed every day, and tested for butter fat each month. A complete record of cost of feed and the value of the product is also kept, and balanced at the end of each month. Two herds have been developed; one a Holstein dairy herd, and the other a Shorthorn herd composed of animals that have some milking tendency. The work with horses has made along the line of improving the ordinary stock for general farm purposes. Co-operative breeding work is planned with farmers of the region. The work with swine has not progressed satisfactorily, on account of the lack of proper swine-houses. These have now been provided, and the plan of the work for the future includes investigations with the Yorkshire bacon type and the Duroc Jersey fat type.

Poultry.

The work in the Poultry department has been continued along the same lines as in previous years. Two breeds, Plymouth Rocks

and White Leghorns, have been raised. The old houses were very unsatisfactory, and a complete new plant was designed and completed. The department has had to meet a great demand for information from farmers on methods of poultry-raising, construction of houses, feeding, etc. The demand for breeding-stock has also been heavy.

Farm and Campus Plan.

A permanent farm and campus plan was completed during the year, and steps have been taken to plan trees and shrubbery, and improve the campus and surroundings of the farm and school buildings.

Buildings and Improvements.

The Legislature has provided funds for making necessary improvements. Late in 1910 a swine-barn was completed and a slaughter house was constructed. The last Legislature granted an appropriation for four cottages for the use of the employes required to stay on the farm. Provision was also made for the enlargement of the horse barn, the dairy barn, additional well, sheep-fold, and other necessary improvements. Provision was also made for the construction of a spur track and the improvement of roads and sidewalks. The carrying out of this work will come in the next fiscal year.

Station Corps.

Several new men began work during this fiscal year. Mr. C. G. Selvig, Superintendent, entered upon his work the first of August, 1910. Mr. J. D. Bilsborrow, Farm Agronomist, entered upon his work the first of November, 1910. Mr. T. McCall, Horticulturist, and Mr. F. H. Sargent, Dairyman, entered upon their work in June, 1911, Mr. C. E. Brown, Poultryman, and Mr. H. R. Danielson, Farm Mechanic and Farm Foreman, served their fifth year here. The heads of the various departments have rendered efficient services in their own spheres and in furthering the work of the entire farm.

THE NORTHEAST EXPERIMENT FARM.

A. J. MCGUIRE, Superintendent.

Since 1904 the work of the Northeast Experiment Farm has been largely centered around the dairy industry, that industry being considered the most profitable branch of agriculture for the farmers of the timbered section of the northern part of the State.

The Dairy Herd.

The dairy herd of the Experiment Farm has been gradually built up, from a few cows to nearly one hundred head, including young stock. Forty-five cows are being milked at the present time. The foundation-stock of the herd consisted mostly of common cows of the dairy type; the object being to show what could be done in dairying with such animals as the farmers of northeastern Minnesota have in their possession. Sires of the Guernsey breed have been used to grade up the herd; and heifers of the first and second crosses are now replacing the common cows of the herd.

In 1910, the record of the herd was as follows :

Number of cows milked.....	28
Average pounds milk per cow.....	5,488
Number pounds butter per cow.....	260
Value of butter at 30c.....	\$79.49
Cost of stall feed per cow.....	30.16
Returns less cost of feed per cow.....	49.33

The cows were on pasture from May 15th to October 10th. The pasture was cut-over and timber and brush land, from which no other revenue could have been obtained until the land was put under the plow. Winter feed consists of fodder corn, field roots, ensilage, mixed clover and timothy hay, and mill feed. The cows are always fed from the standpoint of economy, profit being sought rather than great production. The work with the dairy herd thus far has chiefly been to determine and demonstrate the advantages of dairying to the farmer of northeastern Minnesota. In connection with this, the work aims to determine the difference in productiveness of the common cow and the grade dairy cow, or the advantage of using a pure-bred dairy sire. The male calves of known dairy quality are sold to the farmers at a nominal sum.

Hogs and Poultry.

Hog-raising is carried on in connection with dairying; the hogs utilizing the skim-milk to a considerable degree of profit. A bacon breed of hogs is raised, the large improved Yorkshire. The pigs are grown chiefly on clover pasture and skim-milk, and fattened on barley, peas and roots.

The poultry, which had been limited to one hundred hens, has been put in charge of a professional poultryman, and the flock increased to eight hundred hens. A new poultry house is under construction, and a residence for the poultryman has been built. This department has been given separate grounds on the Experiment Farm, and the object of its operation will be to determine the possibilities of specialized poultry-keeping in northeastern Minnesota.

Acclimating Corn.

The work with acclimating corn, to secure a variety that would mature ears profitably in this latitude, gave encouraging results in 1910. The variety, Minnesota No. 23, a white-cap Yellow Dent, matured 75 per cent. of its crop in 98 days, and yielded at the rate of 35 bushels of shelled corn per acre. Northwestern Dent matured equally well.

Thirty acres were put into fodder corn, and gave an average yield of ten tons per acre, green weight. The variety used was Minnesota No. 13.

Small Grains and Potatoes.

In small grains, wheat, oats and barley, there were normal yields. The rust, which had affected the oat crop for the past two seasons, was almost entirely absent.

The potato crop was heavy, yielding 250 bushels to the acre of marketable potatoes. The Carmen Number 1 variety, that has been used by the Northeast Experiment Farm for a number of years, continues to excel all other varieties in yield. The entire crop is sold to farmers for seed. Through the distribution of this variety by the Northeast Experiment Farm, probably 75 per cent of the entire potato crop of northeastern Minnesota is now the Carmen variety.

Alfalfa.

Tests with alfalfa indicate that this crop is well adapted to the soil and climatic conditions of northeastern Minnesota. No seeding in six years has failed to produce a stand. Inoculation is unnecessary. In comparing alfalfa with clover, the medium red clover proves to be of greater value to the farmers of the timbered section, owing to its importance in crop rotation.

Drainage.

In 1910 one hundred and twenty acres of the Experiment Farm were drained with tile. Five and one-eighth miles of tiling were laid. While but a small portion of the Experiment Farm is swamp land, the greater portion of the farm lies in such a position as to receive the water from surrounding land, which made the tiling necessary. The main tile is estimated to carry the drainage from a water-shed of approximately 500 acres. This fact made the system more expensive than it would otherwise have been. Of the land drained, twelve acres were muskeg, or peat swamp. The peat formation varied in depth from eight to twenty-two feet. The drainage of this muskeg swamp land, and its subsequent cultivation, will be of much importance, owing to the large areas of such swamp land in northern Minnesota.

THE WEST CENTRAL EXPERIMENT FARM.

E. C. HIGBIE, Superintendent.

A detailed working plan for the arrangement of buildings and grounds, and of fields, including rotation and other experimental plots, was completed during the year and approved as a basis for development. The work during the year was not of an experimental nature. Ordinary forage and grain crops were raised for the use of the farm stock. The land has been divided into fields of uniform size and a permanent rotation scheme established for the major part of the farm.