



Pendergast Hall.

Home.

Dining Hall.

Drill Hall. Woman's Building.
Power House.

Horticultural Building.
Dairy Hall.

Farm House.
Barn.

Abattoir.

Sheep Barn.

BIRD'S EYE VIEW OF BUILDINGS AT UNIVERSITY FARM.

ANNUAL REPORT
OF THE
AGRICULTURAL EXPERIMENT STATION

OF THE
UNIVERSITY OF MINNESOTA.

Fiscal Year, July 1, 1899, to June 30, 1900.



UNIVERSITY OF MINNESOTA
DOCUMENTS

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1900.

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

MINNEAPOLIS, MINN., July 1, 1900.

To His Excellency, John Lind, 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, 1900.

JOHN S. PILLSBURY,
President of the Board of Regents.

List of Bulletins Published During the Fiscal Year Ending June 30, 1900.

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REPORT
OF THE
Director of the Experiment Station.

To the President of the Board of Regents :

The Agricultural Experiment Station of the University of Minnesota has finished a most successful year, and I have the honor to submit to you herewith my annual report giving in detail the work accomplished here and at the station on the farm of Mr. O. C. Gregg, superintendent of the Farmer's Institute of Minnesota, near Lynd, Lyon County, and of the stations established by an Act of the Legislature in 1895, the one at Grand Rapids, Minnesota, under the management of Herman H. Chapman, the other at Crookston, Minnesota, with T. A. Hoverstad as superintendent.

The report includes Bulletins No. 65, 66, 67 and 68, issued since last year, and a full account of the disposition of the annual appropriation from the United States Government, as well as that received from the current expense fund of the University.

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THE MINNESOTA AGRICULTURAL EXPERIMENT STATION
 IN ACCOUNT WITH
 THE UNITED STATES APPROPRIATION, 1899-1900.

Dr.		
To receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1900, as per Act of Congress approved March 2, 1888.....		\$15,000.00
Cr.		
By Salaries.....	\$11,689.24	
Labor.....	1,355.00	
Publications.....	45.00	
Postage and stationery.....	49.14	
Freight and express.....	.....
Heat, light and water.....	101.31	
Chemical supplies.....	83.61	
Seeds, plants and sundry appliances.....	417.20	
Fertilizers.....	.....
Feeding stuffs.....	704.30	
Library.....	.....
Tools, implements and machinery.....	98.12	
Furniture and fixtures.....	6.75	
Scientific apparatus.....	.....
Live stock.....	240.00	
Traveling expenses.....	187.08	
Contingent expenses.....	10.00	
Buildings and repairs.....	13.25	
Balance.....	.....
Total.....	\$15,000.00	\$15,000.00

FINANCIAL STATEMENT.

Statement of disbursements and receipts of the Minnesota Experiment Station for the twelve months beginning July 1st, 1899, and ending June 30th, 1900, inclusive.

	Disbursements.	Receipts.	Cash Outlay.
Station.....	\$16,532.54	\$ 684.94	\$15,847.60
Agriculture.....	8,191.19	1,374.27	6,816.92
Horticulture.....	3,327.72	572.93	2,754.79
Chemistry.....	2,719.29	.....	2,719.29
Entomology.....	1,102.40	.....	1,102.40
Veterinary.....	1,537.25	356.02	1,181.23
Dairy.....	1,374.87	.....	1,374.87
Animal Husbandry.....	10,012.83	3,680.63	6,332.20
Coteau.....	403.79	.....	403.79
	<u>\$45,201.88</u>	<u>\$6,668.79</u>	<u>\$38,533.09</u>
Crookston.....	7,300.59	1,727.35	5,573.24
Grand Rapids.....	4,395.66	937.17	3,458.49
	<u>\$11,696.25</u>	<u>\$2,664.52</u>	<u>\$ 9,031.73</u>

AGRICULTURAL DIVISION.

In the Division of Agriculture the experiment work is bearing good results, especially along the lines of farm and field management, and in breeding, testing, and disseminating superior new varieties of field crops. Good crop conditions prevailed in the latter part of 1899; but in the spring of 1900 the drought was so severe that many experiments were ruined by the seeds failing to germinate until very late. On the other hand, this condition made it possible to compare the drought-resisting powers of the varieties under trial, and the relative value in times of drought of many methods of field crop management. The common field crops at University Farm yielded well in 1899, while in 1900 the drought cut the grass crops short and considerably reduced the grain crop, thus lessening the quantity of seed for distribution.

The experiments in crop rotation have progressed very satisfactorily, though the drought of 1900 will seriously interfere with the production of rotation meadows in 1901 on over 30 of the plots where the newly seeded grasses and clovers succumbed for lack of rain, as did the same crops in the drought of 1894. The experiments in pasturing have now assumed an established portion of the work in rotation and field management, and the important question of the relation of live stock to farm management is being investigated under methods which seem destined to produce results of great import.

Material progress has been made in the past year in evolving methods of breeding wheat and other field crops, and some of the methods of testing field crops have also been improved. A comprehensive plan for disseminating newly-originated varieties proved to possess special value, has been put into successful operation throughout the counties of the State. A plan for co-operation between this station and other State experiment stations has been inaugurated meeting with favor at some nearby stations, and receiving encouragement from the National Department of Agriculture. The North Dakota Experiment Station has already begun to distribute new varieties of wheat originated jointly by Minnesota and North Dakota. Since 10

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to 15 years are required to breed, test and develop for distribution new varieties of wheats, and since private individuals do not care to wait so long for results, it seems the part of wisdom for the State to undertake the production of new varieties of this and other field crops. Prof. Hays made a thorough study of seed breeding, variety testing, seed disseminating, and seed merchandizing in foreign countries in 1899, and learned facts which have been useful in further perfecting the plans already well developed by this station. In inviting other State experiment stations to co-operate in breeding and disseminating new varieties, this station realizes the advantage to Minnesota of such co-operation. If this State originates new varieties, discards all but the few promising ones, and furnishes these to the neighboring states, we shall get the cream of the work in the surrounding states in return for our best varieties sent to them. By common courtesy, or by agreement, the other states will distribute new varieties later than the State originating them; or, with the consent of the originator, in the same year. Minn. No. 13 corn and Minn. No. 163 wheat have been sold extensively in Minnesota to those who desire to grow seed for sale. Minn. No. 163 wheat has also been distributed by Prof. Shepperd, of North Dakota, who is co-operating with this section in the production of new wheats. Prof. Chilcot, of South Dakota, and Prof. Atkinson, of the Iowa Experiment Station, are testing the best of our newly originated wheats, and will doubtless desire to distribute them to the farmers of their respective states as soon as any varieties have proved especially valuable in those states.

There have recently been taken to the field for trial from the nursery, where the plant breeding is done, 31 new varieties of wheat, 45 new varieties of field peas, 6 varieties of fiber flax, 8 varieties of meadow timothy, 6 varieties of pasture timothy, 9 varieties of brome grass, 20 varieties of field beans, while several new varieties of these crops and of millet, corn, oats, and barley are nearly ready to pass from the nursery selection to the field tests.

Numerous minor experiments are under way in methods of preparing the land for crops and methods of cultivating,

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harvesting and storing the staple root, grain, and forage crops. About a carload of sugar beets is grown annually for the factory at St. Louis Park, and other roots for live stock are grown in quantity. During the present season the very light hay crop made high prices for hay quite probable, and late in June, and up to the 20th of July, the station teams were used on every available piece of ground to prepare the land and plant fodder corn. About 55 acres planted at the rate of $1\frac{1}{4}$ bushels per acre now promises a large amount of material for filling silos and making fine dried hay-like forage for cattle, sheep, and even work teams next winter; thus materially saving in our expense for hay.

The Agricultural Division is preparing a general bulletin on corn, including varieties and the breeding, cultivation, and preservation of this important crop.

HORTICULTURAL DIVISION.

The Division of Horticulture moved into its commodious new quarters the last of January, 1900. The building is conveniently arranged for instructive and experimental work.

Special attention has been given this year to putting museum material, notes, etc., into more convenient and permanent form. The collection of specimens of various trees, shrubs, fruits and vegetables for the garden herbarium have been continued. The object is to have specimens as well as descriptions and records; and in many cases photographs of the various sorts that have been introduced commercially, and in this way we shall be able to have a check on the introduction of all varieties under new names.

The planting of the apple orchard of standard varieties has been finished. So far this year very little twig blight has been noticed on any of the trees. A large number of young seedling apples started by the late Peter M. Gideon have been planted for trial. These trees in many cases were raised from seed selected by Mr. Gideon from his own apples. Their growth will be watched with interest.

A new feature of our work is the testing of varieties sent here in competition for the \$1000 prize offered by the Min-

nesota State Horticultural Society for a seedling apple, as hardy and prolific as the Duchess, with fruit equal to the Wealthy in size, quality and appearance, and that will keep as well as the Melinda. The competition is open to all, and so far fifteen have entered the contest and sent scions for trial.

The annual summer meeting and exhibit of the Horticultural Society was largely attended and a fine display of strawberries made.

Some of the small fruits were injured during the winter of 1899-1900 but with the exception of blackberries a fairly good crop has been harvested.

The work on the campus has been continued as formerly, the plan being to have the grounds attractive with trees and shrubs of various kinds which are found desirable in this section. Large numbers of trees and shrubs have been tested in the nurseries and when found desirable have been propagated for planting on the campus. In this way the plantings have been arranged to make the grounds beautiful, grouping for a succession of blooms wherever possible, and color of foliage throughout the season.

The edition of 10,000 copies of Forestry in Minnesota prepared by Prof. Green, and issued by the Minnesota State Forestry Assn. a year ago, is now exhausted and a revised edition will be issued in the near future, by the order of the Board of Regents, to be placed on sale at a nominal price. The calls for this book have come from all parts of the United States and Canada, and it has been adopted as a text book in some of the agricultural schools.

Professor Green has been spending the summer in Europe, and at the present time is in Germany making a thorough study of the forestry question, and he will investigate other things of interest in his line before his return. He will be at home in time to take up his work in the College and School of Agriculture with his usual enthusiasm and with fresh material to draw from.

ENTOMOLOGICAL DIVISION.

The Division of Entomology published during the year Bulletin No. 66. It is a complete work of over 250 pages, describing all the beetles found at present in Minnesota that are injurious to fruit producing plants. As our people now take more interest in growing fruit of all kinds suitable to our climatic conditions it is very important that they should be able to discover the proper remedies against the numerous insects detrimental to apples, plums, cherries, raspberries, blackberries, gooseberries, currants, cranberries, strawberries, etc. Bulletin No. 61 was issued last year. It treats of the butterflies and moths injurious to fruit producing plants. Bulletin No. 66 may be called a continuation of this book. It is equally well illustrated so that every insect found upon the above plants can be recognized without special technical training. It is intended to continue this series so that perhaps in another year every lover of fruit trees and berries will have a complete, illustrated hand book containing descriptions of all his enemies. Besides insects the various diseases will be enumerated, and the best remedies now known will be given to assist the grower of fruits to fight the hosts of insects and diseases now preying upon such plants. To make these bulletins still more useful so that they may be employed in our public schools the descriptions and illustrations of a few species not especially harmful to the plants before mentioned are also given whenever required, so as to give a classification of insects.

Many other articles have been prepared and published in those parts of the State that are in danger of losses by ruinous insects.

The extremely dry weather of spring and early summer has done much to increase the numbers of certain injurious insects. This is especially true of chinch bugs and locusts. The chinch bug has caused considerable loss in the southern and central portions of the State, as indicated by numerous letters. These insects multiplied rapidly, and being lovers of drouth and warmth they were perfectly immune against all diseases that in former years had been used with considerable effect. The entomologist has been

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unable to find a single diseased chinch bug, and therefore was not able to grow the spores causing disease, as in former years.

Migratory locusts mentioned in last year's report have not failed to put in an appearance, and they have caused more or less injury in several counties. Dr. Lugger reported the matter to His Excellency, Gov. John Lind, who at once approved of the expenditure of \$1,500 for the purpose of assisting farmers to fight the invaders. Nearly 1,000 machines, the well known hopperdozers, have been in successful operation, and the local armies of these destructive insects were broken up and made more or less harmless. Of course it is impossible to kill all the locusts by the use of machines; but as we possess another, and by far better remedy, plowing the stubble fields at the proper time, at the suggestion of the Governor and State Auditor, a poster has been issued which is to be displayed throughout the infested region. In this poster are given the remedies that are certain to check if not destroy all locusts. Many of the native species, equally well assisted by the long continued drouth, are correspondingly numerous, but by following the advice given in the poster, they can be destroyed with the migratory species. The entomologist has repeatedly urged the necessity of a law to protect good farmers against their thoughtless neighbors. In this case the fact that in the invaded regions are found thousands of neglected fields in which locusts or other destructive insects, as well as bad weeds, are permitted to breed without let or hindrance, is largely to blame for the great number of locusts. One hundred acres of stubble which invite the locust to deposit eggs can produce sufficient numbers of these ruinous insects to destroy thousands of acres of the most promising wheat fields.

Many other insects have been reported but it would require too much space to describe them here in detail, but there is one kind that should be mentioned and that is the Mediterranean Flour Moth, which is threatening our mills. If this insect is permitted to obtain a foothold in the mills the whole milling industry, so very important to the State, will be in danger. An illustrated article in regard to this

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moth has been published in the Northwestern Miller. Dr. Lugger and his assistants have had to make numerous trips to various localities in the State to investigate local outbreaks of troublesome insects, and have always received the most prompt assistance from local newspapers.

The correspondence of the Division of Entomology has become so very expensive that it is impossible to always give such full and prompt replies as would be pleasing.

The museum which contains a very valuable collection, cannot be very extensively added to until a larger place can be secured. The Entomologist is in need of a small building for an apiary and insectary, as for lack of it it is impossible to carry out many important investigations and to give instruction in bee-keeping, etc.

CHEMICAL DIVISION.

In the Chemical Division the work has been along the lines of soil and human and animal food investigations. One bulletin, No. 65 on "Soils" has been published during the year. This book gives the chemical composition of over a hundred soils and the mechanical composition of some of the soil types of the State. The bulletin also discusses the characteristic features of our Minnesota soils, the amount of available plant food which they contain and the best means by which the fertility of the soil may be conserved. The animal food investigations have consisted mainly of a study of the influence of the fertility of the soil upon the food value of the crop. The results have shown that the feeding value of corn fodder and timothy, grown on average soil can be increased to the extent of 20 per cent. by improving the fertility of the soil. In the human food work the study of farm foods and rations for workingmen has been continued; a number of human digestion experiments have been made with men employed at farm labor, with the object of determining the characteristic food value of some of our most common foods, as milk, bread, cheese, beans, butter and eggs.

A large number of miscellaneous analyses have also been made for the farmers of this State.

DAIRY DIVISION.

In the Dairy Division a bulletin has been issued covering the results in feeding experiments during the years 1894, 1895 and 1896, and including a brief summary of the work accomplished since the organization of the division.

Experiments in the cost of milk production have met with the highest commendation from the leading scientists and milk producers throughout the land and the popular phase of the work has given much valuable information to those who are engaged in dairying, while the scientific data obtained show that the returns ordinarily realized from dairy cows may be increased by nearly a hundred per cent. when scientific feeding is practiced. The importance of this work becomes apparent when it is considered that there are some 700,000 dairy cows in this State, and that they are bringing a return for butter of about \$22.50 per head, making an annual aggregate of \$15,750,000, and that if the cows were systematically fed in accordance with the needs of the animal body for milk production, there would be an additional annual net income of \$11,500,000.

A supplemental chapter was added to the bulletin giving a brief outline of principles involved in feeding for milk production with detailed instructions for feeding dairy cows, and a table showing composition and comparative feeding value of most common food stuffs. The instructions are given in such plain language that any farmer can understand them, and it is expected that great improvement will be made in stock feeding.

The data obtained from experimental work in feeding during the last three years are being compiled for publication during 1900. A new series of experiments in feeding is being planned to determine exactly the amount of protein required in rations for economic milk production. Since protein is the most expensive nutrient in our food stuff, it is a matter of great importance to ascertain the minimum amount that can be used in a ration without decreasing the annual yield of milk.

This work will have in addition experiments having for their object the determination of a minimum amount of concentrates that can be used in satisfactory milk produc-

tion. Much money is now being expended annually in purchasing mill products. It seems possible to materially decrease the amount of concentrates that are now used in rations for dairy cows by raising crops of roughage containing more protein than is contained in those ordinarily grown by the farmers of the Northwest. The work on a bulletin giving the results obtained in a series of experiments on calf rearing has been delayed but will be completed by the close of next fiscal year. The information already given out to the agricultural press and in public addresses, has accomplished much good. It has taught farmers that calves can be raised well on skim milk, thereby greatly increasing the returns for butter.

VETERINARY DIVISION.

In the Veterinary Division the work with hog cholera has been continued in connection with the Veterinary Department of the State Board of Health. This work has resulted already in a great saving to the State. Damage from hog cholera during the past year has been very much less than any year since 1896, and the losses have decreased continuously and rapidly since the work began in 1897. A careful examination shows that the situation is now the most favorable that has been known at this season of the year since the work began.

The prevalence of glanders seems to be gradually diminishing. This disease is now rather easily managed except in the western border counties and in the two large cities. The existence of glanders in these counties is probably due to the fact that a great many western horses are moved into them for sale.

The Veterinary Division is co-operating with the bacteriological laboratory of the State Board of Health in studying some of the new, or at least undescribed diseases which are seriously prevalent in this State. Work of this kind in connection with infectious cerebro spinal meningitis is well under way, and very gratifying results have already been obtained. The results will probably not be published for some time, as the data should be made positive by duplicating experiments several times. Some work has also been

done in this way with malignant catarrh. Both of these diseases cause severe losses in Minnesota each year, and it is of the utmost importance that the causes and history be worked out as soon as possible. This emphasizes the need of a new building in the Veterinary Division as it is very difficult to make experiments of this kind with our present facilities without constantly risking the infection of the other stock on the farm.

The hospital work is being continued from year to year although under serious disadvantage on account of inferior accommodations. Careful records are being kept from which valuable statistics may be gathered in the future.

The tuberculosis problem has cleared somewhat during the past year and the amount of tuberculin used has been very greatly increased. Quite a number of pure bred herds have been tested during the year. In some cases the losses have been quite severe, in others moderate.

But one outbreak of anthrax was reported in 1899, and one outbreak in the same neighborhood has recently occurred, but it did not assume serious proportions and was quite easily controlled. It is of course very important that this disease should not be permitted to obtain a foothold in this State.

Sheep scab has been reported in quite a number of places, but investigation has revealed the fact that in each instance the disease has been imported with range sheep from the west. In all cases the infected flocks were dipped and the yards and sheds were disinfected so that there is no reason to expect further spread from these places.

Nothing has been published from the Veterinary Division during the past year, Dr. Reynolds having been busily engaged in organizing and managing the Veterinary Department of the State Board of Health. This work was undertaken at the earnest solicitation of prominent stockmen from various parts of the State, and it was thought that Dr. Reynolds could probably do no more important work for the State, for a few years at least, than to organize and manage the State sanitary work among domestic animals, it being understood that the arrangement was not to be permanent. During his work the passage of a very

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satisfactory law relating to the infectious diseases of domestic animals has been secured. The State appropriation has been increased from \$3,000 to \$8,500, and a complete set of rules, blanks, circulars, placards and accepted methods have been adopted by the State Board of Health.

In justification for this arrangement the following figures may be given, which illustrate the progress made in dealing with hog cholera. It must be remembered that when the work was undertaken in 1897, 43 counties were affected, making the problem an exceedingly difficult one.

Year.	Counties Infected.	Townships Infected.	Loss.
1896.....	43.....	291.....	1,000,000
1897.....	41.....	294.....	477,500
1898.....	32.....	93.....	325,000
1899.....	32.....	75.....	252,000

As illustrating the results accomplished in dealing with glanders the following figures may be given from the State Board of Health records. These counties are selected merely because they are counties in which it is possible to make comparisons for three successive years.

Counties.	1897.	1898.	1899.
Polk.....	32.....	16.....	5
Carver.....	30.....	2.....	0
Chippewa.....	32.....	4.....	0
McLeod.....	11.....	0.....	0
Winona.....	8.....	0.....	1
Kandiyohi.....	8.....	0.....	3
Redwood.....	6.....	0.....	0
Faribault.....	7.....	2.....	1
	134	24	10

This work is now well organized and running smoothly, and it has been thought best that Dr. Reynolds should discontinue active management of the veterinary department of the State Board of Health, although he will retain a membership on the Board, thus insuring very close co-operation between the Board and the Experiment Station.

Several Bulletins have been planned one of which is already near completion. Some of this work has been in contemplation for several years, but owing to the arrangement mentioned in the preceding para-

graph it has not been possible to accomplish it. The study of new or undescribed diseases will continue in connection with the bacteriological laboratory of the State Board of Health, and it can be reasonably hoped that important results will be obtained.

A beginning has been made in the study of stable disinfection. The purpose of this study has been to determine the relative efficiency and expense of the various methods of stable disinfection when the work is done rapidly and on a large scale. It is very important we should have reliable data on this subject. Stable disinfection will probably become much more common in the future than it has been in the past. Recent developments in connection with infectious diseases of domestic animals, such as tuberculosis, scab, anthrax, infectious abortion, etc., emphasize the necessity of thorough disinfection, and it is very evident that the old way of doing this work must be revised on account of inefficiency and expense.

ANIMAL HUSBANDRY.

During the past year experiments have been conducted, first, in fencing pasture crops for sheep; second, in growing soiling foods for sheep and swine; third, in growing winter fodder for sheep; fourth, in feeding steers in stalls and in the open sheds; fifth, in feeding pigs of various breeds and grades on the bacon plan; and sixth, in changing the breeding habits of sheep.

The principal crops thus grown include winter rye, Dwarf Essex rape, sorghum, oats and barley grown together, and corn. These were grown with a view to ascertain their value in providing pasture for sheep, their relative adaptation to the same, the best modes of growing them, the succession in which they may be grown and the best ways of pasturing them.

In addition to these crops other crops were tested in a more limited way, to learn their value as food for sheep under Minnesota conditions. The more promising of these were the cow pea and the soy bean and kale. These experiments were a continuation of a series begun in 1895. They have not been reported earlier in order that sufficient

evidence could be gathered by repetition to give results that would be reliable to the farmers of the State.

The principal soiling crops included peas and oats, rape, corn and sorghum. They were grown chiefly to ascertain their suitability in providing food for sheep and swine which had not access to pastures, and also their comparative value for the purpose. Lambs were confined to their sheds and yards and fed with a view to get rid of stomach worms which infested this flock the previous year. The outcome was satisfactory. As there was practically no opportunity to furnish pasturage for the swine, it was necessary also to confine them to the paddocks and feed them thus on soiling foods.

The winter fodders grown for sheep and the principal crops raised were various kinds of grain grown in mixtures, corn of different varieties, sorghum, millet and soy beans. The chief objects in growing this grain in mixtures were to ascertain the combinations which in themselves would make the most palatable and perfect foods, and to learn more regarding the best modes of growing and harvesting them under our conditions. The corn was grown to find the varieties most suitable as food for sheep and the best methods of growing it. Variety and ways of production were also given attention in growing the other fodders named.

Fourteen two-year old grade, shorthorn steers, all by the same sire, bred by O'Brien Brothers in Wabasha County, purchased in October 1899, were divided into two lots, as nearly alike as possible, only five pounds gross weight difference. One lot was stall fed in a most comfortable barn. The others were fed in a yard having access to a shed. The food was the same kind in both instances, the lot outside requiring a greater quantity but making greater gains. The object of the experiment was to ascertain how steers would feed in a yard as compared with those tied in a stall under our conditions. This experiment attracted much attention and caused great interest with the delegations and numerous visitors. This experiment will be continued for a series of years.

The pigs were of various breeds and grades. They were grown from birth. The dams were fed on the same kinds of food as the pigs. They were grown on the bacon plan. The chief of the objects sought was the relative cost of production and a comparison of quality in the meat.

The experiment in changing the breeding habit of sheep has been progressing for several seasons. In conducting it common grade ewes, some of them of range types, were crossed with Dorset rams. The object was first, to learn the practicability of such a change under farm conditions, and about the probable time required to bring about such a change. Reports concerning all these experiments will be issued in a short time. They will be published in bulletin form and appear in the next annual report.

POULTRY DIVISION.

The interest in the work of the Poultry Division has greatly increased during the past year, and the results promise to be a benefit to the poultry men of Minnesota.

A room incubator has been built which is capable of hatching a large number of chicks; a necessity in the case of feeding experiments where it is essential to have a great many fowls of the same age hatched under precisely similar conditions.

The west wing of the poultry house has been fitted up for use as a brooder house and is capable of caring for eight hundred chicks for the first three or four weeks after hatching. A number of large out of door brooders have been built to care for them in moderate weather.

Four one-fifth acre plots have been fenced with high woven wire fencing, and in these plots a rotation series of crops have been started with a view of determining the best and cheapest green crop to grow for young chicks and for laying hens.

The pens for laying hens have been fitted with trap nests by means of which a complete record can be kept of the work done by each hen. Not only is a record kept of the number of eggs laid by each one, but the weight as well. This is done with the hope of throwing some light on the

discussion as to whether eggs ought to be sold by the pound rather than by the dozen.

It is proposed to breed future generations of laying hens from the best layers to be discovered by the use of trap nests. The keeping of a record in this manner requires a good deal of time and attention to details and is hardly possible or advisable for farmers; but it is the only way to secure reliable records of individual layers, and it is hoped that by beginning with the best stock obtainable and following this line of record keeping, and breeding only from the finest layers, a family or strain may be produced which will be valuable to distribute among the farmers of the State, as foundation stock for improvement of their stock.

It is believed that with the present equipment it will be wiser to experiment with two or three of the most promising breeds rather than to attempt to keep all or nearly all of them. A beginning has been made with Barred Plymouth Rocks and White Leghorns as representing the general purpose type and the special egg type respectively. Foundation stock of these breeds selected from five different sources has been obtained with a view of establishing a strain or family without being obliged to get new blood from outside sources.

Experiments with artificial incubation in comparison with the use of hens have been continued; also experiments in preserving eggs for winter use.

The farmers of the State are showing an increasing interest in poultry, judging from the number of inquiries received in regard to the subject. Many of the inquiries have to do with incubators and their management. It was partly with a view of helping answer such questions that the large room incubator was built.

Several hundred young chicks of common origin are being used in the experiment in artificial brooding and feeding. They are all from one hatch in the room incubator and will be fed different rations and weighed weekly to determine the value of the different foods and methods of feeding.

The division is in urgent need of more room. The present capacity should be at least doubled, and then with

the increased attention this work is now demanding good results may be expected.

FARM AT CROOKSTON.

Work at the Northwestern Experiment Farm, under the direction of Mr. Hoverstad has been very successful.

The testing of varieties of grain, grasses and forage crops has been continued. The rotation experiments begun last year are progressing. Time enough has not elapsed since these experiments were begun to make a satisfactory report.

Feeding experiments with cattle and horses were commenced this year, and the results have been both interesting and instructive.

The forestry plantation has been further developed.

The vegetable garden is progressing finely and serves to show the value of vegetable raising in the Red River Valley.

The condition of the weather has retarded the grains to a certain extent. The crop will be fairly good.

The grasses suffered more this year than any of the other crops. Clover and redbud were the only grasses sown in plots, and they have made a good growth.

To supply cattle with green forage during the dry summer months is a problem demanding attention. Forty varieties of corn were planted in the spring to test their adaptability to produce forage, and to try to develop a variety of corn for seed suitable to this country. Several fields were sown for fodder corn by different methods, and with different amounts to the acre. Later fields were sown to learn how long corn planting could be delayed and get a good crop of fodder. Oats and barley were sown to be cut for hay. Rape, sorghum, peas and millet were planted. These crops give indications of great promise.

A hotbed greenhouse, and a machine shed and cow barn have been erected this year. These are built in a cheap and practical manner, and may suggest ideas to farmers intending to build.

One bulletin has been published covering the field work and distributed during the year. Reports on the results of other lines of work are in preparation.

FARM AT GRAND RAPIDS.

At the Grand Rapids farm one of the most important branches of the work, that of investigating methods and cost of clearing land, has been seriously handicapped for three years past by lack of funds. The work of clearing and draining the muskeg swamp land has been vigorously pushed. The drainage of the swamp has been finally accomplished by cribbing the outlet ditch with tamarack poles. The moss has been stripped from a newly drained portion of the swamp with the aid of an implement devised especially for the purpose. Upon a portion cleared in 1896 numerous tests of grass, grain and other crops were made this year to determine its productive possibilities. The small muskeg broken by plowing in 1898 has been sown to oats and seeded down.

The testing of varieties of small grains has been continued and the variety of oats selected in 1899 as the best yielder has been grown for seed. A large amount will be available for distribution next spring.

Demonstration experiments on the time and amount of grain to sow have been started. Experiments have been carried on to determine the effect upon yield and quality of changing seed oats and wheat versus continuous home culture. A promising variety of dent corn is being improved by selection and many other kinds have been bred. Extensive tests have been made this year of annual forage crops, as follows: varieties of millet, sorghum and allied plants, versus corn fodder; different methods of planting and cultivating corn for fodder.

A larger acreage of fodder corn will be cut. New tests of grasses for meadows have been started.

A field of fifteen acres has been sub-divided by permanent fences and devoted to experiments in raising annual pasture crops for sheep. The crops pastured this year are winter rye, oats, fodder corn and rape. The pastures for hogs are being extended as fast as the ground can be cleared.

The problems of how best to maintain soil fertility and raise the largest crops of oats, hay, corn fodder and potatoes have been embodied in a series of twenty-four rotation crops, each of which is planted to demonstrate the effect,

whether beneficial or detrimental, of some common crop rotation which is or may be practiced in this section. Many new varieties of potatoes have been tried and a few propagated from seed. Efforts are being made to select and improve the earliest varieties of sweet corn, tomatoes, and melons, and the use of the forcing house or greenhouse hot-bed for early starting is emphasized. Strawberry culture, both variety testing and methods of growing, has received much attention. The plantation of raspberries and blackberries has been increased. Many new varieties of apples have been set out. An orchard of one hundred seedling plums was started this spring in hopes of originating varieties well adapted to this section. Several hedges of different hardy ornamental plants have been started and more will be added.

The work in forestry has taken definite form. Seventy acres of poor land on the northwestern portion of the farm have been fenced off from stock and laid out in acre plots. Ten of the most uniform of these plots have been planted with white and Norway pines taken from the nursery. Each acre is planted in a different way in an attempt to solve the problems of how far apart to plant, whether 4, 6 or 8 feet, and the effect of planting in mixtures. Jack pines and Scotch pines have been used to some extent. In all 13,120 trees were set out at a cost of transplanting of \$4.63 per thousand. The cost varied per acre from \$3.14 at eight feet apart to \$11.20 at four foot intervals.

The herd of dairy cows is still small, as the funds of the station have not been sufficient to buy barn room for them. The cows are mostly of the dual purpose type, large formed and good milkers. A red polled bull was recently purchased and the herd will be developed along the lines of both milk and beef, which it is believed will best fill the requirements of the newly settled region. Many pure bred Yorkshire swine have been sold at reasonable prices to settlers. The flock of grade ewes is being improved by use of an Oxford ram. The sheep are effectually clearing up a brush pasture of twenty-five acres, and are being used also on the pasturage experiment on annual crops and in bringing up the fertility of a sandy portion of the farm.

No additions or alterations have been made to the buildings. The farm stands in pressing need of a dairy barn. A poultry house will be erected this year.

FARM AT COTEAU.

The experiments at Lynd, Lyon County, are making good progress with Mr. W. C. Palmer in immediate charge. A bulletin covering the experiment work for the years 1896-1898 written by W. M. Hays and Wm. G. Smith, has been issued and is included in this report. In it are shown the different phases of the general study of field management. The value of much of this work has been greatly increased by the use of the electrical device invented by Prof. Whitney of the National Department of Agriculture for making daily records of the amount of moisture in plots of soil differently treated. The manner of using this device and the method of displaying the results is explained in charts. By the above mentioned device has been demonstrated in a field way the immense amount of water transpired by plants. Under the conditions of Coteau Farm sub-service soil packing is very much less practicable than has been claimed. Sub-soiling for numerous crops does not pay; often resulting in lessened yields in case of general field crops. Numerous experiments in bringing moisture into the soil and retaining it there by plowing, cultivating and mulching are recorded. In a summary, formulæ are given for rotation pastures and meadows on arable land, on rough untillable land and on peaty and wet land. Annual pastures providing succulent food for summer were found very profitable. Methods for growing such pastures are given. The exact results regarding soil moisture and yields of crops under various conditions have led to the inauguration of experiments on larger plots under rotations designed to determine how best to conserve soil moisture and how to rotate the crops so as to have each crop best prepare the land for the succeeding crops. Superintendent O. C. Gregg aided by Prof. Hays has planned a series of rotations for his field, which introduces the best results of the experiments into his general farm management, giving to the southwest portion of the State a demonstration of the experiments carried on by the station. This

farm is attracting much attention and many farmers have visited it during the last year. The results obtained enable Mr. Gregg as Superintendent of the Farmer's Institute, to give much information to the thousands of farmers of Minnesota whom he meets each year.

PUBLICATIONS.

Sixteen thousand copies of each bulletin are issued to supply our mailing list, except in cases where the subject of the bulletin is of special interest to the farmers, such as Bulletin 67, and requests come in advance, when 25,000 copies are issued. In addition to the four bulletins containing 13,687,000 pages of the results of investigations made by the station staff, Press Bulletin No. 10, "Providing Fodder and Silage Corn," was issued May 1st. On June 20th the drouth conditions were so serious that we published two more press bulletins--"Grow Fodder Corn" and "Do Not Sacrifice Your Live Stock." These bulletins were sent to all the newspapers in the State of Minnesota, and from the marked copies that were received it was evident that almost all the papers in the State, including the six dailies of the two cities, published these circulars in full, with strong editorials urging the importance of the timely advice and instruction given by the Minnesota Agricultural Experiment Station. As a result of these bulletins thousands of acres of fodder corn were planted and matured, and this supplemented the short hay crop and provided an abundance of forage for the live stock.

Bulletins are issued for gratuitous distribution to the citizens of this State who apply for them.

Respectfully submitted,

WM. M. LIGGETT, Director.