

FOURTEENTH ANNUAL REPORT

OF THE

Agricultural Experiment Station

OF THE

UNIVERSITY OF MINNESOTA.

Fiscal Year July 1, 1905, to June 30, 1906.



AUSTIN, MINN.

The Basford - Bingham Co., Printers.

1906.

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UNIVERSITY OF MINNESOTA.

| | |
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| CYRUS NORTHRUP, LL. D., Minneapolis | Ex-Officio |
| The President of the University. | |
| The HON. JAMES T. WYMAN, Minneapolis..... | 1907 |
| The President of the Board. | |
| The HON. JOHN A. JOHNSON, St. Peter | Ex-Officio |
| The Governor of the State. | |
| The HON. JOHN W. OLSEN, Albert Lea | Ex-Officio |
| The State Superintendent of Public Instruction. | |
| The HON. STEPHEN MAHONEY, B. A., Minneapolis | 1907 |
| The HON. O. C. STRICKLER, M. D., New Ulm | 1907 |
| The HON. S. G. COMSTOCK, Moorhead | 1909 |
| The HON. THOMAS WILSON, St. Paul | 1909 |
| The HON. B. F. NELSON, Minneapolis | 1909 |
| The HON. A. E. RICE, Willmar | 1909 |
| The HON. EUGENE W. RANDALL, Morris..... | 1910 |
| The HON. DANIEL R. NOYES, St. Paul..... | 1910 |

THE AGRICULTURAL COMMITTEE.

- The HON. A. E. RICE, Chairman.
- The HON. JOHN A. JOHNSON.
- The HON. B. F. NELSON.
- The HON. S. G. COMSTOCK.
- The HON. E. W. RANDALL.

STATION OFFICERS.

| | |
|----------------------|-----------|
| WM. M. LIGGETT | Director |
| J. A. VYE | Secretary |

EXPERIMENT CORPS.

| | |
|----------------------------------|------------------------------------|
| SAMUEL B. GREEN, B. S. | Horticulturist |
| HARRY SNYDER, B. S..... | Chemist |
| T. L. HAECKER | Dairy Husbandry |
| M. H. REYNOLDS, M. D., V. M..... | Veterinarian |
| ANDREW BOSS | Agriculturist and Animal Husbandry |
| FREDERICK L. WASHBURN, M. A..... | Entomologist |
| J. A. HUMMEL, B. Agr..... | Assistant Chemist |
| COATES P. BULL, B. Agr..... | Assistant in Agriculture |
| A. G. RUGGLES, M. A..... | Assistant Entomologist |
| A. J. McGUIRE, B. Agr | Superintendent, Grand Rapids |
| D. A. GAUMNITZ, B. Agr..... | Assistant in Animal Husbandry |
| A. D. WILSON, B. S. Agr..... | Assistant in Agriculture |
| E. C. PARKER, B. S. Agr..... | Assistant in Agriculture |
| WM. ROBERTSON, B. S. | Superintendent, Crookston |

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

Minneapolis, Minn., July 1, 1906.

To His Excellency, John A. Johnson,
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, 1906.

JAMES T. WYMAN,
President Board of Regents.

LIST OF BULLETINS PUBLISHED DURING THE FISCAL
YEAR, ENDING JUNE 30, 1906.

| | Pages. |
|--|---------|
| Press Bulletin No. 25, Results of Work of 1905 With the Cabbage Maggot—Suggestions to Growers of Cabbage, Cauliflower, and Radishes..... | |
| Bulletin 93—Entomological Division—Diptera of Min- nesota: Two-Winged Flies Affecting the Farm, Garden, Stock and Household | 7-164 |
| Bulletin 94—Division of Agricultural Chemistry—Soil Investigations. 1. Fertilizer Tests with Wheat and Corn. 2. The Loss of Nitrogen from Soils..... | 165-194 |
| Bulletin 95—Agricultural Division—Some Common Weeds and Their Eradication..... | 195-238 |
| Bulletin 96—Horticultural Division—Ornamental Trees, Shrubs, and Herbaceous Plants in Minnesota..... | 239-352 |

REPORT OF THE DIRECTOR OF THE EXPERIMENT STATION.

To the President of the Board of Regents:

I have the honor to transmit herewith the fourteenth annual report of the Agricultural Experiment Station of the University of Minnesota, covering the work done at the Station at St. Anthony Park; and the two sub-stations established by an act of the legislature in 1895, the one at Crookston and the other at Grand Rapids, Minnesota.

The report includes Bulletins 93 to 96, inclusive, published during the fiscal year, and a full account of the expenditure of the annual appropriation from the United States Government, as well as that received from the current expense fund of the University.

The Minnesota Agricultural Experiment Station in account with the United States Appropriation, 1905-1906.

Dr.

| | |
|--|-------------|
| To receipts from the treasurer of the United States, as per appropriation for fiscal year ending June 30, 1906, as per act of congress, approved March 2, 1887 | \$15,000.00 |
|--|-------------|

Cr.

| | | |
|---|-------------|-------------|
| By salaries | \$7,983.37 | |
| By labor | | |
| By publications | 624.33 | |
| By postage and stationery | 217.96 | |
| By freight and express | 2.00 | |
| By heat, light, water, and power | 1,332.20 | |
| By chemical supplies | 43.19 | |
| By seeds, plants, and sundry supplies | 876.09 | |
| By fertilizers | | |
| By feeding stuffs | 2,014.30 | |
| By library | | |
| By tools, implements and machinery | 407.80 | |
| By furniture and fixtures | 439.67 | |
| By scientific apparatus | 73.86 | |
| By live stock | 622.34 | |
| By traveling expenses | 178.30 | |
| By contingent expenses | 7.25 | |
| By buildings and repairs | 177.34 | |
| Balance | | |
| | \$15,000.00 | \$15,000.00 |

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FINANCIAL STATEMENT.

Statement of disbursements and receipts of the Minnesota Experiment Station for the twelve months beginning July 1st, 1905, and ending June 30, 1906, inclusive:

| | Disbursements. | Receipts. | Cash Outlay. |
|------------------------|----------------|------------|--------------|
| Station | \$16,097.92 | \$ 473.49 | \$15,624.43 |
| Agriculture | 11,308.34 | 894.27 | 10,414.07 |
| Horticulture | 4,358.55 | 1,275.66 | 3,082.89 |
| Chemistry | 2,920.09 | | 2,920.09 |
| Entomology | 1,507.39 | | 1,507.39 |
| Veterinary | 2,224.45 | 72.92 | 2,151.53 |
| Dairy | 1,200.00 | | 1,200.00 |
| Animal Husbandry | 8,004.32 | 4,715.54 | 3,288.78 |
| | <hr/> | <hr/> | <hr/> |
| | \$47,621.06 | \$7,431.88 | \$40,189.18 |
| Crookston | \$ 9,883.39 | \$1,883.39 | \$ 8,000.00 |
| Grand Rapids | 5,872.94 | 1,872.94 | 4,000.00 |
| | <hr/> | <hr/> | <hr/> |
| | \$15,756.33 | \$3,756.33 | \$12,000.00 |

DIVISION OF AGRICULTURE.

The work in the Division of Agriculture during the past year has been along the following lines:

1. Plant Breeding.
2. Testing of Varieties.
3. Crop Rotations.
4. Farm Management.
5. Farm Statistics.
6. Co-operative Corn Breeding and Testing.

In Plant Breeding, the work has been a continuation of that of former years. Winter wheat, spring wheat, oats, barley, flax, and corn have been the main crops worked with, though considerable work has also been done with grasses, millets, hemp, clovers, and other legumes which appear to be adapted to Minnesota agriculture. No radical changes have been made in the methods of work and a considerable acreage is now devoted to this line of investigation. The work is carried on in co-operation with the United States Department of Agriculture, Bureau of Plant Industry, and is yielding valuable results. One new variety of wheat, Minn. No. 188, which promises to meet the demand for an early wheat of good yielding quality, has been distributed this year to the farmers of the state. Other varieties are being developed which promise quite as much for the economic interests of agriculture, as the 169 wheat and the No. 25 flax.

In testing varieties of grain adapted to Minnesota conditions, the policy is maintained of collecting the most promising commercial varieties put on the market, and testing them in comparison with those developed through the plant breeding nursery. With very few exceptions, we are finding the best varieties coming from the nursery, though some valuable varieties are introduced through commercial sources. A new line of variety testing has been undertaken in connection with a test of Macaroni wheat. It has been commonly observed that Macaroni wheat after growing for two or three years on our heavy, moist soil, is likely to degenerate in character, and become soft and starchy. We aim to learn the reason for this,

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and to find whether varieties may not be developed which are proof against this fault. Two varieties have been furnished to farmers in different sections of the state and grown on different soils. A milling test will be made of the crop resulting, and a careful study made of the adaptability of Macaroni wheat to certain soils and localities.

The work in crop rotations has been a continuation of that started in 1894 by Prof. Hays at University Farm. The 13th year in the rotation has been completed and the results accumulated in a bulletin which is now in press. This bulletin brings out some very valuable information in regard to the benefits of rotation in maintaining the productivity of land.

A study of farm management has been made in connection with the class work in the School of Agriculture, and such fields as are available at University Farm are now kept under record for the purpose of learning the economic value of certain methods of management. This work is supplemented by a number of cooperative farm management experiments which were inaugurated in the fall of 1905 by Mr. A. D. Wilson, assistant in Agriculture, in cooperation with farmers in different sections of the state. In all, ten or twelve farms or portions of farms are being managed under his outlines, and a study made of the economic results as well as of the maintenance of soil fertility.

The statistical work carried on in cooperation with the United States government has been continued throughout the year. The results at Northfield have been entirely satisfactory as have the results on the Marshall route. At Halstad, the continuous wet weather and the inability of farmers to harvest crops in the fall of 1905 and wet weather in the spring of 1906 which prevented cropping, have seriously interfered with the acreage of crops grown. The results so far as obtained, however, are satisfactory. A bulletin has been prepared by Hon. W. M. Hays and Mr. E. C. Parker, assistant in charge of the work, which will be published in co-operation with the Government and also as a state bulletin. The matter is now in press.

In the early winter of 1906 a new line of work was undertaken in cooperation with a number of farmers in different

parts of the state. It has been a difficult problem to secure varieties of corn that were adapted to all sections of the state, and fifteen cooperative trial stations have been established under the direction of Mr. C. P. Bull, Assistant in Agriculture. These trial stations are systematically located in different sections of the state, and varieties of corn that are likely to succeed in each locality have been collected and grown this year. The variety best adapted for the locality has also been planted in a breeding plot, and an effort has been made to instruct farmers in each locality in methods of breeding and handling the corn crop, trying in this way to improve the varieties adapted to each locality.

The work, on the whole, for the year has been very encouraging, and a hearty interest has been felt in the work by those for whom it has been undertaken.

This Division has published during the year Press Bulletin No. 24, on Seed Grain and Bulletin No. 95 on Some Common weeds.

DIVISION OF ANIMAL HUSBANDRY.

The work of the year in the Division of Animal Husbandry has in the main been along the following lines:

1. Records of Cost of Production.
2. Herd and Flock Management.
3. Studies of Forage Crops.
4. Farm Management.
5. Feeding Experiments with Sheep.
6. Swine Feeding Experiments.

The studies of cost of production outlined in former years have been closely followed and improved where possible. Records are still maintained of the feed consumed and weights of cattle, sheep and hogs. These records have become valuable in deducing results from the management of the herds and flocks under different conditions.

In the herd and flock management, experiments have been inaugurated in methods of wintering brood sows, the comparisons being along the line of wintering on alfalfa, roots and other rough feeds, and in comparisons of outdoor runs and

confinement in pens and the effect of both methods of treatment on the size and vigor of herds. The effect of different kinds of roughage on breeding ewes has also been studied and attention given to the effect of confinement in small pens and barns. The plan is to develop better methods of handling the flocks and herds under farm conditions.

For a number of years the Division of Animal Husbandry has given a great deal of attention to the study of forage crops for sheep and pigs. During the past year methods of determining the value of these crops have been perfected and the matter is now in hand for a bulletin on the subject.

Some farm management work has been undertaken in co-operation with the Agricultural Division, with the view of studying the effect of live stock on land, and the value and place of live stock in the management of the farm. These experiments are to be continued through a number of years in connection with the crop rotation work already under way by the Division of Agriculture, and also in a new series of rotation experiments just laid out.

In a sheep feeding trial, comparisons have been made of the fattening qualities of western ewes, wethers and lambs. These sheep were purchased and run on the stubble and corn fields in the fall and the grains and pasturage secured carefully recorded. The sheep were then fattened on farm grown grains, and incidentally the effect of shearing on the rapidity of fattening studied. In connection with these feeding experiments, the maintenance ration of yearling wethers has also been determined, and some preliminary studies made on the effect of dips on the wool and shrinkage of wool after shearing.

In swine feeding, the experiments have been confined largely to the study of economic results in hogging off corn, and the effect of food supplied to the growing pigs on their fattening qualities during the finishing period.

DIVISION OF CHEMISTRY.

The Division of Agricultural Chemistry has published three bulletins during the year, Bulletin No. 94 on Soil Investigations, treating of the Loss of Nitrogen from Soils and Fertiliz-

er Tests with Wheat and Corn. Two of the Bulletins have been published with the Office of Experiment Stations, Bulletin No. 156, Studies on the Digestibility and Nutritive Value of Bread and Macaroni, and Farmers' Bulletin, No. 249 on Cereal Breakfast Foods, in cooperation with the Minn. Experiment Station. Professor Snyder has also written a text book entitled "Dairy Chemistry." The work in the Division of Agricultural Chemistry is confined largely to the study of problems in soil fertility and human and animal nutrition. Two bulletins have been prepared for publication during the coming winter—one on Farm Manures, and the other on Forage Crops.

A large amount of analytical work along agricultural lines has been done for the farmers of the state, and also for other divisions of the Station. There have been no changes among the laboratory assistants during the past year which has added much to the efficiency of the work.

An extended investigation is now in progress relating to the changes which take place in soils due to different systems of cropping. The special appropriation of \$1000 made by the State Legislature for soil investigation became available August 1, 1905. The work was not undertaken, however, until the following year, when experiments with fertilizers were started in a number of different parts of the State, the general plan of the work being similar to that outlined in Bulletin No. 94.

It is believed that these soil investigations will indicate the special kinds and the extent to which fertilizers can be economically used in different parts of the State.

DAIRY DIVISION.

The work in the dairy division during the past year was a continuation in the study of the relation of feed to milk production; completing the work in rearing dairy and cross-bred steers, a preliminary study of the composition of milk and the relation of feed consumed and dairy products yielded as shown by the cows employed in the Dairy Cow Demonstration at St. Louis during the Louisiana Purchase Exposition in 1904. The compilation of the dairy herd record has been continued making a complete record of the daily yield of milk and butter fat

and feed consumed by each cow in the herd during a period of fifteen years.

The herd records covering five years have been published in bulletins already issued by the station, and with the completion of the record for the present calendar year, another bulletin will be prepared covering the work done during ten years.

Bulletins are now being prepared on the work done in rearing dairy and cross-bred steers, the four winters' work in a study on the minimum amount of protein required in normal milk production, the preliminary investigation on the composition of the various grades of milk and the several nutrients and total nutriment required by each cow in the Dairy Cow Demonstration at the Louisiana Purchase Exposition in the production of the different grades of milk and a unit of milk solids. All this work has a direct bearing on the main subject under investigation: The disposition a cow makes of the nutriment provided in the feed—how much is used for the maintenance of the body, the amount used in gain of body weight, if any, and the amount required for the solids in the milk. These things must be at least approximately determined before feeding for milk production can be formulated upon a scientific basis.

During the past year there has been a great increase in the number of samples of milk and cream sent to this division for an official test for per cent of butter fat. The almost universal object is to ascertain if the milk producer is getting proper credit for the butter fat in his milk or cream. A number of creameries periodically send composite samples of the patrons' milk or cream to make sure that all members are fairly dealt with. There is also an increased demand on the part of breeders of dairy stock for official supervision of the yield of milk and butter of individual cows ranging from weekly to yearly records. This work is considered of great importance as it encourages the breeding of better dairy stock, a closer study of the feeding problem and methods of handling dairy stock for best results.

There is also a great demand for addresses at dairy meetings and creamery picnics on the general advantages in cooperative dairying, and at periodical schoolhouse and town-hall meet-

ings on best methods of feeding and caring for dairy stock. These meetings are proving highly beneficial as is shown by the steady increase in our co-operative creameries, the improvement of dairy stock, and the constantly increasing yield of milk and butter fat per cow.

DIVISION OF ENTOMOLOGY.

Prof. Washburn reports that this division has discovered several new points, hitherto unknown, in the history of the Cabbage Maggot. From this maggot have been reared several parasites, and several remedies determined to be useless here, which have found favor in Eastern states.

At present, the most practical treatment for cauliflower and cabbage on a large scale seems to be either the use of carbolic emulsion or the scraping away of the eggs from the vicinity of the plants, with the probability that the latter method is the better. We have been conducting co-operative and comparative experiments on dust and liquid spraying, and have obtained good results from both methods. Co-operative experiments on a large scale have been in progress in trapping species of *Lachnosterna* whose larvae feed upon roots of grass. The experimental garden of this division is proving of excellent assistance in the work against the Cabbage Maggot and other insects.

A large number of insects have been identified and about two thousand letters have been sent out from this office, largely in answer to inquiries regarding insects. About fifty nurseries have been inspected in accordance with the law.

The bulletin on "Two-winged Flies Affecting the Farm, Garden, Stock and Household in Minnesota" was issued by this division.

The insect collection has been enlarged and a number of experiments begun. Work has also been carried on against a scale insect which threatens horticultural interests, and a study of life histories of the Hessian Fly, the Chinch Bug, Scale insects, and various other Minnesota pests in the insectary.

HORTICULTURAL DIVISION.

The principal work of the Division of Horticulture of the Experiment Station during the past year has been with fruits and potatoes, and in the introduction of new plants. One bulletin having about 110 pages has been published, which is a report on the behavior of ornamental and timber trees, shrubs and herbaceous plants used in this state.

The work with fruits has consisted of variety testing, and work in plant breeding, a report of which was presented to the State Horticultural Society and published with their proceedings. This work has consisted of an effort to secure greater size and marketing qualities in our hardy plums, by combining our Americana sorts with the Japanese varieties. A very favorable place for doing this work was found near Lake City, where some of the Japanese varieties were growing near the Americana sorts. Considerable careful hand-crossing of these species has been done and the setting has been very satisfactory. We expect to get about 12 bushels of plums from which the pits will be saved for raising seedlings.

From the crossing of the hardiest grapes, done a year ago, we have 400 seedlings of much promise. These are the result of hand crossing between the Beta and some of the Labruska and the Labruska hybrids. Our aim is to secure grape vines of sufficient hardiness to remain on the trellis even in our severest winter weather without injury, and that will produce a reasonable amount of fruit of good quality. This work is full of promise.

The seed was saved last year from 18 barrels of Malinda apples that had been grown in the tops of Duchess trees. This seed has been planted and we hope that in it we have combined the good qualities of the Duchess with the Malinda. We have now about 5000 seedlings from this seed and have planted out about 400 Hibernial apple trees on which it is proposed to top work these seedlings as soon as scions can be obtained for the purpose.

About 5000 plum seedlings from choice kinds have also been planted out this year for fruiting.

The plant breeding work with potatoes has consisted of an effort to determine why it is that our potatoes produce so little seed. A study has been made of the plant organs, which promises some very excellent results. We are also trying to combine the good qualities of some of our hardier kinds with the wild South American potatoes, in the hope of getting varieties that are more immune from disease than any we now have.

With strawberries we have made a large number of crosses between the wild Alaskan berry, which is extremely hardy and healthy, with some of our best cultivated kinds, and also crosses between our own native and cultivated kinds, and we now have about 3000 seedlings as the result of our work this year. Crossing work of similar nature has also been done with black berries and raspberries and we believe is full of promise.

In connection with variety testing we have grown over 50 varieties of potatoes with the object of finding out those that are most immune to disease; also the most productive and adapted to the manufacture of alcohol. For this latter purpose an entirely new class of potatoes may be used, as it is not necessary to have them of the best quality. Variety tests have also been made with strawberries, apples, plums and our other hardy fruits.

Several thousand seedling plants of kinds adapted to this section have been distributed among the nurserymen and horticulturists of this section. Included among these are, *Pyrus baccata*, *Cratagens rotundifolia*, *Eleagnus angustifolia*, *Shepherdia argentea* and *Ribes alpinum*.

The work contemplated for the coming year will be largely along the lines outlined above. This we regard as the most promising field of work for this section at this time.

VETERINARY DIVISION.

Since the last report for this division the routine work of correspondence and medical care of the farm stock has continued about as during previous years.

The loss from disease and accident among the farm stock has been very light during the year covered by this report. We have tested with tuberculin 147 cattle, of which 8

reacted. Of these reactors 3 were raised upon the farm and 5 were new purchases, which makes a very favorable showing as to the condition of the farm herd.

BULLETIN RESEARCH WORK.

Ventilation. The work with stable ventilation has continued according to plan laid down in previous reports and there is now completed another year's work, which will furnish at least two and perhaps three bulletins.

The chief problems which we are attacking in this work are the following:

(a) To determine if domestic animals are actually injured or rendered unprofitable feeders by naturally vitiated stable air in the absence of disease germs; if so, where and how.

(b) Whether an animal's disease resisting power is decreased by the use of unventilated stable air.

(c) The most efficient means of accomplishing such ventilation.

(d) The least amount of ventilation compatible with normal health, comfort and profitable feeding.

Since the last report new features have been added to this work, especially in connection with laboratory work with urine of confined animals. It is well understood by physiologists that this secretion furnishes a valuable index as to the metabolic processes going on in the body tissues. If the animal is receiving harmful effect it should show in this secretion.

Experimental animals have been confined in atmospheres of varying compositions, in naturally contaminated—also in free air, and considerable amount of data has been secured on this point. Other features will be added, for instance, exposing animals to atmospheres contaminated artificially by means of the introduction of carbon dioxide gas, and to other atmospheres altered by the removal of a portion of the oxygen. The purpose in this is to see whether the addition of carbon dioxide gas or the lessening of oxygen, or a combination of these two conditions will result injuriously, in the absence of other materials which collect under conditions of natural contaminations—especially in the absence of germs of infectious diseases.

One other feature which is deemed of great importance, which has not been touched as yet, is to determine the effect of naturally vitiated stable air upon the disease resisting power of the confined animal. We should expect positive and definite results in connection with work along this line.

Tuberculosis. Work in the study of **outdoor infection** of cattle with tuberculosis is probably closed for the present, it having continued three years. In this experiment it has been the plan to allow healthy young cattle to run in the pasture with a considerable number of tuberculous cattle, and allow the healthy ones no exposure except what they may get in the open air—with the view to determining something concerning the probability of outdoor infection and whether it is safe to allow tuberculous and healthy cattle to pasture together. It is unfortunate that this work could not be carried still further. Our results so far have been quite important and will be published in bulletin form.

The work which was taken up during the latter part of the preceding year, in the study of the virulence or infectiousness of **feces of tuberculous cattle**, has been continued throughout this year. This work is being done in collaboration with the State Live Stock Sanitary Board, the station furnishing the laboratory facilities, stabling for laboratory animals, and the original plan of the experiment; the Sanitary Board furnishing bacteriologist and the laboratory animals used. It is the purpose in this work to secure positive information concerning methods in which this disease is disseminated. There is an abundance of evidence concerning the methods in which the tubercle bacilli are received into the body to be infected, and very little information concerning the methods by which the germs are given off by the diseased animals. This work has included careful laboratory work, together with field notes, and has covered work with feces, nasal secretion and some work with the urine. There has been a considerable amount of work done by others with milk so this feature is not being taken up in this connection.

Available animals at the station have been utilized and also a large herd of tuberculous cattle which are being held for breeding purposes on a farm elsewhere..

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This work is nearing completion, so far as the first section of the original plan is concerned, and will soon be ready for publication.

It is reported with pleasure that Congressman Davis has secured an appropriation of \$5000 for special work at this institution with haemorrhagic septicaemia, malignant catarrh and infectious cerebro-spinal meningitis.

NORTHWEST EXPERIMENT FARM.

Wm. Robertson, Supt. of the Northwest Experiment Farm, Crookston, Minn., reports for the year ending June 30, 1906, as follows:

The past three years have been unusually wet in the Red River Valley. The larger portion of the rain-fall in the season of 1905 came in the months of August and September, interfering much with the harvesting and completion of any results or experiments attempted with the growing of different varieties of crops. As the wet weather has continued through the spring of 1906, practically nothing has been attempted in the propagation of plants, except the setting out of a dozen different varieties of apple trees and half a dozen varieties of strawberries, with a view to determining the results of their growth under cultivation in this region. Most of the grasses which have been on trial here have been in crop so long that the yields are light, and they are badly infested with squirrel-tail. On account of the season and the condition of the fields, most of our energy has been devoted to the matter of securing suitable drainage for the farm. After a topographical survey of the farm had been taken by the National Department of Agriculture in the fall of 1905, and after a proper outlet had been decided upon, a petition was circulated for a County ditch passing the north side of the farm, which would also furnish drainage to a considerable territory north and east of the farm. In April of the present year this petition was granted, and Polk Co. ditch No. 60 was established. Along with this a project for the local drainage of the farm was started, which would give a test of the working of tile-drains in the Red River Valley in comparison with open drainage. In order that this might

be done in a skilled manner, and that the results might be more widely distributed, the Office of Experiment Stations at Washington was invited to enter into a co-operative experiment, the Department drawing up plans and specifications and the State doing the work. This invitation was accepted, and John T. Stewart, Engineer in charge of the Department's topographical survey work in the Red River Valley, was appointed to supervise the work for the department. Plans have been drawn and accepted which will include the laying of about 50,000 feet of tile and the digging of one and one-half miles of open ditch. A portion of the farm will be operated under surface drainage, for comparison of results. It is planned to lay these tiles at different distances apart and at different depths, also to establish wells at different distances from the tile to determine the effect of the tile upon the water-level. Tests will be made of the alkali content of both the water and the soil at the present time and after the drainage is installed, in order to determine the effect of the drainage upon this feature. It is proposed also to keep a record of the expense of installing this drainage system, to help others who may be considering the taking up of like work. Information is being gathered as far as possible in regard to the various machinery in use at the present time for ditching purposes, and its adaptability to the work.

The poultry department of the farm has passed through a very successful year. Considerable stock and eggs have been distributed over the state for breeding purposes. A number of experiments are in progress in the comparison of dry and wet mashers and in the fertility of eggs in heavy and light layers. The breeds kept at present are Barred Plymouth Rock and Single-Comb White Leghorn, Pekin Ducks and African Geese. About 2,000 chicks have been hatched the present season.

The pure-bred cattle kept on the farm are Galloways and Short-horns. Quite a number of sires of both breeds have been sold, and some culling has been done.

A mile of heavy black road adjoining the farm has been maintained in excellent shape by means of the King road-drag, with a view to showing the farmers what can be done with a

heavy dirt road. The results have been very encouraging.

NORTHEAST EXPERIMENT FARM WORK FOR YEAR 1905.

The field work for 1905 dealt with crop rotation, variety tests, improvement of varieties, then selection and acclimating, and soil improvement, then the use of clover and barn-yard manure. Crop rotation is conducted under two systems, a plot system and field system. In the plot system 32 tenth acre plots are used and in the field system, the different fields of the farm vary in size from 4 to 12 acres.

On the small plots various systems of rotation are conducted to determine the one most practical and best adapted to this section of the state. The field rotation is more on a demonstration order using the rotation found best on the small plots.

In the field crops were grown all the small grains including the Canada field pea to which considerable attention is being given owing to its value as a substitute for corn in hog raising.

Clover and timothy gave their usual heavy yield. Fodder corn was grown for ensilage. Corn grown for ears did not mature. Alfalfa sown the spring of 1905 made a good catch and survived the first winter. In the root crop stock carrots were principally grown, being found more reliable in producing a crop than the mangle.

In the variety tests different varieties of wheat, oats, barley, corn, potatoes, etc., were grown. These varieties were selections from a number of varieties grown on the farm for the past six years. The aim now is to improve the varieties that have been found best then selection of the best individuals of each variety.

In soil work the farm affords the different kinds of soils commonly found in northeastern Minnesota—clay, clay loam, sandy loam, and peat or muskeg soil.

An experiment was planned for peat soil, but owing to the excessive rainfall of 1905 nothing was accomplished.

The effect of barnyard manure on sandy soil was most pronounced, the yield being double in the growth of fodder corn and equally effective in the production of root crops.

This spring (1906) an experiment is being conducted with commercial fertilizer.

In live stock most attention is given to dairying and the raising of bacon hogs, this being considered the most promising branch of farming for northeastern Minnesota. As yet the dairy herd is only in its formative stage, being graded up from common stock. A Red Poll bull of the dairy type is being used. The breeding is experimental, the Red Polls not being a fixed dairy type. The purpose of this breeding is to develop dairy quality in connection with the hardiness and adaptability of the Red Polls. A Guernsey bull has recently been purchased and this breed will also be bred to replace the Red Polls in case the latter prove unsatisfactory for special dairy purposes.

A silo was built last year of 100 tons capacity. It was filled with fodder corn and fed throughout the winter, giving entire satisfaction. Attention is also given the feeding of roots to dairy cows as a substitute for grain. Thirteen cows were milked during the year. This number will be increased to twenty for the coming year. A complete record is being kept with each individual cow, of milk and butter produced and feed consumed. All the bull calves are vealed. The heifers are raised for the dairy herd.

The raising of bacon pigs in connection with dairying is most promising.

In 1905 fifteen pigs were raised from two sows. They were grown largely on clover pasture and skim milk and finished on peas and barley. They attained a live weight of 200 pounds at seven months.

In the absence of corn a first class lard hog cannot be produced, but with clover, peas, and barley and the by-products of the dairy there is no apparent reason why northeastern Minnesota cannot produce as choice bacon as any country noted for this product.

A flock of 25 high grade ewes was bought in the fall of 1904 to replace the grade Merino ewes which had been on the farm for some time.

The poultry department is being developed as much as possible from a small beginning. The Barred Plymouth Rocks and Brown Leghorns are being bred.

A new building (23x39) one and one-half story with basement has been built. The basement is for a creamery and the upper part for the farm help.

As yet only 160 acres of the 450 of the farm have been cleared and put under cultivation. It is now necessary to clear up more of the farm to provide better pasture for the increased number of stock.

The results of the work of the farm for 1905 were published in press bulletin form. These bulletins were published in over 60 local papers of this section of the state and in this way gotten before the farmers. The work was also brought before many of the farmers thru a short circuit of institute work in the fall, and thru agricultural meetings held at various times thruout the year.

REPORTS AND BULLETINS.

We have many calls from agricultural colleges and experiment stations, also from public libraries, for copies of former reports and bulletins. We have about 15,000 names on our mailing list; besides many bulletins are sent out on special request. Those who are not keeping files of our publications are urgently requested to return to us any copies they may have of our old reports and bulletins.

Four bulletins comprising 352 pages, with illustrations, have been issued during the year; also one press bulletin. These are free to all citizens of Minnesota who apply for them.

Respectfully submitted,

W. M. LIGGETT.

Director.