SIXTEENTH ANNUAL REPORT

OF THE

AGRICULTURAL EXPERIMENT STATION

UNIVERSITY OF MINNESOTA

Fiscal Year, July 1, 1907, to June 30, 1908

1908

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T. L. HAECKER.....Dairy Husbandry and Animal Nutrition
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WM. ROBERTSON, B.S.....Superintendent, Crookston
C. C. LIPP, D.V.M. .....Assistant Veterinarian
A. D. WILHOIT, M.A. .....Assistant in Soils
L. B. BASSETT .....Assistant in Agriculture
T. P. COOPER, B.S. in Agr.....Assistant in Agriculture

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

MINNEAPOLIS, MINN., July 1, 1908.

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, 1908.

JOHN LIND,

President Board of Regents.

LIST OF BULLETINS PUBLISHED DURING THE FISCAL YEAR, ENDING JUNE 30, 1908.

Pages.

REPORT OF THE DIRECTOR OF THE EXPERIMENT STATION.

To the President of the Board of Regents:

Herewith is submitted the sixteenth annual report of the Agricultural Experiment Station of the University of Minnesota, covering the work at University Farm and the two farms at Crookston and Grand Rapids, Minnesota, for the fiscal year ending June 30th, 1908.

The report includes Bulletins 102 to 109, inclusive, published during the 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 year has been one of remarkable growth and many additions to the Corps and the equipment have been necessary. A division of Vegetable Pathology and Botany has been organized and established and Prof. E. M. Freeman, formerly with the Department of Agriculture at Washington, has been placed in charge. T. L. Haecker, Professor of Dairy Husbandry, has also been made Professor of Animal Nutrition and his duties and responsibilities have been accordingly enlarged. The New Main Building, provision for which was made by the Legislature of 1905, has been completed. It provides much needed executive offices and class rooms, an assembly room, a library, and quarters for the divisions of agriculture, household art, and entomology.

Because of long continued ill health, Hon. W. M. Liggett, a regent of the University from 1888 to 1905, and dean and director of the department of agriculture since 1895, resigned July 31st, 1907, and accepted a position in the agricultural division with duties proportioned to his strength. Col. Liggett, as regent and as dean and director, showed remarkable strength, was aggressive and clear sighted, and has a well earned reputation for loyal, intelligent and effective service.

A. D. Wilson has retired from work in the agricultural division to become Superintendent of Farmers' Institutes. He has an office in the Main Building which, in large measure, centralizes agricultural work at University Farm. It is believed that this closer relationship between the Farmers' Institutes and the various lines of educational and research work centering upon University Farm will be productive of good. E. C. Parker, another efficient worker in the division of agriculture, has resigned in order to meet a call from the Chinese government for service in agriculture at Mukden, Manchuria. T. P. Cooper succeeds Mr. Parker in the work here.

The last legislature made an appropriation of $76,000 for the purchase of additional land. With this money 148 acres immediately adjoining University Farm has been purchased at a cost of $72,761.33, making possible a much needed extension of general farm work.

The Adams fund, with its yearly increment, is making more research work possible each year, is giving a new impetus to original study, and is making the Station and its Corps a more important factor in the solution of agricultural problems.

THE MINNESOTA AGRICULTURAL EXPERIMENT STATION IN ACCOUNT WITH THE UNITED STATES APPROPRIATION, 1907-1908.

Dr.

To receipts from the treasurer of the United States as per appropriation for fiscal year ending June 30, 1908, as per act of congress approved March 2, 1887		$15,000.00

Cr.

By salaries	$8,483.26	
By labor		
By publications	1,038.44	
By postage and stationery	38.00	
By freight and express		
By heat, light, water, and power	1,599.92	
By chemical supplies	1.44	
By seeds, plants, and sundry supplies	360.86	
By fertilizers		
By feeding stuffs	2,082.49	
By library		
By tools, implements, and machinery	398.96	
By furniture and fixtures	123.11	
By scientific apparatus	82.08	
By live stock	416.25	
By traveling expenses	108.29	
By contingent expenses		
By buildings and land	266.90	
By balance		
	$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, 1908, under act of congress approved March 16, 1905		$9,000.00

Cr.

By salaries	$3,595.56	
By labor	3,028.92	
By publications		
By postage and stationery	15.00	
By freight and express	11.35	
By heat, light, water, and power	128.69	
By chemical supples	11.40	
By seeds, plants, and sundry supplies	203.14	
By fertilizers		

By feeding stuffs	101.18	
By library		
By tools, implements, and machinery	411.43	
By furniture and fixtures		
By scientific apparatus	1,222.70	
By live stock	38.00	
By traveling expenses	162.72	
By contingent expenses		
By buildings and land		
By balance	69.91	
	$9,000.00	$9,000.00

FINANCIAL STATEMENT.

Statement of disbursements and receipts of the Minnesota Experiment Station for the twelve months beginning July 1st, 1907, and ending June 30, 1908, inclusive:

	Disbursements.	Receipts.	Cash Outlay.
Station	$22,707.48	$694.16	$22,013.32
Agriculture	14,221.20	1,978.34	12,242.86
Horticulture	4,744.24	744.76	3,999.48
Chemistry	1,403.12		1,403.12
Entomology	397.16		397.16
Veterinary	2,529.53	.85	2,528.68
Dairy Husbandry	142.93		142.93
Animal Husbandry	11,455.54	4,742.26	6,713.28
	$57,601.20	$8,160.37	$49,440.83
Crookston	$10,682.28	$2,682.28	$8,000.00
Grand Rapids	7,123.46	2,123.46	5,000.00
	$17,805.74	$4,805.74	$13,000.00

DIVISION OF AGRICULTURE.

Tangible results from the plant breeding nursery have been obtained during the past year. Several very promising varieties of grains developed from that source are now being increased for distribution. Minnesota No. 2 rye was given a somewhat extended trial at various points in the state during the year with very gratifying results. The average yield from the acreage grown was 27.2 bushels per acre, while the common varieties of rye grown under similar conditions averaged only 17.7 bushels per acre. The increase in yield of this selected rye is 9.5 bushels per acre. About 800 bushels of No. 2 rye was grown in the state and it is believed that every bushel will be sold for seed this fall.

Progress has been made during the year also, in increasing a hardy variety of winter wheat and sufficient stock should be on hand within the next year or two to provide for wide distribution. It is now on trial in three sections of the state.

From funds appropriated by the legislature for plant breeding work, twelve corn breeding stations have been established where varieties are being tested and an effort made to breed varieties especially adapted to the local conditions of the varying sections of the state. An experiment to determine whether or not macaroni wheat would deteriorate and become soft and starchy on our heavy, moist soils has been completed during the present year and is ready for report in bulletin form. This work has also been supported from the special appropriation for plant breeding. A bulletin on corn breeding (No. 107), has been prepared and published during the year.

The land purchased in the spring of 1907 has been surveyed and plotted for experimental work. The investigations in crop rotation on field "C" will be continued and in addition, a series of plots has been laid out on the newly acquired land for additional experiments in crop rotation and farm management. The data from the investigations on field "C" during the ten years, 1895 to 1904 inclusive, have been collected and published as part one, bulletin 109. The co-operative work in farm management carried on with farmers in the state, is also being continued as a part of the study of farm business problems.

The statistical work with the Bureau of Statistics, United States Department of Agriculture, is still carried on at the three

original statistical routes, Northfield, Marshall and Halstead. It has been supplemented somewhat by including farmers at other points in the state who are following specialized types of farming. The results of six years' statistics on cost of production have been put in bulletin form, and are now with the Bureau of Statistics for publication. Mr. T. P. Cooper, a graduate of the College of Agriculture, 1908, has been put in charge of the work.

In addition to the publication of bulletin 107 and part one, bulletin 109, the members of the force in the Agricultural Division have aided in preparing copy for a bulletin on plant breeding and one on farm management. This copy is now in the hands of W. M. Hays, Assistant Secretary of the United States Department of Agriculture, for publication as a joint bulletin.

DIVISION OF AGRICULTURAL CHEMISTRY AND SOILS.

From the division of agricultural chemistry and soils two bulletins have been issued. No. 102 gives the results of soil investigations and co-operative fertilizer tests conducted in different parts of the state. Part two of Bulletin No. 109 discusses the income and outgo of fertility when soils are subjected to different systems of rotation and cropping,—those investigations were inaugurated at University Farm in 1894, in co-operation with the agricultural division of the station, and the bulletin gives the results of the first ten years' work.

Investigations now in progress are along the lines of human nutrition and soils as outlined in former reports. An investigation has also been undertaken relative to the production of denatured alcohol under farm conditions and a small domestic still has been imported from France. As in former years a large number of chemical analyses have been made for other divisions of the station and numerous free analyses for farmers and citizens of the state.

DIVISION OF ANIMAL HUSBANDRY.

The Experiment Station herds have been maintained during the past year at the usual standard. A few choice animals have been purchased and added to the breeding herd. The increase from the herds and flocks has been used in various feeding experiments when they could be properly classified, and the surplus

stock sold either as breeding stock or to the butchers for meat. Work with forage crops for sheep and swine has been continued and extended. Ten acres of the Hendrickson land recently purchased has been fenced for permanent hog lots and paddocks in which to conduct experiments in growing forage for swine. This arrangement allows more room for the sheep in the old quarters and has given relief in a decidedly cramped division. Studies of maintenance rations for brood sows and also for ewes have constituted the major part of the feeding experiments during the winter. During the summer season and through the fall the experiments have largely been on the production and pasturing of forage crops and in experiments on hogging off corn. The results from the experiments in hogging off corn and in the field management of swine were published during the year in bulletin No. 104, for which there has been such a demand that the supply printed was inadequate.

The milking shorthorn experiment which was started a year ago in co-operation with the Bureau of Animal Industry, United States Department of Agriculture, is finally organized with a circuit superintendent in charge and with four herds now under regular record and test. These tests include the milk and butter fat yields and an approximate record of the feed consumed. The object of the experiment is to demonstrate the possibility of organizing the people of a state or community in a co-operative movement to improve a specified class of stock along lines of intrinsic value. The experiment is of national importance and is being closely followed by the United States Government and the Dominion of Canada.

DIVISION OF DAIRY HUSBANDRY AND ANIMAL NUTRITION.

In this division the investigation conducted for a series of years in the nutrient requirements in milk production was practically completed at the close of the winter's work in feeding experiments, and data covering fourteen winters' work are being compiled for publication. The deductions made from the feeding operations carried on with the dairy herds in the St. Louis dairy cow demonstration, where a complete record was kept of feed consumed by each cow and dairy products yielded, have been published in bulletin No. 106. The results obtained have proven

very valuable as they have a direct bearing upon the work carried on at this station in studying the relation between nutrients consumed by dairy cows and milk solids yielded.

The feeding experiments conducted in this division have resulted in the formulation of a scientific and practical feeding standard for milk production adapted to the needs of cows of any size and yielding any quantity and quality of milk. By the use of this standard in feeding for milk great saving can be made in cost of production and a large increase in yield secured.

It was planned to make a more comprehensive and final study of the composition of milk and this final work was inaugurated in the fall of 1907, but because of lack of equipment and help in this and in the chemical division to do the large amount of work involved, it was abandoned.

The new work in Animal Nutrition assigned to this division was inaugurated early in February by setting aside eight steer calves that were in the herd, the purchase during the month of twenty-two new born male calves, beef bred, and later the purchase of thirty male calves similarly bred and dropped the latter part of May. The investigation in animal nutrition will require some twelve years of the most painstaking and skilful work, to which the chief of the division will in the course of a year devote all his time. It will also require the services of one analyst for the current year. By the close of the fiscal year six animals had been slaughtered for analyses, all samples reduced to water free substances and samples delivered to the chemical division for analysis.

During the year the new barn for the division has been erected and the stalls and other furnishings are expected to be in place by the time stall feeding begins. The nutrition work assigned to the division will require provision for considerable more barn room, details of which will be submitted in due time.

A bulletin is now being prepared covering the experiments made from 1894 to 1908, upon the nutrient requirements in milk production.

DIVISION OF ENTOMOLOGY.

More than the usual amount of research work has been accomplished during the year, as indicated by the press and station bulletins, and circulars issued. Press Bulletin No. 28 was issued

last fall, treating of the web worm and the stalk borer; the former a caterpillar which eats the foliage of shade trees and shrubbery, and the latter a serious pest in flower and vegetable gardens. Press Bulletin No. 31 was issued later, giving recipes for various spraying compounds, classifying the pests under the heads of plants affected, and giving directions for their treatment. Crown gall on raspberries seems to be increasing in Minnesota. A circular has been issued upon that disease, indicating how best to eradicate it.

Experiment Station Bulletin No. 105, entitled "The Importance of the Study of Entomology, and How to Collect and Study Insects," was issued in February. This was sent to all schools throughout the state. In April, Experiment Station Bulletin No. 108 was issued on the so-called "Green Bug," and other grain aphids. Circulars on remedies for the cabbage maggot, which we very generally mailed to market gardeners and to the press, were issued, as well as a circular on Hydrocyanic Acid Gas treatment for the flour moth, which was mailed quite generally to millers in Minnesota.

A goodly number of insects have been named for the Minneapolis Park Board, advising certain remedies in connection therewith.

Under the provisions of the Adams law, work is being done upon the life history of and remedies for Brucophagus funebris, which affects the clover crop. Work is also being done with Macrosiphum granaria, affecting wheat; and with the leaf hopper, Emposca mali. In the insectary a large number of experiments are being carried on to determine as many points as possible in the Binomics of insects. The maple tree borer, the locust borer, the ash tree borer, the stalk borer, referred to above, and the bee moth, as well as various lice affecting grain, may be mentioned in this connection.

Communications have been mailed to the press from time to time. One of these gave remedies for black flies when affecting stock, these having been especially troublesome this summer; another showed how to deal with ants in the house and garden; and a third gave particulars regarding the Oak Tree Pruner, which sometimes attacks apple as well as other trees.

Experiments on the maggot, known as Pegomyia brassicæ, which attacks the roots of cabbages and growing radishes and

turnips, have been continued this season, as well as observations on the so-called "Green bug." A very thorough experiment on the use of Arsenate of Lead against the Plum Curculio has been carried on as well as experiments showing the comparative merits of liquid and dust spray. Assistance has been given to citizens in various parts of the state in destroying grasshoppers, tree borers, and other pests as occasion has demanded.

DIVISION OF HORTICULTURE AND FORESTRY.

The work in the Division of Horticulture and Forestry has been along a variety of lines during the past year, and much the same as in preceding years. The establishment of the fruit breeding farm at Zumbro Heights gives us a much needed opportunity for testing out our seedlings. This marks a great advance in our plant breeding work, and is destined to produce important results. There are about 78 acres of land in this farm, and we have erected there during the past season one dwelling house (24x24), with greenhouse (20x50) attached, one concrete storage cellar (20x50), one hip roof barn (30x40) with lean-to for carriages, and one 6-inch well, 250 feet deep. It is proposed to underdrain a few spots that seem too wet for profitable horticulture. This work is now going on.

Mr. A. R. Kohler has carried on an interesting line of investigations with potatoes, including tests of varieties and a comparison of seed potatoes of our own raising with those from other sections, and in co-operation with Prof. Freeman has made a study of the potato diseases and the best way of combating them. He has also raised about 8,000 seedling potatoes.

Experiment work in forestry is not what it should be, owing to a lack of funds, and with the present means available, experiment work cannot be undertaken in a manner commensurate with the importance of the forest wealth of this state. However, in Itasca Park experiments are being carried on in studying the best method of making firebreaks and of accurately measuring standing timber. Experiments have also been made to determine the best way of sowing pine seeds, and some interesting results obtained.

The experiment work, heretofore in charge of Assistant Prof. S. B. Detwiler, will now be carried on under the direction of J. P. Wentling, Prof. Detwiler having resigned to accept a position as forester with a Minnesota lumber concern.

Experiments will be undertaken in the treatment of the quickly perishable woods with creosote, for the purpose of showing the value of open tank treatment for fence posts. This is destined to lead to very important results.

DIVISION OF VEGETABLE PATHOLOGY AND BOTANY.

This division began formal work in January, 1908. The work of organization and equipment of laboratories has naturally occupied considerable time. Work on the diseases of economic plants has been planned and field work is being carried on.

A survey of the plant diseases of Minnesota has been undertaken. This important field, which necessarily underlies the future work of the division, is receiving careful attention. It is planned to thoroughly canvass the diseases of all economic plants in the state and to collect specimens for illustration and reference. This work will give a basis for the future work in the division. Identification of many plants and plant diseases has been made for farmers throughout the state.

The work in rust and smut of wheat and other grains, begun by the head of the division while in charge of this work for the United States Department of Agriculture, has been continued at this station, with the co-operation of the Federal Department. Vital points in the life history of the rusts, chiefly of wheat and oats, are under investigation and some promising work in rust-resistance of wheat has been begun.

The smuts of cereals, especially the loose smut of barley and wheat, which are becoming serious pests in this state, have been thoroughly investigated and practical treatments devised. Varietal resistance of cereals to smut has likewise been tested.

Work has also been commenced along the following lines: the cause and prevention of blight of oats; the prevention of damping-off of coniferous seedlings by various treatments; the cause and prevention of potato rots; collection of seed and plant samples of weeds of the state for demonstration work, to enable the farmer to recognize noxious weeds; plans for work in eradication of weeds; the development of biological features of research in timber rotting to assist in the investigation of preservation and treatment of wood.

An isolated field for disease work of field and garden plants has been planned for immediate use.

XVI

VETERINARY DIVISION.

HOG CHOLERA.

Twenty-four shoats have been used in a vaccine experiment. Sixteen were taken to horse stalls at the Fair Grounds adjoining the University Farm. Eight were left at the Experiment Station. It was the purpose to send these eight out to farm outbreaks in pairs, one vaccinated and one check. Favorable conditions did not develop and but one pair was sent out. Neither of this pair died nor was seriously sick so that this portion of the experiment gave no information.

FAIR GROUNDS EXPERIMENT.

Of the sixteen taken to the Fair Grounds, eight were given the "simultaneous" vaccination November 23, 1907, and confined in Stall 14, with three checks. The purpose of this was to get information concerning the probability of spreading the infection by this method of vaccination. The eight vaccinated pigs were closely observed and apparently received the vaccination without any unfavorable effect. The unvaccinated checks associated with them showed no evidence of hog cholera at any time, so that so far as this experiment is concerned, there is some evidence to indicate that the disease is not liable to be spread by vaccination.

In Stall 10, there were placed three pigs inoculated November 23, 1907, with the virulent blood used in vacinating those in Stall 14, and two checks. The three inoculated pigs in Stall 10 soon developed hog cholera and died as did later the two checks placed with them, indicating a high degree of virulence for the blood used in vaccination and against which the serum protected the eight vaccinated shoats.

UNIVERSITY FARM OUTBREAK. EXPERIMENTAL WORK, FEBRUARY 1 TO MARCH 20, 1908.

A severe outbreak developed among the hogs on the University Farm, fortunately under conditions where it was quite evident that there was no connection between this outbreak and the experimental work. On February 1st, a lot of sick University Farm hogs were divided into three pens, the pens presumably being thoroughly infected. Into each one of these pens there was placed one "simultaneous" vaccine shoat, one "serum only" shoat, and one check. After exposure for several weeks, the vaccinated pigs

were all alive and thrifty, never having been sick. Two of the checks died. In this outbreak, twenty farm hogs died.

CARLING FARM EXPERIMENT. EXPERIMENTAL WORK, APRIL 3 TO JUNE 15, 1908.

During the latter part of March there developed a severe outbreak of cholera on a farm within two miles of the University Farm. This farm had originally forty-two hogs and lost thirty-nine during the outbreak. Five had died prior to April 1st. Careful autopsies showed undoubted hog cholera. Lot "A" refers to eighteen shoats, several of which were evidently sick, selected for this portion of the experiment and placed by themselves in the horse barn. Lot "B" refers to sick hogs running in a large yard where a number of hogs had died, having a good shed and shelter in which there had been much sickness. Lot "A" was divided into two groups, each group containing an equal number of sick and well hogs. One group was vaccinated with "serum only" and the other group left untreated. The shoats were properly ear-marked and then put together in the horse barn already mentioned, ten vaccinated, eight checks. On April 2nd, two "serum only" and two "simultaneous" vaccine experimental shoats were placed with these. Of the eight unvaccinated Carling shoats in lot "A" seven died. Of the ten vaccinated Carling shoats in lot "A" nine died. The three previously vaccinated University Farm experimental shoats continued in perfect health to the end of the experiment. Of the vaccinated hogs that died there were two that showed purulent pneumonia without plain lesions of hog cholera. Of the unvaccinated hogs that died, there were three that showed purulent pneumonia without plain lesions of hog cholera. The University Farm "serum only" experimental shoats, sent over to the Carling outbreak, were vaccinated on February 1st, 1908. The "simultaneous" shoats were vaccinated November 23rd, 1907. During the work with lot "A," one hog died and was eaten by the others. This was, of course, unintentional on the part of those conducting the experiment. What effect this may have had in increasing the loss among the "serum only" vaccinated Carling hogs may only be a conjecture. Certainly it did not harm the vaccinated experimental hogs.

Lot "B" was composed of seven sick Carling hogs having access to a good shed and running in a large field. Into this lot two "serum only" and one "simultaneous" University Farm experi-

mental shoats were placed. The Carling hogs in this lot all died. The total deaths of Carling hogs in this lot, including those alive at the beginning of the experiment and those previously dead, were sixteen. The three experimental pigs were unharmed, growing rapidly and apparently doing unusually well. The seven experimental hogs were returned on June 15th, 1908, from the Carling farm to the University Farm and have since remained in perfect health. They are to be used for hyperimmunizing in the production of serum. Pens and equipment in general are ready and the production of the Dorset-Niles serum is being carried on in a small way for Minnesota. Experience with this vaccine has been exceedingly satisfactory so far as the vaccination of well hogs is concerned. It has been used in only one lot of hogs already infected, some of which were sick, where the results were unsatisfactory. (Carling Lot "A"). This would hardly seem to operate to the serious discredit of the vaccine. Because of lack of funds, the vaccine can be produced on a small scale only. To the extent of the supply, it is the plan to furnish vaccine this season free of expense making the practical use of it through field veterinarians of the Live Stock Sanitary Board.

VENTILATION.

Manuscript for two bulletins for technical series and for annual reports, has been completed. The first of these, Ventilation Bulletin No. 2, presents a full statement of the actual work and results upon which a preliminary bulletin, No. 98, was based. It includes a great amount of very careful work with blood, urine, air, with blood of the confined animals and the air of the ventilation stalls. It also includes a careful study of pulse, temperature, respiration, stall moisture, and the various other data which give information concerning the actual stall conditions and effect upon the confined animal. The second of these two manuscripts, or Ventilation Bulletin No. 3, covers similar work for a different set of experimental animals. A number of additional features were taken up for study so that there is in Ventilation Bulletin No. 3, a duplication of work previously done for Numbers 1 and 2 to check with results obtained in the earlier work. This work with a second set of animals was more thoroughly done and with a number of additional features and confirms fully the suggestions and statements made in Bulletin 98.

Plans for this summer, especially with blood and urine and milk flow, has been interrupted by very hot weather and unexpected high stall temperatures. We have substituted another line of work with light and dark stalls, studying the physical changes in the animal when confined in light and dark stalls, both being well ventilated. The essential purpose of all this ventilation work is to ascertain definitely whether domestic animals are actually injured by lack of ventilation or light in the absence of infectious disease, and if so, how and where. The next item for determination is the least amount of ventilation actually necessary for health and comfort and profitable feeding or milking. The entire work thus far has been in studying effects upon the confined animals. It seems quite evident that some of these things should be known before we attempt to study plans for stable ventilation. Things have already been clearly demonstrated in the course of this work which upset previous teachings concerning stable ventilation.

SWAMP FEVER.

This work has been continued during the past year as hitherto under financial support from the United States Government. This work is under a co-operation agreement between the Federal Bureau of Animal Industry, Experiment Station, and Live Stock Sanitary Board. During the past year, there were only four stalls that could be safely used for work with a serious infectious disease. These stalls have been constantly full, with a number of horses waiting to take the place of those which die of the disease in the course of the work. In connection with the Sanitary Board, an additional seven-stall and feed room building is being constructed which will give eleven stalls in which thirteen to fifteen horses can be used simultaneously. The chief problems studied this year have been the specific cause of the disease. The disease has been reproduced repeatedly by blood inoculation, passing the disease in this way through several animals in succession. In this way it has been clearly demonstrated that the cause of the disease is a living virus or infection and not a mere poison. It has also been demonstrated that certain intestinal parasites of horses which have been supposed to be the cause of the disease can play but a minor part at the most. Another feature of the work done has been in connection with susceptibility. An effort has been made to determine what animals are susceptible to the disease and therefore capable of spreading it; also to find some

laboratory animal susceptible to the disease which could be cheaply used in place of horses for a portion of the work. In this feature we have not been successful as all the common laboratory animals appear to resist this disease. Some evidence has accumulated to the effect that mules are less susceptible than horses. If proven true, this will be important information for certain portions of the state.

Common Methods of Spread: As soon as the new stalls are completed, it is hoped to accumulate information rapidly concerning the ways in which this disease spreads from animal to animal and from farm to farm whether in feed, water, or air-borne. Careful clinical records have been kept of all cases developed during the year and thus valuable information concerning the history and development of this disease is being secured. Efforts are being made to determine the cause of the disease; its methods of spread; susceptibility of different animals; methods of body infection; and finally a preventative serum or vaccine.

TUBERCULOSIS DISSEMINATION.

Studying methods of dissemination for this disease has been a continuation of the work published in Bulletin 103, "Dissemination of Tuberculosis by the Manure of Infected Cattle." By special arrangements with the Inspector in charge and a Sanitary Board veterinarian at South St. Paul, it is possible to collect material for this work, easily, cheaply, and from very large numbers of cattle. We have been using tuberculous cattle sent to South St. Paul for slaughter in the course of the State Live Stock Sanitary Board work. Information is received in advance when tuberculous cattle are coming in for slaughter. A local inspector of the Sanitary Board at South St. Paul secures the necessary material for this division without expense. This is a very marked improvement over the plan by which the work was done for Bulletin No. 103. It gives information for a very large number of cattle at a minimum expense. The seriousness of this question of scattering tuberculosis in the manure of tubercular cattle seems to justify continuing this work until full information is secured. Tuberculosis is scattered by the very easy and common infection of cow's milk with particles of dried manure and the possible infection of the people who consume this milk and by dried manure which may easily become pulverized and float in the air to be inhaled by susceptible cattle and possibly by stable attendants.

The first set of experimental demonstration work with the von Behring anti-tuberculosis vaccine has been practically completed. Calves that were vaccinated a year or so ago together with check calves (young cattle not vaccinated but exposed to similar opportunity for infection) have been tested and the material may be quickly put in form whenever there is opportunity for publication. While results have not made as good a showing for the vaccine as students of the tuberculosis problem might hope, the results are nevertheless of direct and important practical interest for the cattle owner. The work done in the first series of this experiment was purposely conducted under conditions and in about the way in which an average stockman would be compelled to do it. In justice to the vaccine it should be stated that the von Behring rules were not all obeyed, it being the purpose to secure information concerning the efficiency of this vaccine where used under ordinary farm conditions. Some of the calves in this preliminary experiment which reacted under tuberculin are being held over for another year in order to see whether they will react again at the end of the year. Then in view of their tuberculin tests, history and post mortem examinations, it is expected to determine whether the reactions were due to (1) bovine tuberculosis infection in spite of the vaccine, or (2) whether possibly to vaccine infection, or (3) whether original in the calf before vaccination.

INFECTIOUS ABORTION.

Some experimental and very practical work has been done with infectious abortion in the dairy herd. Among other points which have been demonstrated in this work it has been shown that cattle are able to take very large doses of carbolic acid—many times larger doses than was previously supposed possible. In a general way the endeavor in this work has been to free the University Dairy Herd entirely from the infection before the cattle were moved to the new barn. A very large amount of disinfection work was done with both the male and female cattle in addition to internal administration of carbolic acid in large doses. Careful records have been kept. During the present season there have been very few abortions and there is some uncertainty as to whether these were of infectious type.

NORTHEAST EXPERIMENT FARM.

Eighty acres of the one hundred twenty-six acres under cultivation are given to a practical demonstration of a system of farming considered best for this section of the state.

The crops grown are as follows: Oats, 20 acres; clover and timothy hay, 20 acres; fodder corn, 14 acres; barley, 6 acres; wheat, 4 acres; potatoes, 4 acres; peas, 2 acres; stock roots, 2 acres; tame grass for night pasture, 6 acres.

With these crops, six series of rotation are carried on:

1. Wheat, clover and timothy, fodder corn, potatoes. Ground manured lightly for fodder corn and the following year for potatoes, 4-year rotation, four fields;

2. Oats, barley, clover and timothy, fodder corn. 4-year rotation, four fields;

3. Oats two years, clover and timothy two years. 4-year rotation, two fields;

4. Fodder corn, oats, clover and timothy pasture two years. 4-year rotation, two fields;

5. Fodder corn, oats, clover and timothy hay. 3-year rotation, three fields. Ground manured for fodder corn;

6. Stock roots, barley, clover, peas. 4-year rotation, four fields.

With the exception of potatoes, all the crops grown are fed on the farm and the products sold in the form of butter, meat and eggs.

Twenty-two cows were milked during the past year. Their butter production is not yet computed to date, but will average better than two hundred and fifty pounds per cow. Of the twenty-two cows only six are pure bred (Guernseys, bought September, 1907). Common grade cows of the dairy type have been kept to show what profit can be made in dairying with such cows as the farmer has in his possession. A pure bred Guernsey bull is being used for building up the future herd.

In hogs, the large improved Yorkshires are being raised. They are grown mostly on skim milk and clover pasture and those not sold for breeding stock, fattened on barley and peas. The bacon hog is recommended for this section of the state to be raised in connection with dairying. Dairying and bacon hog raising are

recommended as the principal branches of agriculture for Northeastern Minnesota.

In our winter dairying, the cows are fed on clover and timothy hay, fodder corn, fodder corn ensilage, stock roots, bran, and shorts. The butter is made on the farm and sold on the local market. The price for the past year averaged 28 cents per pound.

During the year, the dairy barn was enlarged and remodeled and a root cellar of 3,000 bushels capacity built in connection with it. The barn is now 110 feet long by 32 feet wide and will accommodate forty head of dairy cows and a corresponding number of young stock.

A new hog barn 20x42, a granary 24x26, and a concrete well house were built.

The yield of the crops grown under field conditions is as follows: Oats, 35.5 bushels per acre; wheat, 17 bushels; barley, 22.7 bushels; peas, 8 bushels (badly drowned out); clover and timothy hay, 3 tons, single cutting; fodder corn, green, 11.5 tons; field cured, 6 tons; stock roots, 10 tons; potatoes, 184 bushels. The fore part of the growing season was very wet.

Varieties grown: oats, Improved Ligowa; wheat, Minnesota No. 169; barley, Mandschuria; peas, Canada field; roots, Mastodon stock carrot; potatoes, Carmen No. 1; hay, medium red clover and timothy, alsike clover on low land.

Different varieties of the various grains, etc., were grown on small test plots, but none have proved better adapted to the country than the varieties grown on the fields, which are the result of several years of selection.

Various experiments in different methods of tillage and rotation were conducted on small plots—thirty-two tenth-acre plots being used for this purpose. The results obtained on the small plots, which have been in operation for a number of years, confirm the system of cropping on the large fields that is being made demonstrative of the right system of farming for this section of the state.

The growing of vegetables and small fruits has been done with the usual success. Apples thus far have not proved a success, winter-killing badly. The strawberry, raspberry and currant have proved most profitable.

The open winter made easy the gathering up of considerable down wood. About four hundred cords of wood were removed,

aiding greatly in clearing the land for pasture. Twenty thousand feet of logs were also gotten out and sawed into rough lumber.

The uncleared part of the farm that is not being kept for growing timber, is being cleared up as fast as the means will permit.

The results of the farm work are published in press bulletin form and copied in nearly one hundred papers in this northeastern section of the state. In this way, the farmers become acquainted with the work of the farm and the results obtained.

During the months of November and December, the Superintendent conducts meetings in the northeastern section of the state under the supervision of the Farmers' Institute, and in this way the work is brought still further before the farmers. At any time during the year, when the farmers are in need of a meeting for the purpose of an organization, the Superintendent personally assists them. Numerous organizations have been formed with a view of securing better and more uniform seed, better breeding stock, and for the development of the dairy industry through the co-operative creamery. The agricultural outlook for this section of Minnesota is encouraging.

NORTHWEST EXPERIMENT FARM.

The chief work of the Northwest Experiment Farm the past year has been the installation of an experimental drainage system, the full account of which is given in Bulletin No. 110, soon to be issued. The season of 1908 has been one of the driest on record so that the ditches and tile were in operation for only a few weeks in the spring. The working of the system will be reported later.

About fifty acres of timothy and clover are seeded each year. Both do well here and there is no reason why farmers should hesitate to sow them more extensively.

Of the five varieties of wheat—two macaronies and University 169 (a blue stem), 188, and 163—169 yielded much the best.

A small patch of alfalfa planted several years ago continues to thrive well, no winter-killing being noticeable. Five varieties were seeded this year for trial all of which have made a promising catch.

Three varieties of Canadian field peas are being tested the present season. It is too early to report results.

In stock at the Northwest Experiment Farm, no attempt is made to keep a representation of a large number of breeds. The

present policy is rather to represent types, and to do this by breeds seemingly best adapted to the locality. So in poultry the farm keeps only Barred Rocks and Single Comb White Leghorns; in swine, Yorkshires and Duroc Jerseys; in cattle, the Shorthorns and Holsteins; and in sheep, the Shropshire grades. A few Galloway cattle are still on hand, but will be closed out the coming winter.

The poultry plant continues to thrive. About 2,000 chicks were hatched out the present season. The gross receipts from the plant the past fiscal year, aside from that used at the farm house, amounted to about $1,000. Returns from the cattle amounted to about $1,350.

The flock of sheep is as yet rather small, numbering slightly over fifty. The clip for the season of 1908 averaged 9.6 lbs. per individual. The plan is to increase the flock gradually to about 150. Sheep seem to be well adapted to the region of the Red River Valley, and require little attention except at lambing time.

BULLETINS PUBLISHED.

The station has published during the year four press bulletins and eight general bulletins, a list of which is given on another page. The call from farmers for these publications is increasing yearly so that it has become necessary to enlarge the edition. In accordance with law bulletins are sent only to those interested in agriculture and who make application for them. The mailing list is constantly revised and is a means for distributing information resulting from the research work of the station.

Respectfully submitted,

E. W. RANDALL,
Director.