ELEVENTH ANNUAL REPORT

OF THE

AGRICULTURAL EXPERIMENT STATION

OF THE

UNIVERSITY OF MINNESOTA.

Fiscal Year July 1, 1902, to June 30, 1903.

ST. PAUL, MINN.:
THE PIONEER PRESS COMPANY,
1904.

UNIVERSITY OF MINNESOTA.

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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, 1903.

To His Excellency, Samuel R. Van Sant, 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, 1903.

GREENLEAF CLARK,
President Board of Regents.

List of bulletins published during the fiscal year ending June 30, 1903.

REPORT OF THE DIRECTOR OF THE EXPERIMENT STATION.

To the President of the Board of Regents:

I have the honor to transmit herewith the eleventh annual report of the Agricultural Experiment Station of the University of Minnesota, in accordance with the act of congress of March 2, 1887, establishing the station, giving somewhat in detail the work accomplished here, and at the farm of O. C. Gregg, superintendent of the Farmers' Institute of Minnesota, near Lynd, Lyon county; also of the stations established by an act of the legislature in 1895—one located near Crookston and one near Grand Rapids. This report includes bulletins 77, 78, 79, 80, 81 and 82, published during the government fiscal year, July 1, 1902, to June 30, 1903, inclusive; and a full account of the disposition of the annual appropriation from the U. S. government, as well as of the amount received from the current expense fund of the University.

In carrying on the experiment work the Hatch fund of $15,000, received from the United States government, has been supplemented by $33,882.06 from the current fund of the University. Following this report is a financial statement of the Northeast and Northwest farms that are maintained by special appropriations made by the legislature.

The Minnesota Agricultural Experiment Station,
In account with
The United States Appropriation, 1902-1903.

DR.

To receipts from the treasurer of the United States, as per appropriation for fiscal year ending June 30, 1903, as per act of congress, approved March 2, 1887	$15,000.00

CR.

By Salaries	$10,507.38	
Labor	2,129.00	
Publications	607.70	
Postage and stationery	95.21	
Freight and express	.....	
Heat, light, water and power	48.53	
Chemical supplies	.....	
Seeds, plants and sundry supplies	236.38	
Fertilizers	.....	
Feeding stuffs	1,129.55	
Library	.....	
Tools, implements and machinery	60.25	
Furniture and fixtures	.....	
Scientific apparatus	.....	
Live stock	186.00	
Traveling expenses	.....	
Contingent expenses	.....	
Buildings and repairs	.....	
Balance	$15,000.00	$15,000.00

FINANCIAL STATEMENT.

Statement of disbursements and receipts of the Minnesota Experiment Station for the twelve months beginning July 1, 1902, and ending June 30, 1903, inclusive.

	Disbursements.	Receipts.	Cash Outlay.
Station	$15,374.88	$666.65	$14,708.23
Agriculture	14,348.00	1,729.34	12,618.66
Horticulture	3,787.07	1,102.90	2,684.17
Chemistry	3,059.81	5.70	3,054.11
Entomology	1,270.38	.....	1,270.38
Veterinary	2,070.00	279.29	1,790.71
Dairy	1,200.00	.....	1,200.00
Animal Husbandry	16,522.33	5,488.94	11,033.39
Coteau	522.41	.....	522.41
	$58,154.88	$9,272.82	$48,882.06
Crookston	7,499.88	2,485.67	5,014.21
Grand Rapids	5,521.03	1,398.16	4,122.87
	$13,020.91	$3,883.83	$9,137.08

DIVISION OF AGRICULTURE.

In 1903 the weather conditions were not so favorable as usual for field and crop experiments. Storms during and after harvest made it very difficult to properly save part of the grain and forage crops under experiment. Chinch-bugs very seriously interfered with the breeding nursery, and with field variety tests of spring wheats, also with the wheat experiments on the general theory of breeding. The cold, wet season and the early frosts resulted in loss in some of the experiments with corn, but in some ways assisted in the selection of corn suited to our northern conditions. On the whole, the work with breeding, farm management, statistical investigations and devising new methods of teaching farm management, and of coöperative breeding is progressing most satisfactorily.

Experiments on the introduction of agriculture into the rural schools are also progressing in a promising manner. Bulletins on seed wheat, alfalfa, corn, bromus and farm management are being prepared for publication. Under the coöperative arrangement with the United States Department of Agriculture, results have accumulated which justify the preparation of a bulletin on statistical methods in plant breeding, and another on statistical investigations in farm management, for publication by the national department.

The experiments in breeding all the leading field crops of Minnesota, and the investigations in methods of breeding plants are progressing most satisfactorily. Some of the methods and machinery devised for breeding these crops are being adopted by other stations and by the U. S. Department of Agriculture, thus giving evidence of the value of this work. The varieties of corn, spring and winter wheat, flax seed, also fiber, peas, oats, alfalfa, barley, millet and other crops which are being originated by selection and by hybridizing, followed by selection, are giving abundant evidence that this work is already adding annually thousands of dollars to the crops of the state, and will soon be adding millions. The development of breeding upon a basis comparable with modern manufacturing is an achievement which the station can properly claim as a result of its investigations along this line. The knowledge of how to breed plants is being rapidly acquired. Investigations long since begun in the study of animal breeding promise as important results along that line as are being reached in plant breeding. Coöperation in breeding plants has been begun with farmers throughout the state, as well as with experiment stations of the surrounding states and the U. S. Department of Agriculture. There is in the hands of Minnesota farmers sufficient seed of Minnesota No. 169 wheat and of Minnesota No. 163 wheat to sow thousands of acres in 1904. Since these wheats add two or three bushels per acre to the yields produced by the old varieties they are already contributing large sums to the value of the annual wheat crop. Minnesota No. 13 corn and some of the varieties of oats and barley, which have been tested for years and distributed by the station, are also widely used throughout the

state, and the total increased annual product already approaches a million dollars in value. Numerous former students of this department and other farmers are beginning to coöperate in the breeding of corn. The investments intelligently made in breeding certainly pay to the state a very large dividend, and lands and other equipment needed to enlarge this work should be supplied. The U. S. Department of Agriculture is encouraging the state to enlarge its breeding operations by meeting any increase on the station's part with further assistance from the appropriations made by the national congress.

The coöperative statistical invesigations begun in 1902 by this division and the Bureau of Statistics of the United States Department of Agriculture in Rice, Lyon and Norman counties have progressed most satisfactorily. From simply collecting data on the cost of growing field crops, the work has developed and now includes collecting all available facts concerning the production, marketing and sale of products, the expenses of the family, and the general profits of the entire farm enterprise. To enable the route men to broaden the scope of the data secured, the number of farms on each route has been reduced from fifteen to eight. The United States Department of Agriculture shows its appreciation of this work by paying its share of the expenses, including a small fee to each farmer and to each farmer's wife for their assistance in weighing food stuffs, produce used in the household, etc. These investigations are a part of a general attempt begun by this institution ten years ago, to develop the facts necessary to use in effectively teaching farm management in schools for farmers.

The first ten years of the experiments dealing with the rotation of crops has now been about completed and the results are being compiled for publication.

Experiments at Coteau Farm, in Lyon County, Southwestern Minnesota, during the ten years, 1894 to 1903 inclusive, developed the fact that experiments are needed to work out systems of crop rotation and farm management suited to the drier areas of our country. In dry years in Minnesota, securing the entrance of water into the soil and its conservation for use by crops, are of far greater importance than the

question of fertility. Since the problems of dry land agriculture can be better worked out in states more uniformly drouthy, these investigations have been closed with the tenth year.

Since the publication of the last report, Rural School Agriculture Bulletin No. 1, a bound book of 200 pages, containing exercises relating to agriculture and home economics has been published, and a copy presented through the county superintendents to every rural school in the state. This bulletin has been received with high commendations by educators everywhere, and there has been some demand for them by teachers outside the state.

The last legislature appropriated $5,000, which became available August 1st, 1903, for the construction of a building to house the machinery of the experiment station.

DIVISION OF HORTICULTURE.

The work of the Division of Horticulture during the past year has proceeded in much the same lines as for several years previous.

Mr. R. S. Mackintosh, who had been an assistant in this department for seven years, resigned to take the position of Professor of Horticulture in the Alabama Polytechnic Institute, and his place was filled by the appointment of Le Roy Cady.

One bulletin, No. 83, entitled "Apples and Apple Growing in Minnesota," has been published by this division, during the past year. This comprises eighty pages, describes sixty-seven varieties, and contains forty-nine full page illustrations of apples.

The grounds about the new chemical laboratory have been graded, and a new road leading to it laid out.

The crop of apples was unusually large the past year, and about three hundred bushels were harvested. Much interest is now being taken in our seedling apple orchard, which was planted twelve years ago. One hundred twenty-five of these trees fruited this year, and some of them are of much promise.

Work of special interest with seedling wild fruits has been continued.

The raising of hardier apple seedlings has been carried on and about twelve thousand have been grown this year.

The forest garden, which has been planted fourteen years, is full of interesting object lessons to teachers and students of this subject. It is one of the few forest gardens in this country.

The care of the campus has been unusually heavy this year, which has required much attention, owing to the rank growth of grass and the roads being badly washed during the heavy rains. An appropriation should be made for the purpose of paving the gutters and putting our roads in better shape.

The crop of potatoes was considerably lessened by rot, which was especially bad this season.

The sample hedges which were started several years ago make a fine appearance, affording a very interesting object lesson. They will be maintained from now on with very little expense. Our orchards are in good condition and the outlook is very promising for the successful growing of apples in this section, which was thought incredible but a few years ago.

CHEMICAL DIVISION.

Bulletin No. 80 has been issued during the last year by the Division of Agricultural Chemistry, on "Alfalfa, Its Chemical Development, Feeding Value and Digestibility. The Digestibility of Hog Millet."

Bulletin No. 126, "Studies on the Digestibility and Nutritive Value of Bread," has been published by the United States Department of Agriculture, Office of Experiment Stations, Washington, D. C.

A text book of 425 pages, for use in the School of Agriculture, entitled "Chemistry of Plant and Animal Life," has been prepared by Prof. Harry Snyder.

An article by Professor Snyder was read before the International Congress of Applied Chemists at Berlin, entitled "The Testing of Wheat and Flour for Commercial Purposes."

Articles on "Bread and Breadmaking," "Flour" and "Wheat" have been prepared for the forthcoming Encyclopedia Americana, published by the Scientific American Publishing Co.

An illustrated address on the "Nutritive Value of Bread," was delivered before the Millers' National Federation at Detroit.

Other articles, of a more popular nature, dealing with the chemistry of soils and foods, have been published in different periodicals, as Collier's Weekly, Harpers' Weekly, and the Northwestern Miller.

The following bulletins have been prepared and are ready for publication: "The Food Value of Sugar" and "The Digestive Action of Milk, Wheat, Flour and Bread Investigations," including the study of glutinous and starchy wheats, the influence of storage on the keeping qualities of flour, the effect of bleaching of flours, the nutritive value of flour, a study of the composition of the different streams of flour.

During the year the Division of Agricultural Chemistry has moved from the quarters which it has occupied for the past twelve years to the new laboratory which was completed in the fall of 1902. The new quarters provide more adequate facilities for both instruction and analytical work. In planning the laboratory, particular attention was given to construction and equipment, that the work might be carried on with the least expense, having due regard to rapidity and accuracy. A prominent feature of the new building is the laboratory for instruction in farm chemistry.

Prior to the construction of the laboratory, the plans of a number of the more recently constructed chemical laboratories were critically examined. Particular attention has been given to the lighting and ventilation of the building, which is plain but of substantial construction. It is about 60x90 feet, two stories high, with a high basement. The building cost $25,000. The equipment authorized by the last legislature to cost $5,000, is now being installed.

There have been no changes among the assistants during the past year, and no increase in the working force, although the instruction and other work have materially increased. Among the advanced and special students, some have secured responsible and remunerative positions. Mr. M. A. Grey, a special student, has been placed in charge of the testing laboratory of The Ogilvie Flouring Mill Co. of Montreal, and Miss

Moxness, a post-graduate student, has been appointed laboratory assistant at the Michigan Experiment Station.

Chemical analyses have been made for nearly all of the other divisions of the Experiment Station, as milk, fodders, forage and root crops, paris green, etc. In cases where the chemical analyses have formed a prominent feature of the work, and the conclusions have been based largely upon chemical data, the work has been done on a coöperative basis, each division doing its share of the work and receiving due credit for the work performed, and bearing its portion of the expense. A large amount of free analytical work has been done for the farmers of the state; numerous samples of miscellaneous materials having been received from time to time. This feature of the work of the Division of Agricultural Chemistry has, it is believed, given quite satisfactory results, and has been maintained at comparatively little expense.

DAIRY DIVISION.

In this division systematic records have been kept from the time it was organized of all food stuffs consumed by each animal, the composition of same, the daily yield of milk, butter fat and other solids in the milk, the daily consumption of feed by young stock from time of birth, and weekly gain in growth. In earlier years these data were used in determining the kind of cows that make best return in the dairy, the cost of milk and butter production, the cost of rearing the young and best methods of feeding for the production of stock intended for the dairy. During later years the data have been used in a study of the fundamental principles bearing upon animal nutrition.

Since the publication of bulletin 71, referred to in the last report, a supplementary report has been made in bulletin 79, treating on the "Food of Maintenance, Nutrient Requirements in Milk Production, Protein Requirements and the Influence of the Stage of Lactation on Nutrient Requirements." These subjects are presented by Professor Haecker, under new and improved methods, showing that the standards for food of maintenance and for milk production, in general use, are not reliable guides in feeding practice. In this bulletin new stand-

ards are tentatively formulated, based upon the actual performance of the animals under experiment, giving in detail the amount of each nutrient and total nutriment required by animals in the production of milk of various grades. This is the first work demonstrating that the nutriment required in milk production depends upon the quality of the milk and that the cows should be fed according to the quantity and quality of milk yielded, and not according to the weight of the cow—which has been the basis of the standards in general use. Since economy of production depends upon the knowledge of the needs of the animal for its own use and for milk production, these findings are of great value to the practical feeder.

Experiments in this division are bringing to light the fact that the feed stuffs grown on our western farms come nearer providing the constituents actually needed in milk production than had generally been supposed; that the amount of protein prescribed in the feeding standards is greatly in excess of the amount actually needed, and that by the use of the new standards suggested a marked saving may be made in preparing rations for dairy cows.

Further experiments are being made to determine more definitely the minimum amount of protein with which a normal yield of milk may be obtained and still maintain the cow and her offspring in full vigor.

The experiment referred to in the last report, of rearing dairy bred and cross bred steers, is still in progress and promises satisfactory results. Accurate records are being kept on cost of rearing, gain in weight, comparative value of product; and as soon as definite results are obtained, the matter will be submitted for publication in coöperation with other divisions. The data will also give valuable information bearing upon milk production, which cannot be fully determined by the employment of cows only.

Experiments in calf rearing have been conducted for several years, with gratifying results as to cost and nutriment required through the various stages of growth. This is an exceedingly difficult problem, but from the large number that are still being raised in the dairy herd, calculations can be made which will give the information desired.

In the dairy laboratory daily determinations are made in regard to the per cent. of fat content and solids not fat in the milk from the different cows of the herd, which is now being analzed periodically by the chemical division to show the per cent. of the various constituents in the milk. This gives valuable additional information in regard to the needs of the cow in milk production.

The demand made upon the dairy division for addresses before farmers' meetings is constantly increasing.

The barn accommodations, for the character of the experimental work that is now being done, are inadequate. Cows that are subjected to fixed rations for a series of winters in trials of returns made for digestible matter consumed should have quiet, comfortable quarters, thoroughly lighted and ventilated. They should be kept separate from the members of the herd not employed in nutrition investigation, and should not be used in connection with class work in the study of the breeds and in live stock judging; because if used in connection with class work abnormal shrinkage in milk takes place and the value of the experiment is lessened if not wholly destroyed.

Calf rearing is an industry that is constantly demanding more attention, and heavy losses are sustained every year for want of comfortable, well lighted and ventilated quarters. Many of our prominent experiment stations have built separate barns for the dairy herds, provided with ample stall rooms, judging and lecture rooms, milk rooms and quarters for the stock foreman, feeders and milkers.

VETERINARY DIVISION.

During the past year the health of our farm stock has been as good as usual. There have been a few losses from various causes. Among these I must report a continuance of hæmorrhagic septicæmia, and a few cases of tuberculosis. The cases of hæmorrhagic septicæmia have been confined to young calves of from four to six weeks of age, the infection evidently having lost so much in virulence, that the older cattle have been able to resist it. Our herds have been tested for tuberculosis twice,

spring and fall, a few cases appearing at each test. Most of those reacting during last fall, were of animals that had previously reacted and had been isolated. There has been one outbreak of hog cholera, which was promptly checked by isolation, disinfection and the use of our contagious ward stalls in the veterinary hospital. Infectious abortion has also continued to a rather limited extent in the dairy herd. It seems very difficult to get rid of this infection when once it has obtained foothold. Two cases of lumpy jaw appeared in our herd during the past year, but no serious trouble is anticipated.

About 200 lantern slides have been prepared for class demonstration work, and the museum has been developed, until it has become quite an important teaching feature.

Publications.—Dr. Reynolds has published a text book, "Veterinary Studies," for use in the veterinary classes of the farm school, and the short course work. This book has been very well received by agricultural colleges and agricultural college students, twenty-two agricultural colleges having already adopted it as a text book, or signified their intention of doing so.

Bulletin No. 82, on Hæmorrhagic Septicæmia, containing about 30 pages, was published from this department, and was very favorably received by the agricultural public, by the veterinary profession, and the agricultural papers. The investigations and other work reported in this bulletin deal with the practical features of this serious disease. This bulletin discusses the practical bearing of the disease upon the live stock interests of Minnesota, and shows that it is a very serious problem. The peculiar feature in connection with the cause of the disease, is that the rod-shaped germ which is now recognized as the specific cause is apparently identical with the swine plague bacillus, and very similar to the chicken cholera germ. The history and development of cases are given at considerable length from actual field observations. The veterinarian had opportunity to study quite a number of cases throughout their entire course, and has put these data on record in Bulletin No. 82.

Attention is drawn especially to the fact, that ante-mortem symptoms are as a rule unsatisfactory, the acute cases dying

very suddenly. Symptoms by which stockmen may recognize the disease, especially on examination post-mortem, are given quite fully; also statistics concerning the extent of the spread of this disease in Minnesota and estimated losses. An outbreak of the disease which appeared on the University Experimental Farm was quite serious, on account of its financial loss, but it gave us almost ideal opportunities for studying the disease. Attention is drawn to the fact that certain cases of hæmorrhagic septicæmia very closely resemble cases of milk fever, and may be easily mistaken for such in cases of disease developed within a few days after calving.

A carefully prepared table is presented, which offers a very complete comparative study of hæmorrhagic septicæmia, anthrax, symptomatic anthrax and infectious cerebro-spinal meningitis. This was deemed important, because these diseases were very easily confused by stock men, and often in obscure cases by veterinarians. The diagnosis is especially important for anthrax, symptomatic anthrax and black-leg.

Proposed Station Work.—Quite extensive plans are under way for the station work in this division during the coming year. One series of proposed experiments deals with a practical study of ventilation problems from a physiology standpoint. Another series of experiments has been outlined with a view of determining the relative desirablity of various methods of disinfecting large stables, the following points to be especially considered: Rapidity, expense, difficulties or technicalities involved and efficiency. A pasture experiment with tuberculosis has been under way, since the early spring of 1903. The purpose of this experiment is to determine approximately the risk of outdoor infection, when tuberculous and non-tuberculous cattle are pastured together. This experiment involves two phases, the first an actual field trial by pasturing some tuberculous cows with two yearling steers that were not tuberculous. The second proposes to spread cultures of bovine tubercle bacilli over a small plot of grass and then keep record of climatic conditions, determine how long the grass remains infectious to laboratory animals, and possibly later to cattle.

DIVISION OF ANIMAL HUSBANDRY.

The policy established a year ago, of requiring daily reports, has proved to be a valuable method of regulating the work of this division and will be continued. The feed records of individual beef animals and of litters of pigs kept during the last year, have furnished much information on the cost of production, and will be further perfected and extended until the record of every animal grown on the farm is obtained in detail.

The beef herd has been built up by the purchase of a few breeding animals, and a few pure bred calves have been raised, though an outbreak of hæmorrhagic septicæmia last spring caused the death of a number of calves. The flock of sheep has been strengthened by the purchase of typical specimens of the breeds not represented heretofore, and a number of home bred sheep have been considered good enough to keep for breeding purposes.

The new piggery has proven well adapted to the growth of young pigs, and has enabled us to raise a large number of pigs with very little loss from disease.

Sales of stock have been good throughout the year, and farmers obtaining it have expressed themselves as well pleased with the quality of the animals obtained. The sales for the year exceed the purchases by $393.98. There is also an increase in value of the live stock inventory of $2,095.00, making a total increase in the value of the live stock of $2,488.98.

The experiments in forage crops for sheep and swine have been continued through the year. Only mature sheep were used for pasture work, as it was believed that more reliable data could thus be secured. A number of plots of tame grass have been seeded for comparison with annual crops—as sheep pasture—and the fields have been partly re-fenced with a view to furnishing more economical methods of pasturage. The yards adjoining the piggery have encroached somewhat upon the land formerly used for producing winter forage, and small fields for swine pasture have farther reduced the land avail-

able for sheep foods. The health of the herds and flocks has made necessary the change, and it is not believed that the work done will be any less efficient than in the past. More attention will be given in the future to soiling and pasture crops for swine, and to discovering crops suited to short rotations for hog food.

The steer feeding experiment in progress a year ago was completed in June, and the figures are at hand for compilation, The results show great variation in the capacity of different individuals to make use of the food consumed and in the economy of production. Measurements and photographs have been carefully preserved for illustrative purposes.

More steers have been purchased for the purpose of continuing the study of the influence of individuality on cost of growth, and the records of several home bred calves are being carefully kept for the same purpose.

No extensive experiments have been undertaken with sheep except in forage work. Digestion tests of macaroni wheat and alfalfa have been made in coöperation with the chemical division and minor tests of speltz, corn, barley and oats as sheep foods have been completed.

The experiments with pigs have been confined to cross-breeding and to recording the growth of litters of pigs of the various breeds. As far as possible each litter has been kept intact and fed liberally. When finished the plan is to slaughter the whole litter and observe the variation in growth made and in the quality of meat. Pigs of the cross-bred parentage were again sent to the International Exposition, where they compared favorably with other breeds, getting 2nd and 3rd prizes in their class.

As soon as funds can be had for the purpose, coöperative work should be started with men who are feeding stock, for the purpose of securing data on the methods employed, and the feeds used and to enable us to suggest more economical feeding of farm stock. Statistics should be secured of cost of production on farms, and comparative feeding tests made under various farm conditions. A man who is familiar with all phases of stock feeding, could well be employed by the station for this purpose.

DIVISION OF ENTOMOLOGY.

The entomologist was called to Ottertail County in June, 1902, on account of an outbreak of grasshoppers, the county commissioners urging that he come at once to do what he could to remedy the evil. He found stubble fields filled with thousands of the lesser migratory or White Mountain locusts (*M. atlanis*). For the most part they were well along past the fourth moult, although some were found considerably younger. It is to be noted that these grasshoppers hatched in the old stubble. The most threatened area in this vicinity was a tract of unplowed stubble containing 240 acres, owned largely by non-residents who will not plow. Some farmers were plowing thoroughly, but all were very much alarmed at the near presence of such a large tract of unplowed land. The situation was so serious that, upon consultation with the governor of the state and director of the station, it was determined to plow this tract at the expense of the state, and thus not only avert immediate loss but also reduce, if posible, the number of grasshoppers that would otherwise be on hand to do damage next year. Accordingly the most threatened tracts, about 200 acres, were plowed, and it is believed that the result was satisfactory, for since that time no complaint has come from that part of the county because of grasshoppers.

On June 26 the entomologist was summoned to Gentilly, a town in Pope County, about ten miles from Crookston, where the same variety of locust was found, causing injury upon all well drained sandy ridges. On one farm it was found that the wheat next the old stubble, and beans, barley, and young flax, were eaten clean.

From Gentilly the entomologist went to the Hill River district, near Lindsay postoffice east of Crookston, at the request of the county commissioners, where by far the most serious conditions found in the state prevailed. Flax, grass, wheat, barley and oats were found mowed down by the grasshoppers. At the date of his visit, June 26th, the farmers were complaining bitterly of a 300-acre piece of stubble, which had been allowed to lie fallow for two years or more. Here the grasshoppers were working toward the south.

In all about twelve hundred gallons of oil were distributed free of cost, through the county commisioners, to help the farmers combat the pest. This oil was judiciously used, but as the insects were so numerous the loss to the farmers was severe, although bushels of the grasshoppers were killed. With these two exceptions, and a slight outbreak near Twin Valley, and an early and limited attack near Glyndon, in Clay County, grasshoppers caused no loss in the state, so far as is known.

In July another trip was made to the Hill River district, where hoppers were found by the thousands, feeding upon the wheat heads. The last trip to this region was made in September, when consultations were held with the farmers as to the best means of proceeding the following year. Almost all united in the expression of a desire for some law which would compel the plowing of stubble land infested with eggs.

Complaints of chinch bugs began to arrive at the station in July and during the summer Stearns, Isanti, Chisago, Dakota, Sherburne, Meeker, Kennebec, Lyon, Anoka, Hennepin, Wright and Waseca counties suffered from this persistent pest. Stearns, Isanti and Meeker were the worst sufferers. These counties were visited and the farmers shown the best means of preventing the chinch bug from entering the corn, and given what help was possible under existing conditions. Demonstrations were resorted to in explanation of the dust furrow and tar line, and farmers were urged to kill as many of the bugs as possible, while they were migrating from the wheat to the corn, thus lessening the crop of bugs for the following year.

The Hessian Fly has spread over the entire wheat raising area of our state. It well deserves to head the list of injurious insects in 1902. The following counties were affected: Ottertail, Kennebec, Pope, Clay, Becker, Douglas, Meeker, Marshall, Rock, Isanti, Lyon and Morrison. Many infested farms were visited and it was found that the loss from this pest reached all the way from a fraction of one per cent to as high as fifty per cent. in a few localities. Many farmers not familiar with the Hessian Fly and its work ascribed the fallen wheat heads to the work of the chinch bug or of hail. The

"flax seed" stage of the insect on the wheat plants was shown to the farmers so that they might easily recognize this pest. The life history of the insect was given in brief talks, and the importance of coöperation in plowing the stubble in the fall was urged as being the most effective way of keeping the pest in check. The value of rotation of crops was also dwelt upon.

Besides the work mentioned above, experiments have been conducted as to the best methods of combating the horn fly of cattle and the white grub which infests lawns.

In May a trip was made into the lumber sections of Lake County to study and collect insects affecting our timber interests.

Many nurseries throughout the state have been inspected during the year and have been found fairly free from insect pests and fungous diseases.

POULTRY DIVISION.

The work for the past year in this division, has been mainly a study of best conditions and management of farm flocks. The problem of winter egg production is receiving especial attention. Experiments with natural and artificial incubation have been continued. Owing to lack of room, two breeds only are kept—Plymouth Rocks for general purpose fowls and White Leghorns for layers.

As was mentioned in the last report, it is still thought that a number of small houses, each to illustrate a different method of building a farm poultry house, would be a valuable object lesson and would help to relieve the crowded condition of the poultry quarters.

NORTHWEST EXPERIMENT FARM.

On this farm the experimental work which was being carried on in much the same lines as formerly, was seriously interfered with by a hail storm on July 15th, 1902, which destroyed the standing crops and rendered nearly valueless the work in the trial plots. After the storm the most of the grain was cut for hay.

During the year a barn to accommodate fifty head of stock, containing a root room, silo and feed grinding room was begun; also an incubator house and about seven miles of woven wire fence built. Pipes for supplying water to the different buildings were also laid.

A large field has been seeded to grass, using those varieties which have given promise of usefulness in the trial plots of former years. This is to be a part of a study of the rotation of crops best adapted to this section of the state.

A herd of Galloway cattle has been purchased and other pure bred cattle are being secured as opportunities offer. Specialists have been placed in charge of the live stock and poultry.

In trying to solve the question of fruit for the Red River Valley, the work is confined mostly to seedlings. Several thousand apple, plum and other seedling trees are now growing on the grounds.

The superintendent has devoted considerable time to institute work and to aiding in the organization of creameries and cheese factories in the Red River Valley.

NORTHEAST EXPERIMENT FARM.

The equipment of the Northeast Experiment Farm in buildings and machinery is now fairly complete. The farm house is sufficiently large to accommodate the hired help, kitchen help and superintendent. It would not make a suitable dwelling for the superintendent if he were married, as its capacity is only equal to present conditions. Up to this year the house has been poorly heated by stoves. A wood-burning, brick furnace has now been put in, and a drain and a bathroom, greatly improving the comfort and sanitary conditions, especially during the winter. The house contains four bedrooms on the second floor, and two on the first, with office, sitting and dining rooms, and kitchen. There is also a good cellar. A wagon shed was built in 1902, 16x40 feet. The buildings now consist of a dairy barn 30x58 feet, horse barn with two sheds for machinery, wagon shed, sheep pen, hog

pen, stone root cellar, hot house, blacksmith shop, ice house, stone milk house and well, with water to all the buildings.

There are 2,276 rods of fencing on the farm, and the amount of land under cultivation in 1903 is 112¾ acres, of which 60½ acres were cleared when the farm was acquired and 52¼ acres since the state has managed it. In 1903, about four acres additional was stumped and planted to potatoes. The system of hog pastures was completed and fenced with woven wire. This, with the sheep pasture lots, gives a complete rotation of pastures for hogs and sheep.

Field experiments are giving more and more useful results each year. The twenty-four permanent rotation plots, which illustrate the effect upon the soil of as many different plans of cropping, both good and poor, are beginning to show effects in yields, which will become more and more pronounced from now on. The station is doing a valuable work with potatoes, of which nearly one hundred varieties were tested in 1903, both for yield and quality. Strains of the same variety from different sources were also planted, and showed great difference in yield. An original method by Herman H. Chapman, of correction of the yields of potato plots, so as to eliminate the difference caused by varying soil conditions among the plots was followed with good results. The new variety test of oats for the selection of a new kind for distribution is in its third year. Oats are by far the most important grain crop, and yield is the chief point considered. Variety tests of clovers and grasses for meadow and pasture, and tests of the absolute and relative amount of timothy and clover seed to sow, gave instructive results.

A new experiment in changing seed oats from one locality to another is in its second year, and is planned in such a way as to secure accurate and effectual knowledge on this subject.

Fodder for stock feeding again demonstrated its usefulness, and the test made as to time of sowing, kinds, amounts and methods of sowing, clearly indicated the proper course to pursue for this locality. Corn for ears did not ripen.

Many other but less important lines of experiment work were conducted, as tests of wheat and barley, millet, peas and beans, and garden vegetables. Small fruits were uniformly

successful, and progress was made in determining the best kinds to recommend for planting. Native plums again gave a good crop from orchard trees set in 1899. Apples have not succeeded, due to poor location of orchard in sandy sub-soil as well as severity of winters. The hedges of ornamental shrubs are doing well.

The flock of grade Oxford sheep are now being bred to a Shropshire buck, and continue to give valuable illustrations of their proper use in clearing land.

The herd of cattle bred to a red polled bull is in good condition, and the dairy work is now capable of very satisfactory development.

The ten acre plantation of young white and Norway pine set at intervals of 4, 6 and 10 feet, on cut over land in 1900, is thriving, and will soon be one of the most interesting features of the Experiment Farm.

In the winter of 1902-1903, a bulletin containing 69 pages, No. 81 of the Experiment Station, was published and distributed throughout Northeastern Minnesota. This bulletin contains a full review and summary of the work of the Northeast Farm since it was established.

BULLETINS.

The bulletins are sent free to about seventeen thousand subscribers. Requests from out of the state for our bulletins are increasing rapidly. Many of our files, especially those on special subjects, are exhausted. Readers of our bulletins are showing their appreciation more each year by thousands of personal letters received here during the year relative to our school and experiment station work.

Six bulletins, comprising 280 pages, with many illustrations, have been issued during the year, as well as one press bulletin, "The Criddle Mixture," and one class bulletin, "Growing Field Peas for Seed." Bulletins are issued for gratuitous distribution to the citizens of Minnesota who apply for them.

Respectfully submitted,

WM. M. LIGGETT.