FOURTH ANNUAL REPORT

OF THE

AGRICULTURAL

EXPERIMENT STATION

FOR SOUTH DAKOTA,

FOR THE

FISCAL YEAR ENDING JUNE 30, 1891.

SOUTH DAKOTA AGRICULTURAL COLLEGE,

BROOKINGS, S. D.
DUTCHER & BREED,
STEAM PRINTING HOUSE,
BROOKINGS, S. DAKOTA.
To His Excellency,

A. C. MELLETTE,

Governor of the State of South Dakota.

SIR:—I have the honor to present herewith the Fourth Annual Report of the Agricultural Experiment Station of South Dakota, in accordance with the requirements of the Act of Congress, approved March 2, 1887, establishing the Station.

Respectfully Yours,

J. P. DAY,

President Board of Trustees.
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I. H. Orcutt, M. D., Ph. D.,........ Entomologist
Jas. H. Shepard, A. M., ................ Analytical Chemist
A. H. Wheaton, ................ Dairy Science
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William Frost, LL. B., ..................... Accountant
John M. Aldrich, M. S., ........ Assistant Entomologist
C. G. Hopkins, B. S., ................ Assistant Chemist
T. A. Williams, A. M., ........ Assistant Botanist
V. B. Valleau, B. S., .............. Stenographer
Robert F. Kerr, A. M., ............. Librarian
Chas. A. Duncan, B. S., ............ Irrigator
W. G. Copeland, ................ Foreman of the Farm
REPORT OF DIRECTOR.

The past season's work, with a few exceptions, has been most satisfactory. The insect ravages in the outside work of the Horticultural Department made the results of some lines of little value and entirely destroyed others. In the Agricultural Department some special field experiments were interfered with somewhat by the summer's drought while others were cut short by early frosts.

Previous to July, 1890, most of the Station divisions had completed preliminary arrangements and settled down to their regular work of investigations. During the past year the departments of Veterinary and Entomology have each been supplied with separate buildings and more complete equipments for the successful continuance of their important work.

A new line of investigation, that of dairy science, has been added to the station. A very complete and commodious dairy house, fitted up with all modern improvements for butter and cheese making and experimental work, and also a dairy barn have been constructed for its use.

It seems desirable at this time to give in brief the present equipment of the Station. At the organization under the Hatch Act in 1887, the college was in possession of a farm of 400 acres fairly well equipped with teams, tools and stock. The heads of college departments, whose work ran parallel, took up the corresponding lines of work in the Station. This combination of College and Station forces gave to the latter, from the beginning experienced, specialists for its work and secures to them both, men of greater skill than would otherwise be possible.

It required time and money to properly equip all of the departments, and put them into good condition for investigation and the past season has seen this latter work fairly well completed.
BUILDINGS AND EQUIPMENT.

AGRICULTURAL BUILDINGS. Previous to this year a building had been erected for the use of the department of Forestry, Horticulture and Botany at a cost of $3,000, this amount included the purchase of a Spence hot water heating apparatus for the propagating room.

The building is a one story structure, brick veneered to the top of the windows, with a single course from the window caps to the eaves. It is 28x46 feet in size, with a propagating room along the south side, 18x46 feet, the roof and sides of which are double strength glass. The main floor is divided into the following rooms: an office, microscopic laboratory, herbarium, grafting room and tool room.

The cellar is 28x46 feet, eight feet in the clear; it contains a commodious graft storage room, besides fuel, boiler and packing rooms. The attic is large, well lighted and airy, and will be used for storing seeds. The floors of the main story are of hard pine, the wood work of white pine, finished in oil.

The department also has a barn which furnishes ample room for stabling its horses and storing its implements and food.

INSECTORY. The building erected last summer for the Entomological department is 16x32 feet in size, one half being 12 feet high, the other 8, from the foundation wall. The former half contains a room 16 feet square, plastered and fitted up for office purposes. On one side are cases for the accommodation of the growing collections of the department. A desk, and tables for balances with other appliances, complete the equipment of this room. Overhead is a small loft intended for storage purposes, but not at present in use. The other half of the building, being designed for an insectory for rearing insects, is unplastered and has a dirt floor. Here are breeding cages, stores of insecticides, &c. This room was little used last summer on account of the lateness of the season when the building was completed.

Adjoining the rearing room on the east is a wing or ell 12 feet square, also unfinished inside, opening by double doors to
FOR SOUTH DAKOTA.

the outside. The larger spraying machines are stored here, and it is used primarily as a bee house, the hives being arranged along the sides, where narrow slits in the wall are provided for the exit of the bees.

Dairy Buildings. As before stated a dairy house has, the past year, been erected near the other buildings on the college farm. This is a neat and attractive structure one and one-half stories high built in the form of a cross the dimensions of each arm being 24x50 ft. The first floor is divided as follows: office, hall, main work room and students’ laboratory also rooms for cold storage, cheese curing, boiler and engine, ice and coal. The second floor is at present used for storage only.

The building is supplied with all the latest appliances together with the more common facilities for the purposes of investigation and instruction in dairy science.

This equipment consists of a ten-horse-power engine and boiler, a DeLaval separator, Coonley creamer, Royal’s tempering vat and starter, a double cream and cheese vat, Babcock’s milk tester, a Cornish & Curtis rectangular churn and lever butter worker together with many miner implements and fixtures making a complete outfit for the modern creamery, cheese factory or farm dairy.

The dairy barn is in outside dimensions 40x60 feet with 16 feet post above the basement which is itself 8 feet in the clear. This lower part is used for cows and young calves. It is fitted up with a double row of stalls with a feeding alley between. On one side the cows are fastened in single stalls with the Newton bow tie and on the other in double stalls with ordinary chain ties attached to a ring that is free to move up and down on a vertical rod. At the end of either side is a square pen for calves the portion between being occupied as a root bin.

One side of the first floor is fitted up with box-stalls for bulls of the different breeds, the other side with bins for bran, ground feed and oil meal each with convenient shoots leading to the basement. This arrangement leaves plenty of space for the storage of coarse forage and straw.

Veterinary Building. During the year a frame building was erected for the use of this department. It consists of a main
or upright part 24x32 feet two stories in height and a one story wing 18x36 feet to which a yard for clinics is attached. The first floor is arranged for an office, gas machine and recitation rooms, and the second is fitted up for a Pathological and Bacteriological Laboratory, supplied with the necessary apparatus for research including a new combination gas machine, various sterilizers and incubators of the most approved patterns recently imported from Germany, a Bausch and Loub professional microscope with all the objectives and extras necessary for careful work. The wing contains a museum made up of a large collection of pathological specimens for study and comparison. Here also are instruments necessary for all the operations of general surgery, obstetrics and dentistry. The clinics yard is supplied with a casting harness and operating table.

Chemical Laboratory. During the year some important changes have been made in the Station laboratory. Larger and better rooms have been secured and more desk room has been provided. In addition a good cool store room has been obtained and a room for fine instruments such as balances, microscopes and polariscope, etc. etc.

In the matter of instruments the principal improvements have been along the line of extraction apparatus and distillation apparatus. In this latter respect, a fine still for the rapid production of ammonia free water is nearly completed.

Taking it all in all the Station is now acquiring a good outfit of apparatus. The rooms are the best that can be provided until the State legislature takes steps to provide a separate building for the work of chemistry. It is to be hoped that a suitable building may soon be provided.
COLLEGE FARM BUILDINGS.

Farm Buildings. The farm is supplied with good frame buildings of sufficient capacity to house all the stock and implements, and store all seeds and grain raised. The horse barn is a structure 40x60 ft. with 20-ft. corner posts. It has the best of modern inside fixtures in single and loose stalls and gives abundant room for all pure-bred horses and farm teams. The bins for oats, ground feed and bran are placed in the mow with shoots running to the first floor for convenience in feeding. The mow has capacity for 40 tons of hay and is supplied with a carrier and fork for storing the same. Under this barn is a large root cellar well filled with carrots and sugar beets for the use of the horses and sheep. A lean-to, 20 feet wide, extending the full length of this building is used for storing the farm implements and machinery.

A low building 28x64 with 10-ft. posts is used for a sheep house and a lean-to 16 feet wide running the full length, is divided into comfortable, roomy, loose stalls for stabling colts.

The piggery is made up of a main building 16x26 feet with lean-tos 14 feet wide running the full length on both sides. The lower floor of the main part is used for a cooker and storage of feeding materials and above this is kept a supply of bedding. The side parts are divided into pens arranged for convenient feeding and occupied by pigs and breeding stock. To each of these pens is attached a small outside pen. All open into larger yards and through these to the pasture.

The seed house is a neat two-story frame building the extreme dimensions of which are 28x44 feet. On the first floor is a farm office and tool room with bins for the storage of grains in bulk. Space is also given here for a fanning mill, feed grinder and portable platform scales. The second floor is fitted up with a large number of drawers and small bins for the reception of the experimental grains and seeds. The ceiling is used as a storage room for the vast number of grain samples taken in the straw. A small space on this floor is set apart for a work bench and tools for farm carpentry. Under this entire building is a frost proof cellar supplied with numerous bins and boxes for the storage of the experimental potatoes as well as the general crops.

A plant for supplying water to all farm buildings is well on toward completion. It consists of a 12-foot steel wind mill mounted on a tilting tower, a 240-bbl. tank housed in and supplied with hot water pipes to make it practical for winter use, and a system of pipes laid below frost line that connect with the different buildings.
OUTLINE OF WORK.

HORTICULTURAL. The experiments of this department have been in large measures a continuation of work begun in previous years. Four acres of trees were planted in the forest plantation, making a total of seventeen acres, forty rods. The observations on the plantation began to show very promising indications, and the plantation will be extended until it contains thirty acres.

Experiments with garden vegetables have had for their object determination of value and adaptability to the climate of the state. The results of these experiments are printed in the form of weekly bulletins which are sent to the press of the state only.

In small fruits the work has not been favorable. A large addition was made to the list of strawberries, but owing to very dry weather immediately after setting out all the plants failed.

The experiment orchard came through the winter in fine condition, and a number of varieties of plums, two varieties of cherries, and three varieties of crab apples bloomed this spring.

In botany good progress has been made in determining the flora of South Dakota; a complete collection of native grasses has been made, and samples furnished the Chemist for analysis; a beginning in the study of the fungi of the state has also been made. This part of the work has been conducted by Mr. T. A. Williams, the efficient assistant in botany.

ENTOMOLOGICAL DEPARTMENT. In Entomology, the value of the investigations can hardly be overestimated looking at it from an economic standpoint. The study of the life history of insect pests and the best methods for their destruction, the discovery of parasites that assist in this latter work, their propagation and distribution where needed, over the state, the test of various insecticides as to sure destruction and economic use, a determination of the relative merits of the various machines for applying these insecticides.

The department has devised a sprinkler for applying paris green or London purple to potatoes, which proved quite suc-
cessful and almost entirely replaced hand labor for this work on the college farm. A description of this machine will appear in their next bulletin.

Beekeeping has been given a large share of attention this past season. Five colonies of bees received in May have been under observation during the summer. Their net increase was two swarms. Several seasons work in this line will be required before positive opinion can be expressed as to the value of bees on our prairies.

The new building of the entomological department was completed ready for occupancy about the 25th of June. As this was practically in the middle of the insect season, it was too late to begin some lines of work which had been deferred until the breeding facilities of the new building could be used.

Many observations and small experiments have been recorded, not needing special mention here, and which will be useful to the department in its future work.

Chemistry. In the department of Chemistry 108 samples of sugar beet have been analyzed, twenty samples of native grasses, eight of feeding stuff and forty samples of water. Nearly one thousand determinations, testing methods have been made and over one hundred miscellaneous analyses, some complete and others only single determinations. Also the department has made mechanical analysis of eight samples of soil.

Veterinary. Much of the Veterinarian's time was taken up in superintending the construction of a building for the use of the department and after its completion, in fitting up a Bacteriological and Pathological Laboratory. He investigated numerous outbreaks of diseases in different parts of the state. Among these may be mentioned the disease caused by the tape worm, Tænia fimbriata; infections of Nodular disease caused by the round worm. Oesophagastomum Cloumbianum, Black leg and Glanders.

He also instituted a line of experiments with Glander viris and Tænia fimbriata both of which were cut short by limited time.

Agriculture. The Agricultural Department has continued to a large extent the experiments of previous years with slight
extensions or contractions as the importance of the work seemed to demand.

In the field, variety tests in all lines were considerably lessened the work being mainly confined to what had in previous tests been proven worthy of a continuation. The work in methods of seeding, cultivation and quantity of seed and mulching were extended somewhat in the duplication of plots.

The work in forage plants was very much enlarged both in number of variety trials and methods of soil preparation.

This department had over seven hundred field experiments in progress during the season. The work may be briefly outlined as follows:

1. Variety tests to determine; (a) what kinds of corn can be most safely relied on to mature and give fair return in an average Dakota season, (b) the varieties of wheat, oats, and barley that have strongest straw, are freest from rust, and will give the largest yield and the best quality of grain; (c) what grasses, clovers or other forage plants can be relied on to best serve us for pasture and meadow and what others supply coarse fodder in seasons of drought when the regular sources of supplies fail.

2. Methods of preparing the seed bed for the different crops. This has reference not only to thorough pulverizing and freeing from weeds at time of seeding, but also to depth of plowing and subsoiling, and time of plowing.

3. Methods of seeding or planting and quantity of seed. In this line of work the relative merits of different methods of putting in not only the small grain crop, but corn, potatoes and peas as well are being tested. At the same time the experiments look to economy of seed used as well as economy of labor in accomplishing the work.

4. Methods of cultivation is another line of work being investigated by this division of the Station. This applies principally to the corn and potato crop but is of almost equal value in freeing the small grain crop from some varieties of weeds that threaten to destroy it in its early stage of growth. In relation to corn and potatoes it includes deep and shallow, frequent and regular, and sparing and irregular cultivation.

5. Time of seeding is also quite an important line that is receiving due attention.

6. With live stock a comparison of breeds for different purposes was in progress, special attention being given to Shropshire and Merino sheep their crosses and grades.

In addition to the regular work of the Station lectures have been given by a member of the Staff at various Agricultural meetings and farmers Institutes, and various quieries answered through the Agricultural press and by personal letters.
BULLETINS ISSUED.

Seven Bulletins of 8000 copies each were published during the year Nos. 19 to 25 inclusive. This makes a total of twenty five bulletins since the organization of the Station. They have ranged in the number of copies issued from 2500 to 8000; beginning with small editions and gradually increasing as was found necessary to supply the demand. Much work is under way which has not progressed far enough to warrant publication.

The following is a brief outline of the Bulletins published during the year as referred to above.

BULLETIN No. 19, December, 1890 Department of Agriculture and Chemistry.

The Sugar Beet. This Bulletin treats of the adaptability of our soil and climate to the production of the sugar beet together with an analysis of the soil used by station with amount and kind of fertilizer. It gives directions for planting, cultivating, thining, harvesting and storing the sugar beet with the results of the season's work. The maturity and sugar content of the beet with varieties tested and the results of analyses of beets sent from the various counties of the state where seed has been distributed for trial, with also a few from North Dakota and Minnesota. These analyses show the percent of sugar content to be thirteen.

BULLETIN No. 20. January 1891, Department of Forestry, Horticulture and Botany.

Forestry. A history of the work in forest tree culture for the past year, growth tables of the different species, and weather tables are included in this bulletin. Plats are given showing location of the various kinds. A mechanical analysis of the soil plats is presented and the root growth of transplanted trees is discussed. It is found that the cutting of the top root in transplanting lends to cause the root to throw out lateral branches which do not penetrate the ground to a very great depth and that therefore the tree is less likely to successfully withstand dry weather. “Insect Enemies” is a topic considered, as is also “The Value of a Leaf Canopy.”

BULLETIN No. 21. February, 1891. Agricultural department. Small grain. A tabulated statement of seventeen varieties of
wheat shows Velvet Chaff to have yielded the best. In experiments in drilling wheat sowed east and west yielded better than that drilled north and south.

Cultivation of wheat was a failure. Top dressing with manure, with straw and with salt was tried. The top dressed plats withstood rust better and yielded more than an undressed plat by its side, the manure dressed plat taking the lead. The experiment with twelve varieties of Winter wheat were not encouraging, the dry spring weather killing the plants. Winter rye does well and seems to be an assured crop. Twenty five varieties of Oats are tabulated, White Belgian, American Banner and White Wonder being the best yielders. Ten varieties of barley are tabulated, Manshury being the leader. A comparison of Broadcast vs. Pressdrill seeding shows press drilled wheat and oats to have yielded a little more.

BULLETIN No. 22. Injurious Insects, by I. H. Orcutt and J. M. Aldrich, 40 pp., illustrated. Contents: The Ash Borer: original observations and figure life history; recommendations as to remedies and prevention. The cecropia moth: life history; parasites, methods of preventing its ravages; introduction of its parasites into new localities. Sphinx moths: a few notes on life history, parasites and remedies. The Large Willow Saw-fly: life history, original figure of a parasite not hitherto reported in the United States; natural and artificial remedies. The Small Willow Saw-fly and the Ash Saw-fly: short notes. The Cottonwood Leaf beetle: habits, remedies etc. The False Chinchbug: figure and description to enable farmers to distinguish it from the genuine article. Cabbage Insects: short notes on all the common species. Cut-worms; a summary of about 500 reports from farmers as to the efficacy of various remedies; life history and observations on feeding habits. Insecticides; Paris green, London purple, etc.; several figures of spraying machines.

BULLETIN No. 23. April, 1891. Department of Forestry, Horticulture and Botany. Forest Trees, Fruit, and Vegetables. This bulletin contains suggestions for methods of planting forest trees, street and lawn trees, orchard and small fruits and garden vegetables. In forest trees, Grove Planting, Close vs Wide Planting, Mixed Planting, Growth of Trees from the Seed, Street
and Lawn Planting. Of varieties, Cottonwood, Russian Poplars, White Willow, Russian Willow, Box Elder, Soft Maple, Green Ash, White Elm, Black Wild Cherry, Hackberry, the Walnuts, the Oaks and the Evergreens. Of Apple trees many Russian varieties are mentioned, the common crabs are discussed, and some hardy varieties of plums described. A very full description of the strawberry plant and its culture is given with some mention of varieties and also some mention of other small fruits.

Bulletin No. 24. May, 1891. Department of Agriculture. Corn. Notes on twenty-one varieties. Experiments in time of planting indicated that corn should be planted as soon after May 1 as possible and not later than May 20. A tabulated statement of results in thick and thin planting in both Dent and Flint varieties and in both hills and drills. Deep and shallow Cultivation experiments seemed to favor shallow cultivation.

Bulletin No. 25. June; 1891. Department of Veterinary Science. Glanders. A full description of the symptous progress, characteristics and also Black-leg. Some sheep diseases were taken up.
REPORT OF TREASURER.

THE AGRICULTURAL EXPERIMENT STATION OF SOUTH DAKOTA
IN ACCOUNT WITH
THE UNITED STATES APPROPRIATION.

1891.

To receipts from Treasurer of the United States, as per appropriation for year ending June 30, 1891, under Act of Congress approved March 2, 1887, .......... $15000.00

June 30.

By Salaries ......................... $7975.48
" Buildings ......................... 491.55
" Printing ......................... 747.92
" Incidental expenditures ........ 887.74
" Labor .......................... 2674.69
" Equipment and current expenses—
    Agricultural division .......... 559.57
    Chemistry " .................. 396.26
    Entomological " .............. 110.02
    Horticultural " .............. 478.05
    Veterinary " ................ 405.93
    Irrigation " ................ 272.79

$15000.00 $15000.00

We, the undersigned, committee of the Board of Trustees, appointed for that purpose, have examined the vouchers covering the expenditures of the Experiment Station for the fiscal year ending June 30, 1891, and have compared them with the books containing the Experiment Station accounts, and we hereby certify that the books and vouchers agree, and that the expenditure have been made in accordance with the rules and regulations of the Board of Trustees.

Signed,

C. J. Peterson, Committee.
A. McIntyre, Committee.
S. W. Lockwood.