Mr. E. C. Perisho, President.

Dear Sir: As director, I have the honor to make the following report of the South Dakota Agricultural Experiment Station for the fiscal year ending June 30, 1918.

PERSONNEL

With few exceptions the personnel of the Station is the same as for the preceding years, Mr. James H. Shepard, who has been chemist since the founding of this Station, died during the spring of 1918. He was appointed chemist for the Station in 1888, and served continuously in this capacity until his death or for a period of 30 years. He was Director of the Station from 1895 to 1901. During this period, the pioneer days of investigation, Prof. Shepard rendered excellent service in organizing and developing the present departments of the Station. His judgment in selecting subjects for experiments, that were timely and the results of which would be of benefit to the people of this new state, were eagerly sought and highly appreciated by his co-workers. The data he secured from the manufacture of flour from Durum wheats were recognized by the federal department of agriculture and as a result he was called as an expert witness for the government in some of its most important cases in this country. I have heard government officials say that he had the details of his profession so well in mind that it was beyond the ability of the best corporation lawyer to mix him on cross-examination. At this time Durum wheat was bringing much less in the market than the ordinary bread wheats. Larger yields of the durum were being secured and even with a few cents a bushel less in the market it was the wheat to grow in certain semi-arid sections of the Northwest. Shepard knew this and also that this cheaper grade of wheat was being mixed with the ordinary wheat to make the best flour. It was the farmer's interest he had in mind.

Prof. Shepard issued or was joint author in issuing 27
different bulletins from this Station. He had the habit of encouraging bright graduates to remain with him and assist in investigations. By this system he succeeded in training men who are now well at the top of the profession in the United States. As an investigator he had few equals. His work in connection with the Pure Food Commission in the state was of wonderful value. Probably the most important line of work he undertook was to call the attention of the people of the world to the suitability of South Dakota for the growing of the sugar beet. This was begun in 1888 when little was known of the beet in this country and by breeding and selection he succeeded in producing a beet that tested over 25% sugar while the ordinary commercial varieties test from 14 to 16% sugar. He printed his first bulletin on this subject in 1889 and his last in 1917. To show the enthusiasm of the Professor in his work I quote from his last bulletin as follows: "In conclusion, it is scarcely necessary to state that South Dakota is well adapted to sugar beet culture and to seed production. * * * There are hundreds of square miles of black loamy soils, easy of cultivation and of immense fertility where good careful cultivation, coupled with good seed will produce better paying crops than the state has ever grown. The average tonnage for six years has been about 18 tons per acre for the 18 inch rows. This means over $100.00 per acre. No other crop gives such an income. The raising of seed for commercial use is also a profitable undertaking. Results at this station demonstrate that sugar beet seed can be grown successfully in South Dakota. It yields as high as 1400 pounds per acre at this station. At fifteen cents per pound means a return of $210.00 per acre."

We will all remember Professor Shepard as a servant who gave the best years of his life for the upbuilding of the industries of this great state.

Messrs. Hungerford, Jones, Lynch and Larsen of the department of Dairying, Rilling of the department of Agromony, and Stoltenburg of the department of Horticulture left during the past year. Mr. H. C. Severin and G. Gilbertson Entomologist were added to the force. Some left
because of better positions were received and others because of being in the draft. At the present time there are 19 persons who receive part of their salaries from the Station funds. This does not include labor by the hour during the busy seasons.

THE WORK

For convenience the Experiment Station is divided into six different departments as follows: Agronomy, Animal Husbandry, Chemistry, Dairying, Entomology and Horticulture. The head of each department is also professor of the subject in the College. By this arrangement more efficient employees can be kept and we believe better instruction furnished the students than if each was in charge of two persons. There are two distinct lines of work namely experiments and investigations. For this work we received $36,000.00. This included $15,000.00 from the Adams Fund, $15,000.00 from the Hatch Fund, $5,000.00 for experiments in Animal Husbandry from the State and $1,000.00 from the State for the publication of popular bulletins.

COOPERATIVE WORK

This Station cooperated with the federal government in sending out blackleg vaccine and the testing of new varieties of grains.

DEPARTMENT OF CHEMISTRY

In the absence of Mr. R. Sherwood who has had charge of the experiment in growing sugar beets and also the production of sugar beet seed I make a report for this department. Mr. Sherwood had all work planned and seed in ground when he was called to the colors. In addition to experiments for the production of high sugar yielding beets and beet seed, spacing tests in row also distance of rows apart tests are in progress. We expect Mr. Sherwood to continue supervision and also to return to his work in a few months.

DEPARTMENT OF ANIMAL HUSBANDRY

The demand for information along livestock lines is growing, daily. Because of this, it is evident that producers
of meat products are giving more attention to the breeding and feeding of their animals than formerly. The reason for this can be attributed partly to the fact that this department is becoming wider known and also that meat production animals of all kinds and feeds that produce them are more valuable than a few years ago.

This department spent its allotment, $837.00 of the Hatch Fund during the year. In addition part of the $5,000.00 appropriated by the State Legislature was spent.

The work of this department consisted of breeding and feeding experiments.

**Experiment No. I.**

The object of this experiment is to develop, if possible, a breed of sheep better suited to our conditions than any we now have. Also to eliminate the tail.

Excellent progress has been made. By breeding a cross-bred fat rump ram to a cross-bred fat rump ewe a ram with a short tail that did not require docking was secured. This ram was used last year and quite a per cent of the lambs were short tailed. It is the intention to continue this line of work but it will be necessary to keep large flocks to provide numbers to select from. We are also developing a strain with a square rump. Also one that will furnish a fur. We further believe that lambs with this blood, the fat rump, has more vitality at birth than lambs of any of the other breeds and also that these same lambs will reach 80 pounds sooner than lambs of other breeds from the fact that the ewe will draw on her stored body fat to furnish milk for her young. This can be proven when we have more room. We believe sheep with this blood will live longer during a deep snow than the ordinary sheep because of stored fat in their bodies.

**Experiment No. II.**

The object of this experiment was to determine, by feeding to steers, the value of corn cut at different stages of maturity. Small silos were erected filled with corn at proper times and silage fed to steers. The results show
this to be a comparatively cheap method of making a high quality of meat. Also that the corn silage alone ration is superior for large gains than some more expensive rations when imported by-products of mills and factories are fed.

Experiment No. III.

An experiment in breeding and feeding to determine the effect of feed and exercise of the sow, during period of gestation, on her offspring.

Experiment No. IV.

The object of this experiment was to determine the value of different forage crops sown in corn fields after the last cultivation as compared to the different by-products fed to swine while hogging off corn.

PUBLICATIONS.

Six different bulletins on the following subjects were printed and distributed during the year. No. 176, Potato Culture in South Dakota; No. 177, The Sheep; No. 178, Injurious Corn Insects; No. 179, Emmer in South Dakota; No. 180, Root Crop Culture in South Dakota; No. 181, Corn Culture. The cost of printing and distributing is borne by the Hatch Fund but we receive $1,000.00 from the State which was used for this purpose.

We print 30,000 of each bulletin and distribute to some 22,000 people. It is our practice to include the names of residents of the state, only, on our regular mailing list but we furnish a list of our available bulletins to outside of state people and we send gratis any or all of our bulletins.

We add the names of all county agents, state institutions and farm journals in other states, when requested to do so, to our regular mailing list. Much difficulty was experienced in getting our bulletins printed and it is evident for the best results, changes must be made in our state printing law. The following is the financial report of the Secretary of the College who has charge of the accounting for all funds of the Station.
<table>
<thead>
<tr>
<th>Experiment Station and Sub-Stations</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hatch</td>
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<tr>
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<tr>
<td>Land Endowment</td>
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<tr>
<td>Sales of Produce</td>
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<tr>
<td>Balance on hand July 1, 1917</td>
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<td>Popular Bulletins</td>
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<td>Vivian Sub-Station</td>
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<tr>
<td>Missouri Sub-Station</td>
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---

Costs:
- Hatch: $15,000.00
- Adams: $15,000.00
- State Appropriations: $4,000.00
- Land Endowment: $3,500.00
- Sales of Produce: $1,962.41
- Balance on hand July 1, 1917: $2,392.39

**Total Expenses:** $36,341.64
### Disbursements 1917-1918

#### Hatch
- **Salary**: $4,958.80
- **Labor**: $2,495.39
- **Postage and stationery**: $783.84
- **Freight and express**: $65.07
- **Chemical supplies**: $29.71
- **Seeds and sundry supplies**: $8.26
- **Fertilizers**: $44.26
- **Feeding stuffs**: $33.55
- **Library**: $21.62
- **Tools and implements**: $779.00
- **Furniture and fixtures**: $25.62
- **Scientific apparatus**: $252.45
- **Live stock**: $246.45
- **Traveling expense**: $301.28
- **Contingent expense**: $129.45
- **Buildings and land**: $8,565.77
- **Total expenditures**: $15,000.00

#### Eureka Sub-Station
- **Salary**: $4,958.80
- **Labor**: $2,495.39
- **Postage and stationery**: $783.84
- **Freight and express**: $65.07
- **Chemical supplies**: $29.71
- **Seeds and sundry supplies**: $8.26
- **Fertilizers**: $44.26
- **Feeding stuffs**: $33.55
- **Library**: $21.62
- **Tools and implements**: $779.00
- **Furniture and fixtures**: $25.62
- **Scientific apparatus**: $252.45
- **Live stock**: $246.45
- **Traveling expense**: $301.28
- **Contingent expense**: $129.45
- **Buildings and land**: $8,565.77
- **Total expenditures**: $15,000.00

#### Vivian Sub-Station
- **Salary**: $4,958.80
- **Labor**: $2,495.39
- **Postage and stationery**: $783.84
- **Freight and express**: $65.07
- **Chemical supplies**: $29.71
- **Seeds and sundry supplies**: $8.26
- **Fertilizers**: $44.26
- **Feeding stuffs**: $33.55
- **Library**: $21.62
- **Tools and implements**: $779.00
- **Furniture and fixtures**: $25.62
- **Scientific apparatus**: $252.45
- **Live stock**: $246.45
- **Traveling expense**: $301.28
- **Contingent expense**: $129.45
- **Buildings and land**: $8,565.77
- **Total expenditures**: $15,000.00

#### Adams Local Station
- **Salary**: $4,958.80
- **Labor**: $2,495.39
- **Postage and stationery**: $783.84
- **Freight and express**: $65.07
- **Chemical supplies**: $29.71
- **Seeds and sundry supplies**: $8.26
- **Fertilizers**: $44.26
- **Feeding stuffs**: $33.55
- **Library**: $21.62
- **Tools and implements**: $779.00
- **Furniture and fixtures**: $25.62
- **Scientific apparatus**: $252.45
- **Live stock**: $246.45
- **Traveling expense**: $301.28
- **Contingent expense**: $129.45
- **Buildings and land**: $8,565.77
- **Total expenditures**: $15,000.00

#### Highmore Sub-Station
- **Salary**: $4,958.80
- **Labor**: $2,495.39
- **Postage and stationery**: $783.84
- **Freight and express**: $65.07
- **Chemical supplies**: $29.71
- **Seeds and sundry supplies**: $8.26
- **Fertilizers**: $44.26
- **Feeding stuffs**: $33.55
- **Library**: $21.62
- **Tools and implements**: $779.00
- **Furniture and fixtures**: $25.62
- **Scientific apparatus**: $252.45
- **Live stock**: $246.45
- **Traveling expense**: $301.28
- **Contingent expense**: $129.45
- **Buildings and land**: $8,565.77
- **Total expenditures**: $15,000.00

#### Cottonwood Sub-Station
- **Salary**: $4,958.80
- **Labor**: $2,495.39
- **Postage and stationery**: $783.84
- **Freight and express**: $65.07
- **Chemical supplies**: $29.71
- **Seeds and sundry supplies**: $8.26
- **Fertilizers**: $44.26
- **Feeding stuffs**: $33.55
- **Library**: $21.62
- **Tools and implements**: $779.00
- **Furniture and fixtures**: $25.62
- **Scientific apparatus**: $252.45
- **Live stock**: $246.45
- **Traveling expense**: $301.28
- **Contingent expense**: $129.45
- **Buildings and land**: $8,565.77
- **Total expenditures**: $15,000.00

#### Total
- **Salary**: $4,958.80
- **Labor**: $2,495.39
- **Postage and stationery**: $783.84
- **Freight and express**: $65.07
- **Chemical supplies**: $29.71
- **Seeds and sundry supplies**: $8.26
- **Fertilizers**: $44.26
- **Feeding stuffs**: $33.55
- **Library**: $21.62
- **Tools and implements**: $779.00
- **Furniture and fixtures**: $25.62
- **Scientific apparatus**: $252.45
- **Live stock**: $246.45
- **Traveling expense**: $301.28
- **Contingent expense**: $129.45
- **Buildings and land**: $8,565.77
- **Total expenditures**: $15,000.00
ANNUAL REPORT

LOCAL STATION.
Expenditures by Departments—1917-1918.

<table>
<thead>
<tr>
<th>Department</th>
<th>Hatch</th>
<th>Adams</th>
<th>Station Local</th>
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<td>$15,000.00</td>
<td>$2,951.95</td>
<td>$32,951.95</td>
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</table>

To furnish the best report, possible, of the station I inclose and make a part of this report, a statement from each chief of division to me.

Respectfully submitted,

JAMES W. WILSON,
Director of the South Dakota Agricultural Experiment Station.
Permit me to make the following annual report concerning the progress of Hatch and Adams projects and other experimental work carried on by the Agronomy Department during the fiscal year closing June 30, 1918.

Adams Project No. I.
A Project on the Influence of Rotations Upon the Maintenance of Soil Fertility.

This project which has been in force since 1911 has for its purpose that of developing if possible the effect of various rotations upon the soil, providing these rotations are conducted continually on definite plots of land. The plan is to take representative soil samples at fifteen year intervals from the plots under this project in view of the possibility that chemical and biological changes may be found from period to period. Plots included under this project are East Farm, Brookings, 440-449, 450-459, 140-149, 150-159, West Farm, 140-147, 240-247, 250-253, 340-347, 351-353, 440-447, 451-453, 540-547, 550-553, 640-647, 650-653, total 112 plots. Since making report last fiscal year progress has been made by Mr. H. Loomis, Agronomy Analyst, with analyses from samples of plots 140-159 of the East Farm in connection with the elements nitrogen, phosphorus, calcium and magnesium. No attempt need be made at present to draw conclusions but a very brief perusal of results from the nitrogen analyses of the several plots rather strengthen the belief that it is a possibility to detect gain or loss of nitrogen in plots operated under field conditions by careful chemical methods. It would seem that the same may be said of phosphorus.
Adams Project No. II.

A Study of Correlations Between Certain Physical Characters of Plants and Their Capacity for Yield.

Under the project of the above title the principal work now being conducted relates to a study of “Correlation between the Length of Mother Head in Minnesota 169 wheat, and Yielding Capacity of Progeny.” At the present time correlation tables have been worked out for three separate years showing the correlation between yield of progeny and length of mother head in Minnesota 169 wheat. In the first year, namely 1914, it was ascertained that the positive correlation in favor of larger yield from longer mother heads was .1324. The second year, namely 1915, no attempt was made to compute results accurately on account of the fact that rust practically ruined the head-row yields. In 1916 a correlation table was made between the yield of progeny from the longer mother heads and the shorter mother heads, it being found that at that time there was a negative correlation of 0.0021774. The indications are that whatever advantage there may be in making an original selection of longer mother heads under the conditions of the present experiment such advantage so far as yield is concerned disappears at least with the third generation of progeny.

Adams Project No. III.

A Project to Determine Definitely the Extent to Which Water is a Limiting Factor in the Growth of Sweet Clover (Melilotus alba).

The present season will complete three growing seasons, with the three series of soils, each having four variations of moisture content of the soil within the series. This project is largely conducted by Mr. H. Loomis, Agronomy Analyst. Mr. Loomis reports that the present season seems likely to yield more satisfactory results with the growth of sweet clover plants on the plots, than in either of the two previous seasons. Some difficulties which had previously interfered with the growth of the plants were overcome, one very im-
important one being that freezing down of the plants at severe winter temperatures was largely prevented by removing the plats in the pots to the stock barn. Very briefly the indication is that the plants which suffered most from freezing were those where moisture was most nearly a limiting factor. This indication will be a valuable one in connection with summarizing the results of this project for the three years closing.

It is our intention to make such a summary at the close of this growing year and probably publish results. Although the difficulties with causing plants of Melilotus Alba to grow to maturity in pots, have been found to be great, some results have been obtained that yield actual information on the role of water, as a limiting element in the growth of sweet clover.

HATCH PROJECTS

The experimental work conducted by the Agronomy Department and which might be considered Hatch projects is not greatly altered from work reported in the previous annual report.

The breeding of corn for high protein and the study of possible correlation between percentage of protein in seed and yield of protein per acre has been conducted and analyses of protein have been completed by Agronomy Analyst. Various field rotations have been conducted especially in case of the long time single crop rotations it is possible to observe certain interesting developments. One of the plots in continuous wheat which has been continued since 1897 is becoming so weed infested as to make only a greatly reduced yield in comparison with plots in other rotations. Certain questions present themselves concerning not only the weed factor as related to yield from this plot continuously cropped, but also concerning the flora of the soil. It is hoped that we may be able in due course to make some research along this line.

Two of the rotations included may be entitled “Live Stock and Grain Systems of Farming” which are being conducted for comparison with the use of Hatch Funds on the
West Farm. In the yield of crops especially grain crops in favor of the live stock system, due perhaps to the return of farm manure equivalent to the weight of material taken away in crop residues. At the present time it is interesting to note, however, that the crops look better if one may insert such a popular term on the grain systems than on the livestock system. It is recognized such a situation may be only a temporary indication and is only mentioned here to indicate the apparent facts at the present time.

In addition to Agronomy Adams Projects and experimental work conducted under Hatch Funds, Agronomy Department is conducting a great number of experimental units at the several sub-stations, namely, Eureka, Highmore, Cottonwood, and Vivian. The three former are equipped with a fairly complete system of plot experiments. It is doubtful if any similar stations in the country could be cited that carry any greater number of such units with the use of limited funds. This is especially true at Highmore due largely to the fact that Highmore is one of the oldest sub-stations in the country and also a large amount of valuable cereal investigation work is conducted there under our cooperative agreement with the United States Office of Cereal Investigations. Among the recent contributions to cereals of the northwest which have already added largely to the production of food and feed are Alta corn, a selection from Minnesota 13 and Acme S. D. 284 wheat, a selection from Kubanka S. D. 75. Both of these cereals are additional to those previously worked upon at Highmore and both of them have proved to have higher yielding capacity than the parent stock from whence they were taken.

It is true that our sub-stations have largely effected farm practice in the areas occupied by them. For instance at Eureka it is safe to estimate that the use of corn as a cultivated crop has increased several fold since the establishment of the Eureka sub-station. This fact is exceedingly important when it is understood that there were previously many small grain failures, due in part to the continuous following of small grain. Apparently the total production
of feed has been greatly increased in McPherson and adjoining counties of South Dakota due to the influence of Eureka sub-station; this being accomplished with as large or larger production of wheat and other small grain as formerly.

At Cottonwood the desirability of increasing alfalfa acreage on some of the western soil types has been emphasized.

At all of the sub-stations improved strains of cereals and other crops have been produced and disseminated. It is not possible to over-estimate the benefit which the several sub-stations have been and will be to South Dakota considered along with the work accomplished on the plots and in the laboratories at Brookings.

During the year just closing the Agronomy Department has published the following bulletins:

176—Potato Culture in South Dakota. By Champlin and Winright.

181—Corn Culture in South Dakota. By Champlin and Winright.


Very respectfully,

A. N. HUME,
Agronomist and Supt. Sub-Stations.
DEPARTMENT OF DAIRYING

Professor James W. Wilson,
Director of Experiment Station.

Dear Sir:—

In compliance with your request, I am glad to give you herewith a report of this department for the last year ending June 30, 1918:

Changes in Staff: During the last year there have been several changes and temporary vacancies in our department, due principally to the war. Prof. V. R. Jones, who resigned in June 1917, was succeeded in September by Mr. T. H. Wright, Jr., in September also Mr. E. P. Lynch was elected to the position of assistant to fill the vacancy caused by the resignation in June of Mr. Horace Jones, who entered the military service. Our Dairy Analyst, Mr. E. H. Hungerford, entered the army as a Second Lieutenant in Nov. 1917 and a successor was not found until May 1st, 1918 when Mr. B. L. Johnson began work. Mr. J. M. Eldridge, Creamery Superintendent, left us on April 1st and Mr. E. P. Lynch, Assistant, on June 1st, 1918. Mr. Eldridge's place was filled June 1st by the appointment of Mr. R. W. Terrell but Mr. Lynch's successor has not yet been appointed.

In April the writer was appointed Director of Extension and since that time has looked after the dairy experimental work in an advisory manner. Mr. Robert Wylie will now look after the details of the work in dairy production and Mr. Wright the work in dairy manufactures.

In spite of the above the work has progressed very favorably. A summary of our work is given below:

Adams Fund: Work has been continued on the project: "Relative Value of Proteins of Different Feeds in Dairy Cows' Rations."

Recent investigations have shown that proteins of different feeds are not of equal value. During the summer of 1917 three cows were fed during five periods of from five to ten days each on a varying amount of linseed meal and gluten feed in an attempt to get nitrogen equilibrium and thus to compare values of the proteins.
Complete data of the intake and outgo of the cows for the entire period was kept.

This investigation is not yet complete but the data taken to date shows that it requires less than one half as much protein in gluten feed to reach nitrogen equilibrium as in the linseed meal. It is planned to continue this work.

The other Adams Fund project under investigation is "The Manufacture of a Skimmilk Cheese that Will Keep." The Food Administration and Department of Agriculture have been urging the utilization of skimmilk for human food. Quite a lot of cottage cheese has been manufactured but as it is perishable, it must be marketed shortly after manufacture. Under this project we are trying to find the best method of manufacturing a cheese which will be both palatable and non-perishable in the sense that Cheddar Cheese is non-perishable.

There have been twenty different batches of milk made up into cheese so far. Complete records are kept of the processes used in the manufacture and curing of the cheese and the effect of the various factors upon yield, quality, bacterial content and chemical composition are being studied.

The allotment on the Adams Fund was $1,119.00 with a credit of $625.00 unpaid salary (Dairy Analyst), making a total of $1,744.00.

It was expended as follows:

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<td>Feed</td>
<td>$ 223.14</td>
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</tbody>
</table>

$ 1,718.71

Hatch Fund: The work on the "Ice on the Farm," project has been completed and the results will be published shortly in bulletin form. The object of this work has been to find a suitable method by which water can be frozen into ice in cans during the winter and stored in a simple way for the summer use.

The milking machine experiments have required the
largest portion of the Hatch Fund. The comparative practicability of all the different leading machines is tested. At the present time we have eleven different kinds of machines in use at the Dairy Barn. We have been unable to use these machines all at one time. We plan to continue with the makes which were first started. A good many cows are needed in order to operate so many machines continuously. The effect of machine milking on the length of lactation period; the effect of machine milking upon the shape and condition of the cow's udder and teats and the effect of machine milking upon the total amount of milk during her total lactation period; are questions that can be decided only by continuous use of the milking machine in a dairy herd.

The records pertaining to the production, feeding and breeding of the dairy herd were kept as usual. No experimental funds, whatever, were used for this purpose.

We have also been experimenting with using different crops for silage and for hay. We have now come to the conclusion that for this locality, corn is the best for silage and alfalfa for hay. Everything that has been produced on the dairy farm has been weighed and analyzed and records kept of same.

The Hatch Fund allotment was $626.50. It was expended as follows:

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<td>Labor</td>
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</table>

$ 612.54

Respectfully submitted,

C. LARSEN,
Professor of Dairy Husbandry.
DEPARTMENT OF ENTOMOLOGY.

Director James W. Wilson,
S. D. Experiment Station.

Dear Sir:—

In compliance with your request of September 16, I am sending you herewith a report of the Experiment Station work done by this department for the fiscal year ending June 30, 1918.

The projects which the Entomology department has been investigating are all financed through Adams funds. Owing to the war, it was deemed best to spend practically all of our time on two projects, Adams Projects 2 and 4.

**Adams Project No. II.**

**Title:** The Web Spinning Sawfly of the Plum (Neurotoma inconspicua (Norton) MacGillvray.

The distribution of this insect, the food plants (both cultivated and wild) of the larvae, the injury done to cultivated plants, the life history of the insect, and the behavior of the larvae and the adults have all been determined. Some of the natural enemies, both predaceous and parasitic, have also been discovered. A very important fly parasite (Tachinid), genus and species new to science was found to destroy from 40 to 60 per cent of the larvae at times.

The artificial control measures that we found to be most satisfactory are liquid sprays of lead arsenate 2 lbs. to 25 gallons of water or a 5 per cent kerosene emulsion. Neither of these sprays harm plum, cherry or sand cherry foliage at the strength mentioned, but they both kill 100 per cent of the larvae present on sprayed trees. The liquid lead arsenate spray has the advantage of sticking to the foliage for a long time in spite of rains and of remaining effective during this time, while the kerosene emulsion dries rapidly and then loses its killing properties. Consequently, the lead arsenate spray kills not only the larvae that are present when the spray is applied but also those that appear later, while the kerosene emulsion kills only such larvae as are actually present when the tree is being sprayed. However, it is very important that we know of a spray that will
kill the larvae without poisoning the ripening fruit, and the 5 per cent kerosene emulsion meets our needs exactly in this respect.

We tried the following liquid sprays upon plum trees and while the sprays killed the Neurotoma larvae better than did a lead arsenate spray, they were all found to be unsatisfactory because they burned the foliage:

- Paris green, 5 ounces.
- Freshly slacked lime, 1 pound.
- Water, 50 gallons.
- Zinc arsenate, 5 ounces.
- Freshly slacked lime, 1 pound.
- Water, 50 gallons.
- Calcium arsenate, 5 ounces.
- Freshly slacked lime, 1 pound.
- Water, 50 gallons.

Paris green, Zinc arsenate, and calcium arsenate were each diluted with 15 parts by weight of ground sulphur and then applied as a dust to plum trees infested with Neurotoma larvae, and, while the larvae were killed, the foliage was burned. Lead arsenate powder diluted with 15 parts by weight of sulphur and applied as a dust to infested plum trees killed all the larvae but did not do this nearly as rapidly as did the liquid spray.

Black leaf 40, contrary to expectations, gave very disappointing results even when used as strong as one part to 125 parts of water. A spray consisting of a warm soap solution, one-half pound to two gallons of water, killed many of the larvae, although it was not nearly as satisfactory as the kerosene emulsion.

This project is practically finished except for a number of drawings which must be made to illustrate the life history of the insect.

**Adams Project No. IV.**

Title: The Common Field Cricket (Gryllus abbreviatus Serville.)

This project was begun in July 1917. The distribution
of the insect as well as the injury done to cultivated crops in South Dakota have been investigated. Much of the life history and behavior has been studied, although there is still considerable to learn in these respects. Mating, egg-laying, rate of egg-laying and hibernation have all been closely investigated.

A few predacious enemies and at least two egg parasites of crickets have been discovered.

Control measures have been directed along two lines: first, the destruction of crickets in alfalfa fields, where an immense amount of damage is done to alfalfa seed; and, second, the treatment of binder twine to make the same cricket proof. Experiments in treating binder twine were planned for four different sections of the state and in these experiments, twine treated with three different materials were used. As a check, untreated twine was also used in the same field. All of the treated twine gave very promising results.

The experiments for the destruction of crickets in alfalfa fields were conducted at Capa, S. D. Poisoned baits made according to the following formulas gave very satisfactory results:

**Formula I.**

Bran ........................................... 25 pounds
Black strap molasses .................................. 2 quarts
Oranges .................................................. 6
Water ..................................................... 4 gallons

**Formula II.**

Fresh horse manure .................................. 25 pounds
Black strap molasses .................................. 2 quarts
Oranges .................................................. 6
Water ..................................................... 4 gallons

Salt added to the above formulas did not add to the attractiveness of the bait.

Old hay, straw, weeds, or grass placed in heaps along the edges of alfalfa fields and allowed to remain there for several weeks will become the refuge for thousands of crickets. These heaps of hay, straw, grass, weeds, etc., can
then be systematically burned and all the crickets therein destroyed. However, this means of control must be looked upon as a secondary one rather than as a primary means, especially in alfalfa fields of considerable size.

Very truly yours,

H. C. SEVERIN,
Entomologist.
My Dear Sir:—

The work of the department of Horticulture the past season has been along the lines noted in previous reports. The severe climate of the prairie Northwest demands hardier and better orchard and small fruits than we have at present. To combine hardiness of plant with size and quality of fruit is indeed a difficult problem. The horticultural problems of the southeast part of the state are much different from those in the northwestern part. The standard for northeastern South Dakota would be different from that of southwestern South Dakota. For the newer sections of the state suitable provision should be made for extending the work by establishing trial stations owned and controlled by the state. Hence, we really need several stations to cover the entire field. In order to cover the entire area my standard of hardiness of fruit-breeding work so far has been the ability to stand 40 degrees below zero Fahrenheit with the ground bare of snow. I do not believe in the general cultivation of plants that demand winter protection as that is horticulture on crutches. The busy farmer will not take time to coddle plants.

My policy has been to propagate and distribute new varieties of fruits as soon as possible, not only throughout South Dakota but to many other states across the continent. In combining many species I find that some of the resulting fruits should go farther north and others farther south than this immediate locality.

Many trees and plants were distributed the past spring but the only plants sent out for the first time were one new plum and eight new apples.

A New Plum

The Tecumseh plum was distributed for the first time. It is a fine extra large plum. We have several of this pedigree, which is Shiro crossed with pollen of Surprise. As
Shiro is one of Burbank's hybrid Japan plums combining four species, Surprise pollen makes this an amalgamation of five species. It should go south rather than north.

**Some New Apples**

The most important orchard problem is a hardy winter apple. After raising fully 10,000 seedlings along many lines of pedigree, I have no seedling that I am sure will be the one needed. The evolution of this apple will probably be a step-by-step process rather than a single step. My present plan is to make many combinations, especially of new and complex pedigree, and to bud from the resulting seedling as soon as possible, even before fruiting. This is to determine the growth in nursery and freedom from blight. These trees are one year old, budded on Siberian Crab apple roots. None of these have fruited, but they appear promising after three years of very severe invasion from blight. They will be of interest only to special experimenters who will understand that the trees may turn out to be only of interest as a curiosity or for ornamental purposes.

Eight of these new varieties of apples were sent out for the first time. They were not given names, but only preliminary numbers, S. D. S. C. Nos. 1-8, inclusive. It will be remembered that Opata, Sapa and others of my hybrid plums were sent out before fruiting. Several thousand more trees are on hand of many different combinations. We need more land so they may be given a suitable chance for development.

**Breeding Pears Immune to Blight.**

None of our hybrid pears were available for spring distribution simply because the Japan pear seedlings on which they were budded winter-killed. This definitely determines that fact that we must find a hardier stock than the common Japan pear seedlings, or the trees may be raised farther south and then when planted at the north should be set deeply and carefully mulched each winter. *Pyrus ussuriensis*, the wild pear of the Pacific coast of Siberia, bore a good crop last summer and we have saved every seed. This and *Pyrus ovoidea* will probably be the hardy
blight-proof pear stocks for the North. I am endeavoring to secure a supply of this seed for raising stocks.

Several million people in the West and Northwest have no pears that are hardy against the winter cold and resistant to the bacterial disease known as fire blight. After extensive tests I find two species of Siberian pear that meet this demand, *Pyrus ussuriensis* and *Pyrus ovoidea*, and have already originated and distributed hybrids of *Pyrus ovoidea* with the standard cultivated pear, *Pyrus communis*, of western Europe. It is high time that this work was vastly extended, as these preliminary tests indicate how we may proceed so that every farmer, and also every man in town with sufficient garden space, may raise his own pears.

**Orchard Management**

Experiments in orchard management are not at present possible owing to lack of land. Before we begin to spray or prune in a commercial way, we need something that will endure the winter. Perfect winter hardiness is the great need at present. But as the hardy varieties are now appearing, work in orchard management is indicated.

**Work as Agricultural Explorer**

My five trips to Russia, covering a period of three years, mostly as Agricultural Explorer for the United States Department of Agriculture, and in 1913 for South Dakota, gave rise to unfinished work with plants which seemed best for me to undertake until they were commercially established. Two of these are proso and alfalfa.

**Progress with Proso**

Proso is a large seeded grain millet grown extensively in the dry regions of Eastern Europe and Northern Asia. It is a staple food for many millions of people in this region and also a good grain for all kinds of livestock. In bulletin 158 of this station I have given a summary of this work. Out of thirty-two varieties I imported, probably the best is the one obtained in 1913 in Semipalatinsk, Siberia. Here Proso is the corner stone of agriculture in a climate
with eight inches of annual rainfall. We have been endeavoring to develop a pure line by hand-picking, the aim being to eliminate for table use the few grains of other colors mixed with the original stock as it came from Siberia.

**Proso Hulling Machine.** In August, 1917, the first Proso hulling machine was received from Russia, after one year and seven months on the way. Owing to the submarine campaign it was shipped from Russia by way of Siberia. This machine arrived in time to be exhibited at the South Dakota State Fair, Huron, September, 1917. With a view to saving wheat in 1917 and 1918, I made a special effort to extend the acreage of Proso as a catch cereal crop, especially for dry uplands or for low lands that dry off too late for corn. Proso needs only 60 days for maturity, so may be sown after July first and still give a crop. Table recipes have been worked out to save from one-third to three-fourths, or all, of the wheat.

**Progress with Alfalfa**

Work with the alfalfas from Russia and Siberia is noted in bulletins 159 and 167 and the spring lists for 1917 and 1918, and the annual reports of the Experiment Station. The Cossack has proved to be the best alfalfa for general purposes. From the small spoonful of seed I brought over in 1906 it has rapidly developed in ten years until in 1916 the seed crop of Cossack alfalfa in western South Dakota was over one thousand bushels.

What may be termed a by-product of this alfalfa work is given in bulletin 159, a field method of hybridizing alfalfa by transplanting the parent plants alternately. In the spring of 1915 these hybrid alfalfas proved perfectly resistant to the several late freezes, the last one coming June 9th. I think this method will be found of wide usefulness. Three varieties produced by alternate transplanting and distributed so far are Hansen's Hybrid Alfalfa No. 1 and No. 2, and Hansen's White Flowered Alfalfa.

My conclusion from all this alfalfa work is that if each western state could aid and guide the work of getting a million acres of our driest uplands into the right kind of
alfalfas and certain other drouth-resistant plants, it would prevent the usual exodus of disappointed settlers when the dry seasons come again.

**Research in Herbariums; Field Collecting.**

In order to obtain a wider knowledge of certain groups of plants I visited during the year the herbariums at the Iowa Experiment Station at Ames, the West Virginia Station at Morgantown; the University of Minnesota at Minneapolis; the Arnold Arboretum at Boston, Massachusetts, and the New York Botanical Gardens, New York City. Our thanks are extended to the authorities at all these places. Plants and seeds were collected by personal visits to the timber region near Duluth, Minnesota, and to the mountains of West Virginia. Our thanks are also due to Dr. C. S. Sargent for seeds and plants in my visit to the Arnold Arboretum of Harvard University, Boston.

**Facilities Needed**

The work of fruit-breeding has come to the point where great extension is necessary to obtain the results that the state needs. We need 80 acres of land, so as to give adequate room for the work that is planned, especially in fruit-breeding. 1. I think I see the way clear to develop winter apples that will fill the present great need. 2. We need sub-stations under our control so fruit seedlings can be tested under the most severe conditions, especially in the northern and western parts of the state. These stations need not be expensive, but it means that they must be owned or at least controlled for a long enough period of years to establish the varieties and obtain results. 3. Since success in originating new varieties is dependent upon the fruit-breeding greenhouses granted by the Legislature and the orchard house method developed in connection therewith, I respectfully ask for funds, at least $10,000, for the extension of this work. The state should grant sufficient funds so that we may carry on the work in the right way. To cramp, hinder and slow up the work for lack of land and money, when compared with the great interests involved, is a
policy that is penny-wise and pound-foolish. I have the necessary ideas and right philosophy in the matter. It is up to the state to furnish the money to carry out these plans, which are founded on my experience since 1895 in South Dakota and a wide study of horticultural conditions in countries of similar climate in Europe and Asia.

Yours truly,

N. E. HANSEN,
Horticulturist.