Annual Report

President E. C. Perisho,
State College.

Dear Sir:

I have the honor to transmit herewith the annual report of the Director of the South Dakota Agricultural Experiment Station for the fiscal year ending June 30, 1917.

THE STAFF

Since the establishment of the Extension Division of the College members of the Station Staff are relieved of much of the routine business of the institution and have more time to give to their legitimate duties.

As mentioned in my former reports with few exceptions members of the staff serve in a dual capacity, receiving part of salary for teaching and part for experiments and investigation.

Beginning January 1, 1917, Mr. Harry C. Severin, State Entomologist and also professor of the subject in the college, was added to the staff and three investigations under the Adams Act were assigned him.

THE WORK

The following is a list of projects:
Influence of rotations upon the maintenance of soil fertility.
Study of plant correlations as affecting yielding capacity.
Water as a limiting factor in the growth of sweet clover.
An investigation of the relative value of the proteins in the different feeds for supplying the needs of the dairy cow.
Improvement of hardy fruits of the Northwest by breeding and crossing.
Life history studies of wheat stem maggot.
Life history studies of spinning saw fly of plum.
Life history study of stable fly.
ANNUAL REPORT

Life history studies of common field cricket and the establishment of methods of control.

To determine the relative feeding value of corn silage when corn is cut at different stages of growth.

Feeds for supplementing corn while hogs are in cornfield.

A breeding experiment with sheep to eliminate the "tail" and develop a sheep hardier for western conditions than any we now have.

Crop rotations with a view to definitely observing the comparative effects upon crop yields. For example, it is desired to have quantitative information to show the advantage of rotations over continuous cropping.

A correlation experiment in corn breeding to test the relation between percentage of protein in seed and total amount of protein in the crop.

A comparison of three corn breeding systems to discover, if possible, which is the best calculated to increase yields.

Corn breeding for the development of high and low eared strains.

A comparison of a livestock system with a grain system of farming.

Variety tests of corn, wheat, oats, rye, barley and alfalfa.

The development of the sugar beet by selection for type as related to sugar content.

Making ice on the farm.

Milking machine experiment.

Relation of temperature at time of setting cheese.

The growing of winter apples by top-grafting on hardy stock, such as Virginia and other crab apples and the Hibernal apple.

The Siberian crab and other stocks for the apple to prevent the root-killing which is so often destructive to northern prairie orchards.

A study of plums stocks. We find the native plum to be the best stock but the native sand cherry is useful as a dwarf stock.
Variety tests of coniferous and deciduous trees.
Variety tests of ornamentals, including shrubs, trees, perennials, annuals.

The breeding of hardy roses for the prairie Northwest by crossing the Siberian and native roses with the choicest cultivated varieties.

A test of hedge plants.

PUBLICATIONS
There were seven bulletins published during the year on the following subjects:

169. Flax Culture in South Dakota.
170. Quack Grass and Western Wheat Grass.
171. Pasteurization of Cream.
172. Grasshoppers and Their Control.
173. Sugar Beets in South Dakota.
174. Sorghums for Forage in South Dakota.
175. The Role of Water in a Dairy Cow's Ration.

Thirty thousand copies of each bulletin was printed. We have a mailing list including some 23,000 names. Our practice is to send bulletins to all who apply but add names of residents of the state, county agents in other states, and all public institutions, only, to our regular mailing list. To others we send a list of available bulletins.

The cost of printing and mailing these bulletins is borne by the Hatch Fund altho the state makes an appropriation of $1,000.00 for the purpose which is a great assistance.

COOPERATION
This Station cooperates with the United States Department of Agriculture in testing seeds and in distributing black leg vaccine. The following memorandum of understanding is in force:
ANNUAL REPORT

COOPERATION WITH THE BUREAU OF PLANT INDUSTRY

MEMORANDUM OF UNDERSTANDING

Between the SOUTH DAKOTA EXPERIMENT STATION and the Bureau of Plant Industry, U. S. Department of Agriculture, relative to cooperative investigations with cereals.

Effective March 1, 1916.

The object of these cooperative investigations shall be (a) to improve the cereal industry of the Northern Great Plains region by introducing, or producing, better varieties than those now grown, especially with regard to yield, quality, earliness, hardiness, disease resistance, etc.; (b) to determine the best methods of tillage and crop rotation for grain production; and (c) to conduct such other experiments as may seem advisable for the accomplishment of the greatest good to the region named.

For the purpose of carrying on these investigations it is agreed:

1. That the South Dakota Agricultural Experiment Station shall furnish all necessary land and buildings, teams, machinery for sowing, cultivating, harvesting and threshing, and all ordinary labor, apparatus and other supplies not provided by the Bureau of Plant Industry, and shall make available for use seeds of varieties already under experiment and results obtained at the station at Brookings and such substations as are now or hereafter may be established during the period this agreement is in force.

2. The Bureau of Plant Industry, subject to the approval of the Secretary of Agriculture, shall furnish seed of all hybrids and standard varieties now in its possession that are likely to be at all adapted to the conditions under which these experiments are made, and seed of any new varieties of similar adaptation that may be acquired; and shall provide such assistant, or assistants, (as well as travel funds, labor, and equipment) as may be deemed advisable, at points in the State where cooperative investigations are
being or hereafter may be conducted, the assistants to be jointly selected by and acceptable to both parties to this agreement.

Assistants or collaborators who may be appointed by the Department of Agriculture shall have the franking privilege only for the purpose of carrying on official correspondence concerning cereal work, sending cereal seeds to cooperators for testing, and mailing seeds and other specimens of cereals included in the cooperative experiments to the South Dakota Agricultural Experiment Station and substations and to the Bureau of Plant Industry.

3. The investigations carried on under this cooperative agreement shall be planned and conducted jointly by the duly authorized representatives of the South Dakota Agricultural Experiment Station and the Bureau of Plant Industry, and shall be subject to the approval of the proper authorities in each case. If desired, a detailed outline of plans (including expenditures) for the varying seasons may be attached to this agreement from time to time.

4. Seed of all new varieties of special value may be distributed in localities to which they are adapted, the distribution to be made in accordance with such plan as may be jointly agreed to by the Station and Bureau. The grain resulting from this cooperation shall belong to the Experiment Station provided that if seed is sold, the amount expended by the Bureau of Plant Industry under this agreement shall not exceed half the cost of the cooperative work after the proper credit has been made of the amounts realized from sale, or other disposition, of produce grown under this cooperation.

5. At the close of each season a complete report of the results of the experiments conducted during the year shall be submitted by the assistant in direct charge of the cereal work, one copy to be furnished to the Bureau of Plant Industry and one copy to the South Dakota Agricultural Experiment Station, such report to be delivered as soon after the close of the season as practicable. When requested, thrashed and unthrashed samples of the grain under experiment shall accompany the report.
6. Both parties to this agreement shall be free to use in their official correspondence and in publications the results obtained in these investigations, each giving proper credit to the other cooperating agency.

7. This agreement shall become effective March 1, 1916, and shall remain in force until such time as in the judgment of either party its revision or termination may be desirable.

8. Upon the conclusion of this agreement both parties shall be at liberty to remove from the premises any equipment, apparatus, or other material which they may have furnished during the course of this cooperation.

Dated, April 28, 1916.

JAMES W. WILSON,
Director, South Dakota Agricultural Experiment Station.

Dated, May 2, 1916.

WM. F. TAYLOR,
Chief, Bureau of Plant Industry.

Thousands of doses of black leg vaccine are distributed annually from this Station to cattle growers of the Northwest. The object of this distribution is to save time and I might state that there has been a large increase in the use of this vaccine and especially since the appointment of the county agents.

The following financial statement shows how the federal and state funds were expended:
## EXPERIMENT STATION AND SUB-STATION

**Receipts, 1916-1917**

<table>
<thead>
<tr>
<th></th>
<th>Home Station</th>
<th>Highmore Sub-Station</th>
<th>Eureka Sub-Station</th>
<th>Cottonwood Sub-Station</th>
<th>Vivian Sub-Station</th>
<th>Miscellaneous</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hatch</td>
<td>$15000.00</td>
<td>$15000.00</td>
<td>$15000.00</td>
<td>$15000.00</td>
<td>$15000.00</td>
<td></td>
<td>$15000.00</td>
</tr>
<tr>
<td>Adams</td>
<td>$15000.00</td>
<td>$15000.00</td>
<td>$15000.00</td>
<td>$15000.00</td>
<td>$15000.00</td>
<td></td>
<td>$15000.00</td>
</tr>
<tr>
<td>State Appropriations</td>
<td></td>
<td>$2000.00</td>
<td>$2000.00</td>
<td>$2000.00</td>
<td>$2000.00</td>
<td></td>
<td>$2000.00</td>
</tr>
<tr>
<td>Land Endowment</td>
<td></td>
<td>$3000.00</td>
<td>$3000.00</td>
<td>$3000.00</td>
<td>$3000.00</td>
<td></td>
<td>$3000.00</td>
</tr>
<tr>
<td>Sales of Produce</td>
<td>$5387.62</td>
<td>$1054.90</td>
<td>$928.34</td>
<td>$264.14</td>
<td>$1187.94</td>
<td></td>
<td>$8822.94</td>
</tr>
<tr>
<td>Balance on hand 7-1-1916</td>
<td>$1549.03</td>
<td></td>
<td>$202.00</td>
<td>$4359.53</td>
<td>$6110.56</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL**                  | **$36936.65**  | **$4054.90**         | **$2928.34**       | **$3264.14**           | **$4389.94**      | **$7775.79**  | **$59349.76**|

* Popular Bulletins.
§ Balance Vivian Building (Granary.)
<table>
<thead>
<tr>
<th></th>
<th>HATCH</th>
<th>ADAMS</th>
<th>Home Station</th>
<th>Highmore Sub-Station</th>
<th>Eureka Sub-Station</th>
<th>Cottonwood Sub-Station</th>
<th>Vivian Sub-Station</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salary</td>
<td>$7221.66</td>
<td>$10178.35</td>
<td></td>
<td>$1474.99</td>
<td>$1351.66</td>
<td>$1538.49</td>
<td>$1334.16</td>
<td>$23099.31</td>
</tr>
<tr>
<td>Labor</td>
<td>2288.24</td>
<td>2379.70</td>
<td>351.01</td>
<td>992.91</td>
<td>693.50</td>
<td>921.14</td>
<td>1063.10</td>
<td>8689.60</td>
</tr>
<tr>
<td>Publications</td>
<td>3052.61</td>
<td>266.88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3319.49</td>
</tr>
<tr>
<td>Postage and stationery</td>
<td>125.61</td>
<td>137.37</td>
<td>23.86</td>
<td>6.62</td>
<td>1.76</td>
<td></td>
<td></td>
<td>295.12</td>
</tr>
<tr>
<td>Freight and express</td>
<td>56.54</td>
<td>181.21</td>
<td>54.64</td>
<td>39.96</td>
<td>96.86</td>
<td>73.03</td>
<td>72.15</td>
<td>574.39</td>
</tr>
<tr>
<td>Heat, water and light</td>
<td>25.42</td>
<td>71.93</td>
<td></td>
<td>44.66</td>
<td>13.75</td>
<td>16.15</td>
<td>25.35</td>
<td>197.26</td>
</tr>
<tr>
<td>Chemical supplies</td>
<td>275.08</td>
<td>653.30</td>
<td>6.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>934.38</td>
</tr>
<tr>
<td>Seeds, sundry supplies</td>
<td>409.55</td>
<td>579.07</td>
<td>124.87</td>
<td>255.03</td>
<td>242.08</td>
<td>260.30</td>
<td>366.67</td>
<td>2237.57</td>
</tr>
<tr>
<td>Fertilizers</td>
<td>20.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20.25</td>
</tr>
<tr>
<td>Feeding stuffs</td>
<td>431.15</td>
<td>310.04</td>
<td>13.00</td>
<td>9.40</td>
<td>211.25</td>
<td>191.50</td>
<td>849.84</td>
<td>2016.18</td>
</tr>
<tr>
<td>Library</td>
<td></td>
<td></td>
<td>48.00</td>
<td>48.46</td>
<td></td>
<td></td>
<td></td>
<td>96.46</td>
</tr>
<tr>
<td>Tools and implements</td>
<td>706.61</td>
<td>273.69</td>
<td>31.50</td>
<td>93.77</td>
<td>670.26</td>
<td>306.28</td>
<td>436.18</td>
<td>2518.29</td>
</tr>
<tr>
<td>Furniture and fixtures</td>
<td>124.41</td>
<td></td>
<td>26.50</td>
<td>13.20</td>
<td></td>
<td></td>
<td></td>
<td>181.11</td>
</tr>
<tr>
<td>Scientific apparatus</td>
<td>8.10</td>
<td>275.21</td>
<td></td>
<td>19.18</td>
<td></td>
<td></td>
<td></td>
<td>293.39</td>
</tr>
<tr>
<td>Live stock</td>
<td></td>
<td></td>
<td>1200.80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1587.80</td>
</tr>
<tr>
<td>Traveling expense</td>
<td>133.72</td>
<td>45.00</td>
<td>46.13</td>
<td>60.66</td>
<td>36.16</td>
<td>88.22</td>
<td>80.64</td>
<td>490.53</td>
</tr>
<tr>
<td>Contingent expense</td>
<td>20.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20.00</td>
</tr>
<tr>
<td>Buildings and lands</td>
<td>101.05</td>
<td>4.50</td>
<td>256.36</td>
<td>161.50</td>
<td>1023.57</td>
<td>341.96</td>
<td>1335.51</td>
<td>3224.45</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$15000.00</strong></td>
<td><strong>$15000.00</strong></td>
<td><strong>$2557.42</strong></td>
<td><strong>$3186.12</strong></td>
<td><strong>$4339.09</strong></td>
<td><strong>$3753.69</strong></td>
<td><strong>$6259.36</strong></td>
<td><strong>$50095.68</strong></td>
</tr>
<tr>
<td>Popular Bulletins</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1000.00</td>
</tr>
<tr>
<td>Balance on hand, Local Fund, Home Station July 1, 1917</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4379.23</td>
</tr>
<tr>
<td>Balance on hand Sub-Station Land, July 1, 1917</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3874.85</td>
</tr>
<tr>
<td><strong>GRAND TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>$59349.76</strong></td>
</tr>
</tbody>
</table>
ANNUAL REPORT

EXPENDITURES BY DEPARTMENTS
Home Station, 1916-1917

<table>
<thead>
<tr>
<th>Division</th>
<th>HATCH</th>
<th>ADAMS</th>
<th>Sta. Loc.</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agronomy</td>
<td>$1858.32</td>
<td>$4647.94</td>
<td>$269.63</td>
<td>$6775.89</td>
</tr>
<tr>
<td>Chemistry</td>
<td>$1387.39</td>
<td>$720.00</td>
<td></td>
<td>$2107.39</td>
</tr>
<tr>
<td>Entomology</td>
<td></td>
<td>$888.55</td>
<td></td>
<td>$888.55</td>
</tr>
<tr>
<td>Executive</td>
<td>$2413.69</td>
<td></td>
<td></td>
<td>$2413.69</td>
</tr>
<tr>
<td>Horticulture</td>
<td>$2424.77</td>
<td>$5011.71</td>
<td>$735.93</td>
<td>$8172.41</td>
</tr>
<tr>
<td>Printing</td>
<td>$3052.61</td>
<td></td>
<td></td>
<td>$3052.61</td>
</tr>
<tr>
<td>Animal Husbandry</td>
<td>$2464.16</td>
<td></td>
<td>$1551.86</td>
<td>$4016.02</td>
</tr>
<tr>
<td>Dairy Husbandry</td>
<td>$1399.06</td>
<td>$3731.80</td>
<td></td>
<td>$5130.86</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$15000.00</strong></td>
<td><strong>$15000.00</strong></td>
<td><strong>$2557.42</strong></td>
<td><strong>$32557.42</strong></td>
</tr>
</tbody>
</table>

I include and make a part of this report the report of each chief of division, which gives a more detailed account.

Yours truly,

JAMES W. WILSON,
Director of the Experiment Station and Chief of Animal Husbandry Department.
Dear Sir:

I have your notice requesting report upon the experimental projects now being conducted by the Agronomy Department. It is also noted that reports upon Adams projects are to be kept separate from others.

Adams Project No. 1

A Project on the Influence of Rotations Upon the Maintenance of Soil Fertility.

This project has been in force since 1911. The general plan of the project is to conduct several definite crop rotations continually on definite plots of land, and, by means of chemical analysis, made at several periods of time, to discover in the several rotations, whether the total plant food content has increased or decreased. The project has not been altered in its general scope since it was inaugurated. It has been altered somewhat as to detail. It is now being conducted as previously.

The plots included under this project being now sampled and analyzed are East Farm, Brookings, 440-449, 450-459, 140-149, 151-159, West Farm, 140-147, 240-243, 250-253, 340-347, 351-353, 440-447, 540-547, 550-553, 650-653, total 112 plots.

In my report to you of 1916 attention was called to the fact that up to the time of said report analyses of plots 140-159 of the East Farm had been made for nitrogen, phosphorus, and potassium, also calcium and magnesium. In addition to the foregoing, analyses had been made for total carbon and inorganic carbon from which the quantities of organic carbon were computed by difference.

During the fiscal year just closed, it is to report that Mr. H. Loomis, Analyst for our Agronomy Department, has done considerable work with the analyses for magnesia, and
has further analyzed the “check” plots for total sulphur. The latter work has been completed. Also within a very few days, analyses for total nitrogen have been completed from the second series of samples from five plots. By second series of samples is meant the soil samples taken by boring, since the original soil samples were taken before the present Adams Project was installed. Accordingly, it is a point of progress that these results of nitrogen analyses are likely to give some measure of the effect of rotation and soil treatment, which in fact is the purpose of the project.

Adams Project No. 2

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

In my previous report attention was called to a correlation study which is now in progress, entitled “A Correlation between the Length of Mother Head in Minnesota 169 Wheat, and Yielding Capacity of Progeny.” The first year of results indicated a positive correlation between greater length of mother head and yield of progeny. Results of succeeding seasons indicated that said positive correlation was not maintained. The computations indicating these results have been made by the Department during the year just closed. Likewise at the present time the head rows of the present season have been harvested. The results of these will be weighed and tabulated and the computations from the results will be added to those previously acquired.

Adams Project No. 3

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

The present year of progress with this project has apparently yielded more definite results than either of the previous years. This is due to the fact that in the previous years a good deal of our experience was gained at the expense of the most definite results. For instance, in the two previous years, growth of sweet clover plants, or especially constructed pots mentioned in annual reports of 1915 and
16 was highly variable on the different pots. Furthermore, at the beginning of the project the amounts of water used on the several pots were necessarily empirical to considerable extent.

During the present season Mr. Loomis employed plants of *Melilotus Alba* all of which he secured in the early spring from a secluded area. These plants were selected in the belief that they would represent a given family of plants and would accordingly be less variable than those selected at random. The experience of the season has proved that the natural variation of the plants has been much less than the same variation of previous years.

Certain improvements in protecting the soil of the pots from natural rainfall employed in the first season, have also given much better conditions of moisture control.

At present writing, the plants of the present season are harvested and are now undergoing measurement. It is evident that in due course this project will yield definite information, not only concerning the above water requirement of *Melilotus Alba*, but additional information concerning the influence of type of plant and soil type and seasonal conditions upon water requirement.

The close of the present season marks the end of the first year of growth for the plants now in the series. It is accordingly planned to continue the present plants for another year, which will be their last inasmuch as the plants are biennial. Perhaps at the end of another year it will seem best to tabulate results on this project and publish the same.

**HATCH PROJECTS**

The following are included under Hatch Projects now being conducted:

The breeding of corn for high protein and the study of possible correlation of high percentage of protein in seed with high yield of protein per acre. During the fiscal year just closed, it may be noted that Mr. H. Loomis, Agronomy Analyst, has completed the protein determinations of this project for the year.
The various field rotations conducted under the Hatch fund designed especially to determine if possible the relative values of close and broad rotations from the standpoint of production, have been conducted during the fiscal year just closed. Preliminary computations indicate that although much has been said and written concerning rotations, the problems concerning them require still more research.

The so-called Live Stock and Grain Systems of farming which are being conducted with Hatch funds on the West Farm, Brookings, have been conducted during the year past. The matter of time enters largely into the value of this project. These comparisons should be conducted no doubt many years in part to determine whether the apparent advantage of returning crop-residues to land in form of barnyard manure will ultimately be offset by the apparent decomposition of crop-residues directly in the land.

There are many questions for farm practice, especially in the present time of food shortage, that relate very definitely to a knowledge of systems of farming that will produce the greatest amount of available food. There is much to learn and put into practice concerning whether it is an easy economic possibility to produce relatively cheap human food from land with the employment of Live Stock Systems.

The work of our substations at Eureka, Highmore, Cottonwood, and Vivian, was described at considerable length in the previous annual report for the fiscal year ending June 30, 1916. It may be sufficient to say here that the substation work for the year just closed has been profitable. Evidently, each substation represents its given area of the state more directly than any field more distantly located. Crop rotations have been undertaken at the several substation fields, which therefore yield knowledge concerning the best varieties of corn, wheat, barley, alfalfa and other crops to employ for each locality. Likewise, the several rotations give data which helps indicate the most profitable arrangement of crops whether looking toward the production of grain or live stock.

It is well enough to repeat often that live stock production is desirable, and that production of live stock is bound
to depend upon the supply of crops which can be produced out of the soil. It is in this regard, as well as in the direct production of human food, that soil and crop improvement furnish the material basis for better farming.

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


Very truly,

A. N. HUME,
Agronomist and Supt. of Substations.

ANH-S
The Station work of this department has had to do with hatch projects only for the fiscal year ending June 30, 1917. The work has been exclusively with sugar beet amelioration. The production of pedigreed strains of high sugar content of heavy yield has been continued with success. The aim is to produce strains that will give a yield of twenty tons per acre with a sugar content of 20 per cent. sugar in the beet.

Attention has been given also to cultural conditions adapted to the need of this state consequently spacing the beets in the field and the preservation of the beets in pit silos has been worked out. We find we can preserve the beets in a viable condition perfectly in field pits. Also studies affecting the sugar content have been made.

This department has also given material aid to sugar companies who are conducting commercial tests in this state. Thirty acres in the immediate vicinity of the Station have been overseen and whenever necessary, comfort and advice has been given where needed. The object of this work is the commercial culture of sugar beets in the state.

Analyses have been made of beets from all parts of the state as requested. The conclusion has been reached that the state is well adapted to sugar beet culture. We may expect factories when the times are propitious.

The department has issued Bulletin No. 173, and other bulletins are in preparation.

Very respectfully,

JAS. H. SHEPARD,
Chemist.
DEPARTMENT OF DAIRYING

Director James W. Wilson,
Director of Experiment Station.

Dear Sir:

In compliance with your request, I furnish you here-with a report of this department for the last year ending June 30, 1917:

Adams Fund

The Dairy Husbandry Department completed the project which has been under investigation for sometime, namely: "The Role of Water in a Dairy Cow's Ration." This experiment consisted in giving the cows various amounts of water during the different experimental periods. The cows first received the normal amount of water. In the second period, they were watered only once in 24 hours. In the third period, they were watered once in 60 hours. In the fourth period, the cows received only one-half of the normal water requirements. The feed ration was the same during the experimental periods.

An accurate record was kept of all of the ingo, and all the outgo from the cows. This applies to the chemical composition of all of the feeds and also all of the milk, feces and urine. In addition, a careful study was made of the bacterial flora of the waste products from the cows. The following is the chief summary:

1. Water dissolves nutrients. No foods can be utilized by the system of the cow until they have been brought into complete solution. In accomplishing this, water plays an important part. The more food consumed, the more water a cow requires.

2. Water is a medium for distributing the food to the different parts of the body. Water may serve both as a direct and an indirect transferring agency. For instance, when food is masticated, saliva is mixed with it. Saliva contains about 90 per cent. water. Again, water, when mixed
with food in the digestive tract, serves as a direct medium for transferring food.

3. Water is used as a vehicle for transferring waste and poisonous products from the system. This process of elimination is carried on through the skin, through the kidneys, and through the digestive tract. In all of these instances water plays an important part. In an animal such as the dairy cow, that consumes a relatively large amount of protein, water is of special importance. Urea is one of the soluble poisonous products resulting from a protein ration. With the aid of water and proper circulation, the kidneys are able to rid the system of this particular substance.

An amount of water equal to about 12 per cent. of the total water drunk is eliminated through the skin. This is true during the winter under barn conditions. During the summer or during the month of August about 27 per cent. and accompanying body waste matter were eliminated through the skin.

Little more than one-half, or an amount equal to 56 per cent. of the water drunk, was eliminated in the feces.

About 13 per cent. of the water taken in was passed through the kidneys in the form of urine. All of the excretory agencies need a constant water supply to perform their work of eliminating waste and poisonous matter from the body.

4. A dairy cow uses water for the manufacture of milk. This latter product contains about 87 per cent. water. The cows in these experiments were common cows, and not large milk producers. They used water for milk equal in amount to about 15 per cent. of the water drunk. This will vary according to the amount of milk produced. For instance, cow No. 6 produced more milk and used about 24 per cent. of water drunk for milk production.

The portion of the water eliminated through the urine, through the skin, and used for milk production evidently must first enter into the circulation system of the cow. While the water in the feces probably never serves the system of the cow except as a food solvent, transferring
medium, and for regulating the consistency of the contents of the digestive tract. This does not refer to the water that may enter the digestive tract in connection with secretory or excretory products.

According to Babcock, metabolic water results to the extent of 55.5 per cent. of the cellulose or starch, 60 per cent. of the dextrose, little more than 100 per cent. of the fat, and 60 to 65 per cent. of the protein digested. These various food elements are oxidized in the body of the cow, and form chiefly water and carbon dioxide as by-products. In accordance with this, these cows were supplied with nearly one gallon of metabolic water in addition to that drunk and that contained in the food eaten. When on normal food they drank about 75 pounds, obtained about 17.5 pounds from the silage eaten, 0.7 pounds from the grain, one pound from the hay consumed, and about 8 pounds of metabolic water resulted from oxidation in the body. The total water used daily was then about 102 pounds.

5. Water regulates the body temperature. That there is evaporation from the body surface and from breathing is evident from the above table, and that this loss of water from the body is greater during warm weather or during summer than during the winter. This is shown by the increase from 12 per cent. in experiment A to 26 per cent. in experiment B. This latter experiment was conducted in August, while the former was carried on in January. The rate of respiration is undoubtedly also greater during the summer, which means an increased loss of body moisture.

The new and approved project began during the year is entitled, "The Relative Value of Proteins in the Different Feeds for Milk Production."

The work on this particular project has not progressed far enough so that at this time I cannot make any report on it.

The Dairy Husbandry Department has also been carrying on investigations under the Hatch Fund. For a number of years experiments have been conducted with the practicability of using the cream vat as a combined pasteurizer and cream ripener. A certain amount of cream was put into
a cream vat and the cream pasteurized to 140 degrees F. for 25 minutes. In another series the cream was pasteurized to 160 degrees F. for 10 minutes, and in the third series of trials the cream was pasteurized at temperature of 160 degrees for 10 minutes. The bacterial and chemical composition of these different batches of cream pasteurized to the different temperatures were carefully made and recorded. The quality and keeping quality of these different butters were also made. They were kept in a refrigerator and scored at intervals of one month. Chemical analyses were also made of both butter and butterfat at these different stages. This was done with a view of finding out what caused the decomposition and what decomposition resulted that gave butter the rancid flavor.

The summary of this investigation as reported in Bulletin No. 171 is as follows:

1. It was found that in pasteurization of cream at different temperatures; namely, 140 degrees F. for 25 minutes, 160 degrees F. for 10 minutes, and 180 degrees F., with immediate cooling, the temperature of 160 degrees F. for 10 minutes was the most effective in destroying total microorganisms.

2. Pasteurization of cream at 160 degrees F., or 180 degrees F. proved more efficient in killing molds and non-acid forming organisms than pasteurization at 140 degrees F.

3. The only noticeable change in composition of cream due to pasteurization was a slight decrease in percentage of water, and a consequent increase in percentage of total solids.

4. There was a slight decrease in acidity of the cream after pasteurization at temperatures of 140 degrees F. and 160 degrees F. Cream pasteurized at 180 degrees F. showed on the average less decrease in per cent. acid. This is probably due to the fact that the decrease in acidity by volatilization of acids just about offsets the increase in acidity through evaporation of water from the cream.

5. The numerous microscopical examinations of fat globules in raw and pasteurized cream show that at the
higher temperatures (160 and 180 degrees F.) the fat globules tend to coalesce or unite. This is probably due to the higher heat, together with the greater agitation of the cream by the coil.

6. In no instance was it noticed that the high pasteurization temperatures unfavorably affected the body of the butter.

7. Butter made from cream pasteurized at 180 degrees F. retained its keeping qualities the best.

8. The different temperatures of pasteurization did not have any important effect on the chemical composition of the butter.

We have now begun a study of cheesemaking under South Dakota conditions. The cheese industry bids fair to develop in this state. The first cheese factory was built during the last year.

The “Ice on the Farm” experiment has progressed as usual. The dairy farm ice house was filled as usual with ice made by freezing water in cans. Different sized blocks were made. We are still having some difficulty with the ice bulging at the top during freezing. The question of getting the ice out of the cans in a cheap and practical way is also still a problem that has not been solved to our entire satisfaction. The bulging of the ice cakes on the top prevents the cakes from packing together well in the ice house.

The stored ice is used during the summer, little by little, as it would be used on the farm for cooling milk and cream. A detailed record is kept of the amount of ice stored, and the amount of ice used.

We have also experimented with the keeping of the ice. Some of the ice has been kept in piles on top of the ground. Some seasons the ice has been stored in a hole in the ground, and some season the ice has been stored in the ice house. In this manner, we have data which shows the most economical manner of obtaining ice on the farm and also of storing ice on the farm.

The milking machine experiment has also been continued. Bulletin No. 166 gives the results up to date. During the last year several milking machine companies asked
us to install machines. At the present time we have nine different kinds of machines in use in 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. Besides, no machine is started on cows that have been milked by hand for some time. It has been found in these experiments that cows do much better on milking machines when the machine is put on shortly after a cow freshens and continued through the lactation period.

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, 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, so we are continuing the milking machines in the dairy herd.

In addition to the records of the production of the herd, the records of the grading up of the herd by use of a pure-bred sire have been continued. We now have 10 years of records and hope in the near future to publish some of this interesting data. I might also say in this connection that we have been 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. This is also very interesting data.

Respectfully yours,
C. LARSEN,
Dairy Husbandman.
DEPARTMENT OF ENTOMOLOGY

Director James W. Wilson,
South Dakota Agricultural Experiment Station,
Brookings, S. D.

Dear Sir:

In reply to your request I transmit herewith a report of the work of the Entomology Department for the fiscal year 1917.

The funds for financing the projects which the Entomology department conducted during the year were obtained from the Adams Fund. A brief statement reporting upon the progress of the work is hereby made, the detailed results to follow when each project is published in bulletin form.

Adams Project 2

Title: The Web Spinning Sawfly of Plum (*Neurotoma inconspicua Norton*), its life history, food plants, economic importance, habits and control.

The distribution and economic importance in South Dakota of this pest and the wild and cultivated food plants of the larvae have been determined. Considerable was accomplished in working up the life history of this insect as well as its natural enemies. Spraying and dusting experiments were also conducted, arsenical sprays and dusts being found most satisfactory. We may be able to complete this project next year.

Adams Project 1

Title: The Wheat Stem Maggot (*Meromyza americana* Fitch), its distribution over South Dakota, life history, food plants, injury done, enemies, and control.

The distribution of this fly has been determined and much of its life history has been learned during the past year. The food plants and natural enemies and their importance as checks have been investigated. Considerable was also done with variety susceptibility of plants to fly attack and the effect of early and late spring sowings was
determined. Control experiments with oils were not made this year, it being planned, however, to do work of this kind during the year 1918.

**Adams Project III**

Title: The Stable Fly (*Stomoxys calcitrans* Linn), its distribution in South Dakota, the importance of the fly in different sections of the state, the relative abundance of the fly with reference to breeding material, rainfall and parasitic and predaceous animals, the life history of the insect in South Dakota, migration possibilities of the imagines and tropic reactions of the flies and larvae.

During the fiscal year, our efforts were directed towards learning the distribution of the stable fly in South Dakota and in investigating the relative importance of the fly to the dairy and ranching industries. Some work was done towards determining the importance of various materials chosen by the fly for breeding purposes and a study of the tropic behavior of the flies and larvae was also begun. Some progress was made in learning more accurately and fully certain phases of the life history of this insect.

During the year a 36 page bulletin (*Bulletin 172, Grasshoppers and Their Control*) was published.

Very respectfully,

H. C. SEVERIN,
Entomologist.
DEPARTMENT OF HORTICULTURE

Director James W. Wilson,
South Dakota Agricultural Experiment Station.

My Dear Sir:

The work of the Department of Horticulture the past year has been along the lines noted in previous reports. Creative Horticulture is the main feature, because the prairie Northwest needs 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. Each season, as soon as the plants are available, new fruit trees, ornamentals and other new plants are sent out for trial not only in South Dakota but to many other states. The standard of hardiness adopted for this work is the ability to endure at least 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 prairie farmer will not take time to coddle plants.

The following is a brief description of the new varieties sent out for trial, spring 1917:

Progress with Manitoba Native Plums

Some years ago I obtained some wild plums (*Prunus nigra*) from near Stonewall, Manitoba, and out of many seedlings two were selected and propagated under the names Winnipeg and Assiniboine, as noted in my Bulletin 130. These have been tested at various places at the North, especially in their native region, and have won favor. Here at Brookings the Manitoba plums are characterized by small size of tree, but extremely early season of fruit. In fact, they are the earliest of all the native plums, but are not needed for the main market here since at Brookings we can raise larger and better plums owing to our longer season.

In the endeavor to improve the fruit in size and quality I have made a number of hybrids of the Manitoba wild plum with choice plums from California. None of these hybrids
are as large as Waneta so will probably be planted mainly at
the North. The trees are productive and the large red fruit
is of excellent quality. The names are all of Indian tribes
of the far North, especially Manitoba.

*The Ojibwa Plum.*—Offered for the first time. Pedigree:
Shiro x Manitoba wild plum pollen. Since the Shiro, one of
Luther Burbank’s plums, is a complex hybrid of four species,
the Ojibwa will be a mixture of five different species of
Prunus: *Nigra, Angustfolia, Cerasifera, Triflora, Simoni.*

*The Cree Plum.*—Offered for the first time. Pedigree:
Manitoba wild plum x Combination plum pollen. When
introduced in 1901 by Luther Burbank the Combination was
considered the best in quality of 25,000 seedlings.

*The Pembina Plum.*—Offered for the first time. Pedigree:
Manitoba wild plum x Red June plum pollen. The
Red June is one of the earliest and best plums, imported
many years ago from Japan.

**Late Plums for the South**

We have raised many seedlings of the Sand plum of
Kansas, *Prunus Watsoni*. They are interesting trees of
dwarf habit bearing profusely of good fruit which varies
greatly in size and quality. Two of my hybrids with the
Wolf plum are now offered as being worthy of trial in the
south since they ripen after all other plums are gone but yet
early enough to escape frost year after year. I judge these
new plums should not go much north of Brookings as they
may not ripen. But for the southern part of the state they
are worthy of trial as a distinct new departure in plums.
The names are given in honor of old Indian tribes in the
Sand plum region.

*The Kaw Plum.*—Offered for the first time. Pedigree:
Prunus Watsoni x Wolf plum pollen. The color is a pleasing
bright dark red with firm skin, with fine white dots and
white bloom and peculiar crisp texture of yellow flesh. The
quality is pleasing to all who have tried it.

*The Kiowa Plum.*—Offered for the first time. Pedigree:
Prunus Watsoni x Wolf plum pollen. Much like the Kaw. Perhaps only one will be needed.

A New Hardy Cherry for the North.

The Moscow Cherry.—The prairie Northwest greatly needs a hardy cherry. In the course of my five tours to Russia I became greatly interested in the cherry grown in the Vladimir region of Russia just east of Moscow. The fruit comes to the markets of Moscow in immense quantities. Near Moscow, on the Sparrow Hills where Napoleon stood in 1812, there are some interesting orchards of these cherries which I visited in 1894 and 1897. These cherries are grown mostly from root sprouts and seeds. The type, however, is not as constant as was thought at first, but varies considerably. Out of a lot of my imported seedlings I have selected one and named it Moscow which is now offered for the first time as budded trees, as it would take too many years to work up a stock of the cherry on its own roots. The following trees are offered as one year buds on Mahaleb roots. This means that at the North they must be mulched carefully to prevent root-killing. As soon as possible, the Northern native Pin cherry should be tested as a budding stock. Out of a large number of cherries tested at this station, Moscow is the only one that has borne fruit in satisfactory quantities. The tree is productive and perfectly hardy. The fruit is of medium size, bright red with light colored juice of good quality.

Breeding Pears Immune to Blight, the Greatest Enemy to the Pear.

The experiments in breeding pears immune or resistant to blight are described in Bulletin 159 of this Station. In the spring of 1915 scions of 39 varieties were distributed to 24 men in four different states. The later development of this work I noted in the Minnesota Horticulturist for August, 1916, and in the 13th report of the South Dakota State Horticultural Society. Since the publication of Bulletin 159 the tree called Pyrus sinensis or Pyrus Simonii has been separated from the other Chinese pears by Alfred
Rehder into a new species and is now called Pyrus ovoidea. The past three years 1914-15-16 have been marked by the most severe invasion of blight in the history of the Station. No attempt was made to cut out the affected pear, apple and crab apple trees, so that these resistant pear seedlings have had every opportunity to blight standing as they are in the same row with the blighted trees. None of these seedlings have borne fruit, but it is deemed best to send out some one year trees under restrictions since it is highly important to determine as soon as possible their resistance to blight under all conditions. The original trees of Pyrus betulifolia suffered severely from blight the past season, so that the series of hybrids with this species, N. E. H. 1-13, inclusive, will be held awaiting further developments. Most of the Pyrus ovoidea hybrids, N. E. H. 14-39, inclusive, are still very promising as they have proven resistant against blight the past three years. The trees are one year old buds on seedlings of Japan pear, Kieffer pear, or French pear. My opinion at present is that the Japan pear will be the best commercial stock. This agrees with experience on the Pacific coast where the Japan pear which is also a form of the Chinese sand pear, Pyrus Sinensis, is found to be blight-resistant. My present impression is that the Japan pear stocks are not fully hardy, so the young trees will need to be carefully mulched over winter to guard against root-killing. The varying hardness of the Japan pear seedlings, as grown from imported seed, is no doubt due to the large area over which seed is gathered, the Northern type being hardier than the Southern type. The present indications are that the Pyrus Ussuricensis from the Pacific coast section of Siberia will be the coming pear stock as the tree is absolutely hardy and very strongly resistant to blight. My experience with the Japan pear seedlings is that they make a fine growth in nursery, and take buds easily. But the winter of 1915-16 was one of deep snow so we could not give it the fair test as to whether mulching or not mulching made much difference.

These new hybrid pears have not fruited, but the fruit cannot be expected to be smaller than that of Pyrus ovoidea
itself, which, although only one and five-eighths inches in diameter, is sweet, juicy, and of fair quality.

**Pyrus Ussurienis**

*Pyrus Ussurienis* is a wild pear from the Pacific coast section of Siberia. From my 1908 tour to Russia. This tree has proven perfectly hardy and very strongly resistant to blight. We have several importations including some by Frank N. Meyer as well as my own. The stock offered is some secured from my 1908 tour to Russia. This will probably be the hardy, blight-proof stock of the future so an orchard should be established as quickly as possible for raising seed from which to raise seedlings.

**Progress With American Wild Crabs.**

*Giant Wild Crab.*—Offered for the first time. Probably the largest wild crab found so far. Good specimens of the fruit run three inches in diameter and weigh four ounces. A brief note by W. H. Shroyer, of Sherrard, Illinois, calling attention to a large-fruited wild crab, appeared in the Fruit Grower (St. Joseph, Mo., Nov., 1911, page 32). The article was illustrated with a cut of a specimen of the fruit. Early in December, 1911, I visited the original tree near Sherrard Illinois, and obtained scions. The original tree was cut down in clearing out the brush some time in the winter of 1912-13, so it is fortunate that these scions were saved. As near as I could determine, the original tree of the Mercer (Fluke) wild crab was within about four miles of this place, but it had been grubbed out of the open pasture of native timber where it was found. In color and quality the fruit of the Giant is much like the other large wild crabs, such as Soullard and Mercer, and will be useful mainly for jelly, or for adding a quince-like flavor to common apple sauce.

**A New Red-Jellied Siberian Crab.**

*Dolgo Crab.*—At the annual exhibits of this Department of the South Dakota State Fair many have asked about the remarkably long conical, intensely bright red crabs we used for making letters. This is one I brought over from my
second trip to Russia in 1897. A vigorous productive tree
and so far free from blight. Fruit full of juice, jells easily,
makes a rich ruby red jelly of beautiful color and excellent
flavor.

The one year old trees in nursery are of strong growth
with wide spreading forks and strongly shouldered limbs,
indicating that they will not split down easily. The trees
are budded on common apple seedlings, so must be planted
several inches deeper and carefully mulched over winter to
prevent root-killing.

Siberian Crabs for Apple Stocks.

Root-killing is a frequent occurrence in the apple or-
chards of the prairie Northwest. The Commercial apple
stocks grown in the United States are raised either from
seed imported from France or from seed saved in the cider
mills of Vermont and other eastern states. In Bulletin 65
of this Station I urged the trial of Siberian roots to prevent
the root-killing which is often disastrous at the North. The
experiments are still in progress. In 1915 we seeded fully
50 barrels of various Siberian crab apples. The chief point
brought out was that for raising seedlings the pure Pyrus
baccata, such as the Yellow and Red Siberian, were much
better than the hybrid crabs. The hybrids as a class produce
little seed, as compared with the Red Siberian and Yellow
Siberia. The small fruits of Pyrus baccata produce fine
seedlings but are somewhat smaller in nursery the first year
than the Red and Yellow Siberian, which are larger in both
fruit and seed. The seedlings from the hybrid crabs are
somewhat variable while those of the Pyrus baccata type
are much more uniform. Our method is to line out the one
year seedlings in the spring and bud at the collar in August.
One year buds of many varieties of the apple makes a better,
smoother growth than the ordinary root-grafts. The details
of this method are being worked by actual field trials and
many seedlings were distributed for trial elsewhere.

Progress With the Apple.

A hardy winter apple is the most important problem of
all in the horticulture of the prairie Northwest. After grow-
ing fully 10,000 apple seedlings along various lines of pedigree, I have named and introduced only two crab apples, Amur and Ivan, and one apple, the Sereda. I have as yet no apple to offer as the winter apple so much desired by several million people, but a lot of promising seedlings are coming on along new lines of pedigree. The evolution of this apple will probably be a step-by-step process. For some years I have been building up a series of complex hybrids as well as primary hybrids. All the promising seedlings are put at once in propagation as only in this way can their subsequent behavior in the nursery and orchard be determined. Their resistance to fire blight and scab are considered, as well as hardiness. They are budded on Siberian crab seedlings so that there will be no loss from the root-killing that would occur with the common apple stocks.

Progress With Gooseberries.

The work with native gooseberries began in fall of 1895. The work has been mainly with *Ribes gracile* of the Sioux valley, northeastern South Dakota. Many thousands of seedlings have been fruited. In 1916 great improvement was shown in the fruiting of the sixth generation of seedlings. The seventh generation came up in seed beds this spring. Many of these seedlings are larger in fruit than some of the leading western commercial varieties. The berries are black, smooth and of good quality for culinary purposes. I have also crossed this species extensively with the larger European gooseberry. These hybrids average considerably larger in size of fruit than the pure wild seedlings. They are of excellent quality and ripen more uniformly which is a great advantage. The best of these new gooseberries will be propagated as rapidly as possible for distribution.

Progress With Raspberries.

The work in breeding hardy raspberries is noted in Bulletin 159. I am working mostly with pure seedlings of raspberries, and also hybrids. The main genetic principles under investigation are: 1. The projective efficiency in the hybridization of various species. 2. The comparative value of
primary and derivative hybrids. 3. Is selection from pure seedlings better than hybridization? Out of the first 7,000 seedlings only one was named, the Sunbeam. Out of the next lot of 6,000 seedlings only one was named, the Ohta. Both of these are now grown extensively. The main endeavor is to develop a raspberry that will be hardy as the native so it will obviate the necessity of laying down the canes and covering over winter, work that the busy farmers will not undertake. The past season some very promising seedlings fruited for the first time. Hybridizing so far has given much quicker results than selection from pure native seedlings.

_A New Muskmelon._

_Hansen's Siberian Muskmelon No. 3._—Offered for the first time. Seed obtained on my 1913 trip to the Semipalatinsk Province, Siberia. The skin yellow, flesh white. The best specimen weighed 11 pounds, and was shown at the South Dakota State Fair at Huron, September, 1916. This melon is very early and productive. As tested on sandy soil in Siberia the quality was delicious. Here on the heavy black soil the quality varies, some being good, others not so good. The quality of a muskmelon depends somewhat on the soil.

_Progress With Roses._

The prairie Northwest needs double, everblooming roses that will survive the winter without protection. Hence, rose-breeding is one of the leading projects under the Hatch fund. The main materials used in this work are the wild roses of the Dakotas and Canada, the Siberian form of Rosa rugosa, and as many of the best cultivated roses as possible. Of the thousands of seedlings raised so far only one has been named, the Tetonkaha, described in Bulletin 159 and distributed for the first time in 1912. The past season great progress was evident in the new seedlings that bloomed for the first time, especially a hybrid of the Tetonkaha with the American Beauty. This new seedling with 45 petals and 20 petaloids and blooming all summer, combines in a large
measure the hardiness of Tetonkaha with the large size and rich fragrance of American Beauty.

**Progress With Proso.**

**Hansen’s White Siberian Proso.**—Some will prefer to name this the Hansen White Millet. I found this large white-seeded grain millet among the Kirghiz Tartars near Semipalatinsk, Siberia, in 1913, who grow it extensively as a grain for themselves and their live stock. It is the corner stone of their agriculture in this eight inch rainfall climate, a sure crop in the driest years. For table recipes, see Bulletin 158 of this Station. A minister in Wyoming writes that the ladies of his parish tried with good results eight of these recipes, including pancakes, muffins, sour milk bread griddle cakes, rolls and Boston Brown bread. A farmer at Owanka, Pennington county, Western South Dakota, writes that he raised 300 pounds of grain from the one pound of seed sent him as a free premium in 1915. The first prize offered by the South Dakota State Horticultural Society for 1916 was won by D. Betts, of Alexandria, South Dakota, who raised 115 pounds grain from one-half pound of seed. The past season we grew a small lot from hand-picked seed, the aim being to eliminate for table use the few grains of other colors mixed with the original stock as it came from Siberia. It was very slow and tedious work. One pound of seed sown in the spring means usually four to five bushels in the fall. A grain that will furnish good nutritious food for yourself and family and all your live stock in the driest years on the driest uplands of all our western states. A grain that at a pinch can be prepared for the table with a cheap coffee mill and sieve.

**A Proso Hulling Machine.**—During January and February, 1915, an endeavor was made to get from American manufacturers a machine for hulling proso, but no one could supply it. In Russia many power machines supply the needs of million of people. The Russian peasants make many hand mills but none were available. In January, 1916, I ordered one of the best power machines direct from Russia with the aid of William P. Anderson, Russian Government
Agricultural Commissioner to the United States. War conditions of ocean transportation made it inadvisable to send this machine across the Atlantic ocean so it was sent east by the way of Siberia.

For a time it was lost in the many square miles of freight piled up at Vladivostock. Then it came on by way of Japan and the Pacific ocean. After a time it reached Seattle; then got into a thru car for New York and finally, after over a year and seven months, arrived at Brookings. This machine was tested for the first time August 25, 1917, and does excellent work.

Natural Hybrid Alfalfas.

In my bulletin 141, January, 1913, I made the following statement: "In Asia and southern Europe wherever the common blue-flowered alfalfa and the yellow-flowered alfalfa grow near together, the pollen is carried from one to the other by bees and other insects so that hybridization takes place freely. These hybrid alfalfas are sometimes called Sand Lucerns. Their number is legion and they consist of all sorts of mixtures in varying proportions of the yellow and blue alfalfas.

Since the Medicago falcata is very widely distributed in Europe and Asia, ranging in Asia from India north to above the Artic Circle in Northeast Siberia, the plant varies greatly in its ability to resist cold, hence it follows that hardiness of this hybrid alfalfa must depend largely on the region from which it comes. Coming from the mild region of Southern Europe it could not be expected to be as hardy as if it came from the drier and more severe climates. Hence while nature has indicated in the Sand Lucernes a method of increasing the vigor of alfalfa by hybridization, we do not know that this combination is the best one that is possible to make. I now have at the Experiment Station at Brookings a large cosmopolitan collection of alfalfas and hope in the near future to originate still better varieties combining the best points of the alfalfas of the world.

Cossack Alfalfa.—The strongest and best one of these natural hybrid alfalfas is the one I have named Cossack,
noted in Bulletins 159 and 167. The Cherno alfalfa, sister plant of the Cossack, has been consolidated with the Cossack as it is not possible to distinguish between them. The small spoonful of seed which I obtained in Russia in 1906 and named the Cossack has been developed in the hands of many farmers so that the 1916 crop in the western part of South Dakota was fully One Thousand Bushels. Buyers for the leading seedsmen have been busy in these fields and the seed is now being offered. Many farmers have found by their own experience that the Cossack is the heaviest and best seeder of any alfalfa they have ever tested. The dry seasons of 1911, 1912, 1913, demonstrated the value of the Cossack. Very favorable reports of the Cossack come from many sections, including the far northwest prairie region of Saskatchewan, Canada.

Hybrid Alfalufs Produced by Transplanting.

My machine method of transplanting alfalfa, first noted in Bulletin 141 and later in Bulletin 159, has now been brought up to date in Bulletin 167 which can be obtained upon application. It is interesting to note that, aside from small lots, the first large lot, one thousand pounds of Cossack alfalfa seed, was raised in 1913 by machine transplanting. By transplanting, one pound of seed is sufficient for twenty acres, instead of the old method of twenty pounds for one acre. When fully standardized and perfected, I believe it will be the means of reclaiming millions of acres of dry western uplands where present varieties and methods have been found unequal to the task. In Bulletin 159 is described my new method of hybridizing alfalfa by transplanting the parent plants alternately. In the spring of 1917 the following three varieties produced in this manner were distributed.

Hansen's Hybrid Alfalfa No. 1.—Offered for the first time. This variety was produced by transplanting the Semipalatinsk alternately with my Select Turkestan S. P. 1. 20711. The latter is characterized by its wonderfully tall erect habit of growth. The seed was saved of the Semipalatinsk plants and instead of producing yellow flowers,
I find that the work of hybridizing is practically finished as fully 86 per cent. of the plants come strongly variegated in many colors. Only 14 per cent. come with yellow flowers which is the normal color of the Semipalatinsk. This original seed was sown in 1915 at the rate of 4 pounds per acre in 18-inch drills which we found was much too thick. The crop of 1916 was 7,200 pounds of hay on 1.4 acres or at the rate of 2.57 tons per acre in one cutting. The yield was really heavier but the frequent rains prevented getting all the crop.

_Hansen's Hybrid Alfalfa No. 2._—Offered for the first time. This originated from a single plant of the yellow flowered alfalfa, *Medicago falcata*, from Samara, Russia, S. P. I. 20271, with the typical sickle-shaped pod of the *Medicago falcata* but with blue flowers instead of the typical yellow flowers. Seed of this one plant was saved and the plants showed most wonderful variegation in colors of blossom. These plants proved proof against killing frost June 9, 1915, when common alfalfa was badly hurt. The seed was distributed in packets of 100 seeds.

_Hansen's White Flowered Alfalfa._—Offered for the first time. While the hybrid alfalfas with the variegated flowers have shown wonderful hardiness and productiveness, it would be an advantage if they could be bred with a definite outstanding characteristic by which they could be readily recognized. For example, an alfalfa with white flowers would have in this color a distinctive trade mark that would protect against misbranding and substitution in the sale of seed. This would be much the same as the Hereford cattle breeders putting a white face on their breed to serve as a trade mark. Holstein cattle are known by the black and white color, Hampshire swine are known by the white belt. Many other cases might be mentioned. In the case of alfalfa it would be difficult to keep this seed pure, even after the type is fixed, since the flowers cross-fertilize so readily. But it could be done by suitable care as to the location of seed plantations. The Cossack alfalfa exhibits strong tendency to light-colored variegation, and even to pure white flowers.
For several years I have been endeavoring to select a white flowered alfalfa that would also be as hardy and productive as any of the others. Some of my correspondents report white flowers in the new alfalfas but that the colors do not come true. It is evident that careful selection must be practiced.

The variety here offered distinguishes itself by strong upright growth and productiveness both as to forage and seed. It is a beginning only. From last springs' experience we find that the seed comes fully 70 per cent. true to the white color, but the work may easily be completed. Owing to lack of room the seed is now offered to experimenters elsewhere. The seed may be sown in rows and the plants transplanted after one year's growth as described in my Bulletin 167. The plants that do not come true as to white color of flowers should be removed as soon as they show the off color. This variety originated as a seedling of the yellow-flowered alfalfa, *Medicago falcata*, from Omsk, Siberia, grown closely adjacent to the Cossack.

*Material for Experimenters.*

Seeds of the following five forage plants were also distributed spring 1917.

*Siberian White Sweet Clover.*—As found in cultivation the common white sweet clover, *Melilotus alba*, is a native of western Europe. In my 1913 trip to the Semipalatinsk Province, Siberia, I found this species a common plant on the dry steppes with 8 inches of annual rainfall, with temperature ranging from 50 degrees below zero Fahrenheit in winter to 106 degrees above in summer. The plants are extremely vigorous. This seed may or may not be better than the ordinary white sweet clover, but should be given a trial in the driest sections. A few seeds of the yellow-flowered sweet clovers, *Melilotus officinalis* and *dentatus*, may be found mixed with this stock. They can easily be saved separately. This seed was sent at planting time and run thru the Svalof preparator or seed-scratching machine just before shipping. Such seed must be planted at once and not kept over.
Siberian Red Clover.—I found this growing wild along the Irrish river in the Semipalatinsk Province of Siberia in 1913. The growth indicates that it is only for the far North where winter-killing is more of a factor than further South. This seed was run thru the Svalof preparator or seed-scratching machine just before shipping. Such seed must be planted at once and not kept over.

Daghestan Yellow Sweet Clover.—This is Melilotus officinalis from Daghestan Province, Transcaucasia, Bordering on the Caspian Sea. “Considered as a very good fodder plant.” This is S. P. I. 20682 from my 1906 tour to Russia. Good abundant foliage and a free seeder.

Hansen’s Samara Perennial Clover.—First noted in my list for 1912. A perennial red clover native of the dry steppes of the Volga region and east European Russia. It is Trifolium alpestre Crantz; (S. P. I. 20654) from my 1906 tour. Fine plant but we find difficulty in getting even germination of seed. Freezing or sulphuric acid treatment of seed will probably solve the problem.

Semipalatinska Alfalfa.—Described in Bulletin 141 and 167. From the dry steppes of Semipalatinsk, Siberia. Some of the farmers who have had excellent results with this alfalfa on the driest uplands of the west now abbreviate this word to Semi. A variety of great vigor and especially adapted to transplanting into cultivated rows. It is not at its best the first season as it first makes its remarkable root system. It does its own subsoiling on hardpan. Flowers yellow. I find this to be the strongest in growth of all the varieties of Medicago falcata. A number of reports from high uplands in several states indicates that this plant endures unhurt severe frosts every month all summer.

N. E. HANSEN,
Horticulturist.