Annual Report

of

The South Dakota Agricultural Experiment Station

for

The Fiscal Year
Ending June 30,
1929

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Mr. C. Larsen,
Dean of Agriculture,
South Dakota State College,

Dear Sir:

As director of the South Dakota Agricultural Experiment Station, I have the honor to make the following report for the fiscal year ending June 30, 1929. At the close of the year there were thirteen departments of the station. A report in detail by each department head is included herein and also the financial statement by the secretary of the college, showing how the different funds were expended.

Yours truly,

JAMES W. WILSON

Director of the Experiment Station.
Annual Report
AGRICULTURAL ENGINEERING

“CORN HARVESTING MACHINERY” PROJECT—PURNELL

The purpose of this study is to build a stationary corn husker which when combined with the use of a two-row corn snapper and portable farm elevator, now available, will increase the speed of mechanical harvesting of ear corn by 100 per cent. The average amount of ear corn that is harvested with the present one-row picker-husker is 205 bushels per day. The average number of men required to harvest this amount is 2 1/2 men. The above mentioned machine and plan will double the number of bushels harvested per day by increasing the required man-power by one-half of one man.

Summary

All present husking machinery was studied and the fundamental principles of the mechanical corn husker were thoroughly tested. A husking bed set-up was made in the laboratory, and tests were made to find out the following things desirable in building the stationary husker: (a) the most efficient diameter of husking rolls; (b) the most efficient length of husking roll; (c) the most practical peg for husking rolls; (d) the optimum speed for husking rolls; (e) the optimum angle for husking rolls in the bed; (f) the desirable amount and most efficient type of ear retarders for the husking bed; (g) a practical means of taking the husks from the machine; and (h) a practical means of cleaning and saving the corn that is shelled from the ear in husking.

The following facts have been reasonably well decided from the above. (Other facts have not yet been determined.) The optimum diameter of the husking roll is between 3 1/2 to 4 inches; the optimum length of husking roll for a stationary husker is 36 to 42 inches; the most satisfactory husking peg is a flat headed stud; the optimum speed for husking rolls is 300 R.P.M.; the optimum angle for the husking rolls in the bed is 18 to 22 inches and a machine allowing an adjustable angle to suit the moisture content in the husks of the snapped corn is desirable. One ear-retarder at the top of the husking bed is most satisfactory.

It was found that snapped corn for South Dakota averaged 9 per cent husks, and that these husks can easily be baled for commercial use as it is husked. Work of building the machine is now in progress.

“THE USE OF THE COMBINED HARVESTER-THRESHER” PROJECT—PURNELL

Note: All this season’s work was done on “direct-combining.”

The purpose of this project was to study the small combine in actual operation and to secure information as to the time the combine can be started in grain fields for direct combining (cutting and threshing in one operation). Other purposes were to find out how early in the morning it is safe to start the combine for “direct-
combining”, to test its mechanical efficiency under adverse conditions, and to study the machine for mechanical improvements.

**Summary**

The time that must elapse after the grain binder is started in a grain field and before it is safe to start combining the grain direct will depend somewhat on weather conditions. The range will be from 10 to 15 days under normal conditions in eastern South Dakota. Grain was cut at intervals after it was sufficiently ripe to start the grain binder, beginning two days after such time. On the second day after oats was ready to cut with the binder combined oats contained 35.9 per cent moisture; five days later it contained 17.6 per cent moisture; three days later the moisture content was 14.2 per cent and the oats was ready to combine direct—it was sufficiently dry to store in bin without danger from heating. This was 10 days after the grain binder could have started. In barley for this season the grain was ready to combine 14 days after it was ready to cut with the grain binder.

In durum wheat the moisture content dropped from 19.6 per cent on Aug. 7 to 17.2 per cent on August 9, and to 13 per cent on August 11, when it was safe to combine. This was 11 days after the binding might have been started in the field.

**Time to Start Combine in the Morning**

Generally it is not safe to start direct combining grain until 10:30 to 11 o’clock in the morning under normal harvest weather conditions. In grain cut and threshed direct every hour beginning at 8 the moisture content dropped from 20.4 per cent at 8 o’clock to 14.4 at 11. This was in oats and an average amount of dew was on the grain in the morning. The moisture content started rising again at 8 o’clock, or just at sunset.

**Conditions Adverse to Combining Grain**

The tests showed that the combined harvester-thresher would do satisfactory work mechanically in threshing grain when the moisture content of the grain was much too high, the grain being unfit to store or sell.

The excess growth of green weeds in the bottom makes the direct combining of grain very uncertain as the weed tips and green seeds make the grain damp. This may be true even when the grain itself is dry enough to combine successfully. When a field is very weedy and rainy weather prevails the weeds may increase in growth and cause the moisture content to rise instead of fall as the season advances. This condition was found in one grain field during the past season (1928) (an unfavorable season for combining direct). Uneven ripening of the crop caused by rainy weather is unfavorable to direct combining. In two fields during the 1928 season continued rains caused green seeds to set onto the plants making direct combining impractical. The crops were flax and sweet clover.
The purpose of this project was to study the practicability of electric power-line service for South Dakota farms; to find out how much it would cost to operate various farm equipment and appliances when the line was built primarily for farm service; to find out how much electricity a farmer could use to advantage and to see if additional uses could be found by certain adjustments in present farming operations. A special intensive study was made on Home Electric Refrigeration which is reported in a separate Experiment Station Bulletin No. 241.

Summary

Electricity can be furnished and distributed to farms more economically when a special farm line is built for the purpose. In some cases enough electric power from the highline was used efficiently by the patron, displacing other kinds of power around the farm, so that the saving paid for the lighting of the buildings. It required .334 K.W. Hrs. of electricity to pump 1000 gallons of water from a well 20 feet deep. The energy charge for the electricity required was exactly one cent. Electricity for pumping water for 6 horses, 60 hogs, and 20 cows was $1.43 per month from this well. For a deep well, 250 feet deep, the electricity for pumping water for 80 head of beef cattle, 28 cows, 140 hogs and 9 horses per month was $3.01. At the test-line rate the energy charge for electricity used for running the washing machine averaged $.027 per washing for a family of eight persons. For running the milking machine the cost of electricity for milking one cow per month varied from $.0546 to $.366 depending upon the type of machine used. Corn was shelled at a cost for electric energy of $.96 per 1000 bushels shelled when the energy charge only is figured. Grain was elevated at a cost of $.10 per 1000 bushels elevated on the same basis. The energy charge for electricity used to grind grain for feed varied from $.50 to $1.14 per 100 bushels of grain ground. It cost just slightly over one cent to separate 1000 pounds of milk with the electric motor for power, and the cost of hatching chickens in the electric incubator varied from $4.18 to $4.68 per 1000 eggs hatched. Other electric appliances were tested but space will not permit their report here.

Four home electric refrigerators used an average of 379 kilo-watt hours of electricity for one year. At 3 cents per K.W.H. the electricity cost the owners $11.91. Three of these were turned off during the winter.

During the three warmest months of summer the refrigerators averaged 77 K.W.H. of electricity per month. This was the average of eight refrigerators.

The average temperature maintained by home electric refrigerators was 42.46 degrees F. This is approximately 10 degrees F. lower than the temperature maintained in ice boxes tested.

When the weather gets warmer the refrigerators use more
electricity. An increase of 1 degree F. for a week made the refrigerators use about one-third of a kilowatt hour (0.29KWH) more electricity for the week.

A favorable location for the refrigerator in the house saves some electricity. The most favorably located refrigerator saved 1.2 K.W.H. of electricity per week over the one most unfavorably located. At 3 cents per K.W.H. this would only be $1.87 per year but at 10 cents per K. W. H. it would make a difference of $6.24.

**AGRonomy**

**Carbohydrate Variations**

The project being carried out under the foregoing heading aims to study the comparative amounts of photosynthesis in older and younger corn plants at varying degrees of temperature and also at varying stages of maturity.

Two series of plants have been utilized for this study, (1) a series kept under controlled conditions so far as it has been possible to control them in the greenhouse, (2) a series under outdoor conditions.

In accordance with results of previous seasons the total sugar in the leaves of early and late varieties began to increase before 4:00 and 7:00 A. M. reaching a maximum usually about 1:00 P. M. Conversely starch in the leaves appears to decrease rather rapidly from 4:00 A. M. and reach a minimum about 1:00 P. M.

In addition to previous reports it was observed for 1928 that the early strain of corn employed had a relatively higher total sugar content than the later strain.

It should be added that at the present time additional greenhouse space is being installed which will be partly utilized for this project. Not only will this furnish additional room, but likewise new heating apparatus is being installed which will greatly improve temperature control. (Purnell fund).

**Combine Studies**

The progress of the cooperative project entitled "A Study to Determine the Comparative Quality of Grain (1) Cut with the Combine Harvester and (2) Cut in the Usual Method with a Binder, and Threshed Later with a Threshing Machine after Curing by the Usual Methods" has been summarized for this department by Dr. K. H. Klages, and submitted along with material summarized by Departments of Economics and Agricultural Engineering for publication.

Results indicate that quality of grain harvested especially moisture content may vary even more to time and manner of using a combine in harvesting than due to the particular machinery employed. (Purnell fund).

**Soil Fertility**

Soil studies involved in the project under the foregoing title involve analyses of the soil itself taken from lots subjected to dif-
ferent rotation and fertility systems with a view to discovering indications of such treatments in the soil itself.

The tabulation of increases in crop yields due to fertility treat-
ments were summarized in the previous annual report.

Potassium analyses have been completed on all of the plots for the sampling of 1922. A part of the analyses of inorganic carbon have been completed. (Adams fund).

**Sulphur and Phosphorus**

It was reported last year at the time of summarizing this project that double super-phosphate was producing a larger in-
crease in growth of plants included in comparative cultures than other forms of phosphorous fertilizer, and also that pots which received rock phosphate seemed to be producing relatively larger increases as time progressed. After results of the present season it seems not quite so evident that the largest increases have come from double super-phosphate. It is, however, fairly apparent that relatively larger increases are still coming from rock phosphate. No final conclusions are being attempted at present from the ap-
ppearance of the pot cultures involved in these experiments. (Adams fund).

**Corn Ear Rots**

Disease organisms appear increasingly to be associated with particular selfed strains of corn as contrasted with being associated with the general population. (Adams fund).

**Crop and Culture Experiments**

A number of experiments mostly carried out under field con-
ditions may be included under the foregoing headings. These may be enumerated as follows:

1—**Crop Rotations.**—To discover which crop sequence produces highest quality and quantity with most economy.

2—**Cereal and Forage Crop Breeding.**—To improve crops by selection.

3—**Weed Eradication.**—To discover means of killing, e.g., quack grass, creeping jenny, leafy spurge.

4—**Depth of Plowing.**—To discover effect of tillage upon yield and economy of production.

Continuous wheat, averages 8.9 bushels per acre; wheat after corn yielded 16.4 bushels; wheat after corn, followed by a legume, 20.7.

A variety of wheat yields were produced by: Kubanka S. D. 75 (durum produced an average of 14.4 bushels; Turkey S. D. 144 (winter) 32.5 bushels; Kota S. D. 1184 average 16.7 bushels.

The highest yield of oats for four years was from Richland S. D. 1042, 80.3 bushels.

Quack grass is killed by smothering and fallow; quantities of spent oil up to 2000 gallons per acre and calcium cyanamid up to 3000 pounds per acre failed to eradicate bindweed.

The principal purpose of plowing seems to be that of killing
weeds, judging from the fact that weeds grow luxuriantly on an unplowed plot whereas plowing four inches furnished an adequate seedbed and a high yield. (Hatch fund).

The foregoing are very briefly the statement of experiments carried out during the fiscal year closed, June 30, 1929, under the Hatch, Adams, and Purnell funds. They include not all of the experimental work pursued by this department. Other projects which are being pursued with the use of other funds are as follows:

Substations: Highmore, Eureka, Cottonwood, Vivian

Rotations and cultural experiments adapted to regional conditions.

Variety testing of cereals and forage crops, including alfalfa, sorghums, sudan grass, millets.

Cooperative cereal breeding for discovering rust resistant wheat and other cereals, at the foregoing substations and also at Redfield federal station.

Potato Experiments

Tests of 42 growers strains.

Inspection of potatoes under various conditions in a number of localities in the state with a view to identification of potato diseases.

High and low pressure spraying.

Seed Testing

Seed laboratory tested 2700 samples of seeds, and 363 weed specimens were identified.

Flax Investigations

Testing varieties and strains from numerous sources including the United States Office of Flax Investigations, at Brookings and substations. At present writing the variety known as Bison appears to have the highest combination of favorable quality including yield and disease resistance.

The rate of seeding flax on cultivated land should apparently be at least 20 quarts per acre and even higher.

Cooperative Cereal Breeding with a View to Finding Rust Resistant Wheat and Other Cereals

Within the fiscal year just closed a cooperative agreement has been arranged whereby this department shall engage in selecting and hybridizing various varieties and strains of wheat and other cereals with a view to finding varieties, if possible, that are especially resistant to rust and other diseases and consequently productive. Obviously these varieties and strains shall be selected on a basis of high milling and baking quality. About 3000 experimental units in the cereal nursery, including wheat, barley, oats, flax, rye, are now growing. This work is cooperative between South Dakota Experiment Station, Agronomy Department, and the United States Office of Cereal Investigations. The nurseries are located at Redfield, Brookings, Highmore, and Eureka. Land at
these several places is furnished by the state of South Dakota as a part of a cooperative agreement.

**ANIMAL HUSBANDRY**

The experiments in the Animal Husbandry Department for the year were as follows:

**Purnell**

*How can soybeans be fed with corn to avoid soft pork.*—Five uniform lots of pigs were fed under dry lot conditions, different percentages of soybeans, soybeans and tankage, or tankage with either corn, or a corn and barley mixture. Minerals were allowed all lots. Slaughter and carcass data and chemical analyses of the fats, lean meat and bones were recorded in addition to growth and feed records.

Because of unsatisfactory growth of pigs in some of the lots the experiment is being continued.

Our records indicate that soybeans fed with corn or a corn and barley mixture furnish an unpalatable mixture and one that is a poor growth producer, even though the amount of protein in the mixture is equal to that in a corn and takage ration on which similar pigs made good gains. Soybeans evidently have a damaging effect on the thrift of the pig. By feeding a very small percentage of soybeans with a corn and a corn and barley ration soft pork was produced.

**Hatch and Local**

*Feeding Spring pigs on rape pasture.*—This experiment was to determine the value of feeding corn and barley and the methods of feeding protein supplements to spring pigs on rape pasture. There were forty spring pigs divided into five different lots. Pigs in two lots were self fed shelled corn and ground barley respectively each supplemented with tankage self fed. Pigs of two other lots were fed the same grains and a mixture consisting of tankage and linseed oil meal self fed and pigs in a fifth lot were fed a restricted amount of tankage mixed with ground barley self fed, with rape pasture. Results indicate that ground barley has 86 per cent the feeding value of corn when supplemented with tankage for pigs on rape pasture. Restricted feeding of tankage with ground barley proved more economical than self feeding the tankage.

*Wintering Brood Sows.*—Comparing corn, barley, oats, and alfalfa hay for wintering brood sows. Twenty-four tried sows and fall gilts were divided into four lots and were fed as follows: Lot I Shelled corn plus tankage plus alfalfa hay. Lot II Ground oats and alfalfa hay. Lot III Ground oats and alfalfa hay plus potassium iodide. Lot IV Ground barley plus tankage plus alfalfa hay. Sows in all lots were fed salt and minerals. Pigs from sows fed ground oats were lighter at birth than pigs from sows fed barley or corn, also there was a larger percentage of weak pigs in the litters. By adding potassium iodide to the salt which was given sows fed on oats both the strength and weight of pigs increased slightly.

*Wintering of Fall Pigs.*—Additional data to that reported in
Bulletin 216 of this Station has been secured on the subject of feeding fall pigs.

**State Livestock Fund**

**The Elimination of the Tail of the Sheep.**—Results indicate that it is possible to develop a strain of sheep with dense fleeces, open faces and no tails. Sixty-six and two-thirds percent of the 1929 crop of lambs did not need docking. There were no full length tails. These lambs were sired by four different rams.

**Use of Karakul ram on Breeds and Grades of Sheep.**—From the number of visitors it is evident that there is more than the usual interest in this experiment. This year's work consisted in matching up the suitable furs at birth, killing one of each pair of twins and feeding the others for the production of hothouse lambs.

A ration consisting of 100 pounds of oats, 100 pounds of shelled corn and 25 pounds of linseed oil meal with all the alfalfa hay and their mother's milk seemed to be well suited for the purpose. During the sixty days feeding period these 67 lambs made an average daily gain of .56 pounds per head and an average gain of 33 pounds per head. However, not in every case was one of each pair of lambs killed for its pelt. Had this been done the gains would have been larger.

**Methods of Feeding Lambs.**—To determine the difference in self-feeding and hand feeding with both whole and ground grain and hay. This will be repeated to verify results obtained.

**A Cooperative Experiment in Fattening Lambs at Newell Station.**—During the past winter 350 head of lambs were fattened on different rations for the purpose of determining value of sugar beet pulp; also sugar beet molasses, to grain for fattening lambs. This experiment will be continued.

**CHEMISTRY**

**Hatch Fund**

**Comparative Metabolism of Several Calcareous Materials In Poultry Feeding.**

*(Cooperative With Poultry Division).*

This experiment has progressed through the twenty-fifth week of experimentation and will continue until all chickens are moulting. Although no definite conclusions can be drawn at the present time, the following points stand out:

(a) That the lack of calcareous materials will cause a loss in the strength of egg shells.

(b) It will decrease egg production.

(c) The source of calcium influences egg production.

(d) It also influences egg shell strength.

The tabulation of results obtained is being made at present and it is hoped that the results of this experiment will soon be available.
Purnell Fund

How Soy Beans Can Be Fed With Corn to Avoid Soft Pork.
(Cooperative With the Animal Husbandry Division).

All feeds and lean meat have been analyzed, leaf lard and fat back extracted and the determination of refractive index melting point and iodine number started. No conclusions can be drawn as yet from the chemical work as it has not progressed far enough.

On the basis of growth curves plotted, during the first eighteen weeks, the palatability of soy beans can be questioned.

Study Kind and Quality of Materials in Women's Coats from Typical Retail Stores of the State.
(Cooperating With Home Economics).

Analyses of cloth are now being made and will be completed in a short time.

So-Called Alkali Disease

A preliminary survey indicated that this disease affects an area equal to thirty per cent of the State of South Dakota. A few autopsies on afflicted animals indicated that, beside the loss of hair and hoofs, the normal bone structure is also affected and possibly some of the organs. Qualitative analyses are now being made on a sample of corn which has produced this disease.

Cages and other equipment are being made to start feeding trials with experimental animals as soon as possible.

DAIRY HUSBANDRY

Project 1—Purnell Fund

A Comparison of Sweet Clover, Alfalfa and Sudan Grass Pastures Under South Dakota Conditions.

The cows were turned into the Sweet Clover and Alfalfa pastures the first week in June, and into the Sudan grass pasture the first week in July.

A number of samples of the sweet clover and alfalfa have been taken under varying conditions to determine the type of bacteria present. These samples were taken under different weather conditions and at different periods of the day.

Samples of the soil on which the sweet clover, alfalfa and sudan grass are grown were taken. One-day composite samples of the milk of all the cows were taken before the cows were turned into the pasture lots, and one month after putting the cows in the lots. Complete chemical analyses have been made on these samples. The cows are doing well on all lots. The sudan grass seems to be somewhat more palatable.

No cases of bloat have been observed although the cows have been kept continuously in these lots under all conditions except for the time required to milk them.
Project 2—Hatch Fund

Comparison of the Filterer versus Clarifier for Market Milk

This project has been completed and the data are being compiled in bulletin form.

The following conclusions are deduced from the work in this project:

1. The Clarifier is more efficient than the filter in removing soluble impurities which have a greater specific gravity than milk.
2. The total amount of substances removed by the clarifier was greater in every instance than by the filter.
3. Sediment tests indicate that where milk is produced under good sanitary conditions containing little or no soluble materials, both machines are equally efficient in removing foreign particles.
4. Chemical analyses show that the material removed by the clarifier contains more protein and smaller amounts of fat than the substances removed by the filter.
5. The amounts of protein removed by both methods are fairly constant, but the amounts of fat vary according to the temperature of the milk.
6. Temperatures of the milk below 90 degrees F. gave larger amounts of fat sediment residues of both machines, however when the milk is heated above 100 degrees F. it is doubtful if the increased efficiency of operation will compensate for the delay in time caused by waiting for the milk to become heated above this temperature.
7. Considering the initial cost, rapidity of operation, time in caring for the machine and the length of service of the two machines, the filter can be operated at considerably less expense than the clarifier.
8. Clarification increased the bacterial counts of the milk.
9. The time interval for reduction of methylene blue was less for the clarified milk.
10. Clarification reduced the Leucocyte count by 57% while filtration showed no appreciable change in the count.
11. Temperature Effect—Filtered milk showed from one to three per cent better cream line than the clarified milk.

Project 3—Hatch Fund

A Classification of the Lactobacillus Organism Isolated from Dairy Products

Samples of feed, milk, butter, cheese, silage, feces, vegetation, bedding, and grasses have been placed in bottles of sterile milk, and whenever coagulation of milk occurred, smears were made. If gram positive rods were found to be present in the milk an isolation of the organism was made. Fifty-one isolations have been made that coagulated litmus milk, with the production of acid. These organisms along with others to be isolated will be used in the classifying procedure.

From sources where gram positive rod shaped milk coagulating organisms have been isolated it would seem to indicate that lactobacillus organisms are widely distributed in nature.
EXPERIMENT STATION

Project 4—Station Local

Roughage Grinding

This is a cooperative project and has been carried on with the Animal Husbandry and Agricultural Engineering Departments. Each department has, however, carried on its phase of the project as a complete unit.

The work on this project has been completed and the data compiled ready for publication.

The data from the work as carried on by the Dairy Husbandry Department indicate the following conclusions:

1.—The milk and fat production were increased slightly when the ground roughages were fed. The increase ranged from 2 to 5 per cent.
2.—The increase in fat and milk production was not sufficient to offset the added costs due to grinding.
3.—The coefficients of digestibility were not increased when ground roughages were fed. Ground roughage does not increase the digestibility of the entire ration.
4.—The grinding of roughage does not seem to be necessary nor profitable for dairy cows.

Project 5—Dairy Station Local

Percent of Grain Recovered in Feces when Whole Grain is Fed

Whole corn and whole oats were fed to two dry dairy cows together with alfalfa hay for roughage. One pound of dry roughage was fed to every 100 pounds of live weight. Ten pounds of grain per day was fed. The feces were collected and the grain washed out through a fine sieve with cold water. The grain was then dried, and the remaining material divided into whole kernels, and broken kernels.

The grain as fed was analyzed. The material obtained in the feces was weighed and the broken and whole kernels analyzed separately.

The work seemed to warrant the following conclusions:

1.—From 18 to 20 per cent of the whole corn was returned in the feces in the form fed.
2.—The amount of grain returned in the feces is greater in case of old cows than from younger cows.
3.—Very little of the nutrient value had been taken out of the kernels which appeared in the feces whole.
4.—The nutrients of the cracked kernels and finer parts were digested except ash.
5.—This work indicates the need for grinding grain for dairy cows. The state of fineness is not as important as the breaking of the hull of the seed.

Project 6—Dairy Station Local

Digestibility Coefficients of Whole and Ground Fodder and Whole and Ground Wild Hay

This work was carried on to obtain data on the effect of grinding on the coefficients of digestibility. These roughages were used
because they are fed more generally than any other roughages in South Dakota.

The data from this work indicated that the grinding of the roughage did not increase the coefficients of digestibility. In the case of the corn fodder the decreases in the coefficients were so uniform that it clearly indicates that grinding depresses the coefficients of digestibility.

**Project 7—State Exp. Fund**

**Cross breeding**

Three crossbred heifers have completed one lactation period. The first one to freshen aborted her second calf, and was sold.

<table>
<thead>
<tr>
<th>Heifer</th>
<th>Milk</th>
<th>Fat</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-A</td>
<td>7691.2</td>
<td>354.51</td>
<td>4.60</td>
</tr>
<tr>
<td>3-A</td>
<td>4626.2</td>
<td>192.58</td>
<td>4.16</td>
</tr>
<tr>
<td>4-A</td>
<td>11719.8</td>
<td>540.03</td>
<td>4.61</td>
</tr>
</tbody>
</table>

The dams of these crossbred heifers produced under similar conditions as follows:

<table>
<thead>
<tr>
<th>Dam</th>
<th>Milk</th>
<th>Fat</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-A</td>
<td>3758.7</td>
<td>200.77</td>
<td>5.34</td>
</tr>
<tr>
<td>3-A</td>
<td>9584.8</td>
<td>313.96</td>
<td>3.30</td>
</tr>
<tr>
<td>4-A</td>
<td>8170.4</td>
<td>276.73</td>
<td>3.33</td>
</tr>
</tbody>
</table>

The increase in production of the crossbred daughters over their dams cannot be attributed to cross breeding, but rather to the sires used. Both sires used have proven themselves sires of production.

It will be noted that the percent of fat is about the average of the Holstein and Jersey breeds. The same was true for the weight of the calves.

**Project 8—State Exp.**

**Influence of Direct Sunlight on the Growth and Health of Dairy Calves**

The heifers on this project are now two years old. All of them have been bred, and from all indications are settled in calf. They have been weighed regularly every ten days, and measured every 30 days.

Several of the heifers are springing and will freshen in November and December.

The plan contemplates analyzing the blood of all heifers, as well as the milk.

At least one animal in each lot will be killed after calving to get data on the breaking strength, and a chemical analysis of the bones.

To date we can draw no conclusions from this work.
heifers which are kept in the shed are receiving only such light as comes through the window and they seem to be doing as well as the heifers which are exposed to the direct sunlight. The heifers which are not in direct sunlight look sleeker and are gaining in weight somewhat faster. This can probably be explained however because of cooler quarters, and less annoyance from flies.

It is believed that the chemical analysis of the bones, and blood, together with the breaking strength of the bones, and the condition of their calves will be a more significant indication of the assimilation of the calcium, than the weight and measurement of the heifers.

HOME ECONOMICS

Home Makers

A study of the use of time by rural Home Makers which is in the nature of a survey has been made in co-operation with the Bureau of Home Economics, the blanks and general directions being provided by the Bureau. Material was largely given out to the women of South Dakota through the Extension Clubs of the State.

The time for closing this study was extended from January 1, 1929 to June 1, 1929. The results are now being tabulated. (Purnell Fund.)

Clothing

The study of the construction of the material in women's coats in relation to their wearing qualities and cost was continued.

Fifty garments have been studied under the construction of the fabric, physical, chemical; and microscopic analyses have been made. The physical tests have included the weight per square yard, the weave, the number of picks and ends, number of twists per inch in yarn and length of staple. Chemical tests have been made to determine the percentage of dyes and other finishing materials, percentage of wool, cotton, and silk, and percentage of moisture the material holds at ordinary atmospheric conditions.

Microscopic studies have been made to determine the width of the fibres, and condition of the fibres as to prevalence of split and broken fibres and the absence of epidermis. Micrographs have been taken to show typical damaged fibres.

Under wearing qualities, the degree of waterproofing, the strength of the material, fastness to dye, and resistance to weathering have been considered. Tests on fastness of dye have been made as fastness to alkali, to acid, to mud, to hot pressing, to rubbing, and to weathering. Aside from the effect of weathering on fastness of dye, its effect on shrinking, tests of texture and strength have been made. The drop test was used to determine the degree of waterproofing. (Purnell Fund).

Nutrition

The study of the Vitamin C in certain canned and fresh vegetable, namely spinach and Swiss chard was continued.
The spinach used in 1928 was a spinach that was shipped into the local stores and retailed by them. This spinach was canned in April and the early part of May which means that it likely had been picked for several days before it reached our laboratory and was canned.

The spinach used this year, 1929, was grown in the college gardens and canned the same day that it was picked. The same method of canning was used as was used previous years, (spinach blanched two minutes and processed 70 minutes at 15 pounds pressure.)

The Swiss chard used was canned by the same method as the spinach and was a home grown product canned the same day that it was picked.

During the summer months the experiment has been continued, feeding one group of guinea pigs 1 gram of raw spinach, three groups varying amounts (1 to 4 grams) of the green leaf of the Swiss chard, and three groups varying amounts (1 to 4 grams) of the white ribs. Also 5 and 10 grams of both spinach and Swiss chard cooked in an open kettle are being fed.

Conclusions:

That the home grown, home canned spinach has a far higher Vitamin C potency than the spinach that was bought in the market and then canned.

That the home grown and home canned spinach has a Vitamin C potency equal to the commercial canned spinach.

That canned Swiss chard while rich in mineral has a very low Vitamin C content.

That at the time of writing this report the summer work has not been carried on long enough so that it is safe to make any comparison between the vegetables cooked by the open kettle method and the canned products or to say anything as to the Vitamin C potency of the green vegetable. (Purnell Fund)

ENTOMOLOGY
Adams Project 3

Distribution, Life History, Economic Importance, Natural Enemies and Control of the Common Black Field Cricket (Gryllus assimilis Fab.)

This project has been completed during the past fiscal year except for preparing two life history drawings and writing up a manuscript for the publication of a station bulletin. In South Dakota we have two varieties of Gryllus assimilis Fab., namely Gryllus assimilis Fab. and Gryllus assimilis lineaticeps Stal. The first named variety is exceedingly variable so far as its morphology is concerned, but it is impossible to break up or subdivide this variety into constant units by using the morphology. However, when one studies the life cycles of this variety, one finds that there are two physiological races or forms, one of which hibernates in the egg stage, the other in the nymph. It is the first form or race
that hibernates in the egg stage that becomes so abundant in South Dakota as to be highly injurious. Gryllus assimilis lineaticeps Stal. hibernates in the nymph stage, and never become sufficiently abundant to be classed as an insect of considerable economic importance.

A complete account of the life cycle of Gryllus assimilis Fab. will be written up in technical scientific language, and this manuscript will be submitted for publication to the Editorial Board of the Journal of Agricultural Research. A manuscript discussing the distribution, life history, economic importance and control of Gryllus assimilis Fab. is now being written and should be completed in the fall at the latest. This manuscript will be submitted to you for publication as an Experiment Station bulletin. It will be well illustrated, and will be written in non-technical form. The bulletin, it is now estimated, will be 32 pages in length.

Adams Project 5

The Plum Tree Borer (Synanthedon pictipes G & R), its Distribution, Life History, Economic Importance and Control.

Additional investigation has revealed that the plum tree borer occurs in practically all the plum plantings in eastern South Dakota, and in many sections of western South Dakota in both tame and wild plum thickets.

The food plants of the borer consist of native drupes such as the wild black cherry and the wild plum. Of the cultivated drupes, the cherry and all varieties of plums are attacked.

Additional information has been secured regarding the life cycle and habits of this insect. Over a three year period during which this pest has been investigated, seasonal variations and their effect upon the normal life cycle of the borer have been worked out. Our work thus far indicates that the borer has but one brood per year at Brookings, with the parent forms or moths emerging during late May, June and early July.

We have found that the plum tree borer does the greatest amount of damage in neglected and uncared for orchards and plum thickets. Trees carelessly pruned or injured by careless cultivation or through wind storms, suffer more than do healthy uninjured trees. However, even uninjured and apparently healthy trees are attacked and badly injured and even killed by this pest.

Some work has been done toward discovering the factors that are favorable or unfavorable to the survival of the borers. However, additional study is necessary before all or even the most important of these factors are thoroughly understood. The enemies of the borer, as far as we now know them, consist of a Hymenopterous parasite, a number of species of ants, an unidentified fungous disease, and a number of species of birds.

In the past year we have found that many growers of plums and cherries pay little or no attention to cultural practices as a means of lessening insect depredations. Through careful inspections of many plum orchards, we have become convinced that in many cases the plum tree borer has become established in the orchards because the trees were not properly cared for. Wounds
and abrasions on the trunk or larger limbs, split crotches, broken branches and similar unhealthy areas are ideal for egg deposition, and many a primary infestation has had its incipiency in such areas.

Our work of the past year has again demonstrated the feasibility of the use of paraffin and paradichlorobenzine as an efficient control of the borer. We have already reported upon the method that we use in preparing and applying the paint that we make of these two ingredients. Through the cooperation of the Pharmacy department of the State College, the chemical aspects of this problem, such as the volatilization of the paradichlorobenzine, are being worked out. The length of time for complete dissipation of the P. D. B. needs further research.

During the past year we have treated an additional number of plum trees with a mixture of P. D. B. and paraffin, but the proportion of P. D. B. to paraffin was varied in these experiments. The object of these experiments was to determine the effect of varying concentration of P. D. B. upon the trees and upon the borers. Trees of varying ages were treated to learn whether or not the treatment could be given with safety, both to young and old plum trees. Our work of the past two years has demonstrated that plum trees, both young and old, may be treated with the P. D. B. and paraffin mixtures without danger of injuring the trees and with the assurance that it will kill the borers.

**Adams Project 6**

The Grasshoppers of the Subfamily Cyrtacanthacrinae of South Dakota, Their Economic Importance, Distribution, Histories and Control.

Up to the present writing we have found in South Dakota 35 species of grasshoppers belonging to the Cyrtacanthacrinae. During the past year an additional 1,000 specimens of these species were collected in the State. The total number of specimens of Cyrtocanthacrinae that we now have in our collections that were taken in South Dakota is approximately 12,500. These specimens are classified and properly labeled with date and locality data attached to each specimen. All of the specimens of a species are kept in one or more Comstock cases, separate from the remainder of the species. A map of South Dakota has been prepared for each species, showing the distribution of that species so far as we now know it. The survey work of the past fiscal year, materially increased our knowledge of the geographic distribution of our 35 species of Cyrtocanthacrin grasshoppers. During the past year we have gathered together an immense amount of data regarding the seasonal life cycle of these grasshoppers, and, what is still more important, the kind of plants that are eaten. We have found that some species of grasshoppers feed upon a large variety of plants, while others are very choice in what they eat and are limited to one or two species of food plants. Considerable data were also gathered concerning the relative abundance of the various species of hoppers, and especially those species that are of economic importance because
of their feeding habits. We are learning some of the reasons why grasshoppers fluctuate in numbers over a period of years, why some localities are seldom if ever troubled with grasshoppers and why others, on the other hand, are troubled every few years. We are also learning which species of hoppers are of the greatest economic importance and which are of practically no importance, and the reason for this state of affairs.

It is now possible for us to examine an area in the fall of the year for grasshopper eggs, and by gathering data on the abundance of eggs and the predaceous animals feeding upon them, predict with considerable accuracy just what will be the possibility of a hopper outbreak under a given set of prevailing weather conditions, during the following spring.

Adams Project 7

A Study of the Pollinating Agents of Sweet Clover in South Dakota With Special Emphasis Upon Seed Production as Influenced by the Honey Bee.

The cage experiments which were begun with the inception of this project, were discontinued during the past year. In place of this work, an attempt was made to determine the identity of the most important pollinating agents of sweet clover outside of the honey bee. Ten fields of sweet clover were chosen near Brookings, South Dakota for this work, five of yellow and five of white flowering sweet clover. These fields were visited at least three times a week during the entire time that the plants were blooming, and a thorough collection was made of all insects visiting the flowers. Approximately 10,000 insects were collected during this period, and these were all labeled with such information as was deemed necessary. Rainfall data were kept throughout the year, as well as a daily record of the temperature, sunshine, and velocity of the wind. The insect material that was collected has been stored in Comstock cases, but none of this material has as yet been identified. Until the identification has been completed, definite conclusions cannot be drawn as to the identity of the most important insect pollinators of sweet clover in the vicinity of Brookings.

It was planned to visit a large number of growers of sweet clover in South Dakota, with the purpose of learning the amount of seed that is produced by each grower and correlating this, if possible, with the distance that the fields are removed from apiaries. It was impossible for us to carry on this work during the past fiscal year, but it will be done during the next year.

FARM ECONOMICS

The projects for study in this field have been grouped in a general way under the following main headings: Studies in Farm Management; Studies of Prices and Statistics; Studies of Public Relations such as taxation, transportation, and land economics; Studies in the Field of Agricultural Finance; Studies in Marketing
of Farm Products; and Studies of General Problems, such as Foreign Trade in Agricultural Products, Agricultural Policies, etc.

The first of these to be taken up was the study of the management of the individual farm unit with a view to determining to what extent and in what way profit could be improved on the individual farms of the state.

**Farm Management**

Five major projects in the field of farm management have been planned. Two of these, namely, the Kingsbury County Project and Brown County Project were reviewed in the annual report ending June 30th, 1928, and reported in Station Bulletins Nos. 226 and 235.

The third study is one of farm organization and management in southeastern South Dakota. It has been the purpose of this study to determine the production requirements for crops and livestock as handled by typical farms of this intensive corn and hog producing area with a view of setting up standards and farming systems which will be useful to individual farmers in planning for better farm organization on their own farms; useful in showing a method whereby annual outlook and other economic information may be applied to specific farm systems; and useful to extension workers and other teachers in that specific examples of farm reorganizations are given for farms of the most typical size in the area.

This study in southeastern South Dakota covered the period January 1, 1928 to December 31, 1928, and on a few farms the hog and beef-feeding enterprise studies were continued into 1929 until the stock was disposed of. In March, 1929, a preliminary report, Department Circular 14, was prepared which included a financial summary of all farms, enterprise cost figures, etc. This report, together with a personal summary of inventories, and financial records, and a map of each farm was submitted to each cooperator. Material is now being assembled for publication in bulletin form which should be ready for printing during the present summer. In the preliminary report it is shown that the rate earned on the various farms varied from 0.3 to 10.6 per cent; that most of the farms that made a higher rate than the average had a larger-than-average beef enterprise; that the pork enterprise was unprofitable for most farmers, due largely to the price situation; that the percentage of the total investment that is used for items other than productive livestock or crops showed a wide variation and influenced the production costs of all enterprises; and that the yields obtained, especially with crops, greatly influenced the unit costs.

The fourth study in this field is an analysis of the types of farming areas in South Dakota. The purpose of this study has been to utilize all of the available information pertaining to South Dakota's agriculture in order to present as clearly as possible the various type-of-farming areas and the underlying reasons for the systems of farming now being followed, as well as outlining suggested systems. The results of this project fall into three divisions: (1)
a graphic and narrative description of the natural and economic factors which have influenced the agriculture of the state which agriculture the study divides into thirteen type-of-farming areas; (2) a presentation of typical farming systems as found on farms of the most common sizes in each area; and (3) a suggested plan whereby farmers, extension workers, teachers and research agencies may use this material in more specifically applying outlook and other price and production information in a way which will be of very practical benefit to the agriculture of South Dakota. This study is reported in Experiment Station Bulletin 238, entitled "Types of Farming in South Dakota," printed in June, 1929. This project has been carried on in cooperation with the Bureau of Agricultural Economics of the United States Department of Agriculture.

The field work on a fifth study, a three-year project having to do with the organization and operation of cattle ranches in northwestern South Dakota, southwestern North Dakota, southeastern Montana, and northeastern Wyoming, has just been completed. This has been a joint undertaking between the Agricultural Economics and Animal Husbandry sections of these four states, and the bureaus of Agricultural Economics and Animal Industry of the United States Department of Agriculture. In 1925 a reconnaissance survey, made of over three hundred ranches in the area, and reported in United States Technical Bulletin No. 45, indicated the need for more intensive study. Arrangements were accordingly made for the present study which consists of sixty ranches, fifteen in each of the four states. The purpose of this study has been to determine successful organizations and methods which are being used by ranchers on ranches of different sizes. The problems involved have had to do largely with the production of homegrown feeds, the handling of problems of land tenure, the increasing of the size of the calf crop, the time of selling, etc. The technical presentation of the entire study is to be published by the United States Department of Agriculture and will cover the entire area. Each state will then present such information in popular or extension style as is deemed pertinent to the local situation.

Prices and Statistics

The gathering and organizing of all available material as to the prices received by farmers in years past is recognized as being fundamental to many of the studies such as costs of marketing problems, transportation problems, etc.; also such price information is necessary for many studies of the various factors affecting price. It is the purpose of our present price study to establish a series of historical prices and to determine the principal factors affecting prices and production of agricultural products in South Dakota. It is believed that practically all the historical price data available at the present time have been collected. These have been secured from elevators, livestock buyers, farmers, newspapers, and market papers. During the last year, most of the work has consisted in summarizing the price records obtained and putting them in a permanent form. It is believed that these records are of sufficient value to justify this before doing further work on any one commo-
dity as it would be practically impossible to replace these records if they should become lost.

During the fiscal year ending June 30, 1927, a bulletin from this project was published, Experiment Station Bulletin 225, "South Dakota Farm Production and Prices." This brought together basic data on prices and production back to 1890. At the close of the fiscal year ending June 30, 1928, Experiment Station Bulletin No. 233 "South Dakota Potatoes, Production, Movement, Prices", was published. A study of the factors affecting the price and acreage of flax was begun in September, 1927. This study has not been completed, but it is expected that the results will be summarized and published in mimeographed form in the course of a few months.

Public Relations

Two studies have been undertaken in the field of public relations. The first of these consisting of a study of the taxation problems of agriculture in South Dakota has been completed and results were published during the fiscal period ending June 30, 1928 in Experiment Station Bulletin No. 232, "Taxation and Public Finance in South Dakota."

The second study in this field was started August 15, 1928 and has to do with the relation of transportation rates and facilities to farm prices and types of farming. The purposes of the phase of this project now under study are: (1) to make a general historical survey of freight rates; and, to develop points of attack on the problem by determining the periods when rate changes took place and the areas affected by them; (2) to make a detailed study of the price spreads on similar grades and qualities of products between the local and terminal prices for periods before and after a rate change; also to make comparisons between towns in the same area having different rates to terminal markets. It is also planned to study the possibilities and advantages and disadvantages of further concentration of products before shipment, also to study the effect of distance from the railroad upon land values, types of farming, etc. Thus far the historical phase of railroad rates and especially such part as is necessary to develop points of attack to the main problem have been compiled. Terminal prices for wheat and corn have been secured, compiled and put into shape for ready comparison. Local price data have been secured from eight towns in South Dakota and in Minnesota along the South Dakota border. These prices cover all periods of rate changes where records are available. The work is well started, but much remains to be done in securing, compiling and analyzing the material collected.

Agricultural Finance

In the field of agricultural finance, a general study of the credit agencies serving South Dakota agriculture and of the cost of credit to farmers and the possibilities of betterment was begun about three years ago. A considerable quantity of statistical data concerning this has been assembled; and credit changes occurring on a considerable number of farms in representative counties have been studied.
The purpose of the phase of this investigation pursued during the current year was to collect information on the farm real estate mortgage situation. It is desired to know the amount of indebtedness both as a total for the township and on a per acre basis for the land mortgaged together with changes over a period of years. The source of funds, and the cost, term and duration of the loans at different periods are to be determined. It is the purpose of this phase of the study to show the long term credit needs of farmers, how these have been met, and what changes may be desirable. In each of the counties of Brookings, Clark, Turner, and Haakon data covering all mortgages recorded since 1905 have been procured and are being analyzed. The material from Brookings County has been worked up to the point where it is expected a preliminary report will be published within the near future. The data from Brookings County show an increase since 1910 in the proportion of the land mortgaged from about fifty per cent to over sixty per cent. The total indebtedness had more than doubled by 1920 as compared to 1910, but has since somewhat declined. In 1910 the bulk of the funds came from individuals, whereas in 1927 insurance companies were the largest single source of funds.

**Marketing**

In the field of marketing, the first study undertaken has been a study of the management, financing, and organization of farmers' elevators in the spring wheat area with a view of finding possibilities of bettering their organization, lowering their costs, and improving their services. The first phase, which deals with a historical study of farmers' elevator, traces the development of business and organization practices of about fifteen widely scattered representative spring-wheat farmers' elevators beginning with the 1919 crop. This phase is being carried on independently by this station. The second phase, which deals with a detailed study of current operating practices of farmers' elevators, has to do with current data and is especially broad in that it covers practically all aspects of the business. This phase is being pursued in cooperation with the Division of Cooperation of the United States Department of Agriculture with which Division three other states, namely, Minnesota, North Dakota and Montana, are cooperating in a spring wheat area study. These three states will complete their fifth and last year with the 1929-1930 station fiscal year, when the South Dakota Station will complete its third and last year collecting data.

Much historical data have been tabulated during the past year. With regard to the detailed phase, twenty-two elevators are being visited from which information is obtained covering the economic set-up as it affects costs of operation and stability of the enterprise, considering such factors as the size of business units, the amount of labor, size of plant, amount of supplies, etc., required for economical operation of volume of business, completeness of hedging practices, seasonability, transportation facilities, etc., to efficiency of operation; the relation of the management to the board of directors and to other employees; and the sources of capital and problems involved in the different methods of financing. The material has all been summarized to date, and will be analyzed.
by both the Division of Cooperation of the United States Department of Agriculture, and by this station at the conclusion of the summary of crop data being collected during the 1929-1930 fiscal year. The tabulations this year seem to substantiate the conclusions previously drawn that it seems advantageous in many cases to increase volume of business by sideline operation and that economies result in the local conditioning and cleaning of grain; also that low grain handling costs appear between 200 and 400 thousand-bushel volume, and that sidelines are too often handled merely as an accommodation to grain growers instead of for profit to the business enterprise.

**Combine Harvester Study**

The purpose of this study is to provide information as to the cost and practicability of the combine harvester for use under South Dakota conditions. Most of the work on this project was done during the current fiscal year, although it was started during the preceding year. In this study combined grain is compared as to costs, quality and price with grain harvested with binders or headers and threshed with stationary separators. It is hoped that the study will bring out the cause and the remedy for differences. About four hundred samples of grain were obtained, which, together with samples secured locally by the departments of Agricultural Engineering and Agronomy, with which departments the project was carried on cooperatively, formed the basis for the findings as to quality and price. The manuscript is now in the hands of the editor and it is expected to be printed within the near future.

The results of the study showed the combined grain to be more variable than binder-cut grain as to moisture content, and its average moisture content was higher. The cause of this wider range may be attributed to excessive moisture in grain combined early in the season, early in the morning, and too soon after rains. The other extreme of very dry combined grain was the result of a short period of excessively hot and dry weather. The price differentials for the various moisture percentages were such, during August, 1928, that there were slight losses from marketing wheat with moisture contents both above 14 per cent and below 13 per cent. However, the losses per bushel on the wet grain were not as great as the price discounts because the latter did not fully offset the weight of the water. Although there was a premium for extra dryness this premium was not sufficient to compensate for the weight lost through evaporation below the 13 per cent moisture content. Hence there was a small loss in price both on the extra dry and the extra wet combined grain. However, this loss was not enough to wipe out the gain from lower costs of harvesting with the combine.

**HORTICULTURE**

**Adams Fund**

**Fruit Breeding**

The number of fruit seedlings steadily increases and selections are being made each year for propagation and distribution. The
following were offered for the first time in 1929, and plants were distributed.

**Sanoba Hybrid Sandcherry**—Pedigree: Sapa X Dropmore, Manitoba sandcherry. The name is made up from the two words, Sapa and Manitoba. The Sapa is my hybrid of the South Dakota sandcherry with the Japanese plum and is famous for its black-red flesh and choice quality. At Brookings, the Sanoba is a good plant; productive; of upright habit; fruit thirteen-sixteenths inches in diameter; flesh red; good quality; pit round and small. If the Sanoba inherits the extreme hardiness of the Manitoba sandcherry, it will be hardier than the Sapa and hence very popular in Manitoba and Saskatchewan, as well as south of the Canadian line.

**Weeota Apple**—Pedigree: Nevis wild crab X Northwestern Greening apple. Fruit two inches in diameter; round; skin oily; flavor acid; not very acerb. Cooks up softer than the others and with less wild crab flavor. Season, all winter. The Weeota and Wetonka are the first two hybrids of the wild crab from Nevis, Minnesota, the farthest northern point where this species has been found wild.

**Wetonka Apple**—Pedigree: Nevis wild crab X Wolf River apple. Fruit about 1¾ inches in diameter; clear greenish yellow, largely covered with mixed, lively, dark red with darker splashes and stripes; surface very oily; fragrant. Flesh white; moderately juicy; firm with slight wild crab flavor. Cooks up into a fair sauce. Season, late winter. A great improvement over Nevis, the wild crab parent.

**The Taming of the American Crabapple**

This has been one of my favorite experiments since coming to South Dakota thirty-three years ago. This work is now beginning to yield results. Many more hybrids were fruited the past season. When bred back to the apple they will probably be of better quality, but at least these are a good beginning toward an apple that will keep a year after picking. The Nevis wild crab hybrids were first announced in my paper, The Relative Value of Homozygous and Heterozygous Parents in the Breeding of the Apple, Plum, Cherry, Grape, and other Fruits, prepared for the Fifth International Congress of Genetics at Berlin in 1927. I am developing a large lot of apple hybrids of intricate pedigree, including the native American wild crabapple, with the object of reducing the size of the tree so as to permit easier spraying and to promote early bearing. Such trees will be of special value for home orchards in the prairie Northwest.

Trees of earlier introductions were distributed as follows:

**Chinook Apple**—Introduced 1919. The first of a series of hybrids of the standard apple with the wild crab in which the wild crab is the pollen parent. Pedigree: Baldwin apple X Elk River, Minnesota wild crab, about 40 miles north of Minneapolis. Fruit two inches in diameter, oblate, of a fine dark red, sub-acid; season, late winter. May 14, 1929, fruit of the Chinook apple was examined and found in good condition, and made a good, pleasant flavored sauce 18 months after picking. The fruit was picked September 3, 1927, and kept in an outdoor cellar.
Wakpala Apple—Introduced 1928. A choice late winter apple worthy of notice, but probably not for the far North. Pedigree: Mercer crab X Tolman Sweet apple. This makes the Wakpala apple about 3/4 cultivated apple and 1/4 wild crab (Pyrus loensis). Fruit medium size, 2 1/2 inches in diameter, round, yellow, striped with red. Flesh white; sub-acid with spicy sweet fragrance with faint trace of wild crab. Cooks up quickly into excellent sauce. Season, late winter.

Anoka Apple—Introduced 1918. The Anoka apple is probably the earliest and heaviest bearing apple in the world at the present time. Trees of the Anoka were recently ordered by the government of New South Wales, Australia, and trees have been sent to other foreign countries as well as all over the United States. The Anoka apple is attracting world-wide attention because it bears freely on one-year-old wood, beginning the second year after planting a one-year-old tree, and annually thereafter. In the nursery, blossoms sometimes appear on the one-year-old shoots.

Redflesh Crabapple: Good for the Lawn and for the Orchard

Introduced 1928. A most remarkable novelty, that is probably destined to world-wide popularity wherever apples are grown. The tree is ornamental as well as useful, the beautiful red flowers and moderate growth making it a highly desirable lawn tree. The original tree gives promise of being a good annual bearer and bore its first two crops in 1927 and 1928. The fruit in size is 1 1/2 x 1 1/2 inches in diameter, in color a brilliant, solid, polished, dark red all over. The flesh is red throughout and makes excellent red preserves and red jelly, which attracted favorable attention at the State College exhibit at the South Dakota State Fair, Huron, September, 1928. Season, fall. Pedigree: Pyrus Malus Niedzwetzkyana X Elk River, Minnesota, wild crab. The seed parent is from the Tian Shan Mountains that separate Russian Turkestan and western China.

The Hansen Select Sandcherries

These are selected from several hundred thousand seedlings through seven or eight plant generations of the native sandcherry, a low shrub of western South Dakota. They vary in size and quality of fruit. The largest is one inch in diameter. However, the fruit of all the seedlings makes good sauce and preserves. Also desirable as a low shrub in front of taller shrubs on the lawn. Has white flowers and glossy leaves. More than 300,000 seedlings have been grown during the past thirty-three years. Selections are being made this summer from over 60,000 new seedlings grown at Watertown, and from the 1700 planted at Philip. A great advance has been made in reducing the size of the pit in proportion to the size of the fruit.

Progress with Pears

My opinion is that successful pear culture for home and market use is now possible for all South Dakota and the prairie Northwest, also for southern Manitoba and Saskatchewan. In 1924, I thought it would save fifty years of time by going to North Manchuria in the mountains along the railroad. I found the western limit
of this northern type of *Pyrus Ussuriensis* to be about fifty miles east of Harbin, where the temperature ranges to about 47 degrees below zero. The fruit of this winter pear is about 2 1/2 inches long and 2 inches across. The foliage is very ornamental in the fall due to the bright red and yellow color. I see no reason why it would not be a good shade tree for the lawn. It may be worth trying a few as a roadside or street tree.

The value of this type of pear is the strong resistance to the bacterial disease known as fire blight which kills the ordinary pear. From the seeds picked from the fresh fruit in 1924, I grew many thousands of trees in 1925. In 1926 most of them were transplanted in the State Orchard at Watertown. They have now grown three years and are ready for the final transplanting. The nurseryman should plant an orchard to provide hardy blight-resistant nursery stocks for the new hybrids now coming on. *Pyrus Ussuriensis* from the extreme southern part of Manchuria did not prove hardy at Brookings. The main bulk of these seedlings introduced in 1926, known as Harbin pears, had their final transplanting in the spring of 1929. The ordinary commercial *Pyrus Ussuriensis* seed is from sources much farther south and such seedlings winter-kill at Brookings.

**Ming Pear: A Good Hardy Pear for the Northwest**

I hope to have many more pear hybrids coming on in the future, but the Ming pear is worthy of trial right now. The original tree bore a heavy crop in 1926 and again in 1927. It has proven very resistant to fire blight. Pedigree: *Pyrus Ovoidea X Louise Bonne de Jersey*, a choice French pear. The fruit is of good commercial size, flesh melting, of delicious flavor. A first class pear.

**Perennial Sweet Pear (Lathyrus tuberosus)**

Which I obtained in the dry Semipalatinsk region of Siberia in 1913, forms a long tuber; blossoms, bright pink color. An interesting novelty.

**PHARMACY**

A study of the properties of oil of chenopodium obtained by cross-fertilization as well as anthelmintic value of this oil. A good quality and yield of oil was produced from our cross-fertilized plants this year. Preliminary experiments conducted using various concentrations of the oil, show that it has a high anthelmintic value. Living ascarides were used in the test tube experiments and some 200 hogs were wormed. This work will be extended through co-operation with the Animal Husbandry Department during 1929 and 1930.

**POULTRY**

**Hatch Fund**

I—Under this fund the direct marketing all mash vs. mash and scratch and artificial lighting experiments have been closed and the results reported in bulletin form.
II—Ventilation of poultry houses has been continued throughout the year with few new developments or results. It has become evident that proper insulation is about as important as good ventilation. Condensation of moisture is reduced with a rapid change of air but in a thoroughly insulated house it is not necessary to speed up the circulation as much. Good insulation, however, means greater cost of construction, which may be offset by better production. During the current year, more attention is to be given to better insulation in poultry houses.

III—Metabolism of calcareous materials in poultry. This work is still going on and not far enough along to justify very definite conclusions. The work indicates that oyster shell is as good a source of calcium as any. The presence or absence of calcium material in the diet has a direct effect on egg production and the strength of the egg shell, and indirectly on the strength of bone in the fowl.

Purnell Fund

I—Comparison of high protein feeds. The results of this experiment have been written up and included in a bulletin on feeding.

II—Alfalfa Feeding: Green alfalfa cut and fed in the pens does not give good results. It wilts quickly and then the hens do not eat it readily. The season or period during which it may be used is very limited. The dry hay, however, when ground with meal and included in the wet and dry mashes gave excellent returns. Egg production in the alfalfa mash pens averaged as high as any ration used and in the breeding pens gave better hatching percentages than any other. Ten to fifteen percent alfalfa mashes proved most effective. The quality of alfalfa meal varies greatly depending much on the stage at which it is cut and the method of curing and handling.

III—White vs. Yellow Corn: This experiment has been running through the past year but as similar work has been done in other stations it has been thought best to discontinue it. The hens on yellow corn in scratch and mash laid twenty-five per cent more eggs and consumed slightly less mash and an equal amount of scratch. The only variant was the corn and the cost per cwt. was the same for both. Three hens were replaced in the white corn lot and four in the yellow corn pen.

RURAL SOCIOLOGY

At the present time the prevailing type of public school in the agricultural districts of South Dakota is the elementary one-room school. While farmers are rapidly taking advantage of the state high school tuition law, there seems to be practically no desire to consolidate the rural district with other rural districts or with the town so as to include a high school department in the rural public school system. From a total of 274 replies from rural districts, 98 percent of the rural school officers are content with the present system.
Despite the fact of satisfaction with the present system, over half of all the boys and girls of high school age (14-17) who live on farms in South Dakota are now attending high school. While the farmers of the state comprise approximately 53 per cent of the total population, their children comprise 51 per cent of all those attending high school. Out of a total of 27,021 high school students in the state, 13,769 are from the open country and 13,252 are from villages, towns, and cities. There are 412 high schools of all classes in the state.

Out of this total group there are 91 of the high schools which receive state aid, having met the requirements for consolidated schools. Not all of these are legally consolidated but meet the requirements according to the law. Owing to this fact, most of the farm boys and girls live outside of a high school district and accordingly must attend as tuition pupils. In such cases the law provides that the district from which the pupil comes pays the tuition. Last year there were 10,846 tuition pupils from the country who paid an average of $12.29 per month or $110.61 per school year of nine months.

Of the five alternatives offered to residents of the state as to the type of high school which they wish to support, the independent high school is predominantly the prevailing type. The five types permitted are: (1) the independent high school, (2) the consolidated high school, (3) the township high school, (4) the county high school, and (5) a high school department maintained by a rural school district.

Out of the 412 high schools only 27 offer Smith-Hughes work in agriculture. This is rather startling when we consider that 65% of all the men engaged in gainful occupations in South Dakota are farmers, while approximately 7 percent of the high schools offer a vocational agricultural course. In contrast to this, only 7.8 percent of the men engaged in gainful occupations in the state are in some form of commercial work, but 38 percent of the schools teach some commercial work. One cannot escape the conclusion, therefore, that while farmers are encouraging their children to go on and receive a high school education, they have not urged the teaching of agriculture with the view of encouraging boys to return to the farm. A survey of all the graduates of the Smith-Hughes courses in agriculture in South Dakota reveals, however, that 54 percent are now actually engaged in farming, while 9.53 percent are in work closely related to agriculture and 6.34 percent are taking advanced work in agriculture at the State College.

There are certain implications that have come out of the study as a guide to the small town. The chief factors determining the choice of high school on the part of the rural boy or girl are in this order: (1) nearness to home, (2) trade centers, (3) friends attending the school, and (4) the reputation of the school. This indicates that each town having a school can well afford to develop it as a service center as a means of attracting rural people to patronize the town. It is increasingly evident that the small town is rapidly becoming the nucleus or center for a larger community. Judging from returns by questionnaire from nearly one-third of all the farm homes
in Brookings County, most farmers patronize one town only for their various economic and social services. The following table shows the percentage of farmers having one center only for various services and the percentage having two centers which they patronize:

<table>
<thead>
<tr>
<th>Farmers having one center only</th>
<th>Farmers having two centers</th>
</tr>
</thead>
<tbody>
<tr>
<td>55% Selling</td>
<td>31% Selling</td>
</tr>
<tr>
<td>39% Buying</td>
<td>47% Buying</td>
</tr>
<tr>
<td>80% Social affairs</td>
<td>4.5 Social affairs</td>
</tr>
<tr>
<td>76% Amusements</td>
<td>10 Amusements</td>
</tr>
<tr>
<td>78% Newspaper</td>
<td>10 Newspaper</td>
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<tr>
<td>87% Doctor</td>
<td>1 Doctor</td>
</tr>
<tr>
<td>73% Hospital</td>
<td>3 Hospital</td>
</tr>
</tbody>
</table>

(1) In conclusion it would seem to be a fair inference to say that in keeping with the trend of the times, farmers in South Dakota are eager to have their children receive a secondary education. This is more true for girls than it is for boys. There are fully one-third more country girls attending high school than boys.

(2) As yet, however, farm people have not seen fit to initiate and maintain their own high school system, but simply patronize, for the most part, the independent village or town school. So far, the cost of this system is probably less than their taxes would amount to if they were a part of a regular high school district, but the time is not far distant when this will no longer be true. In the meantime the weakness of the present plan is that farmers as a class do not participate directly in the control and maintenance of the high school. Accordingly, their influence is not felt directly in the type of high school education which is offered. As a consequence the more favorable side of farm life as a vocation is not emphasized in the general high school course and in this way he unconsciously receives a bias towards some other vocation. In contrast, however, where an agricultural vocational course is offered, the majority of boys electing this work return to some form of agriculture and become active leaders in it.

VETERINARY

Adams Fund

The research project in progress in the Veterinary Department under the Adams Fund includes a detailed study of hemorrhagic septicemia organisms isolated from material presented for diagnostic purposes. This project includes a rather thorough laboratory examination of the organisms isolated and growth reactions to the various sugars, and a study of their pathogenic properties as determined by animal inoculation.
## EXPERIMENT STATION

### FINANCIAL REPORT

**SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION**

**FOR YEAR ENDED JUNE 30, 1920**

### Receipts

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<thead>
<tr>
<th>Hatch</th>
<th>Adams</th>
<th>Purnell</th>
</tr>
</thead>
<tbody>
<tr>
<td>States</td>
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<td>$15,000.00</td>
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### Disbursements

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</tr>
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<tbody>
<tr>
<td>By Salaries</td>
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<td>$7,708.24</td>
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<tr>
<td>Labor</td>
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<tr>
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<tr>
<td>Contingent expenses</td>
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**TOTAL** | $15,000.00 | $15,000.00 | $50,000.00 |

### HORTICULTURAL AND LIVESTOCK EXPERIMENT FUND

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<tr>
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<tbody>
<tr>
<td>Appropriation</td>
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### Expended

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</thead>
<tbody>
<tr>
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<tr>
<td>Labor</td>
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<td>Stationery and office supplies</td>
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<td>Travelling Expense</td>
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<td>Tools and machinery</td>
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**TOTAL** | $16,822.00 |        |         |

### SUB STATION FUNDS

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### Expended

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<tbody>
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<td>Tools and Machinery</td>
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**TOTAL** | $2,716.75 | $2,716.75 | $2,716.75 |

### POTATO EXPERIMENT FUND

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<tbody>
<tr>
<td>Appropriation</td>
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<td>$841.10</td>
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### Expended

<table>
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<tr>
<th>Hatch</th>
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<th>Purnell</th>
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<tbody>
<tr>
<td>Salaries</td>
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<tr>
<td>Labor</td>
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<td>Sundry supplies</td>
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<tr>
<td>Transportation of things</td>
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**TOTAL** | | $841.10 | |
## POPULAR BULLETIN FUND

**Appropriation** ........................................... $1,261.65

**Expended**

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<th>Description</th>
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<tr>
<td><strong>TOTAL</strong></td>
<td>$1,261.65</td>
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## SALES FUND (BROOKINGS STATION)

**Balance on hand July 1, 1928** ........................................... 
**Receipts sales** ........................................... $665.50

**TOTAL** ........................................... $8,259.60

**Expended**

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<tbody>
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<td>Labor</td>
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<tr>
<td>Stationery &amp; office supplies</td>
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<td>Livestock</td>
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<tr>
<td>Tools and machinery</td>
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<td>Buildings and land</td>
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<td>Contingent expense</td>
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<td><strong>Total</strong></td>
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<td><strong>Balance on hand</strong></td>
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<td><strong>TOTAL</strong></td>
<td>$8,925.10</td>
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## EXPERIMENT SUB STATION

**Balance on hand July 1, 1928** ........................................... 
**Receipts including sales from all sub stations** .................. $10,343.77

**Total** ........................................... $11,880.63

**Expended**

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<th>Amount</th>
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<td>Fertilizer</td>
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<td>Communication service</td>
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<td>Buildings and land</td>
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<td><strong>Total</strong></td>
<td>$12,945.39</td>
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<tr>
<td><strong>Balance on hand June 30, 1929</strong></td>
<td>13,945.39</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$22,224.40</td>
</tr>
</tbody>
</table>

## LIVESTOCK EXPERIMENTAL REVOLVING

**Balance on hand July 1, 1928** ........................................... 

**Expended**

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeding stuffs</td>
<td>$40.03</td>
</tr>
<tr>
<td><strong>Total Expenditures</strong></td>
<td>$40.03</td>
</tr>
<tr>
<td><strong>Balance on hand June 30, 1929</strong></td>
<td>765.63</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$805.66</td>
</tr>
</tbody>
</table>
List of available free publications. **Print** name and address plainly, check numbers desired and return list to Bulletin Department, Agric. Experiment Station.

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**BOX.... R.F.D.... STREET.......................... STATE..........................**


**Circulars** No. 1 Nitrogen from the air.

**Bulletins—**

162 First Annual Report of Vivian Experiment and Demonstration Farm.
166 Factors effecting Milking Machines.
168 Breakfast Foods And Their Relative Value.
171 Cream Pasteurization.
174 Sorghums for Forage in South Dakota.
175 The Role of Water in a Dairy Cows ration.
177 The Sheep.
180 Root Crop Culture.
182 Corn Silage For Steers.
183 Barley Culture in South Dakota.
184 Yields from Two Systems of Corn Breeding.
185 Ice on the Farm.
186 Corn Families in South Dakota.
187 The Influence of Length of Wheat Heads.
188 Relative Value of Food Protein for Dairy Cows.
189 Corn and Millet Silage for Cattle.
190 The Web Spinning Sawfly of Plums and Sandcherries.
191 Water as a Limiting Factor in the Growth of Sweet Clover.
192 Rations for Pigs.
193 Soybeans in South Dakota.
194 Acme Wheat.
195 Feeding Dairy Cattle.
196 Potatoes in South Dakota.
197 Milk Testing in Practice.
198 Influence of Purebred Dairy Sires.
199 Sunflower Silage for Steers Smutted Corn Silage for Pregnant Cows.
200 Winter Wheat in South Dakota.
201 Spring Wheat in South Dakota.
202 The Chinch Bug.
203 Pasteurization of Market Milk.
204 Varieties of Corn in South Dakota.
205 Some Tentative Statements Concerning Fowls Huless Oats.
206 Purebred Dairy Sires.
207 Forage Crops for Lambs.
208 Flowers Every Day in the Year.
209 Potatoes as a Food for Fattening Pigs.
210 Some Chemical Characteristics of Soft Corn.
211 Weeds and Their Control.
212 Effects Following Feeding of Extremely Wide Rations for Horses.
213 Growing Flax in South Dakota.
214 Correlation Between Length of Spike and Culm in Wheat.
215 Soybeans for Dairy Cows.
216 Improving Winter Rations for Pigs.
217 The Wheat Stemmed Magrot.
218 Bacterial Flora of Norman Cow's Udder.
219 Soft Corn for Fattening Cattle.
220 Date of Seeding Winter Rye.
221 Commercial Varieties of Canning Peas.
222 Wheat in South Dakota.
223 What Farmers Think of Farming.
224 Plant Introductions.
225 Farm Production and Prices.
226 Profitable Farming Systems.
227 Spring Seeding Time.
228 Certain Physical and Chemical Characteristics of Flaxseed and Linseed Oil.
229 Stacked Green Corn for Cattle.
230 Better Oats for South Dakota.
231 Profitable Feeding of the Dairy Cow.
232 Taxes and Public Finance in S. D.
233 Equalizing Library Conditions in South Dakota.
234 South Dakota Potatoes.
235 Profitable Farming Systems.
236 Self Feeders in Dairy Calf Feeding.
237 Experiments in Plant Heredity.
238 Types of Farming in S. D.
239 A Study of Power Line Service in South Dakota Farms.
240 Hardy Roses for South Dakota.
241 Cost of Electricity for the Home Electric Refrigerator.
242 Results of Poultry Feeding Experiments.
243 Marketing of Poultry Products.

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